Statutory Consultation 2022

Preliminary Environmental Information Report

Volume 3: Appendix 16.1

Noise and Vibration Information

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1 HUMAN HEARING AND ACOUSTIC TERMINOLOGY

1.1.1 Sound is the sensation caused in the ear by tiny variations in air pressure. The rate of these variations is expressed as the frequency of the sound and is measured in Hertz, abbreviated to Hz. A frequency of 1 Hz is equivalent to one variation in air pressure per second. Human hearing has a frequency range from 16 Hz to 16,000 Hz.

1.1.2 The pressure range detected by the human ear as sound covers an extremely large range. In practice the decibel (dB) unit is used to condense this range into a manageable scale by taking the logarithm of the ratio of the sound pressure to a reference sound pressure. The resulting quantity is termed the Sound Pressure Level (SPL) and is given the symbol Lp. Generally sound units measured in decibels are given the symbol L with a subscript used to identify the specific quantity. Expressed as SPL, the threshold of hearing would be an Lp of 0 dB and the threshold of pain is taken to be an Lp of 140 dB.

1.1.3 Human hearing sensitivity varies with the frequency of the sound; it is at its greatest between 2,000 Hz and 5,000 Hz. When measuring sound an 'A' weighting is often applied to the dB value. This weighting is a bias built into the frequency response of the sound level meter that aims to match the frequency sensitivity of the meter to that of the human ear. An SPL that has been 'A' weighted is indicated by the symbol LAp.

1.1.4 When two sound sources at the same level are combined the resulting level will be 3 dB higher than the single source. When two sounds differ by 10 dB the higher will generally be perceived as being twice as loud as the lower.

1.1.5 A summary of acoustic terminology used in the assessment are presented in **Table 1**.

Table 1: Acoustic Terminology

Term	Definition
Decibel (dB)	The range of audible sound pressures is approximately 2 x 10-5 Pa to 200 Pa. Using decibel notation presents this range in a more manageable form, 0dB to 140dB. Mathematically Sound Pressure level = 20 log {p(t)/p0} Where P0 = 2 x 10-5 Pa.
"A" Weighting (dB(A))	The human ear does not respond uniformly to different frequencies. "A" weighting is commonly used to simulate the frequency response of the ear.
Frequency (Hz)	The number of cycles per second, for sound this is subjectively perceived as pitch.
Frequency Spectrum	Analysis of the relative contributions of different frequencies that make up a sound.
Ambient Sound	Totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far. The

	ambient sound comprises the residual sound and the specific sound when present.
Background Sound Level $L_{A90,T}$	A-weighted sound pressure level that is exceeded at the assessment location for 90% of a given time interval, T, measured using time weighting F.
$L_{A10,T}$	A-weighted sound pressure level that is exceeded at the assessment location for 10% of a given time interval, T, measured using time weighting F.
L_{ASmax}	The maximum sound pressure level using 'slow' sound level meter response time of 1-second
Equivalent Continuous A-weighted Sound Pressure Level $L_{Aeq,T}$	Value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, T = t2 – t1, has the same mean-squared sound pressure as a sound that varies with time, and is given by the following equation: $LAeq,T = 10 \times \log\left\{\left(\frac{1}{T}\right)\left(\frac{P_A^2}{P_o^2}\right)dt\right\}$ Where p0 is the reference sound pressure (20μPA); and PA(t) is the instantaneous A-weighted sound pressure level at time t

2 RELEVANT LEGISLATION, POLICY AND GUIDANCE

2.1 Legislation

Control of Pollution Act (1974)

2.1.1 The Control of Pollution Act 1974 (Ref. 1) (CoPA) requires that Best Practicable Means (BPM) (as defined in section 72 of CoPA) are adopted to control construction noise on any given site. The term "practicable" means having regard for, among other things, local conditions and circumstances, to the current state of technical knowledge and to the financial implications.

2.1.2 BPM essentially refers to the selection of the quietest techniques and equipment, in addition to considering factors such as timing, duration, location and opportunities for mitigation, to ensure that impacts are controlled as far as reasonably practicable. Demonstrating the use of best practicable means to minimise noise levels is an accepted defence against a noise abatement notice.

2.1.3 Sections 60 and 61 of the CoPA provide the main legislation regarding demolition and construction site noise and vibration. A Section 60 notice may be issued by the local authority with instructions to cease work until specific measures to reduce noise have been adopted.

2.1.4 Section 61 of the CoPA provides a means for applying for prior consent to carry out noise generating activities during demolition and construction. Once prior consent has been agreed under Section 61, a Section 60 notice cannot be served provided the agreed measures in the Section 61 consent are maintained on the site.

Environmental Protection Act as amended (1990)

2.1.5 The Environmental Protection Act 1990 (Ref. 2) (EPA) Part 3 prescribes noise (and vibration) emitted from premises (including land) so as to be prejudicial to health or a nuisance as a statutory nuisance. Local Authorities are required to investigate any public complaints of noise and if they are satisfied that a statutory nuisance exists, or is likely to occur or recur, they must serve a noise abatement notice.

2.1.6 For the operation of the airport, the Civil Aviation Act states (s76) "*No action shall lie in respect of …nuisance, by reason only of the flight of an aircraft over any property at a height above the ground which, having regard to wind, weather and all the circumstances of the case is reasonable, or the ordinary incidents of such flight, so long as the provisions of any Air Navigation Order and of any orders under section 62 above have been duly complied with*".

2.1.7 For construction activities, as set out in the Draft CoCP BPM will be applied as a basis minimising noise and will be agreed with the relevant local authority before construction starts and this will also provide defence against enforcement action. Good practice mitigation measures for construction activities that represent BPM are provided in the Draft CoCP (**Appendix 4.2** in Volume 3 of the PEIR).

The Environmental Noise (England) Regulations 2006

2.1.8 The Environmental Noise (England) Regulations (Ref. 3) implement the methods for assessment and management of environmental noise set out in the EU Environmental Noise Directive (END) 2002/49/EC, which is now part of UK legislation following Brexit. The regulations set out the requirement to undertake strategic noise mapping and implement Noise Action Plans every five-years. The aim is to help identify:

"whether there are any people unnecessarily exposed to high noise levels, suffering accordingly and causing a cost to society; and

what areas of relative quiet we might or could have, thus enabling us to develop measures to protect them and not have the noise environment inadvertently eroded".

2.1.9 London Luton Airport Operations Limited (LLAOL) produce a Noise Action Plan every five years to comply with the requirements of the END. The most recent Noise Action Plan for London Luton Airport was adopted in February 2019[4].

The Noise Insulation Regulations (1975)

2.1.10 The Noise Insulation Regulations (Ref. 5)) set out the duty and provisions to carry out noise insulation work or to make grants due to noise from new or realigned road schemes and/ or associated works.

The Land Compensation Act (1973)

2.1.11 Part 1 of the Land Compensation Act 1973 (Ref. 6) allows for compensation due to a depreciation in value of a residential property due to physical factors (such as noise and pollution) as a result of public works.

The Civil Aviation Act 1982

2.1.12 The Civil Aviation Act 1982 (Ref. 16.7) provides that no action for trespass or nuisance can be taken as long as an aircraft observes the provisions of any Air Navigation Order and grants the Government powers to introduce noise control measures at designated airports.

2.1.13 The Civil Aviation Act 2006 (Ref. 16.8) enables an aerodrome authority may charge aircraft operators for use of the aerodrome by reference to the noise emissions from an aircraft. This enables aerodrome operators to set their charges to reflect the noise impact of aircraft in the vicinity of an airport.

2.1.14 The Civil Aviation Act 2012 (Ref. 16.9) defines the scope of airport operation functions that the CAA has concurrent power over.

The Infrastructure Planning (EIA) Regulations 2017;

2.1.15 The Infrastructure Planning (EIA) Regulations 2017 (REF) regulate the process for undertaking an Environmental Impact Assessment.

The Airports (Noise-related Operating Restrictions) (England and Wales) Regulations 2018

2.1.16 The regulations designate competent authorities for the purposes of EU Regulation 598/2014 (Ref. 16.10), which establishes the rules and procedures on the introduction of noise-related operating restrictions at airports within a "balanced approach" to noise management, as promoted by the International Civil Aviation Organisation (ICAO).

Regulation (EU) 598/2014

2.1.17 Aircraft noise management is subject to the concept of a 'Balanced Approach' (ICAO Resolution A33/7(Ref. 11)). This is given legal effect in the UK through EU Regulation 598/2014 (Ref. 12), Following the departure of the UK from the European Union, Regulation (EU) No 598/2014 was adopted into UK law on 15 January 2021 and establishes the rules and procedures on the introduction of noise-related operating restrictions at airports within a 'Balanced Approach' to noise management, as promoted by the ICAO.

2.2 National Planning Policy

Noise Policy Statement for England

2.2.1 The NPSE seeks to clarify the underlying principles and aims in existing policy documents, legislation and guidance that relate to noise. The statement applies to all forms of noise, including environmental noise, neighbour noise and neighbourhood noise.

2.2.2 The NPSE sets out the long-term vision of the government's noise policy, which is to "promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development".

2.2.3 This long-term vision is supported by three aims:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

a. *"Avoid significant adverse impacts on health and quality of life;*
b. *Mitigate and minimise adverse impacts on health and quality of life; and*
c. *Where possible, contribute to the improvements of health and quality of life*."

2.2.4 The 'Explanatory Note' within the NPSE provides further guidance on defining 'significant adverse effects' and 'adverse effects' using the concepts:

a. No Observed Effect Level (NOEL) - the level below which no effect can be detected. Below this level no detectable effect on health and quality of life due to noise can be established;
b. Lowest Observable Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected; and

c. Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur.

2.2.5 With reference to the SOAEL, the NPSE states:

"It is recognised that it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."

2.2.6 For situations where noise levels are between the LOAEL and SOAEL, all reasonable steps should be taken to mitigate and minimise the effects. However, this does not mean that such adverse effects cannot occur.

Airports National Policy Statement – June 2018

2.2.7 The Proposed Development must be undertaken in accordance with the relevant policies on noise management. For this proposal, the contents of the Airports National Policy Statement (ANPS) (Ref. 13)) are regarded as important and relevant considerations. In addition, the ANPS states that due regard must be given to national policy on aviation noise, the relevant sections of the Noise Policy Statement for England (Ref. 14) (NPSE), the National Planning Policy Framework (NPPF), and the Government's associated planning guidance on noise (Ref. 15).

2.2.8 The ANPS sets out the scope of a noise assessment for airport development at paragraphs 5.52-5.53. Paragraph 5.52 states that:

"The noise assessment should include the following:

- *A description of the noise sources;*
- *An assessment of the likely significant effect of predicted changes in the noise environment on any noise sensitive premises (including schools and hospitals) and noise sensitive areas (including National Parks and Areas of Outstanding Natural Beauty);*
- *The characteristics of the existing noise environment, including noise from aircraft, using noise exposure maps, and from surface transport and ground operations associated with the project, the latter during both the construction and operational phases of the project;*
- *A prediction on how the noise environment will change with the proposed project; and*
- *Measures to be employed in mitigating the effects of noise."*

2.2.9 Paragraph 5.68 of the ANPS is concerned with the decision-making process and states:

"Development consent should not be granted unless the Secretary of State is satisfied that the proposals will meet the following aims for the effective management and control of noise, within the context of Government policy on sustainable development:

- *Avoid significant adverse impacts on health and quality of life from noise;*
- *Mitigate and minimise adverse impacts on health and quality of life from noise; and*
- *Where possible, contribute to improvements to health and quality of life."*

2.2.10 These requirements are virtually identical to the three aims of the Government's overarching noise policy as set out in the NPSE.

2.2.11 Paragraphs 5.54 to 5.66 of the ANPS provides details of the type of mitigation measures that could be incorporated into an airport development during construction or operation. Although primarily concerned with a new runway at Heathrow, some of these measures could be relevant to the airport.

2.3 Civil Aviation Policy Relating to Noise

2.3.1 There is policy on noise within the government's emerging Aviation Strategy (December 2018), which finished consultation on 20th June 2019. One of the parameters in this document is an objective for modernising airspace to deliver quieter and cleaner journeys to:

"progressively reduce the noise of individual flights, through quieter operating procedures and, in situations where planning decisions have enabled growth which may adversely affect noise, require that noise impacts are considered through the airspace design process and clearly communicated." (Ref. 16)

2.3.2 Paragraphs 3.102 to 3.122 of the Consultation Draft Aviation Strategy are concerned with "Managing Noise". In this section there is policy concerned with moving towards a stronger noise policy framework which states that "*the government intends to put in place a stronger and clearer framework which addresses the weaknesses in current policy and ensures industry is sufficiently incentivised to reduce noise, or to put mitigation measures in place where reductions are not possible.*" (paragraph 3.114). It also describes new measures for this Framework, including:

"setting a new objective to limit, and where possible, reduce total adverse effects on health and quality of life from aviation noise;

developing a new national indicator to track the long term performance of the sector in reducing noise;

routinely setting noise caps as part of planning approvals (for increase in passengers or flights); and

requiring all major airports to set out a plan which commits to future noise reduction, and to review this periodically". (paragraph 3.115)

2.3.3 Until the Government's aviation strategy is finalised, current UK aviation noise policy is spread over three documents. These are:

a. The Aviation Policy Framework (2013) (Ref. 17);
b. UK Airspace Policy: A framework for balanced decisions on the design and use of airspace (February 2017) (Ref. 18); and
c. Consultation Response on UK Airspace Policy: A framework for balanced decisions on the design and use of airspace (October 2017) (Ref. 19).

2.3.4 Paragraph 3.12 of the Aviation Policy Framework (APF) states that:

"The Government's overall policy on aviation noise is to limit and, where possible, reduce the number of people in the UK significantly affected by aircraft noise, as part of a policy of sharing benefits of noise reduction with industry".

2.3.5 The APF aims to strike a balance between the adverse impacts of noise and economic benefits of air travel.

2.3.6 This aim is maintained at paragraph 5.24 of the UK Airspace Policy and paragraph 2.69 of the Consultation response on UK Airspace Policy, which state:

"The government's overall policy on aviation noise is to limit and, where possible, reduce the number of people in the UK significantly affected by aircraft noise as part of a policy of sharing benefits of noise reduction with industry in support of sustainable development. Consistent with the Noise Policy Statement for England, our objectives in implementing this policy are to:

a. limit and, where possible, reduce the number of people in the UK significantly affected by the adverse impacts from aircraft noise".

2.3.7 Consultation proposals for the long-term UK aviation strategy are set out in Aviation 2050: The Future of UK Aviation (2018) (Ref. 20).

National Planning Policy Framework – June 2021

2.3.8 One of the aims of the NPPF in terms of noise and vibration is that

"Planning policies and decisions should contribute to and enhance the natural and local environment by: e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans" (paragraph 174).

2.3.9 Section 15 of the NPPF is concerned with conserving and enhancing the natural environment, including the matters that should be considered for planning decisions in relation to ground conditions and pollution. This includes ensuring "*that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the* *site or the wider area to impacts that could arise from the development. In doing so they should:*

2.3.10 *Mitigate and reduce to a minimum other adverse impacts resulting from noise from new development and avoid noise giving rise to significant adverse impacts on health and quality of life; and*

2.3.11 *Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason*." (Paragraph 185).

2.3.12 These policies must be applied in the context of Government policy on sustainable development.

Planning Practice Guidance Noise (July 2019)

2.3.13 The Planning Practice Guidance concerned with noise (PPGN) (Ref. 15) advises that "*Noise needs to be considered when development may create additional noise, or would be sensitive to the prevailing acoustic environment (including any anticipated changes to that environment from activities that are permitted but not yet commenced)*" and provides guidelines that are designed to assist with the implementation of the NPPF.

2.3.14 The PPG states that local planning authorities should take account of the acoustic environment and in doing so consider:

a. *"whether or not a significant adverse effect is occurring or likely to occur;*

b. *whether or not an adverse effect is occurring or likely to occur; and*

c. *whether or not a good standard of amenity can be achieved."*

2.3.15 Factors to be considered in determining whether noise is a concern are identified including the absolute noise level of the source, the existing ambient noise climate, time of day, frequency of occurrence, duration, character of the noise and cumulative effects.

2.3.16 Further details on the hierarchy of noise effects are presented in **Table 2**, which has been reproduced from PPGN.

Table 2: Planning Practice Guidance Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not present	No effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but	No Observed Adverse Effect	No specific measures required

	not such that there is a change in the quality of life		
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

3 ASSESSMENT METHODOLOGY

3.1 Construction

Introduction

3.1.1 Due to the proximity of sensitive receptors to the Main Application Site, temporary significant effects may occur at sensitive receptors during the earthworks and construction programme. The assessment of noise and vibration considers the following:

a. construction noise emissions from on-site activities;

b. construction vibration emissions from on-site activities; and

c. changes in road traffic noise due to construction traffic on the local road network.

Construction Noise

3.1.2 Although there is currently a lack of evidence relating to health effects to construction noise, the method for assessing construction noise effects are defined based on the current industry standard approach. Criteria for assessing construction noise effects are presented in **Table 3** and were defined with reference to 'example method 1 – the ABC method' as defined in BS 5228 1:2009+A1:2014 (Ref. 21). Category A criteria in the ABC method are interpreted as LOAEL and Category C criteria are considered equivalent to SOAEL. The UAEL for construction noise is based on the trigger level for temporary rehousing as set out in section E.4 of BS 5228-1.

Table 3: Thresholds of potential effects of construction noise at residential buildings

Time Period	Threshold Value ($L_{Aeq,T}$ dB)		
	LOAEL	SOAEL	UAEL
Day (07:00 – 19:00) Saturday (07:00 – 13:00)	65	75	85
Evening (19.00 – 23.00) Weekends (13.00–23.00 Saturdays and 07.00–23.00 Sundays)	55	65	75
Night (23.00 – 07.00)	45	55	65
a) These effects are expected to occur if the programme of works indicates that the relevant threshold values are likely to be exceeded over a period of at least one month. The values apply to a location one metre from a residential building façade containing a window, ignoring the effect of the acoustic reflection from that façade.			

Construction Vibration

3.1.3 When defining assessment criteria, reference has been made to BS 5228-2:2009+A1:2014 (Ref. 22), which provides descriptions of the impact of vibration in terms PPV on human receptors. For residential receptors and equivalent, the LOAEL has been defined as a vibration dose value of 0.3 mm/s (millimetres per second), this being the point at which construction vibration is likely to become perceptible. The SOAEL has been defined as a vibration dose value of 1.0 mm/s, this being the level at which construction vibration can be tolerated with prior warning. The UAEL is defined as 10 mm/s, which is the level at which vibration is likely to be intolerable.

Construction Traffic

3.1.4 The Proposed Development has the potential to influence traffic flows on existing roads in the area surrounding the construction sites. Construction traffic noise has been assessed by considering the increase in traffic flows during works through calculation of the Basic Noise Level (BNL), as defined in the 'Calculation of Road Traffic Noise' (CRTN) (Ref. 23). The method for determining the magnitude of impact due to changes in road traffic noise are presented in **Table 7**.

3.2 Operation

Introduction

3.2.1 Potential noise effects due to the operation of the Proposed Development may be experienced at sensitive receptors due to:

a. Air Noise – noise from aircraft during the landing and take-off cycle, including noise from start-of-roll for take-off until end-of-roll at landing, and while in flight;
b. Airside Ground Noise – noise from on-site ground activities such as aircraft on the ground prior to take-off and after landing i.e. taxiing, holding and aircraft activity at stand. Additionally, on-site road traffic, fire testing areas and noise generated at areas designated for engine testing have been be included; and
c. Surface Access Noise – noise from changes in road traffic flows on the existing road network and new road infrastructure serving the Proposed Development.

3.2.2 Noise emissions from fixed plant may also need to be considered; however, it is likely that airside ground noise will dominate on-site noise emissions and an assessment of these sources can potentially be scoped out. However, as there remains uncertainty over this aspect, the need for a fixed plant noise assessment will be kept under review and updated in the ES.

Air Noise Assessment Methodology

3.2.3 In the Consultation Response on UK Airspace Policy: A framework for balanced decisions on the design and use of airspace (October 2017) (Ref. 24), the Department for Transport (DfT) stated that:

"…we will set a LOAEL at 51 dB LAeq 16 hr for daytime, and based on feedback and further discussion with CAA we are making one minor change to

the LOAEL night metric to be 45 dB LAeq 8hr rather than Lnight to be consistent with the daytime metric."

3.2.4 These indicators refer to the summer average day and night respectively.

3.2.5 To account for this definition of the LOAEL, impacts have been identified within the 51 dB $L_{Aeq,16h}$ noise contour and the 45 dB $L_{Aeq,8h}$ noise contour. Consequently, the range of average mode noise contours that have been considered in the assessment are as follows:

a. $L_{Aeq,16h}$ – average summer's day: 51 dB and above in 3 dB increments; and

b. $L_{Aeq,8h}$ – average summer's night: 45 dB and above in 3 dB increments.

3.2.6 For the purposes of this assessment, SOAEL has been regarded as 63 dB $L_{Aeq,16h}$. The equivalent night-time SOAEL is considered to be 55 dB $L_{Aeq,8h}$. This is common practice in UK airport planning application, as detailed in **Table 4**. N justification or explanation for the difference in night-time SOAEL was provided in the Stansted Environmental Statement.

Table 4: Adopted SOAEL in UK Airport Planning Applications

Time Period	Adopted SOAEL	
	Daytime	Night-time
Bristol	63 dB $L_{Aeq,16h}$	55 dB $L_{Aeq,8h}$
London City	63 dB $L_{Aeq,16h}$	n/a
Stansted	63 dB $L_{Aeq,16h}$	54 dB $L_{Aeq,8h}$
Manston	63 dB $L_{Aeq,16h}$	55 dB $L_{Aeq,8h}$
Southampton	63 dB $L_{Aeq,16h}$	n/a
Leeds Bradford	63 dB $L_{Aeq,16h}$	55 dB $L_{Aeq,8h}$

3.2.7 The defined air noise LOAEL and SOAEL are presented in **Table 5**. A precautionary UAEL for air noise has been defined at 69 dB $L_{Aeq,16h}$[1]; however, no properties are exposed to noise exceeding these levels.

[1] NPPF (para 174e) states: "*Planning …decisions should contribute to and enhance the natural and local environment by: e) preventing new .. development from contributing to .. unacceptable levels of .. noise pollution* ..". The PPG(N) definition of unacceptable adverse effect is: "*Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and nonauditory" and that "this situation should be prevented from occurring*" (para 005)
The threshold for these effects is described as an Unacceptable Adverse Effect Level (UAEL).
As an example of an action to prevent unacceptable adverse effects, the NPS for National Networks sets out that "*the applicant may consider it appropriate to provide noise mitigation through the compulsory acquisition of affected properties in order to gain consent for what might otherwise be unacceptable development*." (para 5.199). The APF states "The Government continues to expect airport operators to offer households exposed to levels of noise of 69 dB LAeq,16h or more, assistance with the costs of moving." 69 dB LAeq,16h may therefore be considered a 'precautionary UAEL' for daytime noise (because this is the threshold for assisting with the costs of moving rather than mandatory acquisition of homes that would be expected to be required at a high level of noise exposure where the actual UAEL is reached).

Table 5: Air Noise LOAEL and SOAEL

Time Period	Threshold Level dB $L_{Aeq,T}$ for Average Day in the 92-day Summer Period	
	LOAEL	SOAEL
07:00 to 23:00	51	63
23:00 to 07:00	45	55

3.2.8 Whereas the construction assessment considers significance of the absolute level of a temporary noise or vibration source, changes in existing noise sources have been assessed based on the predicted change in noise. The criteria that have been used to describe the magnitude of impact, in terms of the change in noise arising from the operational phase of the Proposed Development, are presented in **Table 6**.

3.2.9 As there is no clear method to rate the significance of effect due to changes in air noise, the criteria are based on the approach adopted in the Bristol Airport application to increase airport capacity (Ref. 25). The criteria set different levels for identifying a significant effect depending on whether noise in the DS scenario is either above or below the SOAEL. This addresses the following point in PPGN, which states:

"In cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in the overall noise level may result in a significant adverse effect occurring even though little to no change in behaviour would be likely to occur".

Table 6: Magnitude of Impact Criteria for Changes in Air and Ground Noise

Significance of Effect	Change in Noise Level	
	DS Noise Between LOAEL and SOAEL	DS Noise Exceeding SOAEL
Major	5.9 dB or more	4.9 dB or more
Moderate	3.0 dB – 5.9 dB	2.0 dB – 3.9 dB
Minor	2.0 – 2.9 dB	1.0 – 1.9 dB
Negligible	0.1 – 1.9 dB	0.1 – 0.9 dB
No change	0.0 dB	0.0 dB

Airside Ground Noise

3.2.10 The Proposed Development will result in an intensification of ground activities at the airport. As ground noise is considered equivalent to air noise, the LOAEL and SOAEL presented in **Table 5** are considered applicable. The change in airside ground noise at nearby sensitive receptors has been assessed in line with the magnitude of impact criteria presented in **Table 6** (see paragraph **2.5.9**).

Surface Access Noise

3.2.11 The increase in passenger numbers is likely to result in increases in traffic on the local road network. The road traffic noise assessment will consider the likely noise impact on all transport routes covered in the transport assessment.

3.2.12 A road traffic noise model has been developed to predict levels of road traffic noise at sensitive receptors. The software applies the CRTN calculation methodology, which utilises road traffic data in terms of the 18-hour AAWT (Average Annual Weekday Traffic) flow from 06:00 to 24:00. Surface access noise levels are shown in terms of the daytime $L_{Aeq,16h}$ free-field level. This is derived from the CRTN $L_{A10,18h}$ level following WebTAG guidance (Ref. 26).

3.2.13 The LOAEL and SOAEL for road traffic noise are defined in **Table 7** based on guidance in the Design Manual for Roads and Bridges (DMRB) (Ref. 27)[2]. A precautionary UAEL has been set at 74 dB LAeq,16h[3].

Table 7: Road Traffic Noise LOAEL and SOAEL

Time Period	Threshold Level dB $L_{Aeq,T}$ for Average Annual Day	
	LOAEL	SOAEL
07:00 to 23:00[4]	50	63
23:00 to 07:00	40	55

3.2.14 The criteria that are used to define the significance of effect in terms of the changes in road traffic noise are presented in **Table 8**. These criteria are based on guidance for assessing short-term changes in noise from DMRB.

Table 8: Magnitude of Impact Criteria for Short-Term Changes In Road Traffic Noise

Significance of Effect	Change in Noise Level
Major	5.0 dB or more
Moderate	3.0 dB – 4.9 dB
Minor	2.0 – 2.9 dB
Negligible	0.1 – 0.9 dB
No change	0.0 dB

[2] The evidence for using some these values can be found in guidance from the World Health Organisation. Similar values have been used for the assessment of other schemes such as A14 DCO.
[3] Accepted in the DCO decision for the A14 Cambridge to Huntingdon Improvement Scheme DCO. Refer to ES Appendix 14.3: Noise and vibration significance criteria.
[4] LOAEL and SOAEL for the daytime period are calculated from DMRB LA10,18h values by applying a correction of -3 dB to convert from the façade level to a free-field level and by applying a further correction of -2 dB to convert from LA10,18h to LAeq,16h.

3.2.15 Under normal circumstances, Moderate and Major Adverse effects due to change in level of surface access noise are identified as significant. However, DRMB states that:

"Where any do-something absolute noise levels are above the SOAEL, a noise change in the short term of 1.0dB or over results in a likely significant effect".

3.2.16 Preliminary modelling indicates that changes in noise at high noise levels are minimal. As such, the assessment at this stage focuses on the significance of effect due to moderate and major changes in surface access noise. Additional detail will be provided in the ES to clarify the change in noise level at receptors where surface access noise exceeds the SOAEL.

3.3 World Health Organization Environmental Noise Guidelines for the European Region, 2018

3.3.1 The WHO's 'Environmental Noise Guidelines for the European Region' (Ref. 28) has recently been published and provides updated guidelines based on research about the health impacts of community noise. The updated guidelines identify a new dose-response relationship between noise and health effects. The noise exposure levels are based on global research; however, the guidelines state that:

"…*data and exposure–response curves derived in a local context should be applied whenever possible to assess the specific relationship between noise and annoyance in a given situation*."

3.3.2 Paragraph 3.106 of The Aviation Strategy makes reference to the updated WHO Guidelines and states agreement with the ambition to reduce noise (Ref. 29). However, in line with WHO Guidelines statement to apply local data, the Aviation Strategy states that UK policy will be underpinned with recent UK specific evidence in the Civil Aviation Authorities Survey of Noise Attitudes (SoNA) (Ref. 30)). Consequently, dose-response relationship in the new WHO Guidelines is not currently considered directly applicable to the assessment. However, sensitivity testing on the dose-response relationships in the new WHO Guidelines will be undertaken in the ES.

4 BASELINE SOUND SURVEY

4.1 Defining the Assessment Baseline

4.1.1 A baseline year of 2019 was selected for the noise assessment. This year represents the last year of normal activity at the airport pre-Covid pandemic. Although it is acknowledged that, in 2019, existing noise contour limits[5] were exceeded for both day and night periods, the use of 2019 as a baseline is to identify if there will be any changes to health and quality of life from the last year of typical operating conditions.

4.1.2 To define consistent and representative baseline noise levels at community locations across the study area and to enable consistent comparison with future baseline, 'Do Nothing' and Do Something scenarios, the baseline for air noise and road traffic noise has been calculated as described below.

4.1.3 The 2019 air noise baseline was defined through noise modelling using the Aviation Environmental Design Tool (AEDT) and 2019 ATM data for the 92-day summer period (16 June to 15 September inclusive). The 2019 air noise baseline and was validated using measured noise data from LLAOL's permanent and temporary monitoring stations. Details on noise data used for validation and the model validation method are provided in **Section 6**.

4.1.4 The 2019 surface access noise baseline was calculated using the CRTN Basic Noise Level (BNL), which represents the road traffic noise level at 10m from the road edge, for the roads in the transport model in the baseline year. Detailed modelling of the surface access 2019 baseline will be provided in the ES, including validation of the baseline model using measured noise data.

4.1.5 Baseline monitoring has also been undertaken as described in the next sub-section. This is for two purposes: first to inform the baseline for the construction noise assessment; and second to support characterisation of the existing noise environment (contextual information that will be used to inform the refined noise assessment to be presented in the ES).

4.1.6 Noise monitoring was undertaken at locations agreed with the Noise Working Group and at additional locations identified through 2019 statutory consultation.

4.2 Noise Monitoring Locations and Protocol

4.2.1 Baseline sound surveys were undertaken at locations surrounding the Proposed Development as shown in **Figure 16.3** in Volume 4 of the PEIR. The geographical extent of noise monitoring was based on the possible extent of potential adverse noise impacts arising from the Proposed Development, and monitoring locations were agreed through consultation with the Noise Working Group. The baseline noise survey has been undertaken following the principles contained in BS 7445-1 2003 (Ref. 31).

[5] Noise contour limits for the airport to operate to its consented limit of 18 mppa, as modelled using INM, were set at 19.4 km^2 for the daytime 57 dB LAeq,16h noise contours and 37.2 km^2 for the night-time LAeq,8h noise contour.

4.2.2 Long term (minimum of 2 weeks) unattended monitoring was completed at four locations (ML8, ML18, ML30 and ML31) between 23 August 2018 and 21 September 2018. Long-term monitoring was also performed at seven locations (ML1, ML7, ML9, ML17, ML19, ML20 and ML22) between 21 September and 2 November 2018 and at a further twelve locations (ML2 to ML5, ML10 to ML16 and ML21) between 16 April and 23 May 2019.

4.2.3 At an additional seven monitoring locations, aircraft noise was not a key contributor to the soundscape and road traffic noise dominated. At these locations, short-term daytime monitoring was performed over a 3-hour period in accordance with the CRTN ‘shortened measurement procedure’. These were performed on 2 (ML23 and ML25), 29 (ML24) and 30 (ML28 and ML29) November 2018, and 23 January 2019 (ML26 and ML27).

4.2.4 Meteorological conditions recorded by the London Luton Airport weather station have been used to identify periods of adverse weather conditions over the unattended monitoring periods i.e. periods of rain and windspeeds greater than 5 m/s. These periods have been removed from the monitoring results.

4.2.5 The measurement locations are described in **Table 9**. Descriptions of the dominant and secondary noise sources have been included from the observations made at the start and end of the measurements.

Table 9: Baseline monitoring locations

Location	Details	Dominant Sound Sources	Secondary Sound Sources	Measurement Format
ML1	Someries Castle, Central Beds	Aircraft	Road traffic	Unattended
ML2	Diamond End, North Herts	Aircraft	Road traffic, dog barking	Unattended
ML3	Langley, North Herts	Aircraft	Road traffic	Unattended
ML4	Breachwood Green, North Herts	Birdcall	Aircraft and road traffic	Unattended
ML5	Bendish, North Herts	Aircraft	Birdcall	Unattended
ML7	Luton Hoo, Central Beds	Road traffic and aircraft	None noted	Unattended
ML8	Dagnall, Aylesbury Vale	Aircraft	Road traffic, occasional gardening activities	Unattended
ML9	Markyate, Dacorum	Aircraft	None noted	Unattended
ML10	Caddington, Central Beds	Road traffic	Aircraft, birdsong	Unattended

ML11	Woodside, Central Beds	Birdsong	Conversation, aircraft, road traffic	Unattended
ML12	Front Street, Slip End, Luton	Road traffic	Aircraft, processing plant at McClaid Screening	Unattended
ML13	Strathmore Avenue, Luton	Aircraft, running water	Road traffic	Unattended
ML14	Vauxhall Way, Luton	Road traffic	None noted	Unattended
ML15	Eaton Green Road, Luton	Road traffic	Aircraft	Unattended
ML16	Malthouse Green, Luton	Aircraft	Road traffic	Unattended
ML17	Kensworth, Central Beds	Road traffic	Aircraft	Unattended
ML18	Stevenage	Aircraft and road traffic	Occasional dog barking	Unattended
ML19	Flamstead, Dacorum	Aircraft	Road traffic, occasional gardening activities	Unattended
ML20	Jockey End, Dacorum	Aircraft	Occasional gardening activities	Unattended
ML21	Preston, North Herts	Road traffic	Aircraft	Unattended
ML22	Holywell, Central Beds	Aircraft	Occasional gardening activities	Unattended
ML23	A602 Stevenage Road, North Herts	Road traffic	Pedestrians	Attended
ML24	Hitchin Road, Luton	Road traffic	None	Attended
ML25	A505 Beech Hill, North Herts	Road traffic	Pedestrians	Attended
ML26	A1081 London Road, Central Beds	Road traffic	None	Attended
ML27	A505 Hatters Way, Luton	Road traffic	Pedestrians	Attended
ML28	A6 New Bedford Road, Luton	Road traffic	Birdcall	Attended
ML29	B653 Lower Harpenden Road, Central Beds	Road traffic	Occasional train passbys	Attended

ML30	Pitstone, Aylesbury Vale	Aircraft	Road traffic, occasional gardening activities	Unattended
ML31	St Pauls Walden, North Herts	Aircraft	Road traffic, occasional gardening activities	Unattended
ML41	Brick Kiln Lane, Luton	Road traffic	Road traffic, aircraft, birdsong	Unattended
ML37	Breachwood Green JMI School	Aircraft	Road traffic, birdsong, school activities	Unattended
ML42	Chalk Hill, Luton	Road traffic	Road traffic, aircraft, birdsong	Attended
ML43	Wandon End, Luton	Road traffic	Dog barking, road traffic, aircraft, birdsong	Attended
ML44	Stony Lane, Luton	Road traffic	Road traffic, aircraft, birdsong	Attended

4.2.6 Information relating to the measurement equipment used during the survey is presented in **Table 10**.

Table 10: Instrument details

Location	Instrument	Manufacturer	Model	Serial Number
ML1	Sound-level meter	Rion	NL-52	420765
ML2	Sound-level meter	01 dB	Duo	12062
ML3	Sound-level meter	Rion	NL-52	743082
ML4	Sound-level meter	Norsonic	Nor 140	1402919
ML5	Sound-level meter	Rion	NL-52	386765
ML7	Sound-level meter	Rion	NL-52	420765
ML8	Sound-level meter	01 dB	Duo	12076
ML9	Sound-level meter	01 dB	Duo	12081
ML10	Sound-level meter	Rion	NL-52	542906
ML11	Sound-level meter	Rion	NL-52	00529407
ML12	Sound-level meter	Rion	NL-52	420764
ML13	Sound-level meter	Rion	NL-52	00386764
ML14	Sound-level meter	Rion	NL-52	00386763
ML15	Sound-level meter	Rion	NL-52	00386762
ML16	Sound-level meter	Rion	NL-52	420763

ML17	Sound-level meter	01 dB	Duo	12081
ML18	Sound-level meter	Rion	NL-52	420765
ML19	Sound-level meter	01 dB	Duo	12062
ML20	Sound-level meter	01 dB	Duo	12029
ML21	Sound-level meter	Rion	NL-52	420764
ML22	Sound-level meter	01 dB	Duo	12062
ML23	Sound-level meter	01 dB	Duo	12029
ML24	Sound-level meter	01 dB	Duo	12029
ML25	Sound-level meter	01 dB	Duo	12029
ML26	Sound-level meter	01 dB	Duo	12052
ML27	Sound-level meter	01 dB	Duo	12051
ML28	Sound-level meter	01 dB	Duo	12029
ML29	Sound-level meter	01 dB	Duo	12029
ML30	Sound-level meter	01 dB	Duo	12081
ML31	Sound-level meter	01 dB	Duo	12062
ML1, ML3, ML8, ML9, ML16, ML18, ML19, ML21, ML22, ML26, ML30, ML31	Calibrator	Rion	NC-74	34304647
ML7, ML10, ML11, ML12, ML17, ML20, ML23, ML24, ML25, ML27, ML28, ML29	Calibrator	Rion	NC-74	35173436
ML2, ML5, ML13, ML14, ML15	Calibrator	Rion	NC-74	34425537
ML4	Calibrator	Norsonic	Nor 1251	31431
ML37, ML41, ML42, ML44	Sound-level meter	Rion	NL-52	809414
ML43	Sound-level meter	Rion	NL-52	809413
ML37, ML42, ML43, ML44	Calibrator	B&K	4231	2642980

4.2.7 All sound level; meters were calibrated at the start and end of monitoring and significant deviations (more than 0.5 dB) from the reference value was noted. Full calibration details can be made available upon request.

4.2.8 The sound level meters were programmed to log a number of indicators including $L_{Aeq,T}$, $L_{A90,T}$, $L_{A10,T}$ and L_{ASmax} values, in 15-minute contiguous intervals with a resolution of 1s at all unattended monitoring locations. For the attended measurements the sound level meter was programmed to record values in 1-hour contiguous intervals with a 1-second resolution.

4.2.9 Graphs showing the time-history of the measured 15-minute levels over the survey period for each long-term monitoring location are provided in **Section 4.4**.

4.3 Noise Monitoring Results

4.3.1 A summary of the attended monitoring results is presented in **Table 11**. The $L_{A10,18h}$ was calculated based on the CRTN shortened measurement procedure.

Table 11: Attended Baseline Monitoring Results

Location	Measured Sound Levels (dB)		
	Average $L_{Aeq,1h}$	Average $L_{A10,1h}$	Calculated $L_{A10,18h}$
ML23	75	77	76
ML24	67	71	70
ML25	78	81	80
ML26	78	82	81
ML27	79	83	82
ML28	75	77	76
ML29	69	73	72
ML42	55	57	56
ML43	48	47	46
ML44	53	48	47

4.3.2 A summary of monitoring results is provided in **Table 12**. This includes results for the entire unattended monitoring period, which are presented based on the airport operating on runway 07 (in an easterly direction) or runway 25 (in a westerly direction). The unattended monitoring results have been broken down into day (07:00 hrs to 19:00 hrs), evening (19:00 hrs to 23:00 hrs) and night-time (23:00 hrs to 07:00 hrs) sound levels. The exception to this is ML41, which was set up to measure road traffic noise.

Table 12: Unattended Baseline Monitoring Results

Location	Start Date (dd/mm/yy)	End Date (dd/mm/yy)	Airport Runway Operation	Measured Sound Levels (dB)											
				Day				Evening				Night			
				Periods of Aircraft Activity	$L_{Aeq,12h}$	L_{ASMax}	$L_{A90,15min}$	Periods of Aircraft Activity	$L_{Aeq,4h}$	L_{ASMax}	$L_{A90,15min}$	Periods of Aircraft Activity	$L_{Aeq,8h}$	L_{ASMax}	$L_{A90,15min}$
ML1	19/10/2018	02/11/2018	07	3	60	84	45	3	60	83	46	3	55	80	41
			25	10	62	84	44	8	60	83	46	8	55	81	43
ML2	16/04/2019	30/04/2019	07	13	67	87	36	10	65	85	27	10	61	85	23
			25	4	61	85	36	3	61	81	31	0	-	-	-
ML3	23/04/2019	08/05/2019	07	8	58	77	39	7	53	75	38	8	49	73	33
			25	9	55	76	38	4	52	75	33	6	48	71	30
ML4	16/04/2019	20/05/191	07	10	57	81	35	8	59	82	41	8	59	81	38
			25	4	54	77	28	3	59	81	37	1	61	82	40
ML5	16/04/2019	30/04/2019	07	13	62	81	36	10	61	80	29	10	55	78	24
			25	4	62	81	37	3	61	80	34	1	59	82	27
ML7	04/10/2018	19/10/2018	07	3	61	81	50	4	59	78	48	4	55	78	44
			25	10	68	91	49	8	66	89	47	9	61	88	45
ML8	23/08/2018	19/10/182	07	5	58	77	43	6	56	77	42	5	54	77	35
			25	9	62	62	43	7	59	87	36	9	56	68	31
ML9	21/09/2018	04/10/2018	07	1	50	58	47	2	49	59	47	3	46	59	42
			25	6	56	74	39	6	57	74	41	5	52	72	39
ML10	23/04/2019	22/05/193	07	18	58	79	49	15	56	76	48	17	54	72	46
			25	11	59	79	47	7	56	77	44	10	52	71	43
ML11	23/04/2019	22/05/193	07	18	60	80	49	13	60	79	53	15	58	78	51
			25	11	58	79	46	7	57	76	50	8	55	75	49
ML12	23/04/2019	23/05/193	07	18	66	84	56	13	63	83	59	15	61	82	56
			25	12	67	85	52	7	64	82	55	8	60	81	53
ML13	16/04/2019	30/04/2019	07	12	60	80	50	9	61	81	49	9	57	80	46

			25	4	64	85	51	3	64	85	49	1	55	77	52
ML14	16/04/2019	30/04/2019	07	13	72	87	63	10	71	85	58	10	68	83	47
			25	4	73	88	66	3	71	82	60	1	66	82	46
ML15	16/04/2019	30/04/2019	07	13	66	77	54	10	64	77	48	10	60	77	42
			25	4	67	77	59	3	64	77	52	1	59	75	46
ML16	23/04/2019	08/05/2019	07	8	54	75	40	7	51	73	32	9	48	73	26
			25	10	50	74	39	7	53	78	37	7	44	67	30
ML17	04/10/2018	25/10/184	07	1	58	76	40	1	60	76	39	2	50	76	29
			25	11	49	66	41	11	44	60	35	10	40	57	32
ML18	23/08/2018	21/09/2018	07	6	60	80	40	7	53	74	35	10	47	71	35
			25	19	51	74	43	16	52	70	43	23	46	68	37
ML19	19/10/2018	02/11/2018	07	0	-	-	-	0	-	-	-	1	44	48	42
			25	7	53	73	36	6	52	70	35	6	47	70	33
ML20	21/09/2019	13/10/2019	07	3	53	71	37	3	51	69	31	5	50	68	27
			25	14	51	69	35	13	46	62	29	12	42	52	28
ML21	23/04/2019	08/05/2019	07	8	57	82	41	7	52	75	33	9	47	72	30
			25	10	60	81	41	7	53	76	34	7	46	72	29
ML22	21/09/2018	19/10/186	07	3	53	71	37	3	51	69	31	5	50	68	27
			25	14	51	69	35	13	46	62	29	12	42	52	28
ML30	23/08/2018	21/09/2018	07	3	51	68	36	3	50	67	35	3	48	68	30
			25	12	50	66	37	11	43	60	32	14	40	60	27
ML31	23/08/2018	21/09/2018	07	5	55	73	35	5	55	73	33	5	52	72	29
			25	18	52	69	36	16	51	68	31	19	48	68	27
ML37	26/2/2020	22/3/2020	07	4	60	85	40	5	59	83	30	6	55	85	28
			25	10	58	83	42	8	59	81	37	11	53	82	36
ML41	13/07/2021	21/07/2021	-	-	51	78	33	-	45	69	29	-	40	62	28

$L_{Aeq,T}$ was calculated using the logarithmic average of measurements, L_{ASmax} was calculated using the statistical 90th percentile to remove potentially anomalous measurements that may occur due to noise events in close proximity to the microphone and the $L_{A90,T}$ was calculated as the arithmetic mean.

1 Recorded data are from 23/04 to 30/04 and 08/05 to 20/05

2 Recorded data are from 23/08 to 02/09 and 14/10 to 19/10

3 Recorded data are from 23/04 to 05/05 and 10/05 to 22/05

4 Recorded data are from 04/10 to 12/10 and 19/10 to 25/10

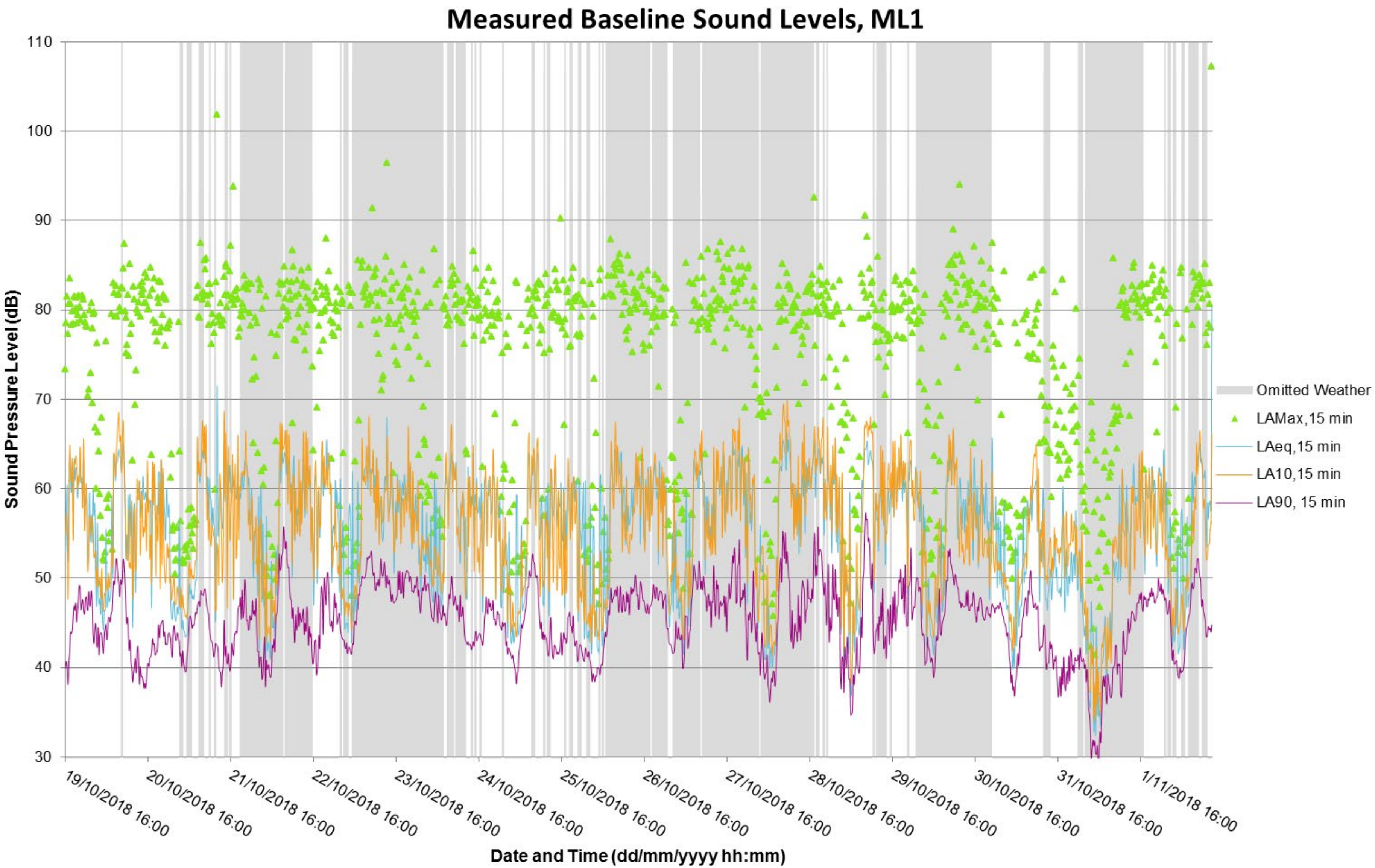
5 Survey period is 9 days instead of 2 weeks, however, the results are considered to be consistent with a longer time period

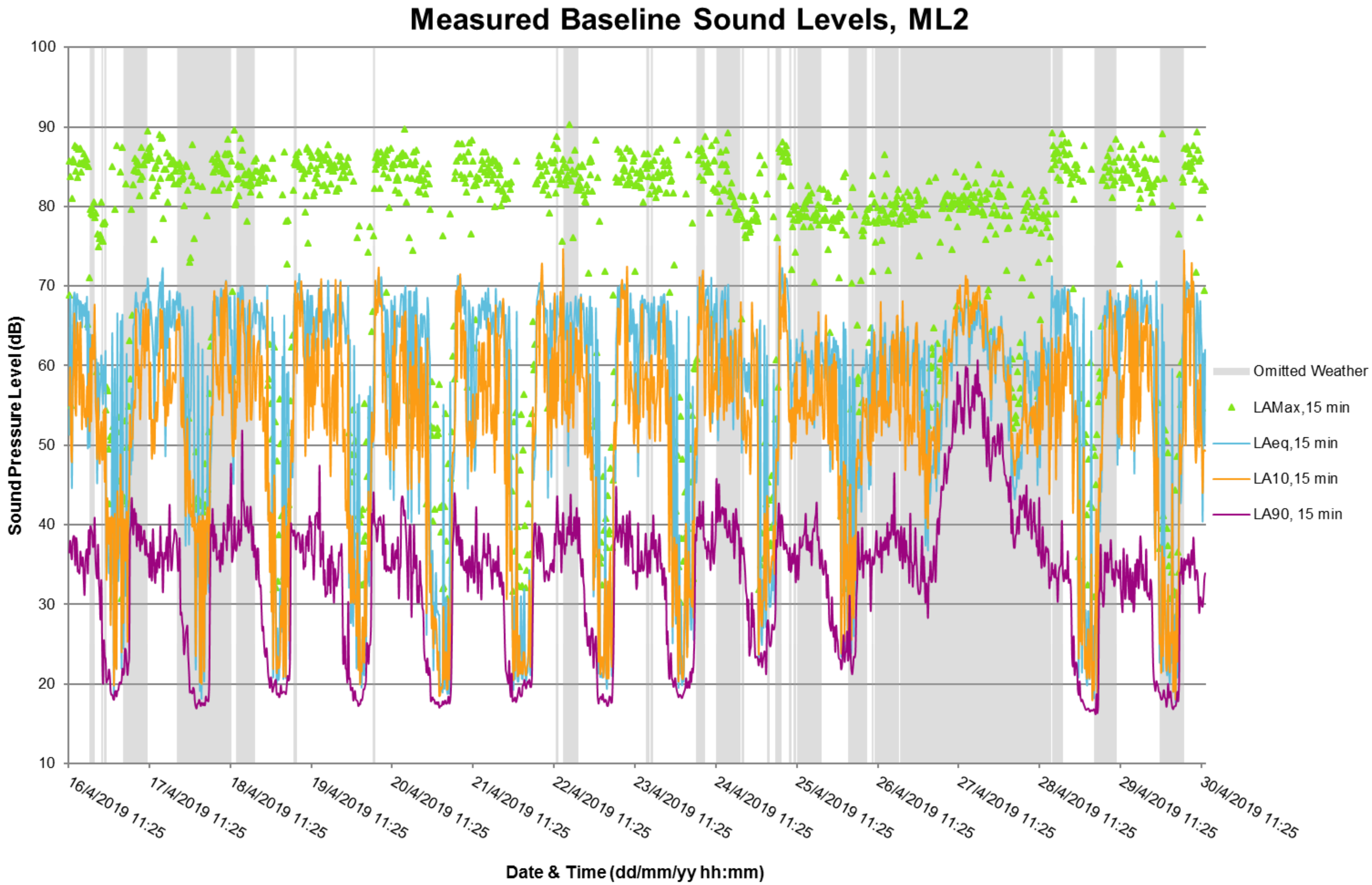
6 Recorded data are from 21/09 to 30/09 and 04/10 to 13/10

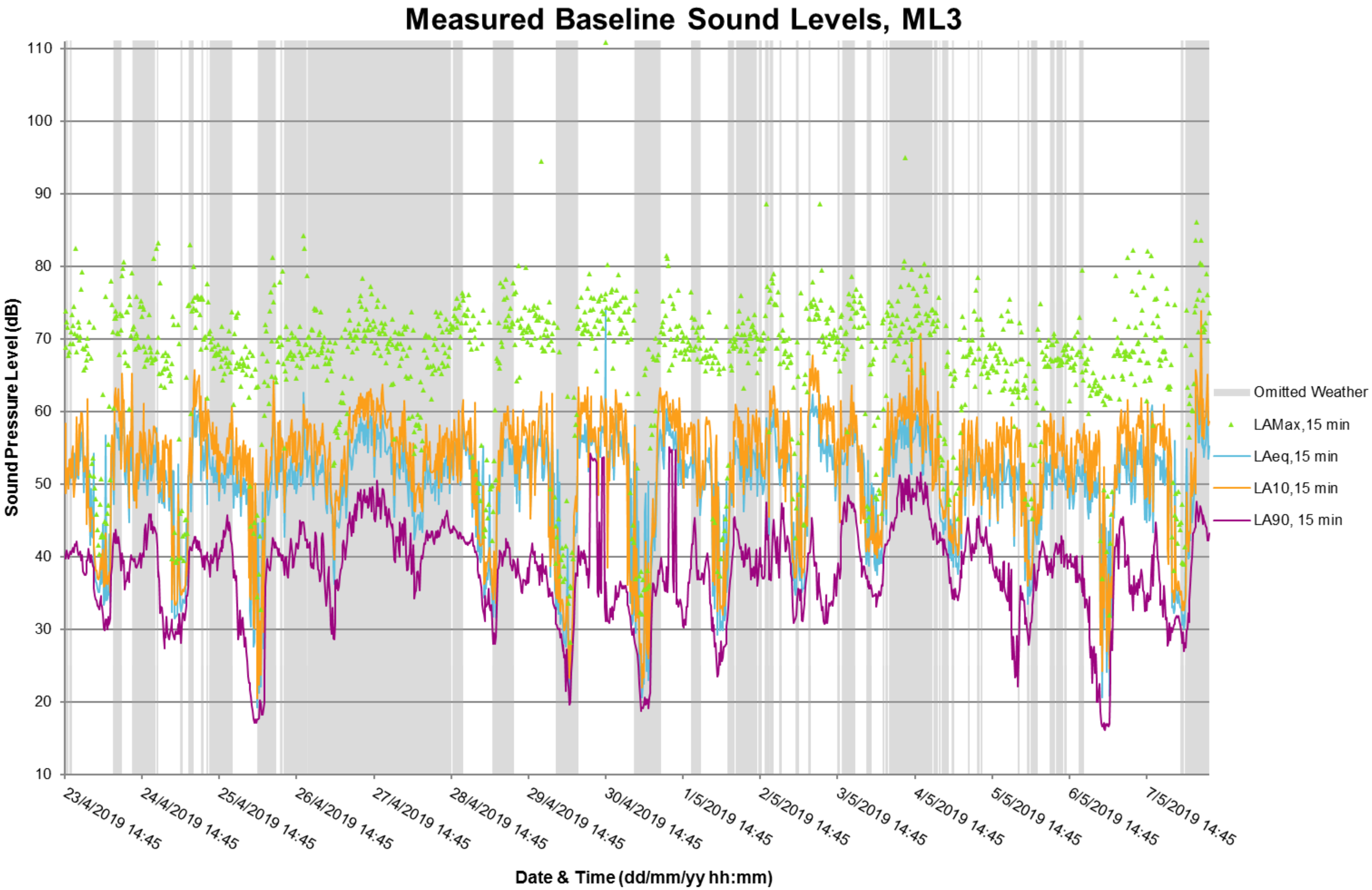
7 Recorded data are from 23/08 to 01/09 and 05/09 to 14/09

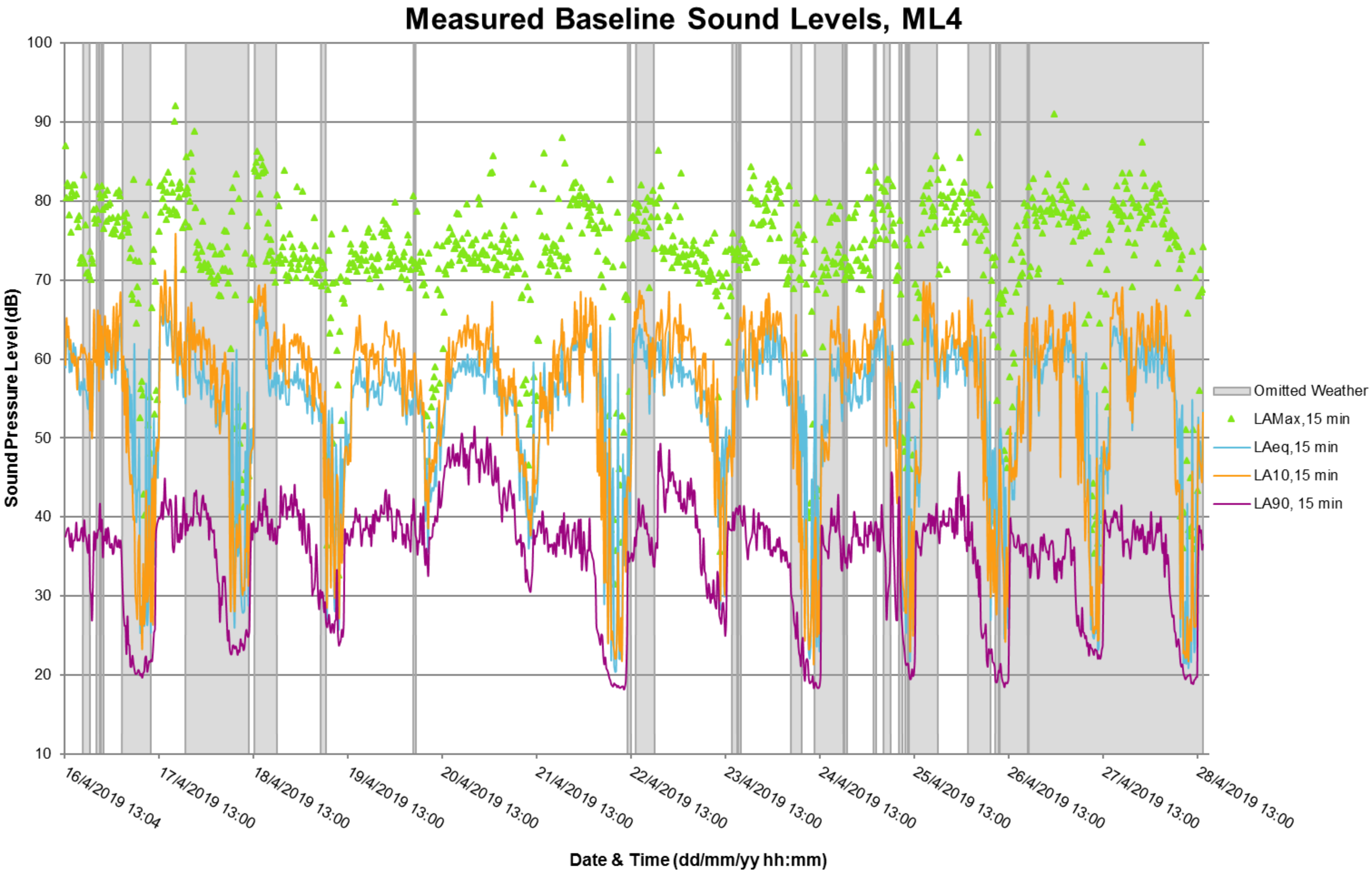
8 Recorded data are from 23/08 to 02/09 and 10/09 to 19/09

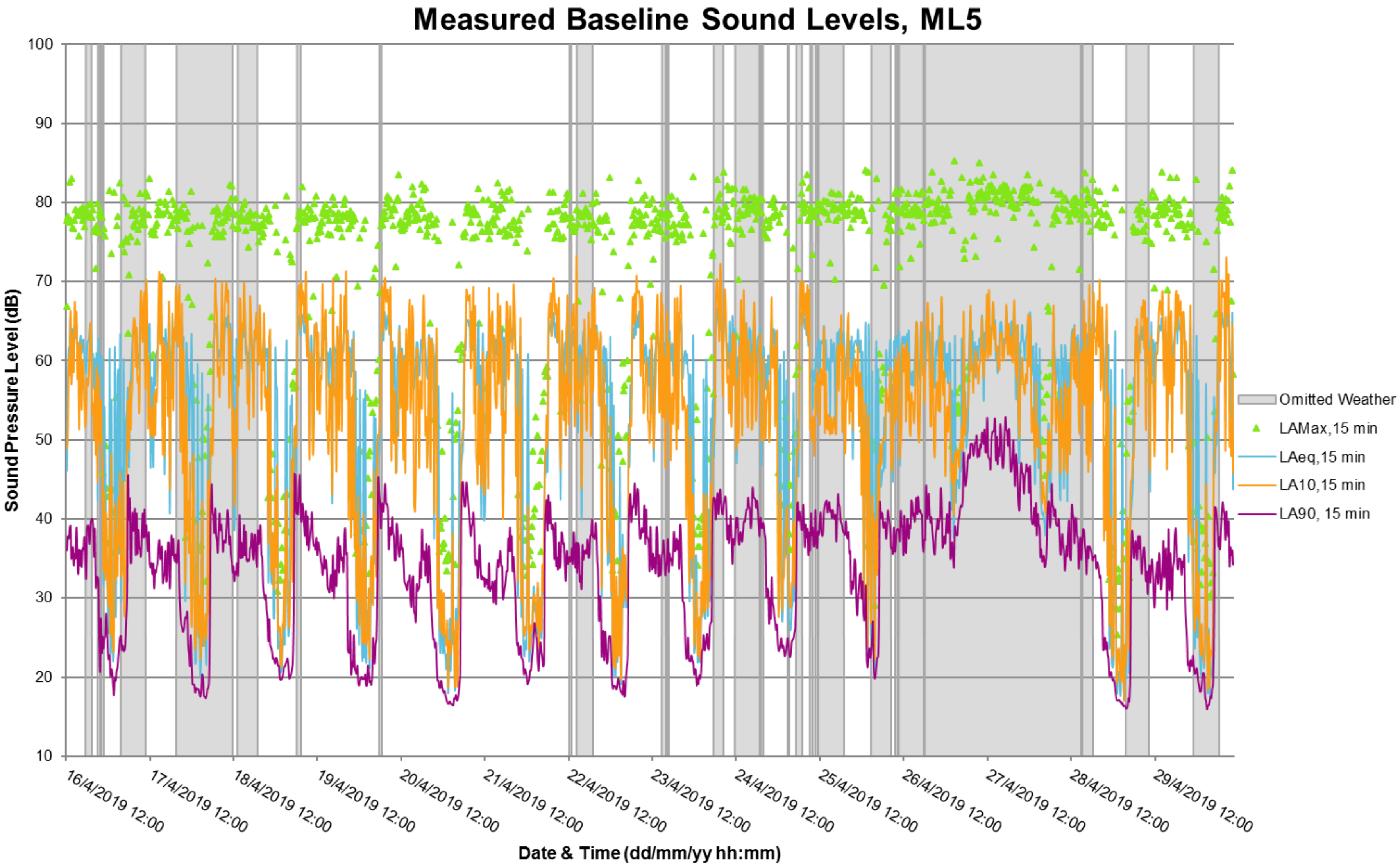
4.4 Noise Monitoring Time Histories

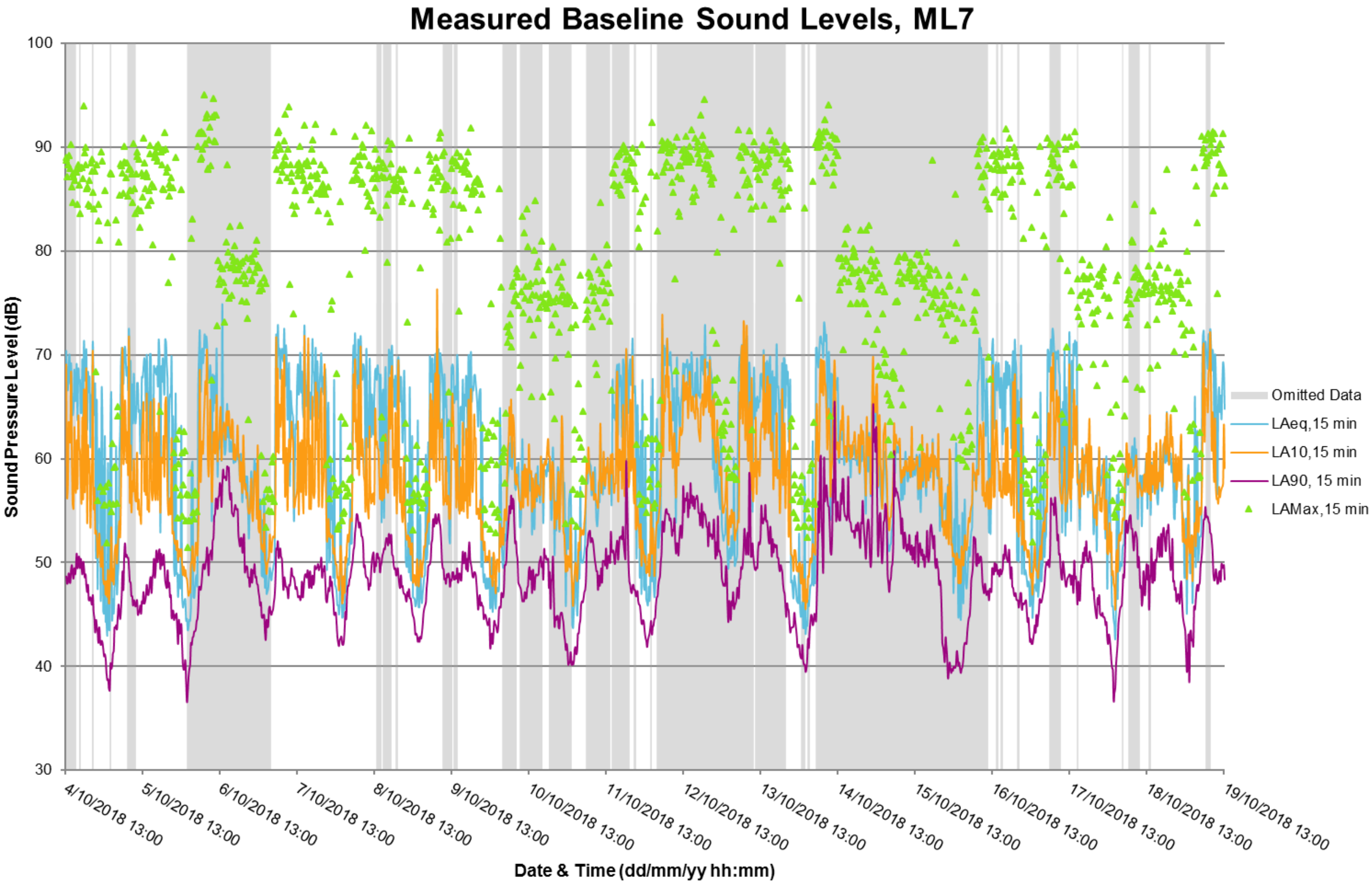


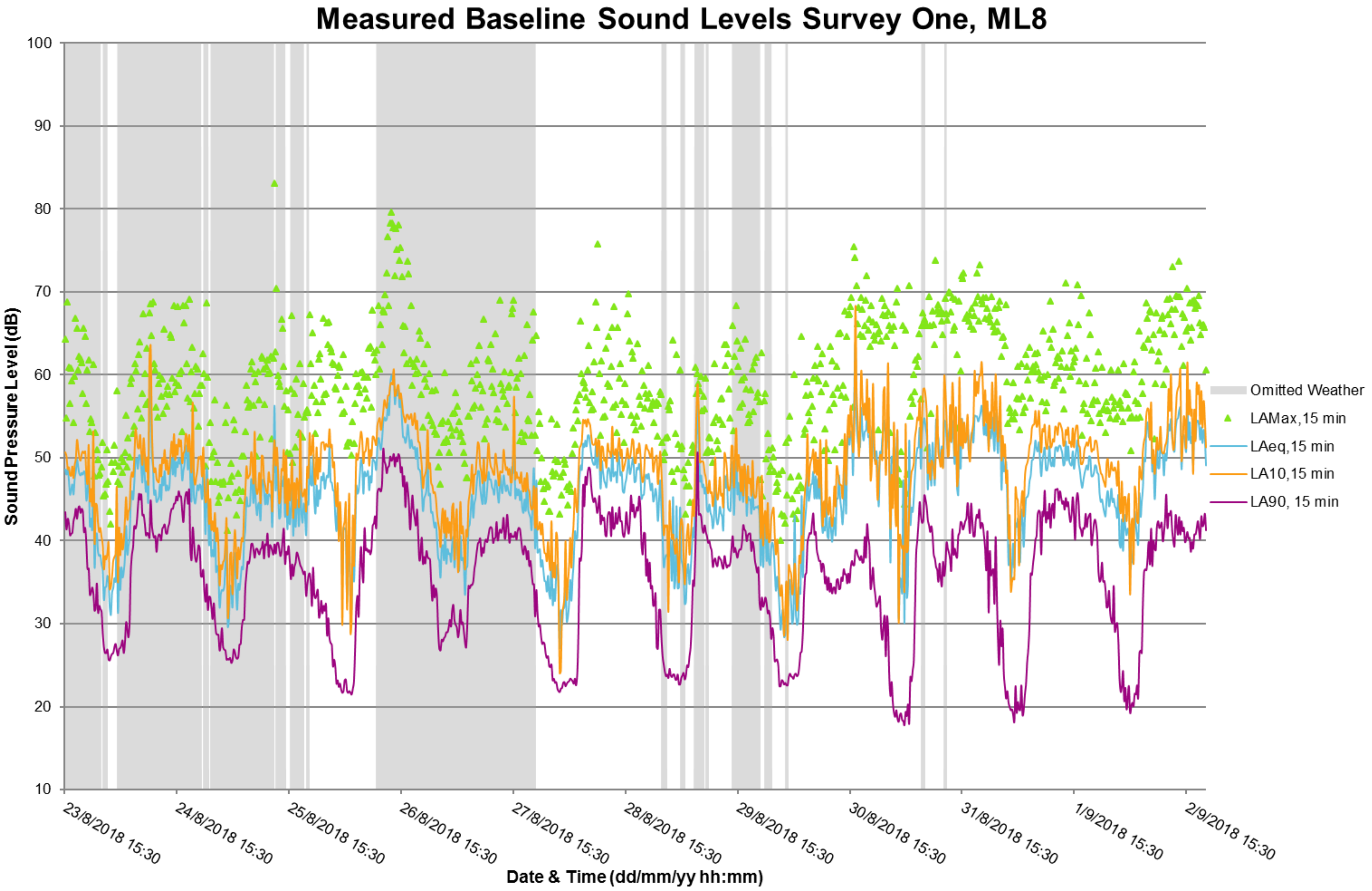

Measured Baseline Sound Levels, ML2
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
10
16/4/2019 11:25
17/4/2019 11:25
18/4/2019 11:25
19/4/2019 11:25
20/4/2019 11:25
21/4/2019 11:25
22/4/2019 11:25
23/4/2019 11:25
24/4/2019 11:25
25/4/2019 11:25
26/4/2019 11:25
27/4/2019 11:25
28/4/2019 11:25
29/4/2019 11:25
30/4/2019 11:25
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

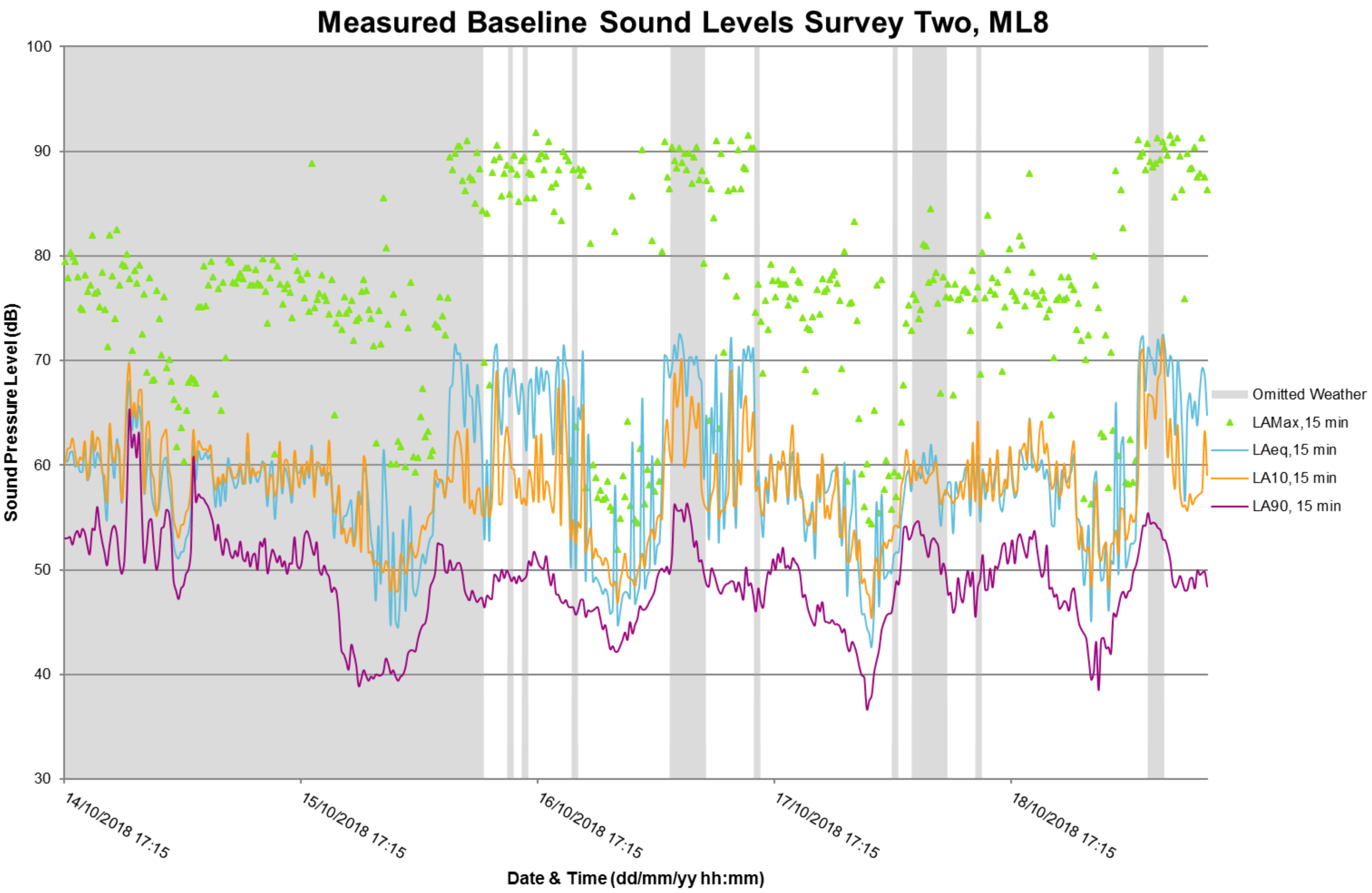

Measured Baseline Sound Levels, ML3
Sound Pressure Level (dB)
110
100
90
80
70
60
50
40
30
20
10
23/4/2019 14:45
24/4/2019 14:45
25/4/2019 14:45
26/4/2019 14:45
27/4/2019 14:45
28/4/2019 14:45
29/4/2019 14:45
30/4/2019 14:45
1/5/2019 14:45
2/5/2019 14:45
3/5/2019 14:45
4/5/2019 14:45
5/5/2019 14:45
6/5/2019 14:45
7/5/2019 14:45
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

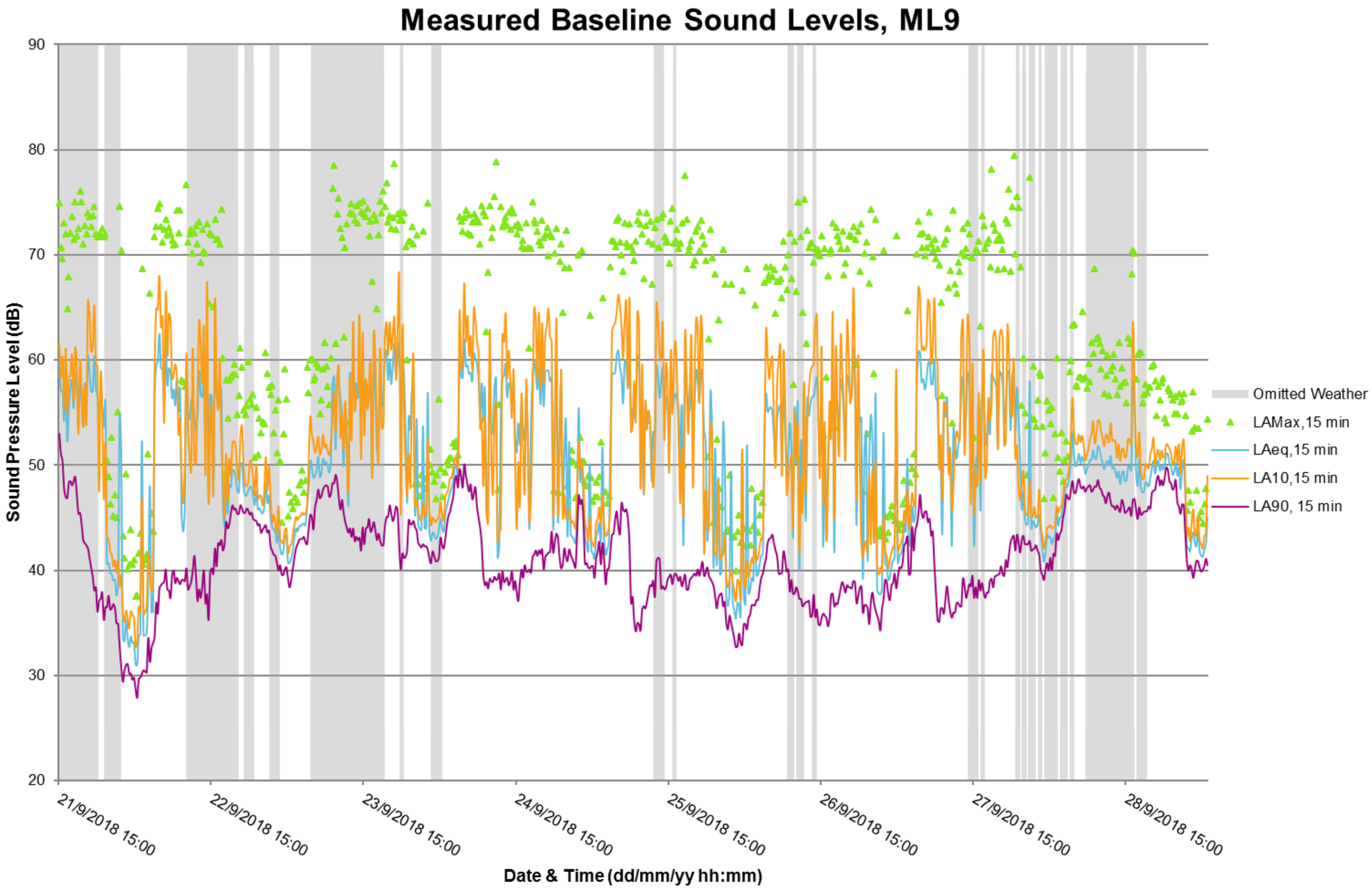

Measured Baseline Sound Levels, ML4
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
10
16/4/2019 13:04
17/4/2019 13:00
18/4/2019 13:00
19/4/2019 13:00
20/4/2019 13:00
21/4/2019 13:00
22/4/2019 13:00
23/4/2019 13:00
24/4/2019 13:00
25/4/2019 13:00
26/4/2019 13:00
27/4/2019 13:00
28/4/2019 13:00
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

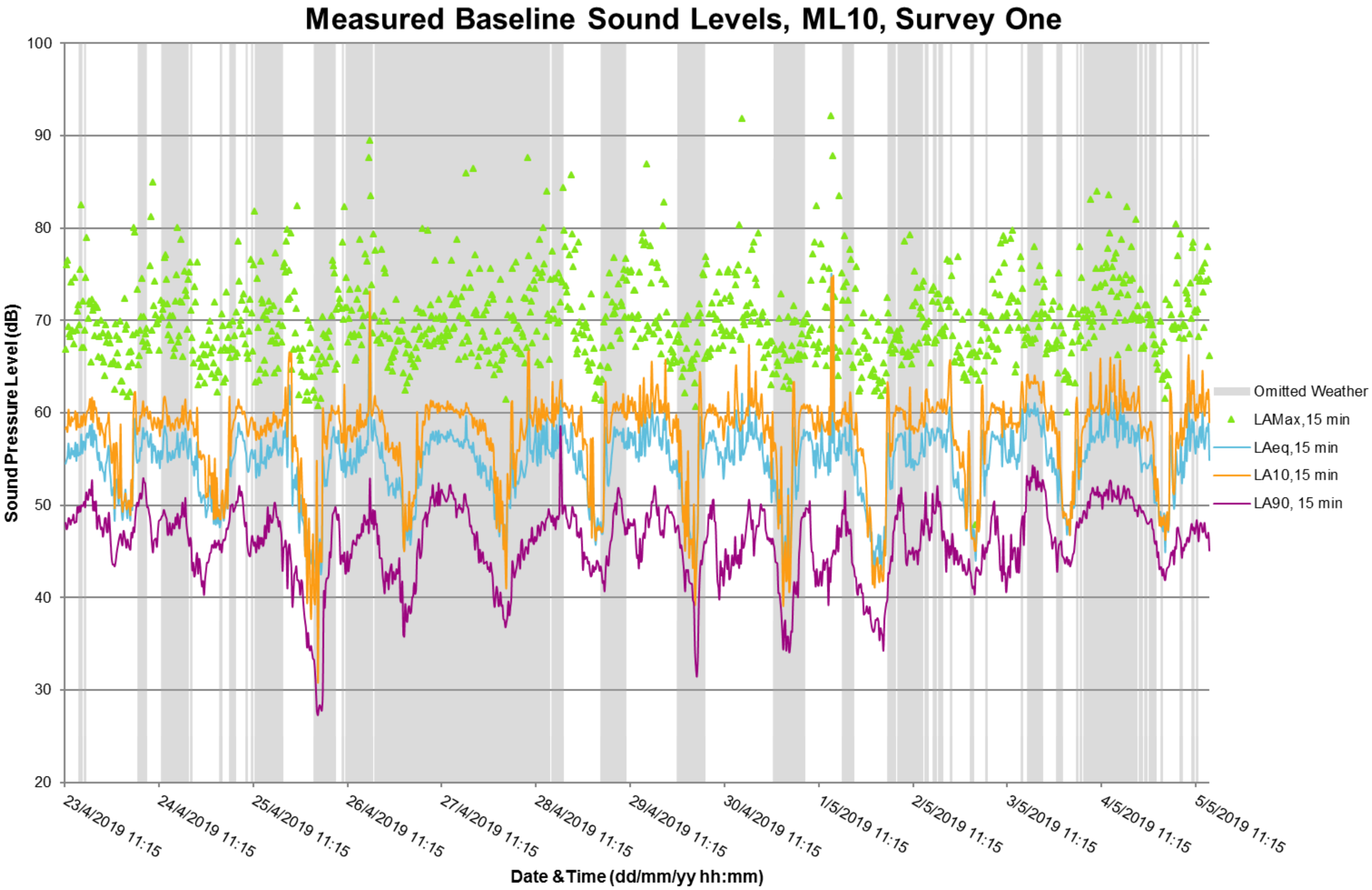

Measured Baseline Sound Levels, ML5
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
10
16/4/2019 12:00
17/4/2019 12:00
18/4/2019 12:00
19/4/2019 12:00
20/4/2019 12:00
21/4/2019 12:00
22/4/2019 12:00
23/4/2019 12:00
24/4/2019 12:00
25/4/2019 12:00
26/4/2019 12:00
27/4/2019 12:00
28/4/2019 12:00
29/4/2019 12:00
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

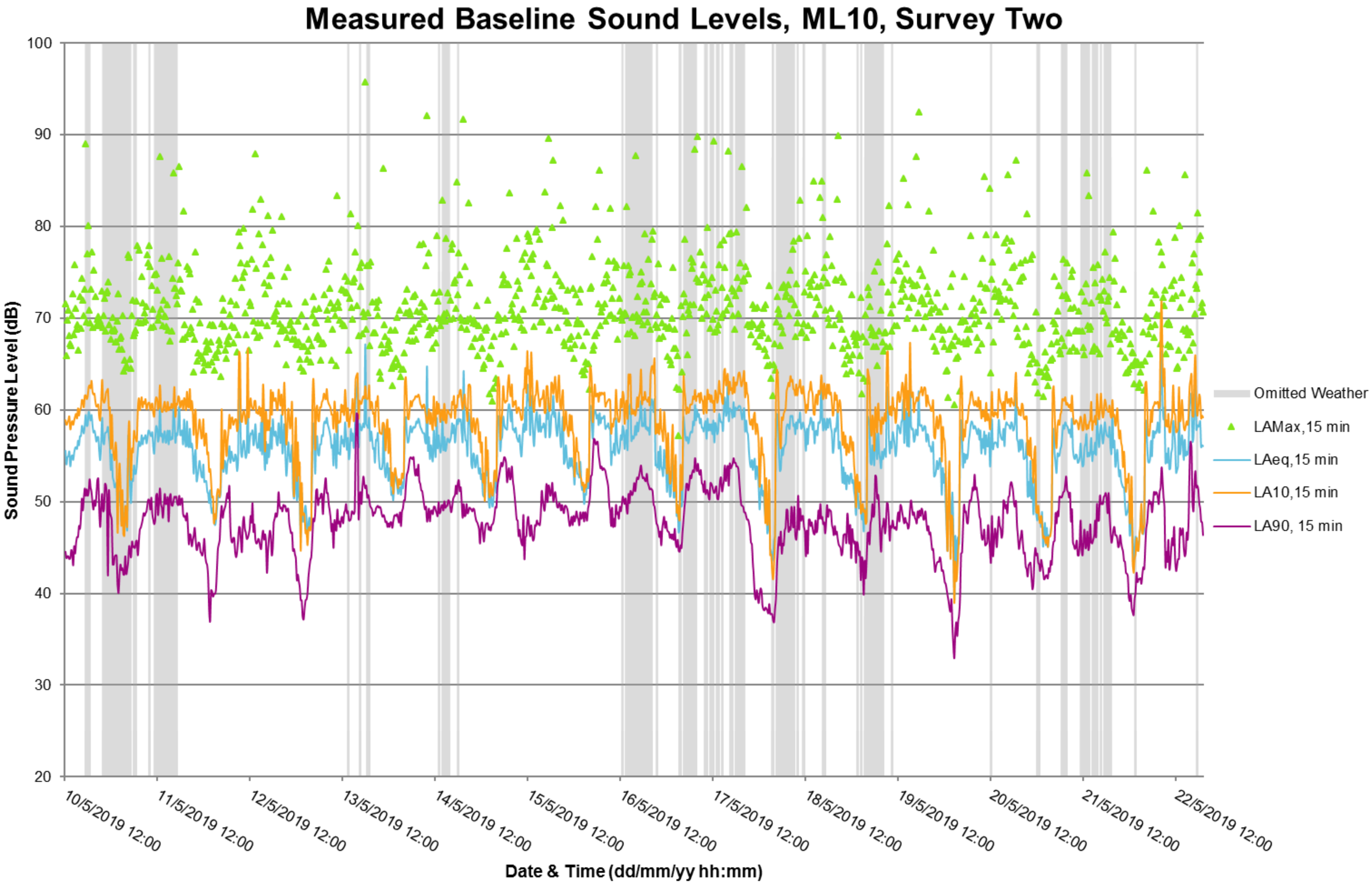

Measured Baseline Sound Levels, ML7
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
4/10/2018 13:00
5/10/2018 13:00
6/10/2018 13:00
7/10/2018 13:00
8/10/2018 13:00
9/10/2018 13:00
10/10/2018 13:00
11/10/2018 13:00
12/10/2018 13:00
13/10/2018 13:00
14/10/2018 13:00
15/10/2018 13:00
16/10/2018 13:00
17/10/2018 13:00
18/10/2018 13:00
19/10/2018 13:00
Date & Time (dd/mm/yy hh:mm)
Omitted Data
LAeq,15 min
LA10,15 min
LA90, 15 min
LAMax,15 min

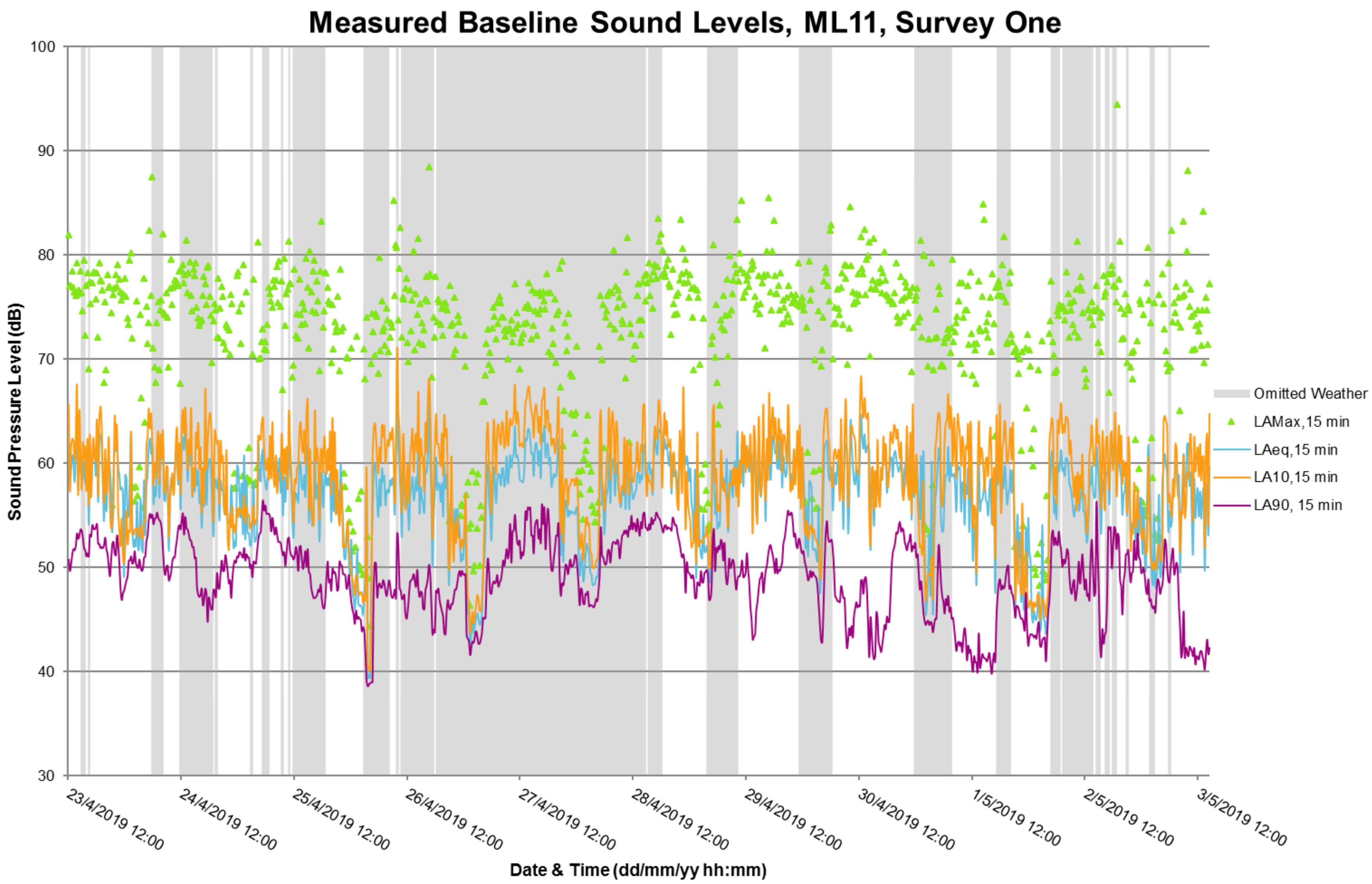

Measured Baseline Sound Levels Survey One, ML8
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
10
23/8/2018 15:30
24/8/2018 15:30
25/8/2018 15:30
26/8/2018 15:30
27/8/2018 15:30
28/8/2018 15:30
29/8/2018 15:30
30/8/2018 15:30
31/8/2018 15:30
1/9/2018 15:30
2/9/2018 15:30
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

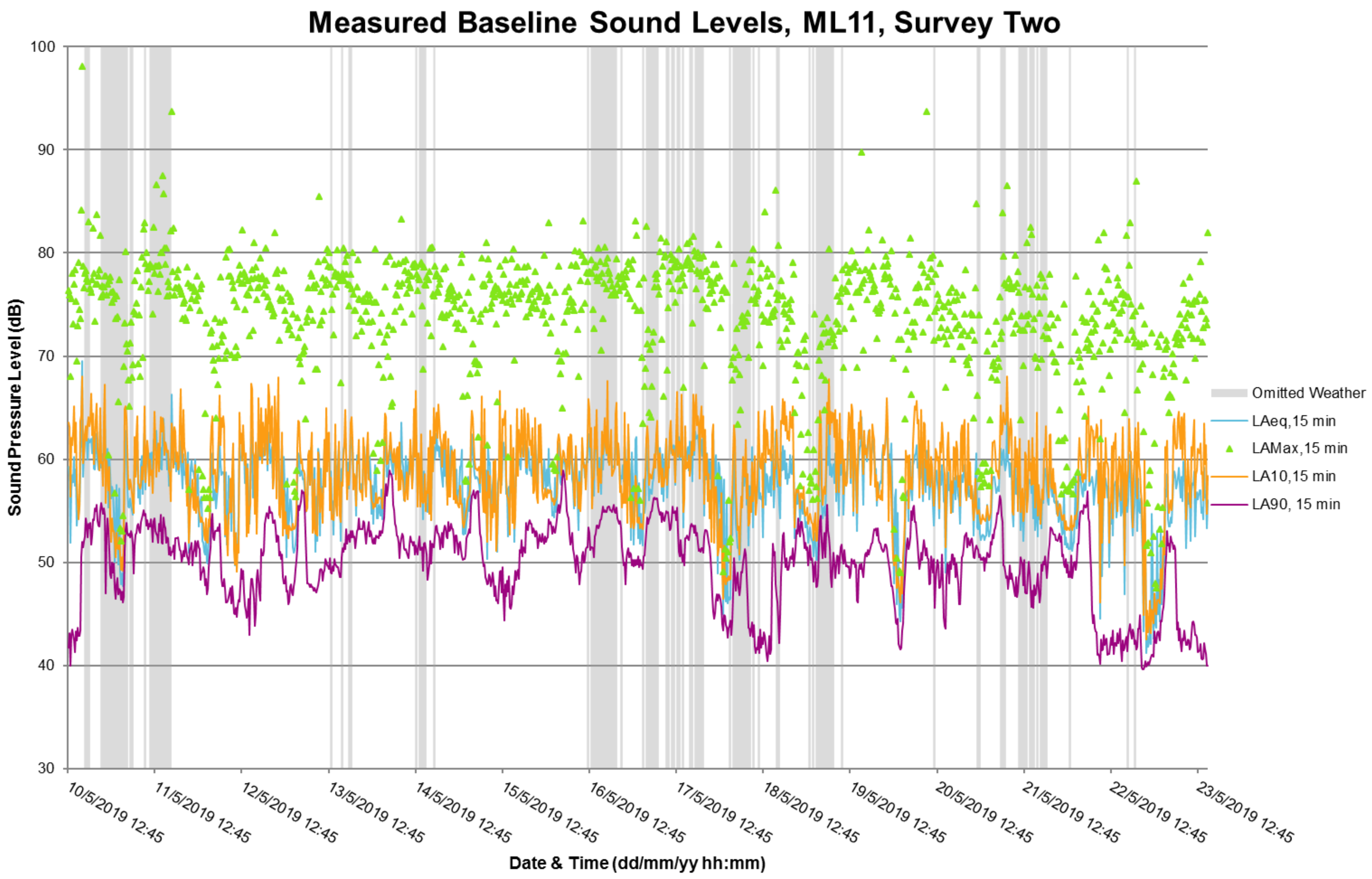

Measured Baseline Sound Levels Survey Two, ML8
100
90
80
70
60
50
40
30
Sound Pressure Level (dB)
14/10/2018 17:15
15/10/2018 17:15
16/10/2018 17:15
17/10/2018 17:15
18/10/2018 17:15
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

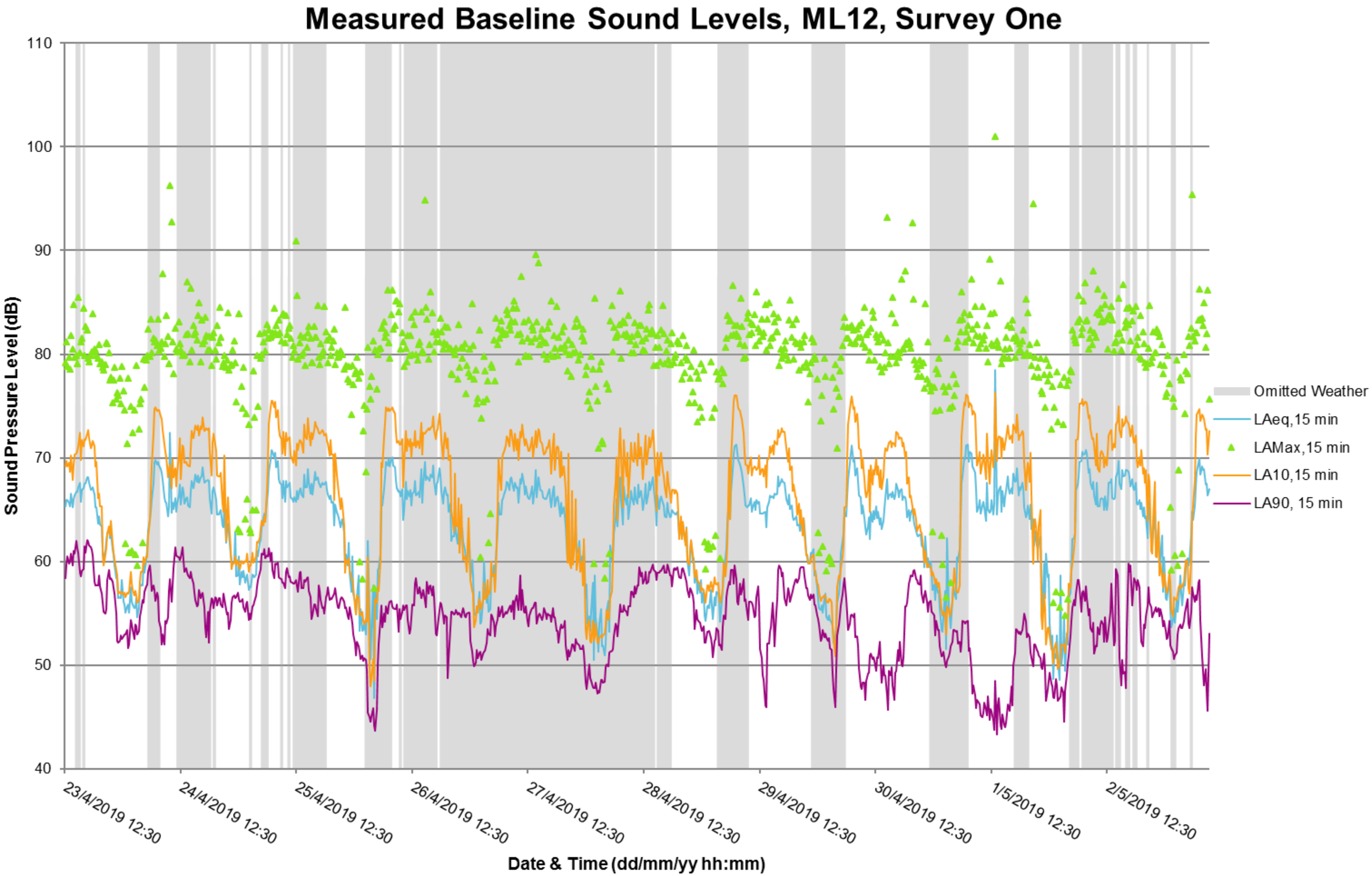

Measured Baseline Sound Levels, ML9
Sound Pressure Level (dB)
90
80
70
60
50
40
30
20
21/9/2018 15:00
22/9/2018 15:00
23/9/2018 15:00
24/9/2018 15:00
25/9/2018 15:00
26/9/2018 15:00
27/9/2018 15:00
28/9/2018 15:00
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

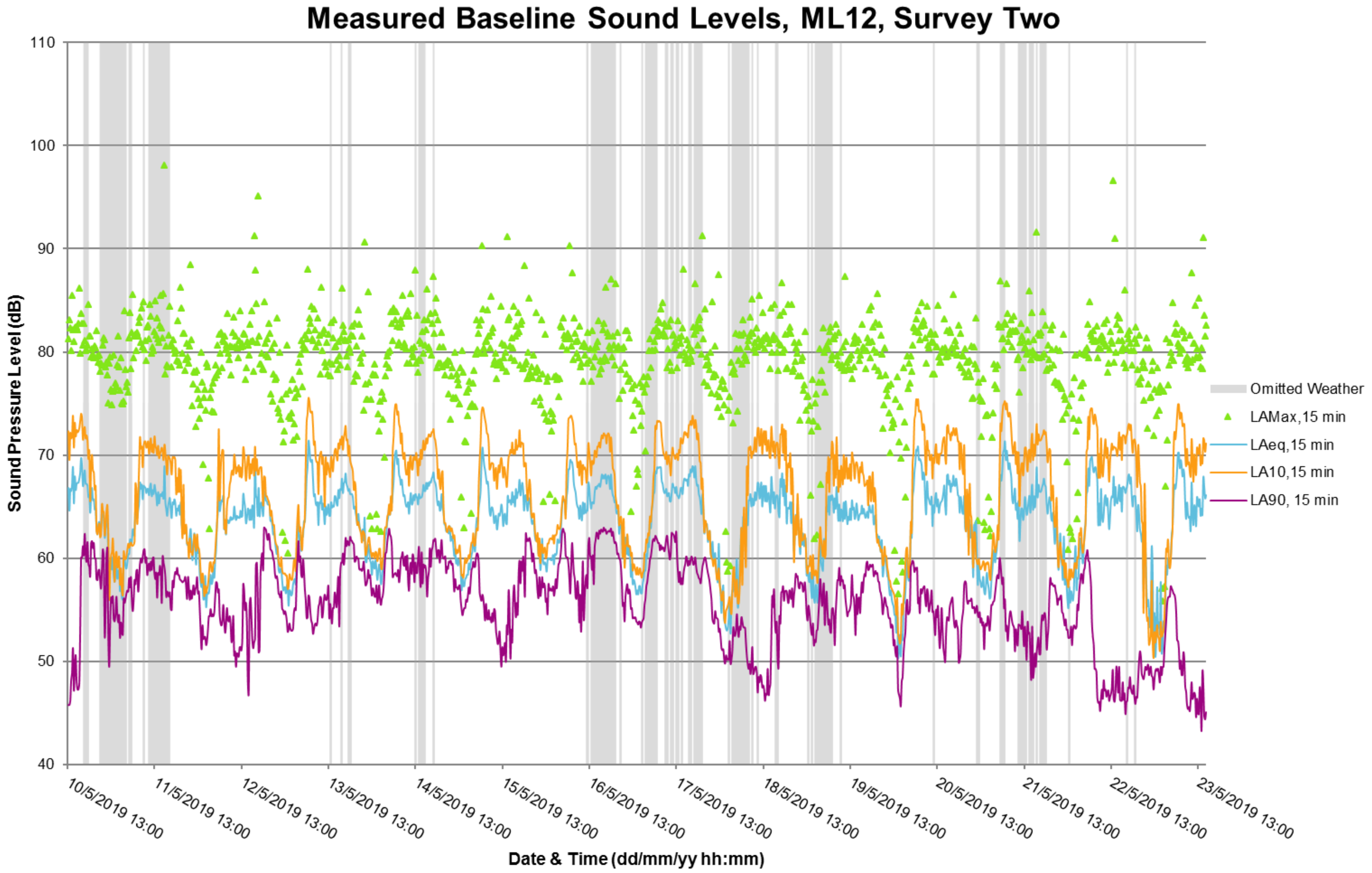

Measured Baseline Sound Levels, ML10, Survey One
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min
23/4/2019 11:15
24/4/2019 11:15
25/4/2019 11:15
26/4/2019 11:15
27/4/2019 11:15
28/4/2019 11:15
29/4/2019 11:15
30/4/2019 11:15
1/5/2019 11:15
2/5/2019 11:15
3/5/2019 11:15
4/5/2019 11:15
5/5/2019 11:15
Date & Time (dd/mm/yy hh:mm)

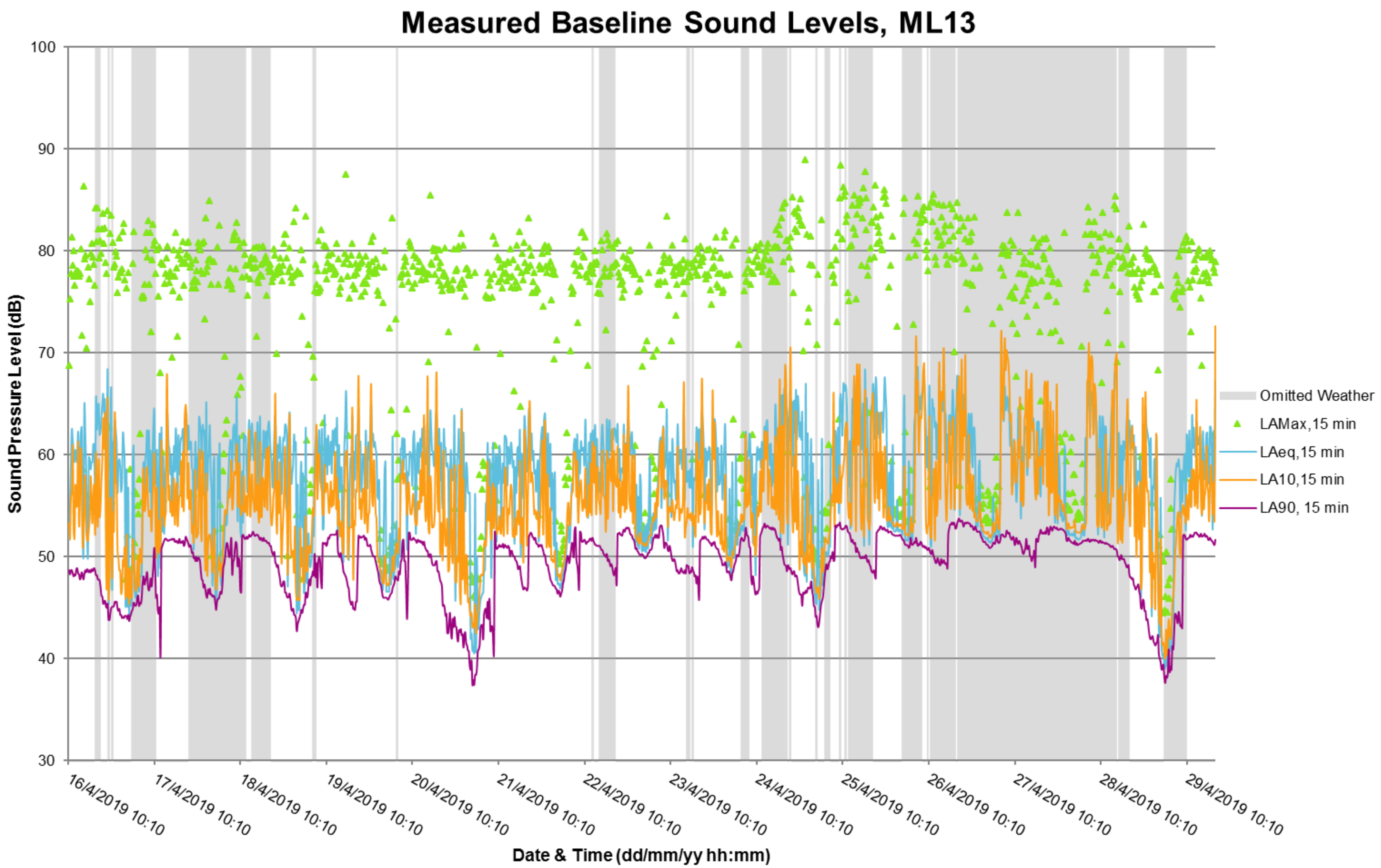

Measured Baseline Sound Levels, ML10, Survey Two
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
10/5/2019 12:00
11/5/2019 12:00
12/5/2019 12:00
13/5/2019 12:00
14/5/2019 12:00
15/5/2019 12:00
16/5/2019 12:00
17/5/2019 12:00
18/5/2019 12:00
19/5/2019 12:00
20/5/2019 12:00
21/5/2019 12:00
22/5/2019 12:00
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

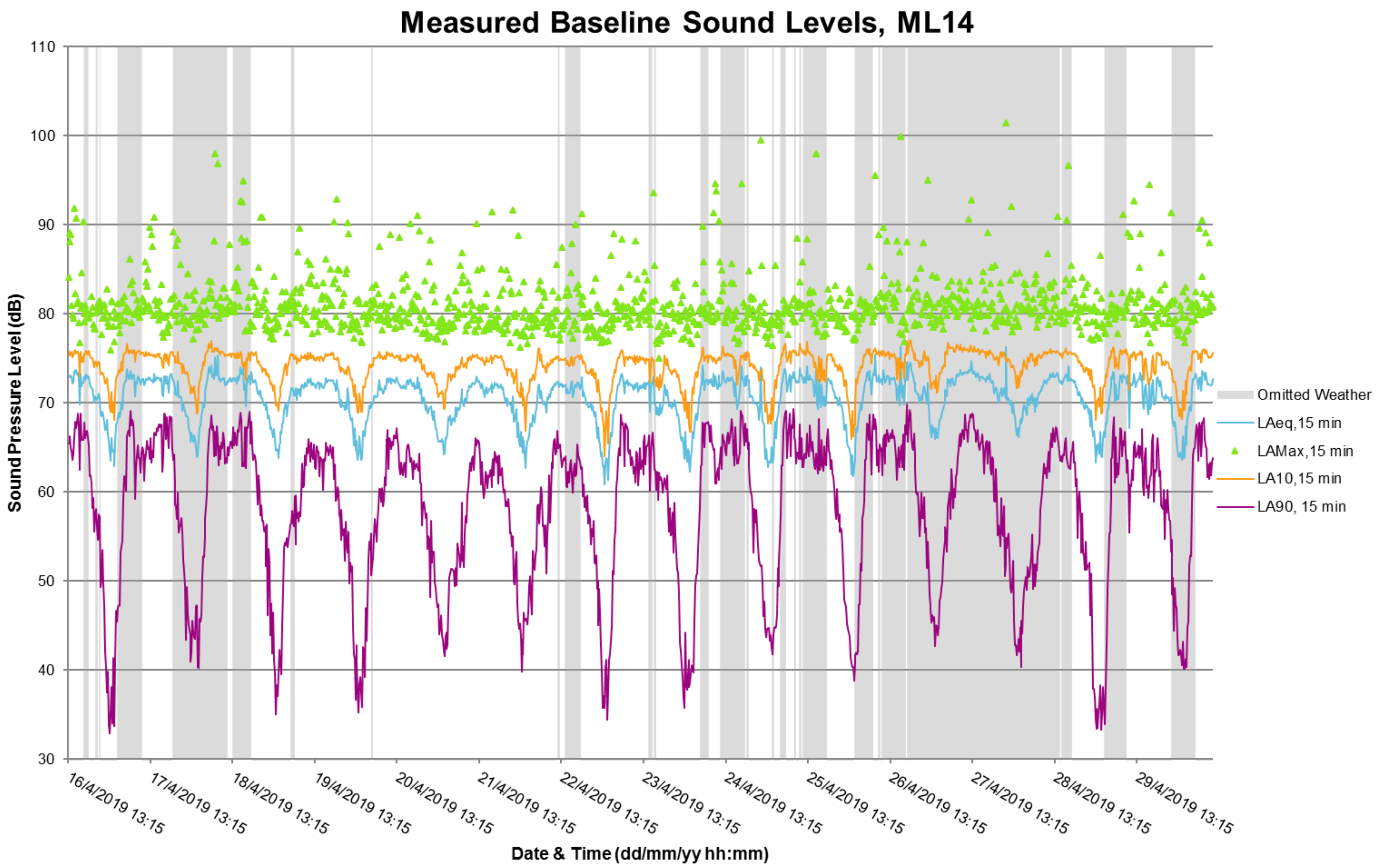

Measured Baseline Sound Levels, ML11, Survey One
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
23/4/2019 12:00
24/4/2019 12:00
25/4/2019 12:00
26/4/2019 12:00
27/4/2019 12:00
28/4/2019 12:00
29/4/2019 12:00
30/4/2019 12:00
1/5/2019 12:00
2/5/2019 12:00
3/5/2019 12:00
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

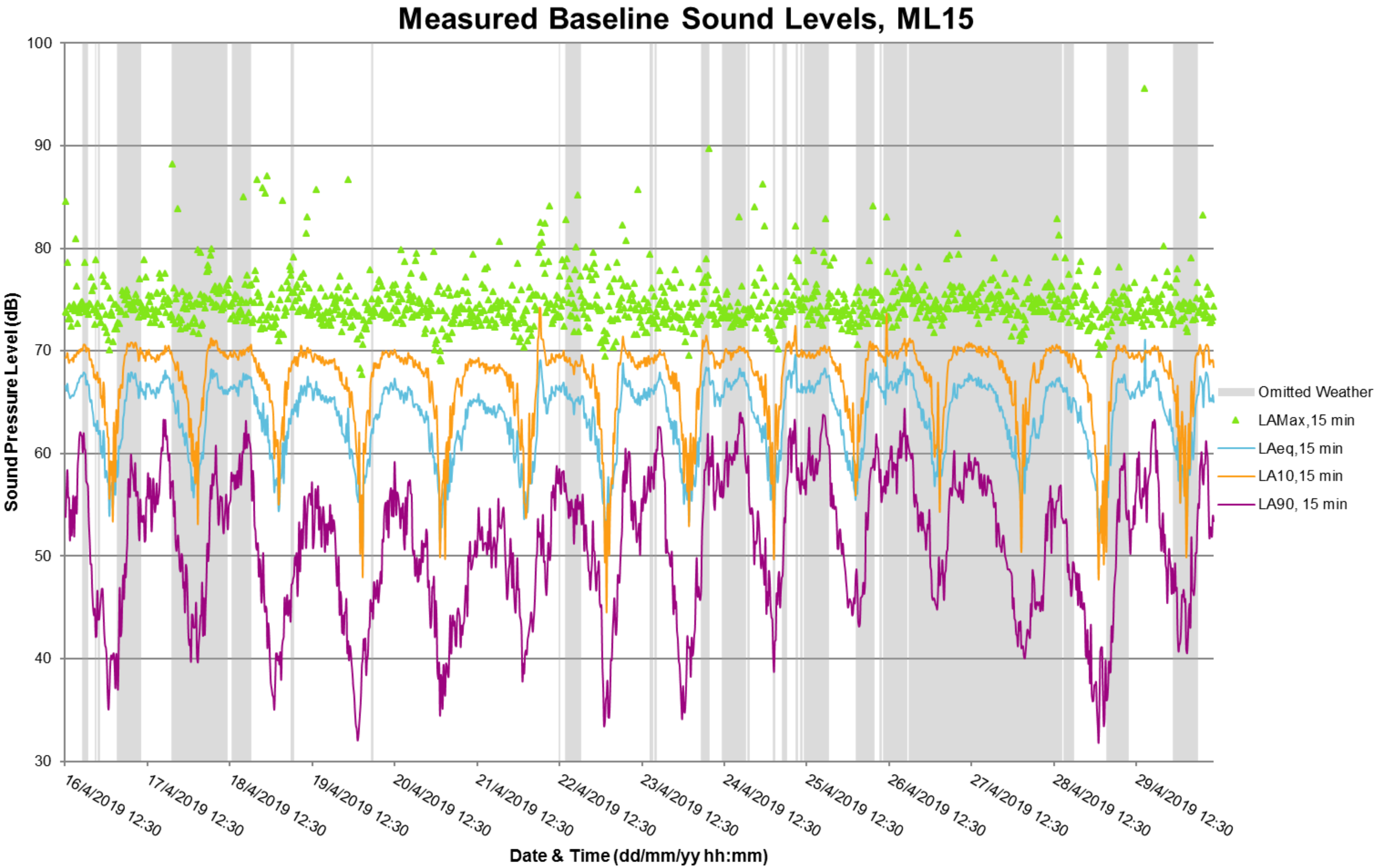

Measured Baseline Sound Levels, ML11, Survey Two
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
10/5/2019 12:45
11/5/2019 12:45
12/5/2019 12:45
13/5/2019 12:45
14/5/2019 12:45
15/5/2019 12:45
16/5/2019 12:45
17/5/2019 12:45
18/5/2019 12:45
19/5/2019 12:45
20/5/2019 12:45
21/5/2019 12:45
22/5/2019 12:45
23/5/2019 12:45
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAeq,15 min
LAMax,15 min
LA10,15 min
LA90, 15 min

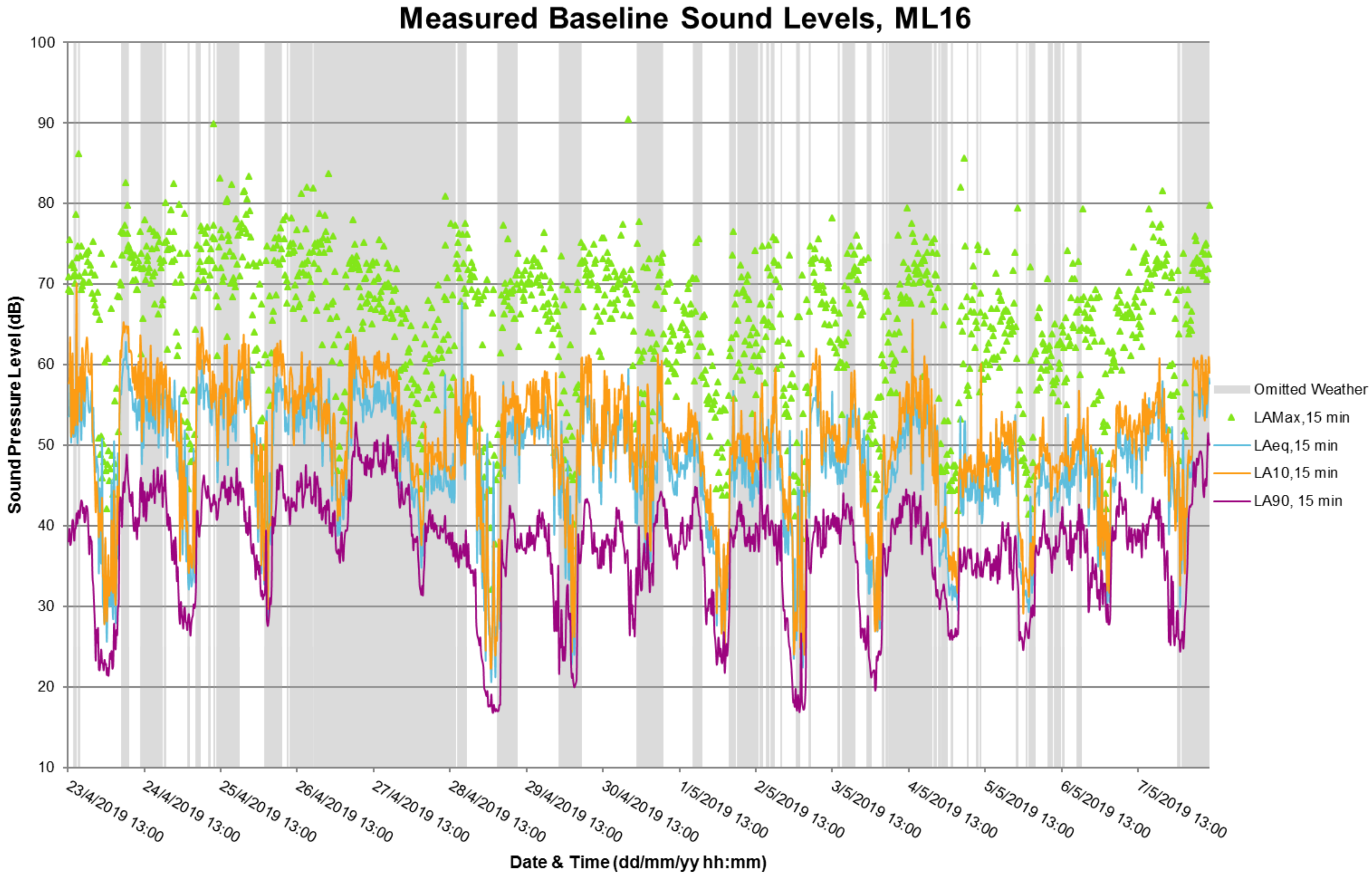

Measured Baseline Sound Levels, ML12, Survey One
Sound Pressure Level (dB)
110
100
90
80
70
60
50
40
23/4/2019 12:30
24/4/2019 12:30
25/4/2019 12:30
26/4/2019 12:30
27/4/2019 12:30
28/4/2019 12:30
29/4/2019 12:30
30/4/2019 12:30
1/5/2019 12:30
2/5/2019 12:30
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAeq,15 min
LAMax,15 min
LA10,15 min
LA90, 15 min

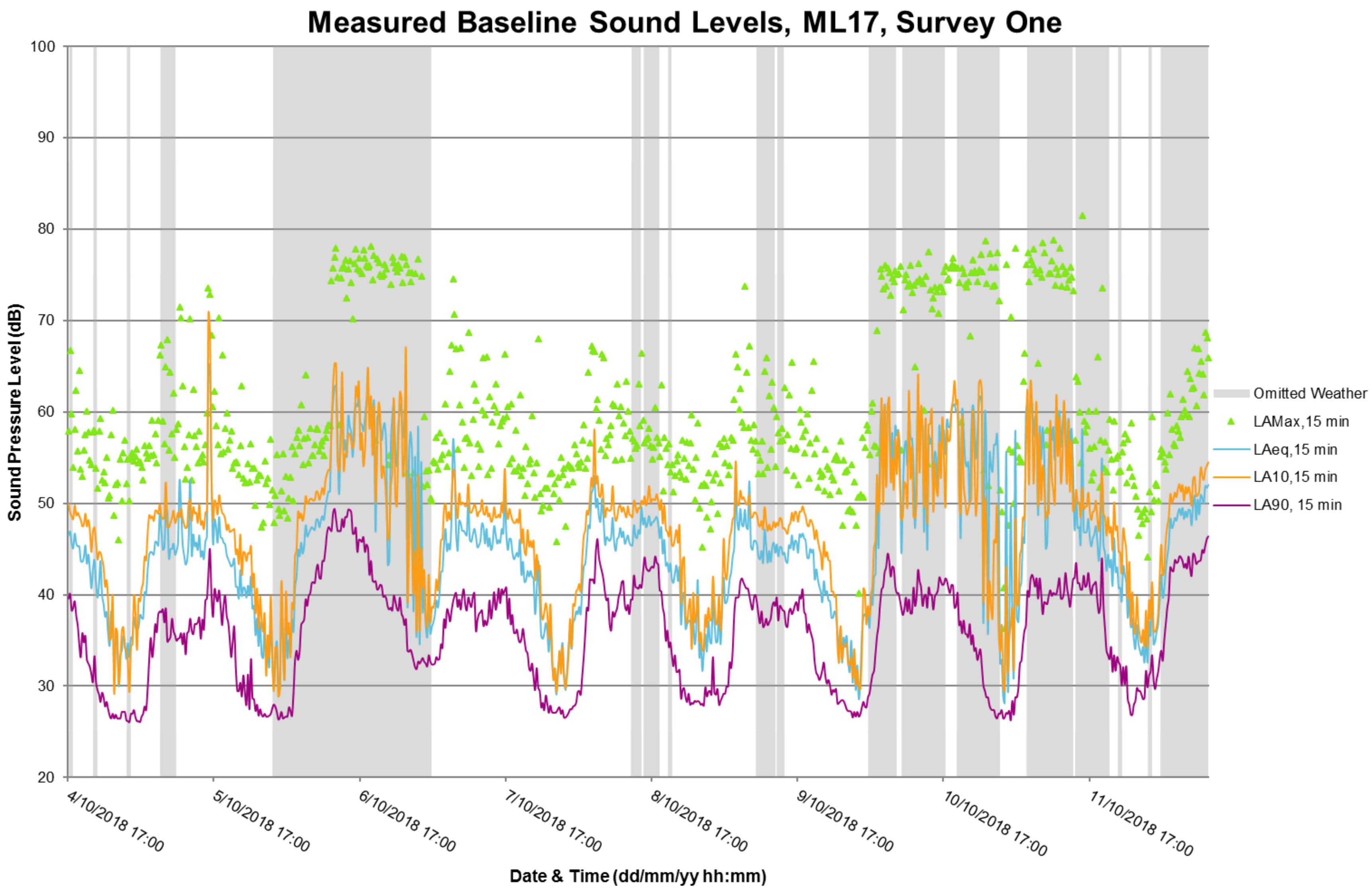

Measured Baseline Sound Levels, ML12, Survey Two
Sound Pressure Level (dB)
110
100
90
80
70
60
50
40
10/5/2019 13:00
11/5/2019 13:00
12/5/2019 13:00
13/5/2019 13:00
14/5/2019 13:00
15/5/2019 13:00
16/5/2019 13:00
17/5/2019 13:00
18/5/2019 13:00
19/5/2019 13:00
20/5/2019 13:00
21/5/2019 13:00
22/5/2019 13:00
23/5/2019 13:00
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

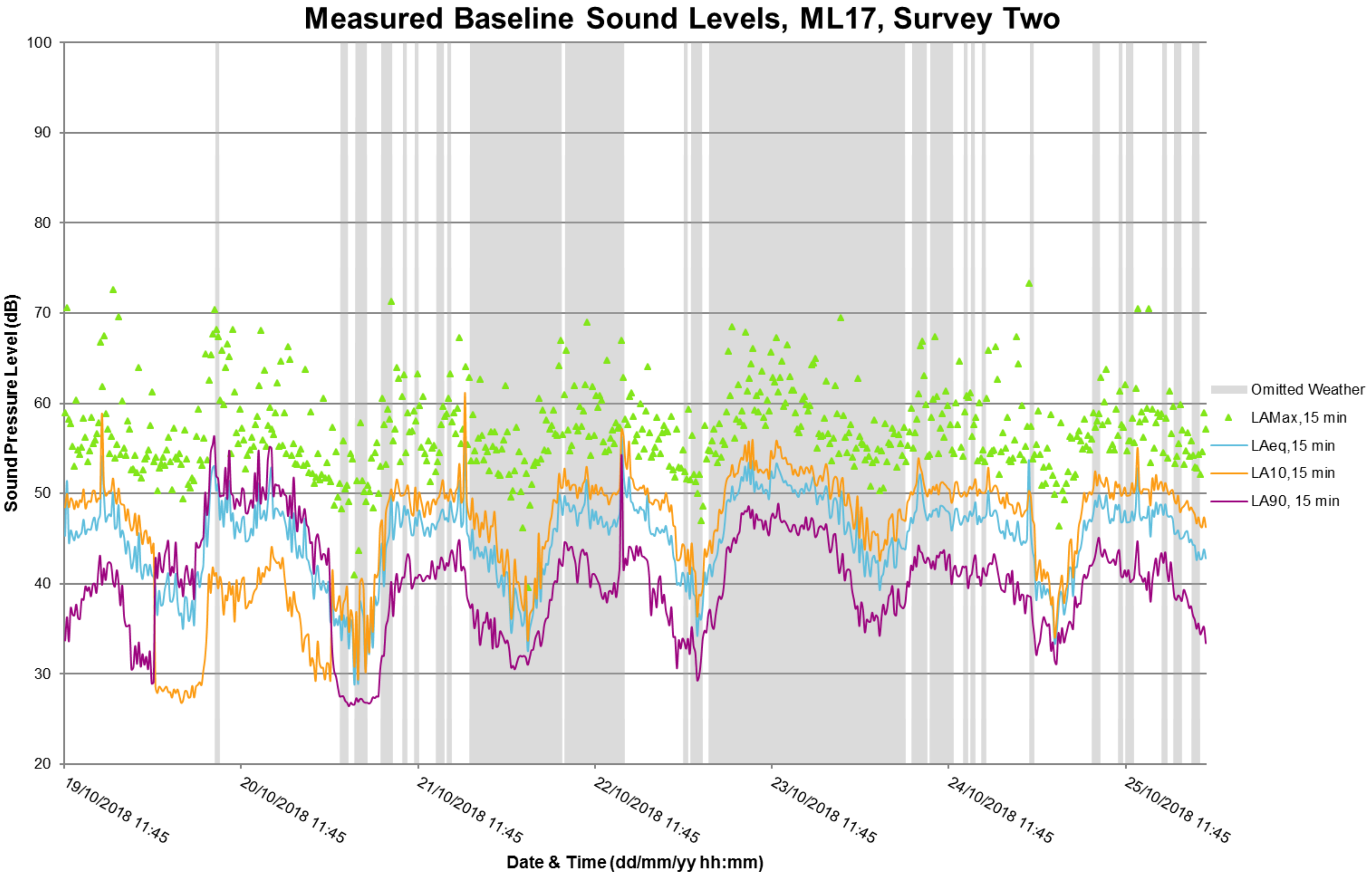

Measured Baseline Sound Levels, ML13
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
16/4/2019 10:10
17/4/2019 10:10
18/4/2019 10:10
19/4/2019 10:10
20/4/2019 10:10
21/4/2019 10:10
22/4/2019 10:10
23/4/2019 10:10
24/4/2019 10:10
25/4/2019 10:10
26/4/2019 10:10
27/4/2019 10:10
28/4/2019 10:10
29/4/2019 10:10
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

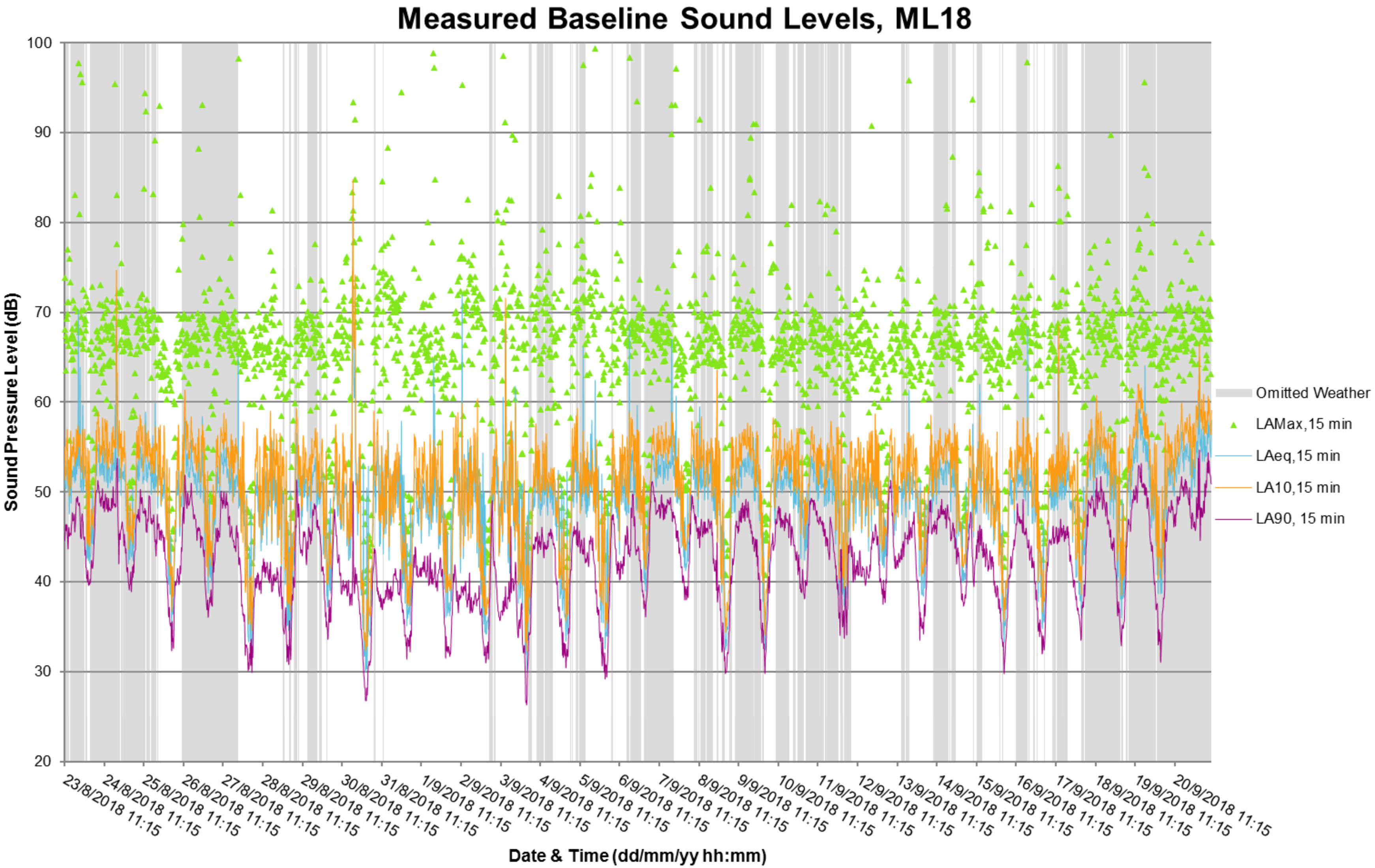

Measured Baseline Sound Levels, ML14
Sound Pressure Level (dB)
110
100
90
80
70
60
50
40
30
16/4/2019 13:15
17/4/2019 13:15
18/4/2019 13:15
19/4/2019 13:15
20/4/2019 13:15
21/4/2019 13:15
22/4/2019 13:15
23/4/2019 13:15
24/4/2019 13:15
25/4/2019 13:15
26/4/2019 13:15
27/4/2019 13:15
28/4/2019 13:15
29/4/2019 13:15
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAeq,15 min
LAMax,15 min
LA10,15 min
LA90, 15 min

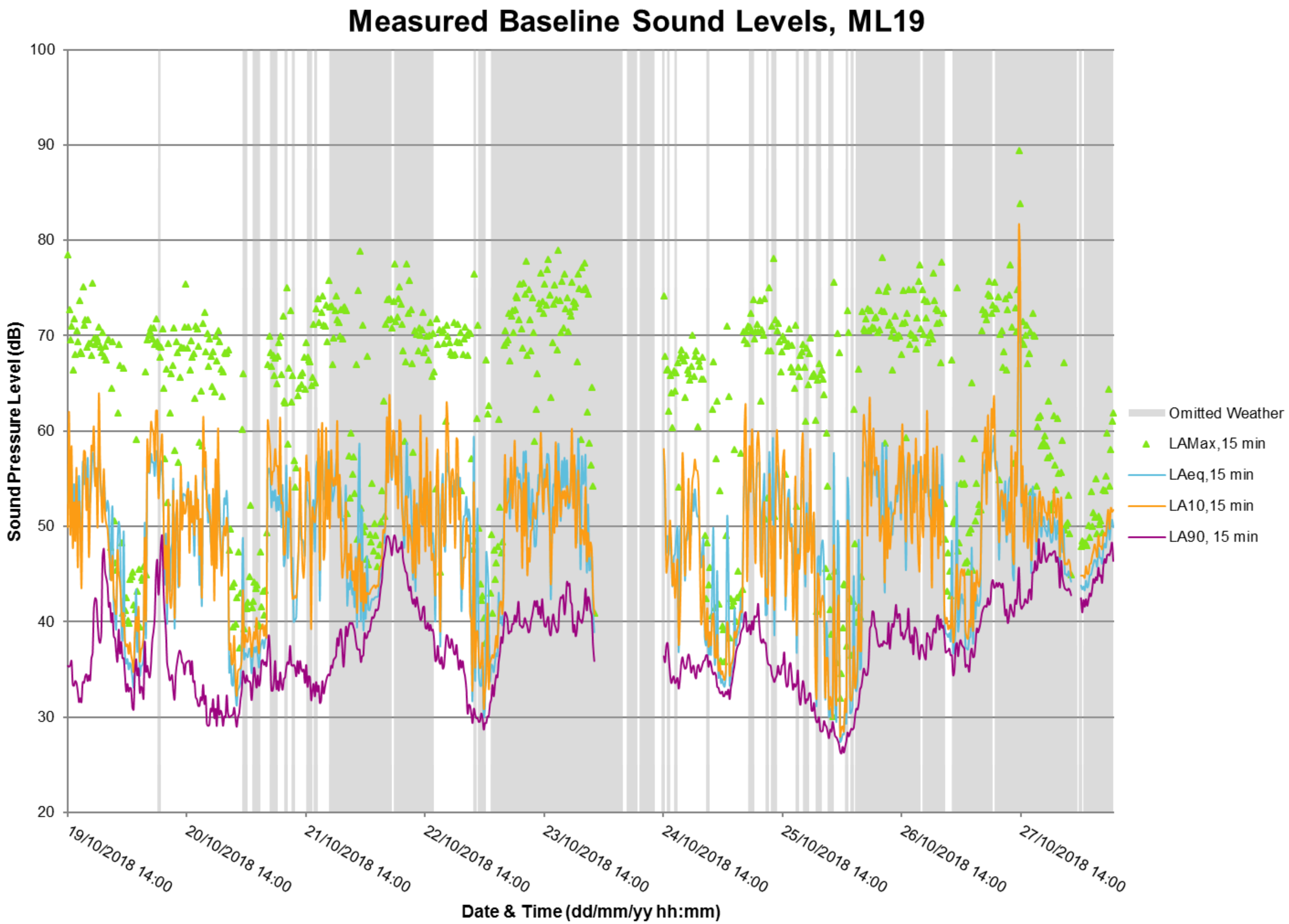

Measured Baseline Sound Levels, ML15
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
16/4/2019 12:30
17/4/2019 12:30
18/4/2019 12:30
19/4/2019 12:30
20/4/2019 12:30
21/4/2019 12:30
22/4/2019 12:30
23/4/2019 12:30
24/4/2019 12:30
25/4/2019 12:30
26/4/2019 12:30
27/4/2019 12:30
28/4/2019 12:30
29/4/2019 12:30
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

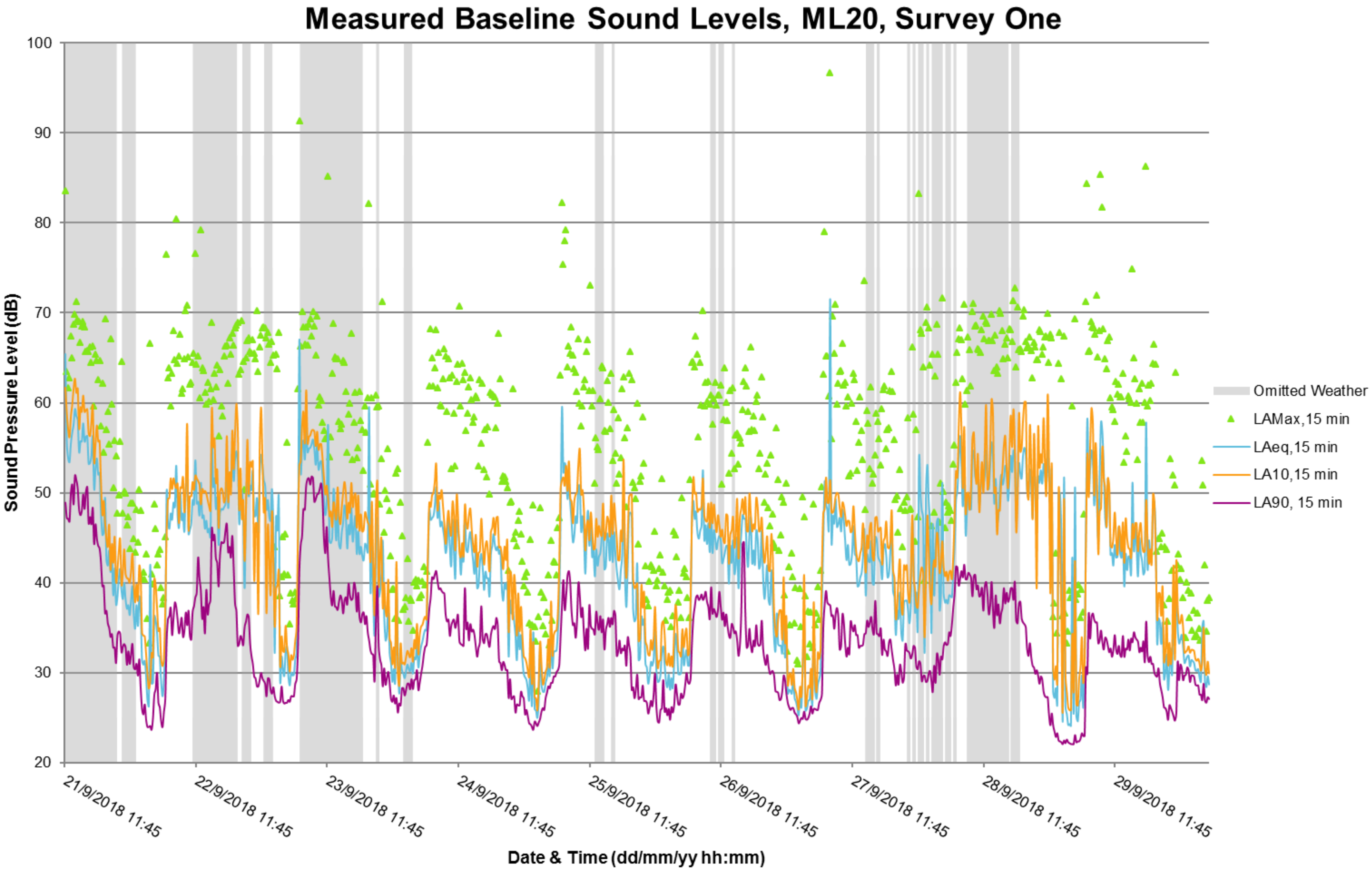

Measured Baseline Sound Levels, ML16
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
10
23/4/2019 13:00
24/4/2019 13:00
25/4/2019 13:00
26/4/2019 13:00
27/4/2019 13:00
28/4/2019 13:00
29/4/2019 13:00
30/4/2019 13:00
1/5/2019 13:00
2/5/2019 13:00
3/5/2019 13:00
4/5/2019 13:00
5/5/2019 13:00
6/5/2019 13:00
7/5/2019 13:00
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

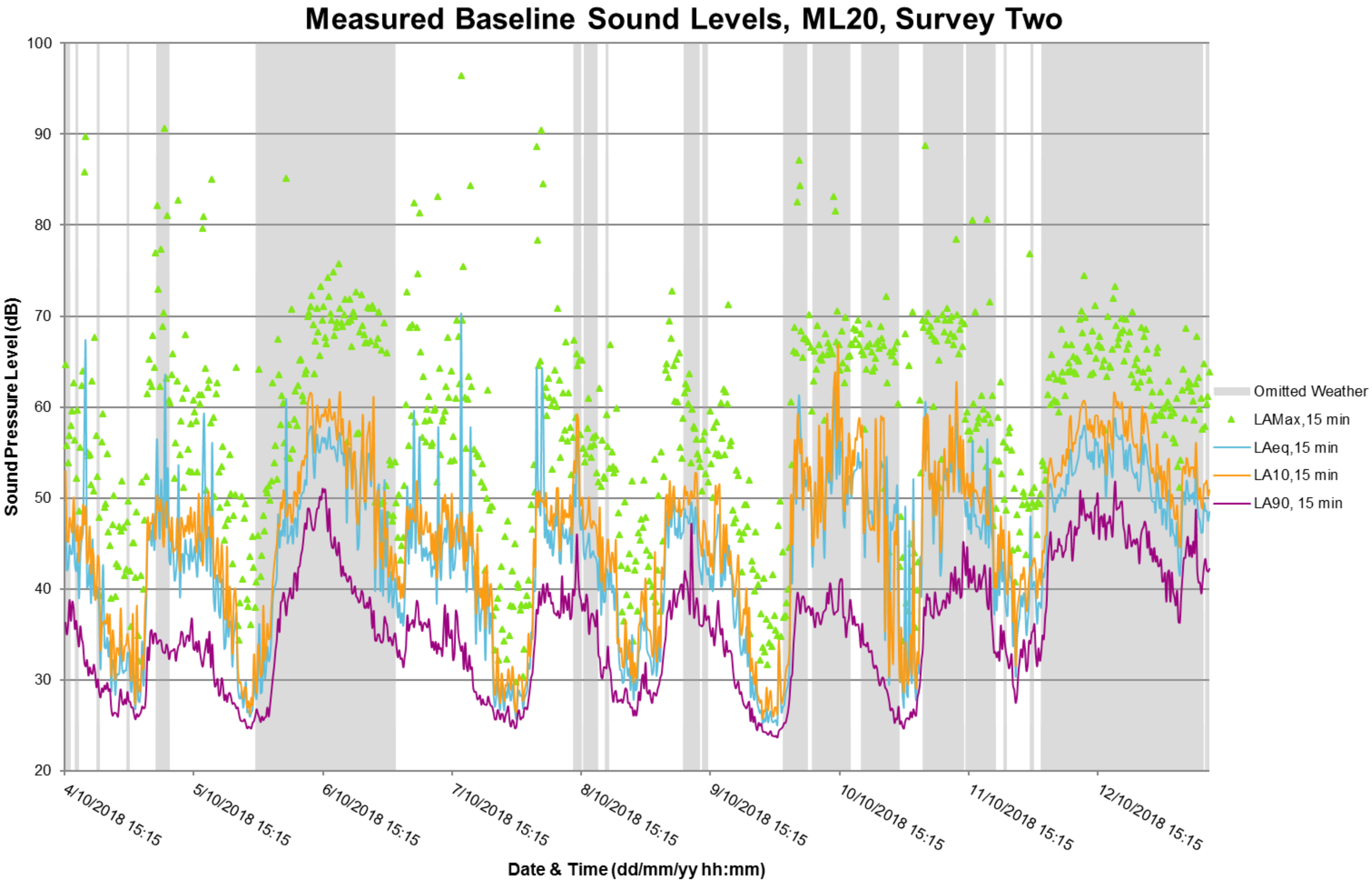

Measured Baseline Sound Levels, ML17, Survey One
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
4/10/2018 17:00
5/10/2018 17:00
6/10/2018 17:00
7/10/2018 17:00
8/10/2018 17:00
9/10/2018 17:00
10/10/2018 17:00
11/10/2018 17:00
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

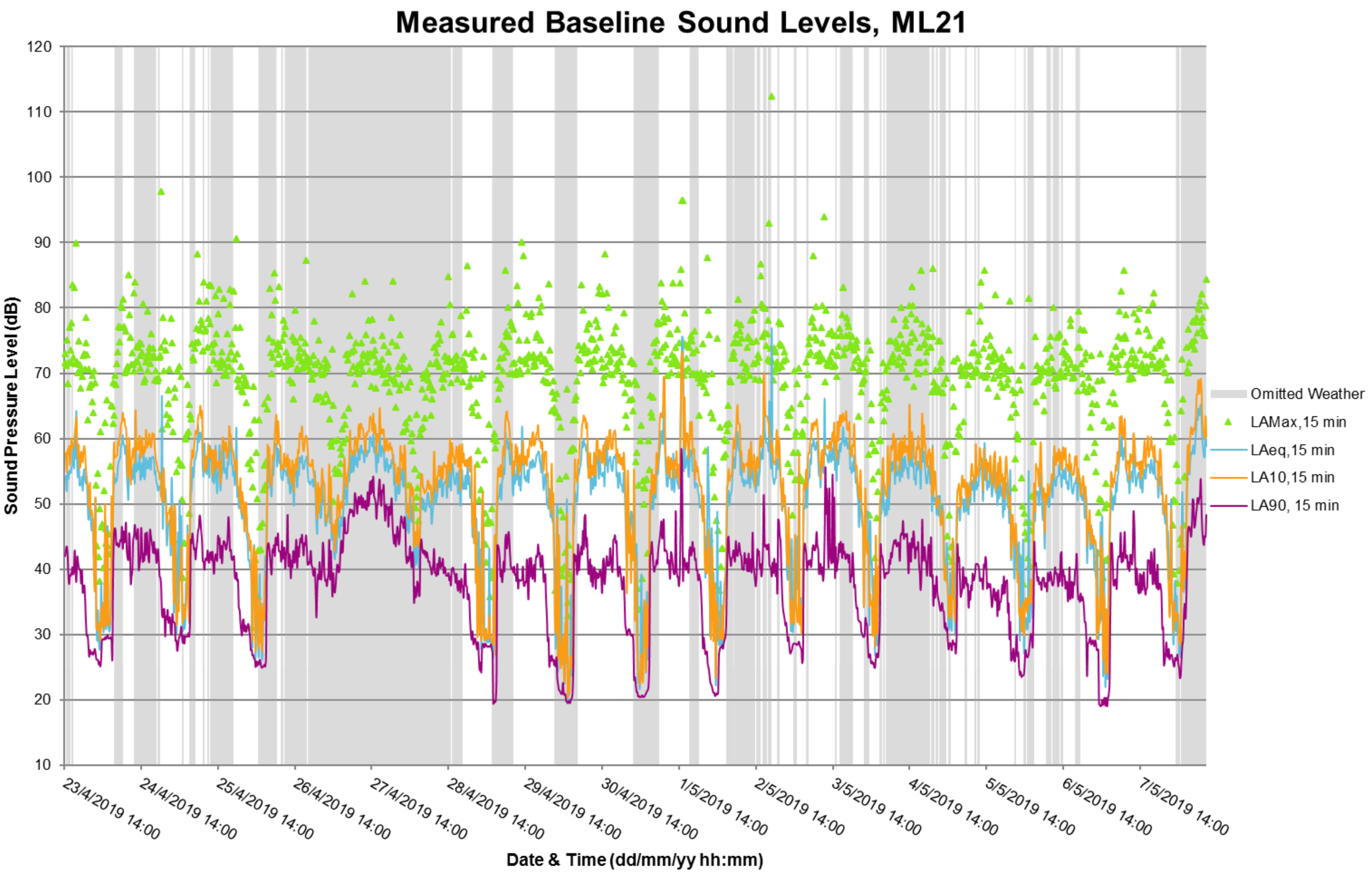

Measured Baseline Sound Levels, ML17, Survey Two
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
19/10/2018 11:45
20/10/2018 11:45
21/10/2018 11:45
22/10/2018 11:45
23/10/2018 11:45
24/10/2018 11:45
25/10/2018 11:45
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

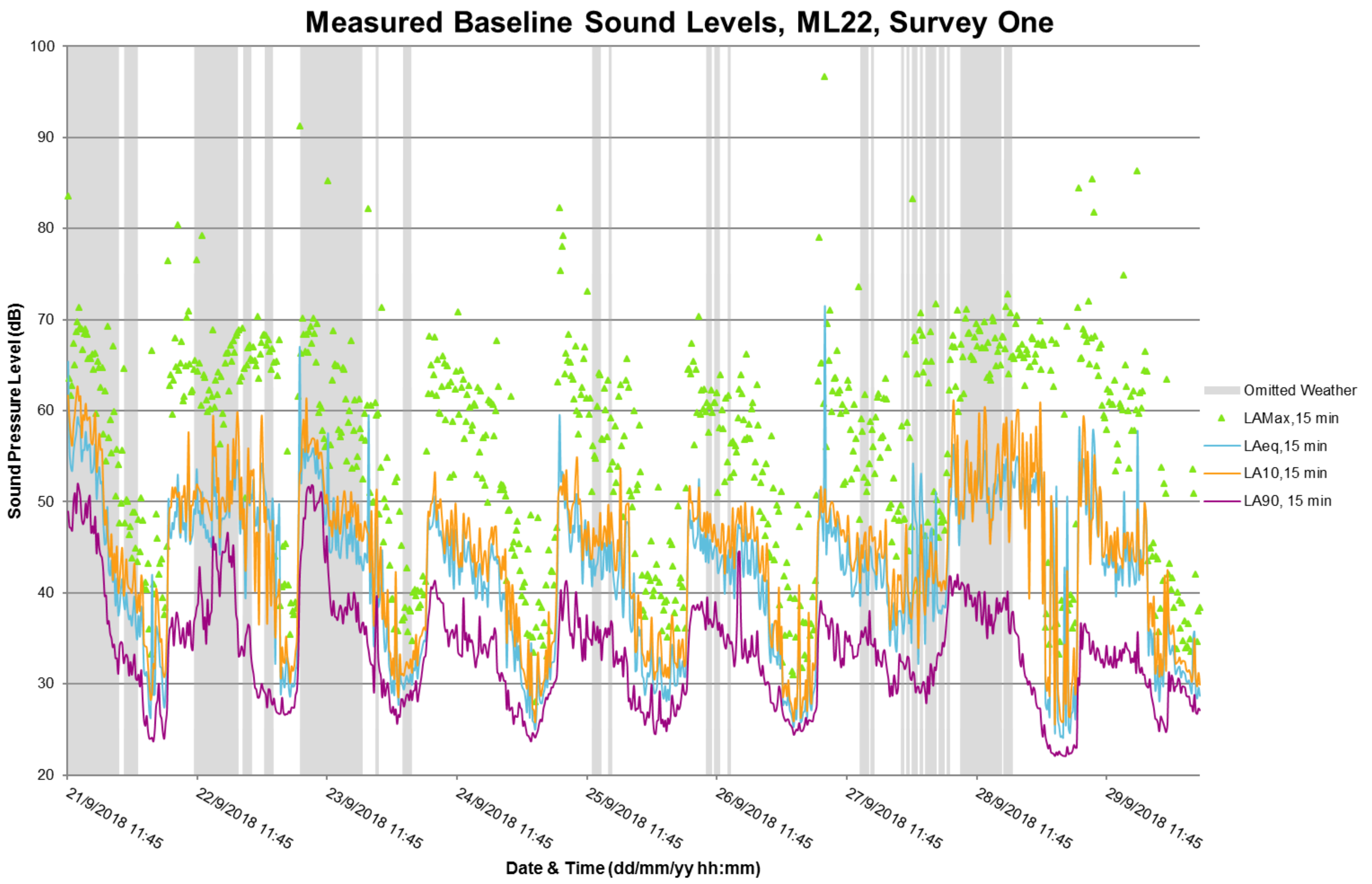

Measured Baseline Sound Levels, ML18
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
23/8/2018 11:15
24/8/2018 11:15
25/8/2018 11:15
26/8/2018 11:15
27/8/2018 11:15
28/8/2018 11:15
29/8/2018 11:15
30/8/2018 11:15
31/8/2018 11:15
1/9/2018 11:15
2/9/2018 11:15
3/9/2018 11:15
4/9/2018 11:15
5/9/2018 11:15
6/9/2018 11:15
7/9/2018 11:15
8/9/2018 11:15
9/9/2018 11:15
10/9/2018 11:15
11/9/2018 11:15
12/9/2018 11:15
13/9/2018 11:15
14/9/2018 11:15
15/9/2018 11:15
16/9/2018 11:15
17/9/2018 11:15
18/9/2018 11:15
19/9/2018 11:15
20/9/2018 11:15
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

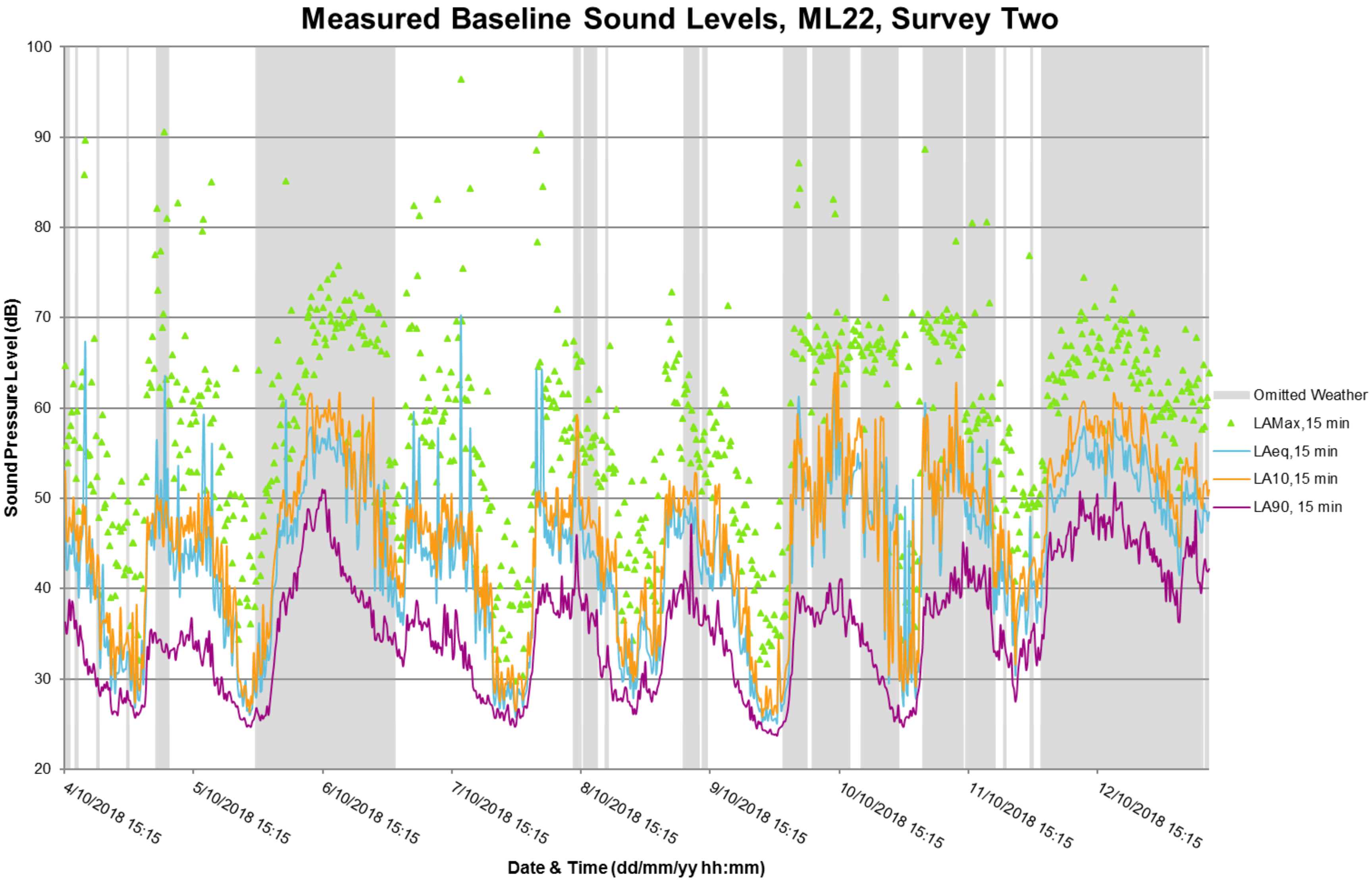

Measured Baseline Sound Levels, ML19
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
19/10/2018 14:00
20/10/2018 14:00
21/10/2018 14:00
22/10/2018 14:00
23/10/2018 14:00
24/10/2018 14:00
25/10/2018 14:00
26/10/2018 14:00
27/10/2018 14:00
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

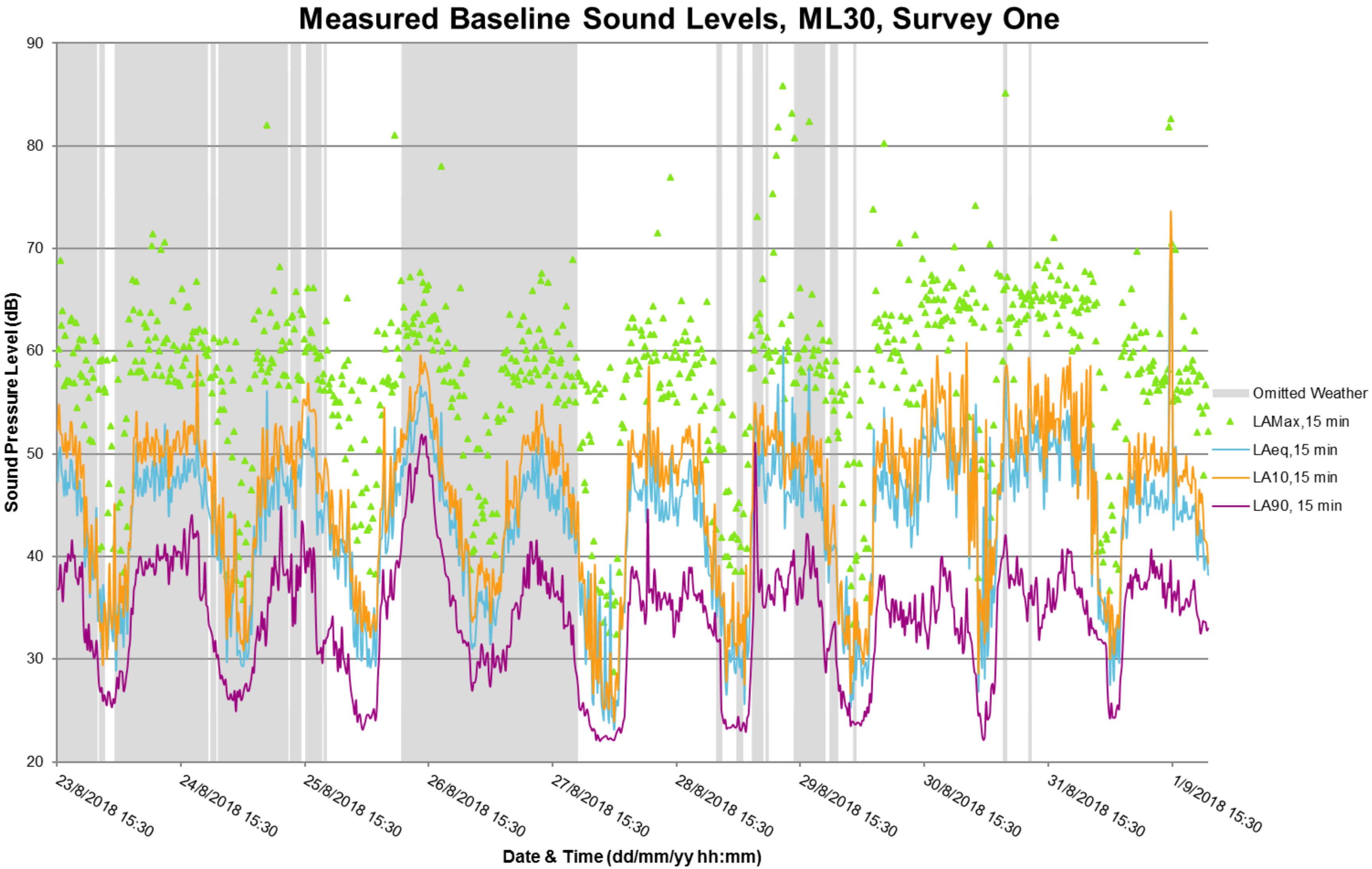

Measured Baseline Sound Levels, ML20, Survey One
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
21/9/2018 11:45
22/9/2018 11:45
23/9/2018 11:45
24/9/2018 11:45
25/9/2018 11:45
26/9/2018 11:45
27/9/2018 11:45
28/9/2018 11:45
29/9/2018 11:45
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

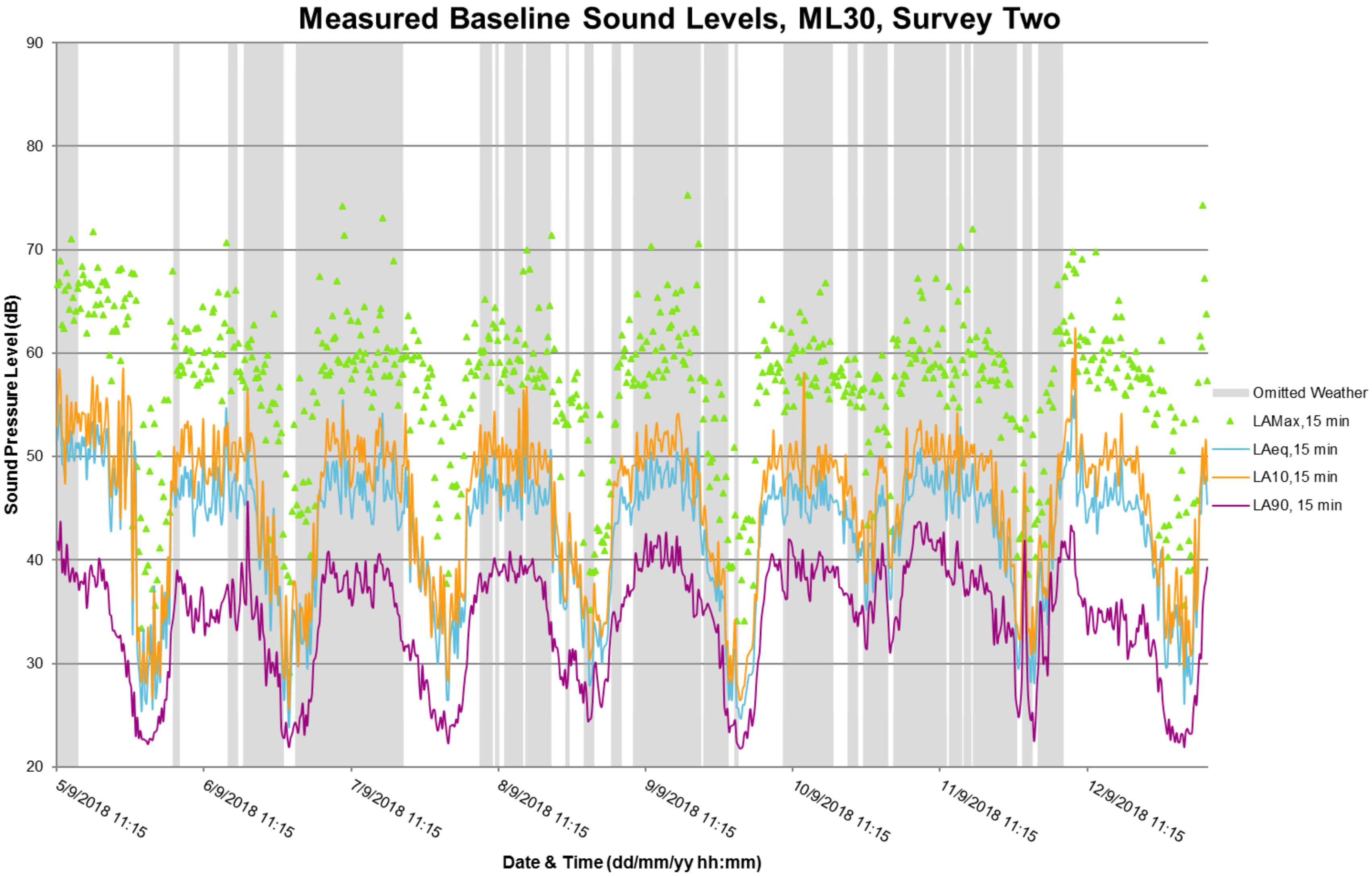

Measured Baseline Sound Levels, ML20, Survey Two
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
4/10/2018 15:15
5/10/2018 15:15
6/10/2018 15:15
7/10/2018 15:15
8/10/2018 15:15
9/10/2018 15:15
10/10/2018 15:15
11/10/2018 15:15
12/10/2018 15:15
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

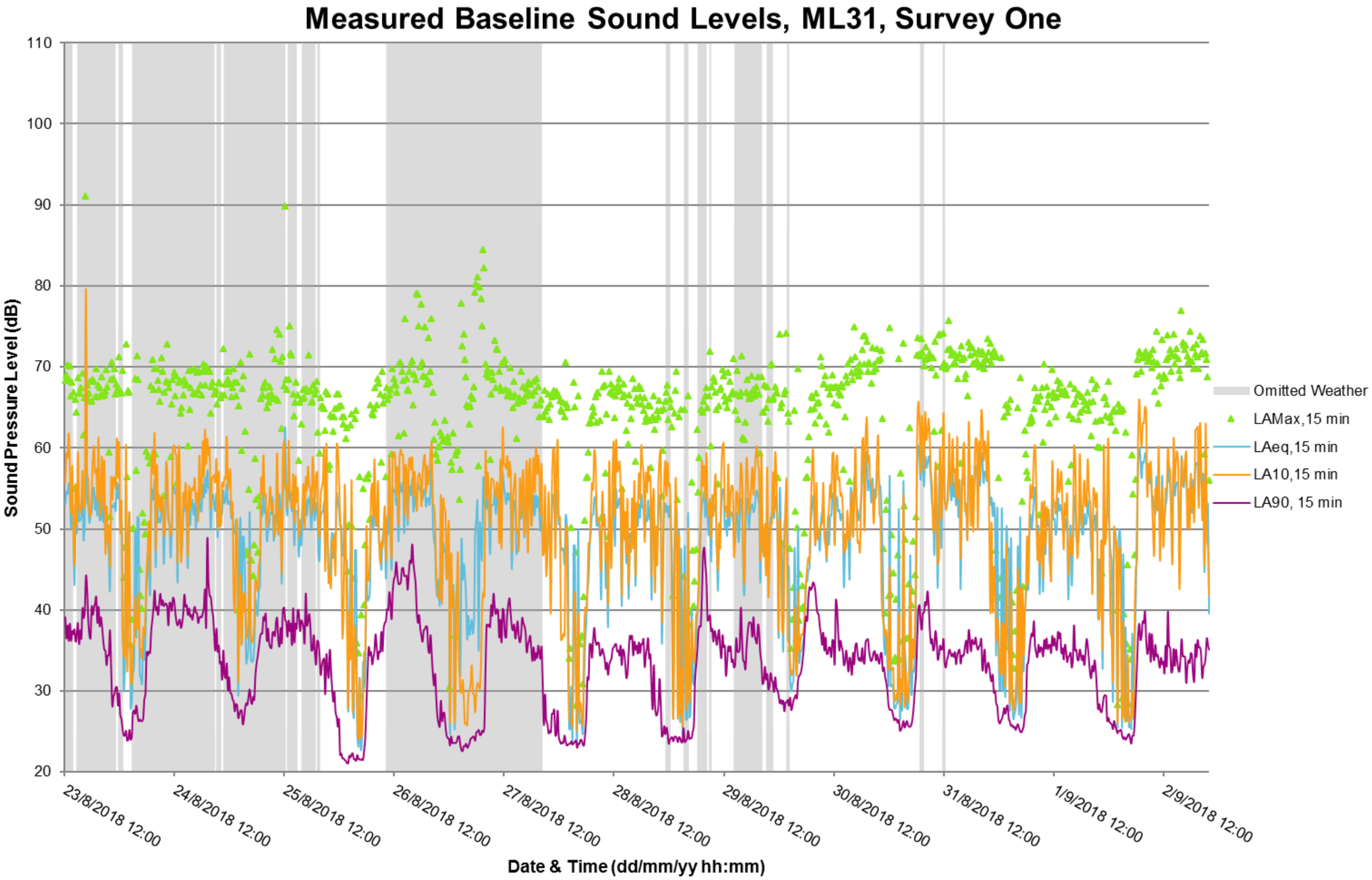

Measured Baseline Sound Levels, ML21
Sound Pressure Level (dB)
120
110
100
90
80
70
60
50
40
30
20
10
23/4/2019 14:00
24/4/2019 14:00
25/4/2019 14:00
26/4/2019 14:00
27/4/2019 14:00
28/4/2019 14:00
29/4/2019 14:00
30/4/2019 14:00
1/5/2019 14:00
2/5/2019 14:00
3/5/2019 14:00
4/5/2019 14:00
5/5/2019 14:00
6/5/2019 14:00
7/5/2019 14:00
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

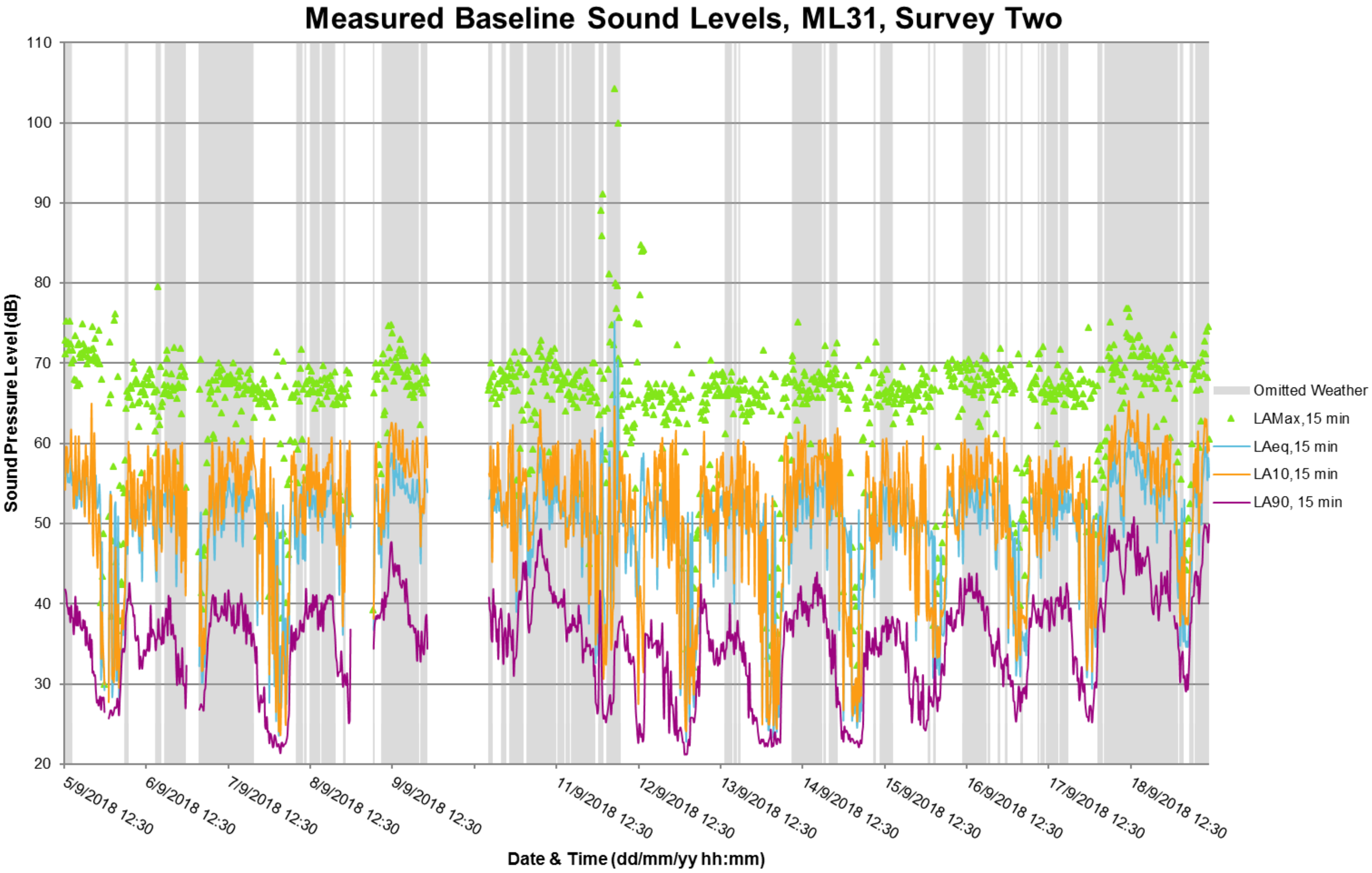

Measured Baseline Sound Levels, ML22, Survey One
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
21/9/2018 11:45
22/9/2018 11:45
23/9/2018 11:45
24/9/2018 11:45
25/9/2018 11:45
26/9/2018 11:45
27/9/2018 11:45
28/9/2018 11:45
29/9/2018 11:45
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min

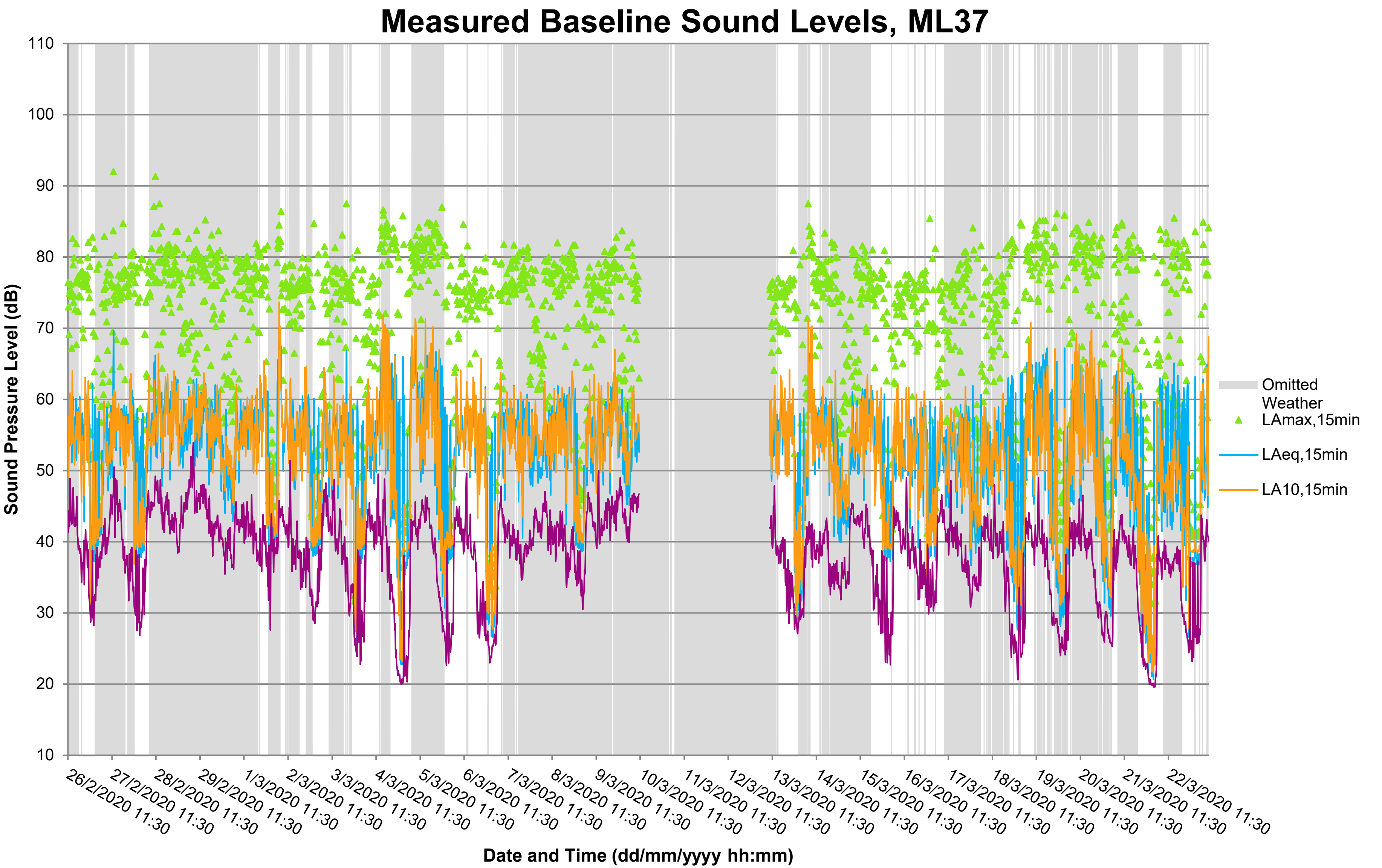

Measured Baseline Sound Levels, ML22, Survey Two
Sound Pressure Level (dB)
100
90
80
70
60
50
40
30
20
4/10/2018 15:15
5/10/2018 15:15
6/10/2018 15:15
7/10/2018 15:15
8/10/2018 15:15
9/10/2018 15:15
10/10/2018 15:15
11/10/2018 15:15
12/10/2018 15:15
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min


Measured Baseline Sound Levels, ML30, Survey One
Sound Pressure Level (dB)
90
80
70
60
50
40
30
20
23/8/2018 15:30
24/8/2018 15:30
25/8/2018 15:30
26/8/2018 15:30
27/8/2018 15:30
28/8/2018 15:30
29/8/2018 15:30
30/8/2018 15:30
31/8/2018 15:30
1/9/2018 15:30
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min


Measured Baseline Sound Levels, ML30, Survey Two
Sound Pressure Level (dB)
90
80
70
60
50
40
30
20
5/9/2018 11:15
6/9/2018 11:15
7/9/2018 11:15
8/9/2018 11:15
9/9/2018 11:15
10/9/2018 11:15
11/9/2018 11:15
12/9/2018 11:15
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min


Measured Baseline Sound Levels, ML31, Survey One
Sound Pressure Level (dB)
110
100
90
80
70
60
50
40
30
20
23/8/2018 12:00
24/8/2018 12:00
25/8/2018 12:00
26/8/2018 12:00
27/8/2018 12:00
28/8/2018 12:00
29/8/2018 12:00
30/8/2018 12:00
31/8/2018 12:00
1/9/2018 12:00
2/9/2018 12:00
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min


Measured Baseline Sound Levels, ML31, Survey Two
Sound Pressure Level (dB)
110
100
90
80
70
60
50
40
30
20
5/9/2018 12:30
6/9/2018 12:30
7/9/2018 12:30
8/9/2018 12:30
9/9/2018 12:30
11/9/2018 12:30
12/9/2018 12:30
13/9/2018 12:30
14/9/2018 12:30
15/9/2018 12:30
16/9/2018 12:30
17/9/2018 12:30
18/9/2018 12:30
Date & Time (dd/mm/yy hh:mm)
Omitted Weather
LAMax,15 min
LAeq,15 min
LA10,15 min
LA90, 15 min


Measured Baseline Sound Levels, ML37
Sound Pressure Level (dB)
110
100
90
80
70
60
50
40
30
20
10
26/2/2020 11:30
27/2/2020 11:30
28/2/2020 11:30
29/2/2020 11:30
1/3/2020 11:30
2/3/2020 11:30
3/3/2020 11:30
4/3/2020 11:30
5/3/2020 11:30
6/3/2020 11:30
7/3/2020 11:30
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20/3/2020 11:30
21/3/2020 11:30
22/3/2020 11:30
Date and Time (dd/mm/yyyy hh:mm)
Omitted Weather
LAmax,15min
LAeq,15min
LA10,15min

5 CONSTRUCTION/ EARTHWORKS NOISE AND VIBRATION ASSESSMENT

5.1 Construction/ Earthworks Noise Calculation Methodology

5.1.1 To assess potential noise effects due to construction works, the construction programme has been broken down into key periods of activity, as presented in **Table 13**. These key periods are considered to represent reasonable worst-case periods of construction activities that are likely to generate the highest noise levels during the construction programme.

Table 13: Periods of Representative Worst-Case Construction Activity

Stage	Year	Activities
1-1	2025	Wigmore Valley Park works Construction of P6 and P7 car parks Terminal 1 enhancements New stand for temporary engine run-up bay
1-2	2026	P5 car park reduced Reconfiguring of P9 car park Terminal 1 enhancements New stands
1-3	2027	Completion of airfield works
2-1	2032	Earthworks Airport access road – east section works P1 and P2 car park construction Terminal 2 construction
2-2	2033	Earthworks Airport access road – east section works Airport access road – west section works P1 car park construction Terminal 2 construction DART extension
2-3	2034	Airport access road – east section works Airport access road – west section works P10 car park construction Terminal 2 and west pier construction DART extension ETP/STP/Fuel Farm construction Apron and stands construction Alpha taxiway realignment
2-4	2035	Landside buildings Terminal 2 and west pier construction

		ETP/STP/Fuel Farm construction Apron and stands construction Alpha taxiway realignment P6 and P7 car park reconfiguration
3-1	2037	Earthworks Fire training ground move
3-2	2038	Earthworks Terminal 2 extension Airport access road
3-3	2039	Airfield works Terminal 2 extension East pier P10 and P11 car park reconfiguration New century ark buildings P12 car park construction
3-4	2040	Airfield works P10 and P11 car park reconfiguration New century ark buildings P12 car park construction

5.1.2 For the purposes of assessing noise from construction activities, sound power level Lw data for representative plant to be used have been sourced from BS 5228-1:2009+A1:2014. Noise predictions of construction activities have been undertaken using Cadna-A noise modelling software. Cadna-A applies methodologies within BS 5228-1:2009+A1:2014 to predict construction noise.

5.1.3 The calculation method provided in BS 5228-1:2009+A1:2014 is based on the number and type of equipment operating, their associated Sound Power Level (Lw), and the distance to sensitive receptors. Sound power data for representative construction plant for each type of activity that have been applied in noise predictions are presented in **Table 14** to **Table 18**.

Table 14: Excavation/ Earthworks Plant

Plant	Reference	Sound Power Level dB(A)	Number
40-tonne excavator	BS5228-1: Table C.2, Item 14	107	1
20-tonne excavator	BS5228-1: Table C.2, Item 21	99	1
40-tonne dump truck	BS 5228-1: Table C.5 Item 16	109	8
Bulldozer	BS5228-1: Table C5, Item 15	111	1
Vibratory roller	BS5228-1: Table C.2, Item 40	101	1
Back loader	BS5228-1: Table C.2, item 7	98	1

Table 15: Site Preparation Plant

Plant	Reference	Sound Power Level dB(A)	Number of Plant
Air compressors	BS5228-1: Table C.5, Item 5	93	2
Diamond cutting tools/saws	BS5228-1: Table C.4, Item 70	119	2
Mobile access platforms	BS5228-1: Table C.4, Item 57	95	2
Forklift trucks	BS5228-1: Table D.7, Item 93	104	2
360-degree excavators with breaker	BS5228-1: Table C.1, Item 9	118	1
Handheld tools including breakers (pneumatic and hydraulic)	BS5228-1: Table C.1, Item 6	111	1
Dumpers	BS5228-1: Table C.1, Item 11	108	2
Concrete crushing plant	BS5228-1: Table C.1, Item 15	112	1
Mobile craneage / tower cranes	BS5228-1: Table C.4, Item 48	104	1

Table 16: Sheet Piling Plant

Plant	Reference	Sound Power Level dB(A)	Number of Plant
Excavator	BS5228-1: Table C.2, Item 5	104	1
Mobile crane/ tower cranes	BS5228-1: Table C.3, Item 29	98	1
Sheet piling rig	BS5228-1: Table C.3, Item 8	116	1

Table 17: Building Construction Plant

Plant	Reference	Sound Power Level dB(A)	Number of Plant
Mobile craneage / tower cranes	BS5228-1: Table C.4, Item 48	104	2
Air compressors	BS5228-1: Table C.5, Item 5	93	1
Diamond cutting tools/saws	BS5228-1: Table C.4, Item 70	119	1
Scaffolding	BS5228-1: Table D.7, Item 2	100	1
Mobile access platforms	BS5228-1: Table C.4, Item 57	95	1
Hands power tools	BS5228-1: Table D.6 item 52	106	1
Delivery trucks	BS5228-1: Table C.8, Item 21	106	1
Forklift trucks	BS5228-1: Table D.7, Item 93	104	1
360-degree excavators	BS5228-1: Table C.2, Item 2	105	1

Percussive piling rigs	BS5228-1: Table C.3, Item 3	116	1
Welding plant	BS5228-1: Table C.3, Item 31	101	1
Concrete pump	BS5228-1: Table C.3, Item 25	106	1

Table 18: Hard Standing Area Construction Plant

Plant	Reference	Sound Power Level dB(A)	Number of Plant
Excavator	BS 5228-1: Table C.5 item 18	108	2
Dumper	BS 5228-1: Table C.5 Item 16	109	2
Asphalt paver	BS 5228-1: Table C.5 Item 31	105	2
Concrete batching plant	AECOM Measurements	109	1
Concrete truck and pump	BS 5228-1: Table C.4, Item 25	110	2
Vibratory roller	BS 5228-1: Table C.5 Item 26	105	2

5.2 Results of Construction/ Earthworks Noise Calculations

5.2.1 Results of construction noise predictions at sensitive receptors are presented in **Table 19**.

Table 19: Construction Noise Predictions

Receptors	Predicted Noise Level $L_{Aeq,T}$ dB per Construction Stage										
	1-1	1-2	1-3	2-1	2-2	2-3	2-4	3-1	3-2	3-3	3-4
GR1	51	49	38	55	55	53	53	58	52	52	50
GR2	45	42	32	49	49	48	48	46	45	47	45
GR3	50	47	36	54	54	52	51	53	52	52	49
GR4	56	51	42	61	61	58	58	59	59	58	55
GR5	55	51	39	61	61	58	57	59	59	59	56
GR6	68	51	37	73	74	63	62	72	72	65	61
GR7	72	51	35	63	63	58	57	62	62	61	58
GR8	68	44	25	61	62	56	54	61	61	61	56
GR9	71	52	36	63	63	57	57	62	62	62	59
GR10	68	52	37	62	63	57	57	61	62	62	60
GR11	70	58	41	65	65	60	62	63	64	66	64
GR12	66	59	41	65	65	60	62	63	64	66	65
GR13	65	59	42	65	65	60	63	64	64	66	65
GR14	65	63	44	65	65	61	63	63	63	67	66
GR15	66	63	43	64	66	63	65	61	62	68	68
GR16	62	68	44	60	66	65	65	57	58	63	62

Receptors	Predicted Noise Level $L_{Aeq,T}$ dB per Construction Stage										
	1-1	1-2	1-3	2-1	2-2	2-3	2-4	3-1	3-2	3-3	3-4
GR17	62	70	41	61	64	63	63	57	58	62	61
GR18	62	74	42	60	64	63	63	57	58	62	62
GR19	62	72	41	61	63	62	63	57	58	63	63
GR20	60	69	41	58	62	60	61	55	56	61	61
GR21	58	67	41	57	60	59	60	54	55	59	59
GR22	58	64	43	59	59	62	59	53	54	60	60
GR23	57	61	41	55	58	56	57	52	53	57	56
GR24	53	55	38	55	55	57	55	49	51	54	54

5.3 Construction/ Earthworks Vibration Calculation Methodology

5.3.1 Ground-borne vibration will be generated from vibratory rollers used during earthworks. Although vibration is unlikely to be higher than that generated by piling, vibratory rollers may be used in close proximity to receptors during earthworks so have potential to cause adverse levels of vibration.

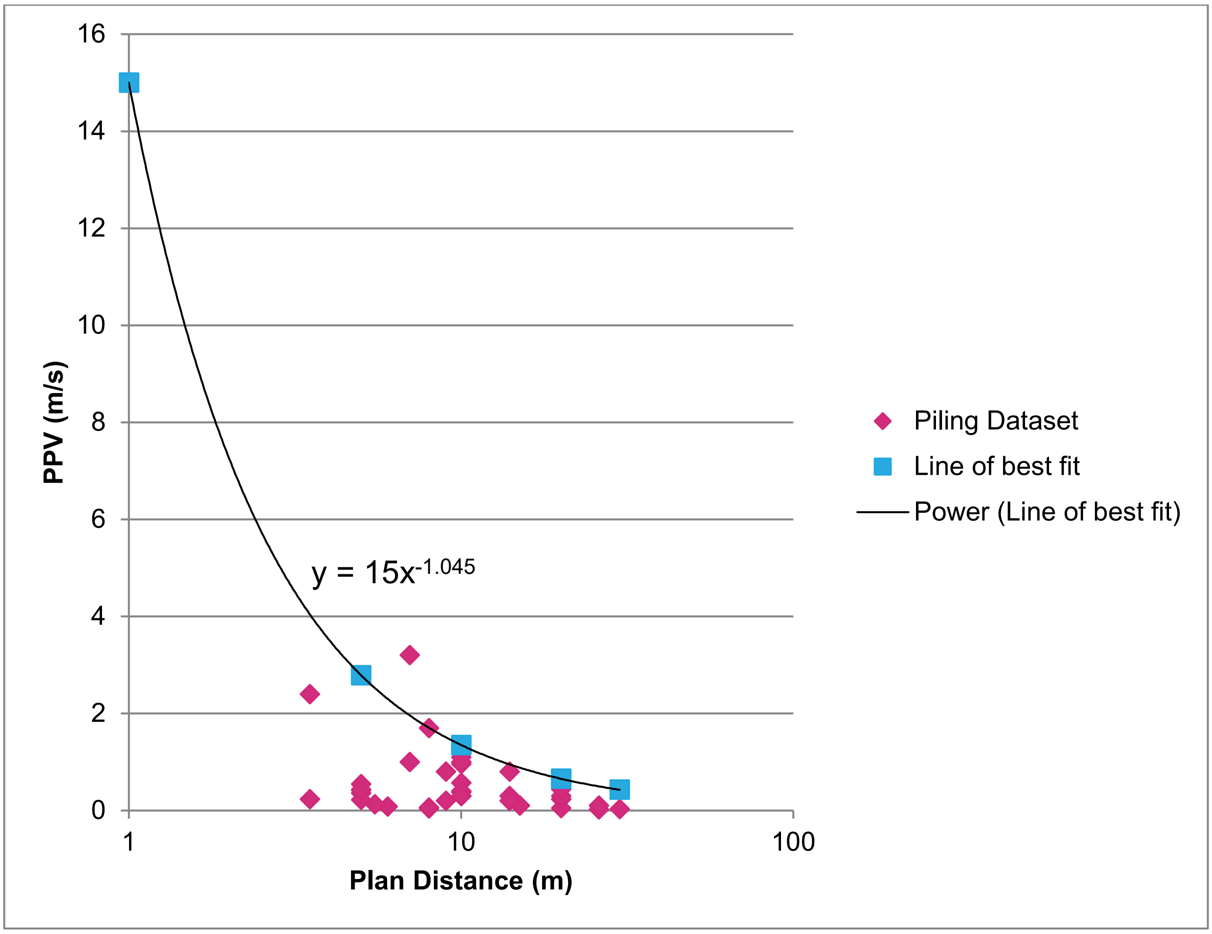
5.3.2 A typical vibratory roller that may be used during earthworks is the Tandem Vibratory Roller. Table E.1 of BS 5228-2:2009+A1:2014 contains a method for calculating the percentage chance of a Peak Particle Velocity (PPV) occurring at distance due to a vibratory roller based on the diameter of the drum and the amplitude of vibration. The Tandem Vibratory Roller has drum of 0.72 m and amplitude of vibration of 0.56 mm. Using the formula for steady state compaction in Table E.1 of BS 5228-2, the probability for predicted levels of vibration to be exceeded are presented in **Table 20**.

Table 20: Earthworks Vibratory Roller PPV Predictions

Probability of Predicted PPV Being Exceeded	Predicted PPV （mm/s）
50%	0.2
33.3%	0.5
5%	0.9

5.3.3 The level of vibration that is transmitted from the piling to receptors is dependent on many factors including the type of pile; the length of pile; the coupling between the pile and the ground; the distance to the receptor; the type of ground between the pile and receptor; and the building foundations. Due to these site-specific factors, there is always some uncertainty in any predicted level of vibration.

5.3.4 Data from continuous flight auger piling activities was referenced from BS 5228-2 to determine the likely level of vibration that may be experienced during piling works. Regression analysis was undertaken to determine a formula for calculating the PPV from piling activities. This analysis is presented in **Inset 1**.



Inset 1: Piling Data Regression Analysis

6 AIR NOISE ASSESSMENT

6.1 Aircraft Noise Modelling

6.1.1 Noise modelling for this PEIR was undertaken using the Aviation Environmental Design Tool 3d (AEDT). AEDT is produced by the US Federal Aviation Administration (FAA) and replaced the Integrated Noise Model (INM) as of May 2015. The use of AEDT (along with the Civil Aviation Authority's ANCON, which is their in-house noise modelling software package) is advocated in the CAA's CAP 1616a (Ref. 32). Whilst CAP 1616a is more associated with the modelling of the noise impacts from airspace change, the advice it contains is considered to represent best practice for aircraft noise modelling. As a requirement for a DCO application is to apply the latest methods and standards, Luton Rising (a trading name for London Luton Airport Limited) has built its noise model using AEDT software and input assumptions, as set out in current industry practice guidance in ECAC Doc 29, 4th Edition (Ref. 33) and ICAO Doc 9911 (Ref. 34).

6.1.2 AEDT is developed from the algorithms and frameworks for calculation of aircraft noise outlined in the SAE-AIR-1845 document (Ref. 35). AEDT uses Noise-Power-Distance[6] (NPD) data to estimate noise levels, accounting for the typical operational mode, engine thrust setting, source-to-receiver geometry, acoustic directivity and other environmental factors. AEDT can calculate exposure, maximum-level and time-based noise contours, as well as levels at pre-selected locations. AEDT contains an extensive database of the noise attributes of aircraft and provides flexibility in allowing data from new aircraft or aircraft types to be inserted.

6.2 Difference Between INM and AEDT

6.2.1 To understand and assess the likely effects of the Proposed Development, Luton Rising has undertaken noise modelling to enable a comparison between noise levels around the airport without the Proposed Development with noise levels around the airport if the Proposed Development is delivered. This modelling allows the expected effects of the Proposed Development on noise around the airport to be isolated so that it is clear how the proposals would affect those who live, work and visit the airport and surrounding area.

6.2.2 It is a requirement for the application for Development Consent to apply the latest, up-to-date methods and standards. AEDT is the current industry standard commercial aircraft noise modelling software package. AEDT replaced another type of modelling software called Integrated Noise Model (INM), which is now considered to be a legacy tool (as of May 2015). As such, AEDT has received updates of the latest aircraft data from the Aircraft Noise and Performance database .

6.2.3 Historically, noise at Luton Airport has been modelled by the airport operator (London Luton Airport Operating Limited or LLAOL) using INM. The 2012 planning consent, which established the current passenger cap for the airport of 18 million passengers per year, relied on noise contours generated using INM

[6] Aircraft noise level at ground height as a function of distance and power setting.

software which at that time was the industry standard for aviation noise assessments. Consequently, LLAOL have continued to use INM due to the requirement to demonstrate compliance with existing noise planning commitments. The INM-based noise model that LLAOL used for its planning application was validated using measured data.

6.2.4 In 2021, LLAOL submitted a planning application to increase the passenger cap from 18 million to 19 million passengers per year by varying the condition attached to the 2012 planning consent which limits annual passengers to 18 million. Because LLAOL's application seeks to directly amend the 2012 planning consent, LLAOL has used the same noise modelling approach that was used to support the original application (INM and associated input assumptions). This way direct comparisons can be made between the noise contours associated with the 2012 planning consent and the forecast noise contours which support LLAOL's application to vary that consent.

6.2.5 For the application for Development Consent, Luton Rising has set up a Noise Envelope Design Group (NEDG) with representation from key stakeholders. The NEDG's role is to provide recommendations to Luton Rising on noise control measures that allow predictable growth and benefits of new aircraft technology to be shared between the airport and local communities. These noise control measures will form a 'noise envelope' that will be submitted as part of the application for development consent. The NEDG recommendations allow clear performance targets to be set in the noise envelope that are tailored to local priorities. The NEDG includes representatives from nearby local authorities, airlines, cargo operations, NATS, the Chamber of Commerce, and local interest groups. The NEDG has agreed that AEDT should be used to model noise contours and used to define noise control values which will comprise the noise envelope.

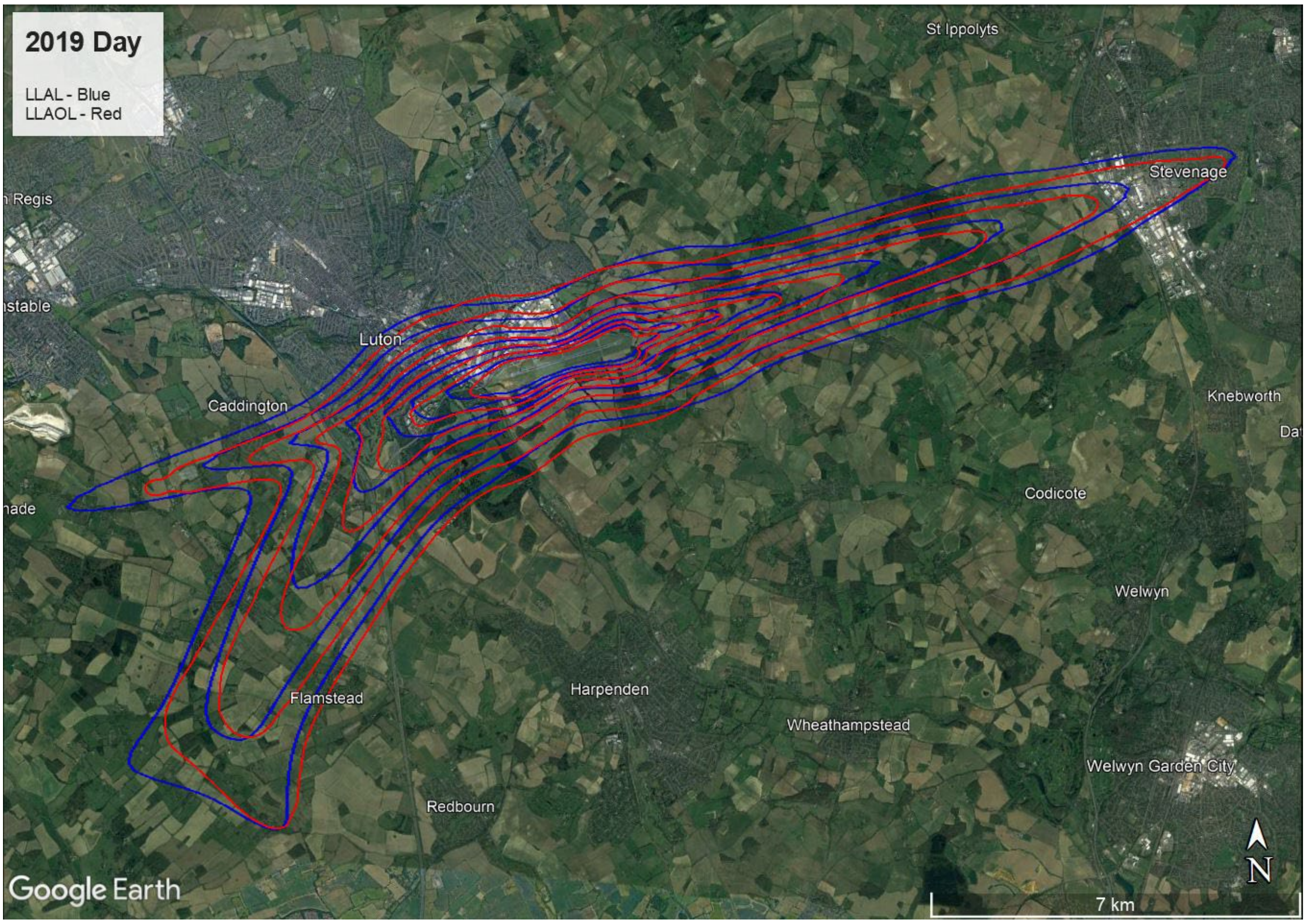
6.2.6 The use of AEDT (along with the Civil Aviation Authority's (CAA) ANCON, which is the CAA's in-house noise modelling software) is advocated by the CAA and aligns with accepted industry best practice. Because a requirement for an application for development consent is to apply the latest methods and standards, Luton Rising has built its noise model using AEDT software and input assumptions, as set out in current industry practice guidance , .

6.2.7 AEDT was used to produce the noise information presented as part of the Statutory Consultation exercise that Luton Rising carried out in 2019. Since the 2019 Statutory Consultation, the noise model has been validated using measured data to ensure that noise contours are representative of noise conditions experienced by affected communities. The validation exercise was recommended by the NEDG to provide a robust and transparent noise modelling methodology and is an approved practice.

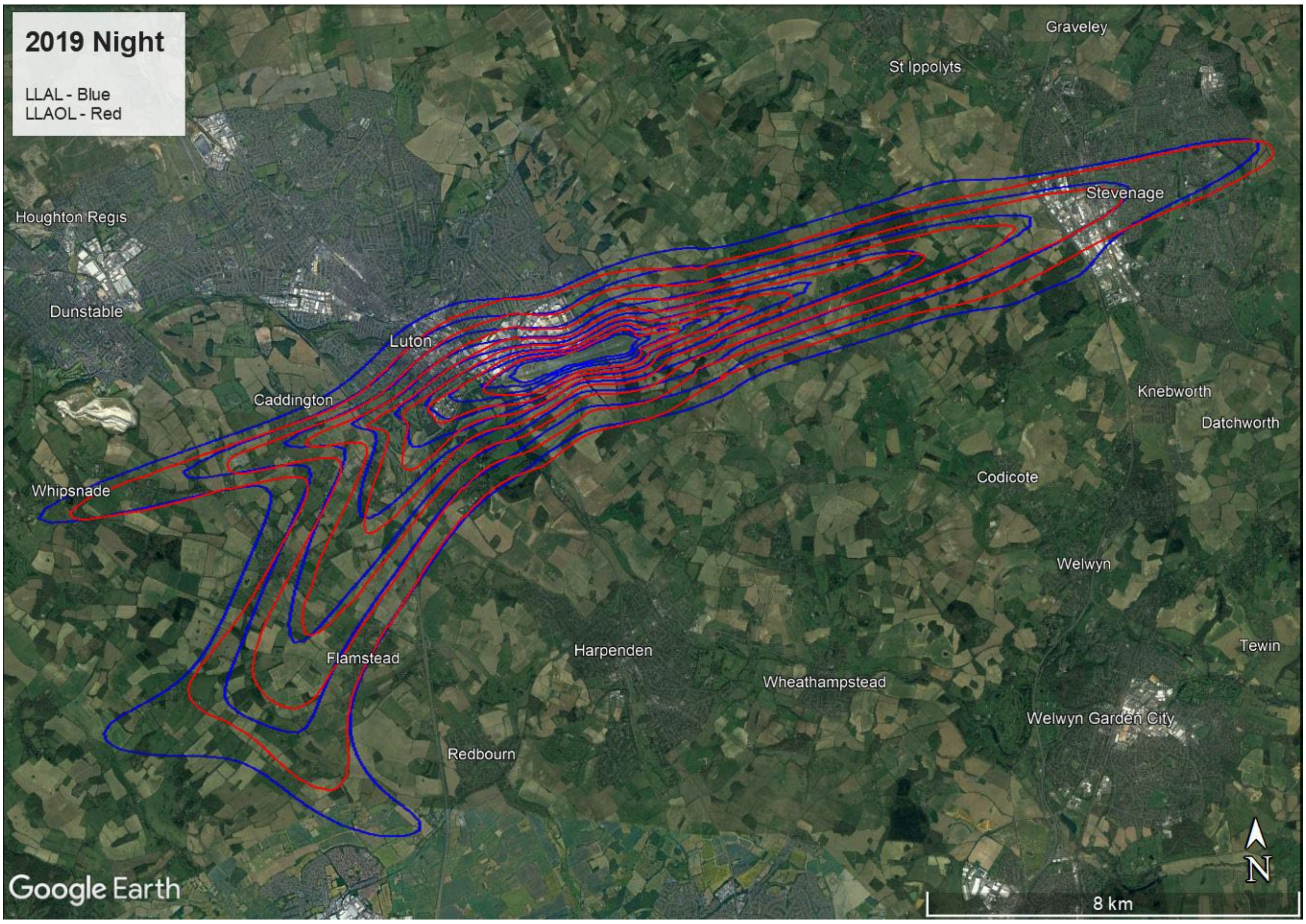
6.2.8 If the DCO was consented, the noise contour outputs from AEDT would be used to define noise contour limits and thresholds and will supersede the existing contour limits based on INM. Consequently, there is no requirement to make a direct comparison between the AEDT noise contours and INM based noise contour limits.

6.2.9 Although AEDT and INM use the same aircraft movement data, the two noise model types and their associated input assumptions produce different noise contours, which are not directly comparable. The difference between the 2019 baseline noise contours produced by the INM and AEDT at **Inset 2** and **Inset 3**, which show daytime and night-time noise contours for 2019. The noise contours produced by the two models are reasonably similar at higher contour bands, where both noise models have been validated with measured noise data. However. the contours diverge more noticeably at lower contour bands (that are not yet tested against measured noise data) where contours produced using AEDT are, on average, larger than those produced by INM. The variability of noise measurements is greater than the variability in the INM and AEDT noise contours so , although outputs differ, they are considered to be within the margin of error. As you can see, the contours for both models are very similar in shape.

6.2.10 Whilst the two different modelling types produce different contours, it is important to note that switching from one model to the other (e.g. from INM modelling to AEDT) does not have any impact on the noise that is experienced on the ground, just the way it is described.



Inset 2: Daytime noise contours produced by INM (red) and AEDT (blue) for 2019



Inset 3: Night-time noise contours produced by INM (red) and AEDT (blue) for 2019

6.3 Validation

6.3.1 Noise model validation is a key point brought up in the Noise Envelope Design Group (NEDG). It was stated by the NEDG that it is essential to provide a robust and transparent noise modelling methodology before any noise contour limits/ thresholds can be agreed on. Consequently, it is an important process as part of defining the Noise Envelope to ensure that noise contours are representative of noise conditions experienced by affected communities.

6.3.2 The validation exercise consists analysis of measured noise data and departure profiles based on radar data provided by LLAOL. There can be a significant level of variability during aircraft departures, so analysis was undertaken of departure profiles. As approach procedures are more standardised than departures, approach noise predictions are only tested against measured noise data.

6.3.3 The aim of the validation exercise was to ensure that, at all validation point, average noise for an aircraft type was predicted within a 3 dB range of measurements with the aim being to minimise the difference between predictions and measurements as far as reasonably practicable. Where there was any variation in differences at validation locations, overpredictions were favoured to ensure a robust approach.

6.3.4 The validation exercise can help reduce discrepancies between models when using different atmospheric attenuation methods; however, this is only likely to occur within the validation locations. The further contours extend from the validation locations, the difference between predictions using different atmospheric attenuation methods is likely to increase.

6.4 Validation Requirements

6.4.1 The noise model validation exercise was based on guidance set out in the CAA Policy on Minimum Standards for Noise Modelling (Ref. 36). The method categorises the level of validation required based on the population exposed to aircraft noise above daytime 51 dB $L_{Aeq,16h}$ and night-time 45 dB $L_{Aeq,8h}$. Based on the results of noise modelling presented in the 2019 PEIR, the airport falls into Category C.

6.4.2 Noise model validation requirements for Category C should include:

a. Aircraft flight profiles are adapted from the standard ICAO dataset for the main noise dominant aircraft types, which must cover more than 75 percent.

b. Noise measurements are not required.

6.4.3 It should be noted that, although Category C does not require noise measurements, the use of noise data to validate predictions is seen as key part of the validation process. Consequently, the validation process undertaken is equivalent to Category B requirements, which is identical to Category C but requires at least two monitoring locations for each approach and departure route.

6.5 Aircraft Tested

6.5.1 Aircraft were tested depending on the data available. As departure profiles were analysed using 2017 data, departure profiles for the A320neo were not flying in sufficient numbers to allow any meaningful analysis. However, it is considered reasonable to assume that the A321neo will fly a similar profile to the A321. It is also assumed that departure profiles have not changed since 2017 and the data is still relevant. A summary of how aircraft were tested against radar and noise data is presented in **Table 21**.

Table 21: Aircraft Testing Summary

Aircraft	Departure Test	Noise Test
A319	✓	✓
A320	✓	✓
A320neo		✓
A321	✓	✓
B737-800	✓	✓

6.5.2 No noise or radar data is available for the B737MAX, so it has been modelled using default data and profiles in AEDT.

6.5.3 Measured noise data from the A321neo indicates it is currently not performing as well as in certification tests. Consequently, for the 2027 scenario, the A321neo was modelled based on recommended Air Noise and Performance (ANP) database[37] v2.3 (released 14th October 2020) aircraft substitutions[7] of using the A321 as a surrogate with approach and departure noise corrections applied based on the measured difference between A321 and A321neo from LLAOL's data. For the 2039 and 2043 scenarios, it has been assumed that the A321neo noise performance will improve to that expected from noise certification tests, and corrections from the ANP database were applied.

6.5.4 No radar or noise data is available for the A319neo, so reference was made to ANP guidance to model. Corrections applied to A319 and A321 aircraft to model A319neo and A321neo are presented in **Table 22**.

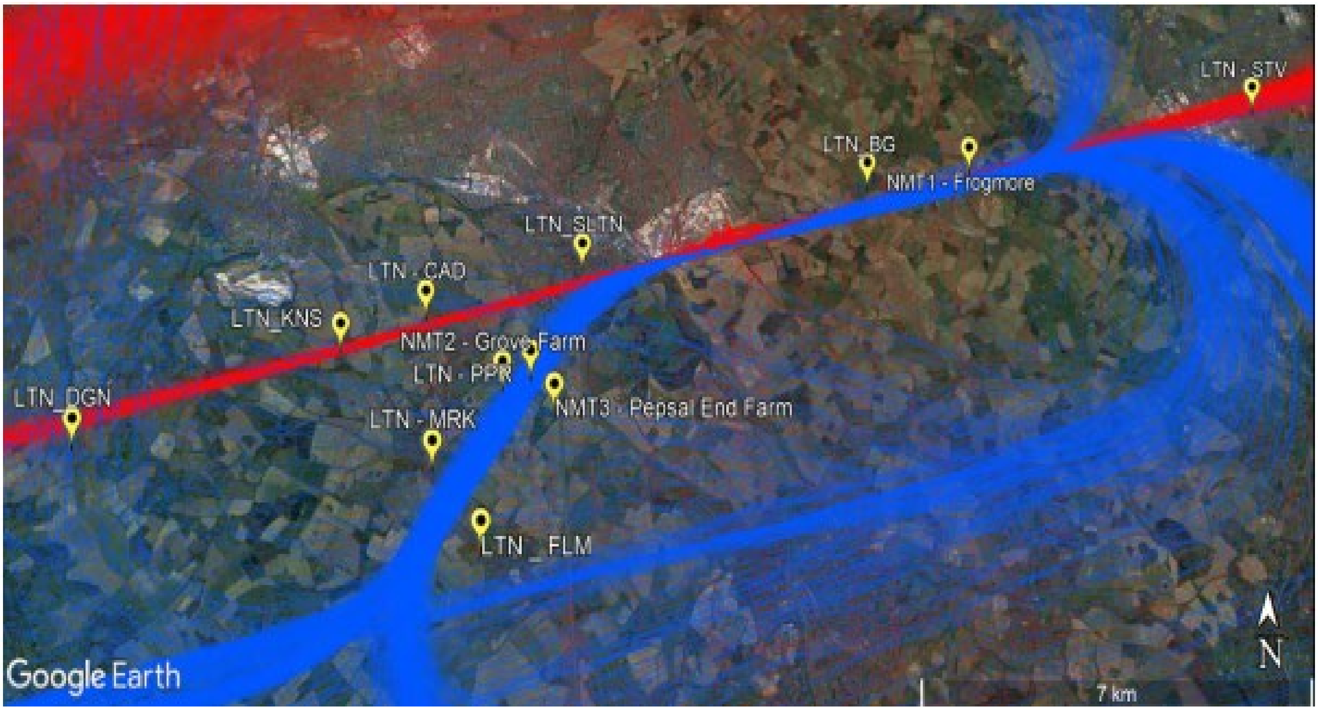
Table 22: Next Generation Aircraft Modelling with no Data

Aircraft	Surrogate Aircraft	Approach Correction dB	Departure Correction dB	Source
A319neo	A319	-4.0	-1.0	ANP
A321neo (2027)	A321	+0.6	-2.0	LLAOL data
A321neo (2039, 2043)	A321	-0.7	-3.7	ANP

6.6 Measured Noise Data

6.6.1 Noise data was provided by LLAOL in order to validate the noise model. LLAOL noise monitoring locations used to validate modelled aircraft and radar tracks are presented in **Inset 4**. The noise data consists of SEL measurements of a variety of aircraft at a number of different locations along approach and departure routes.

[7] ANP v2.2 Aircraft substitutions - jets & heavy props (22022018)



Inset 4: LLAOL Noise Monitoring Locations Used for Validation

6.6.2 A summary of how noise monitoring locations relate to approach and departure tracks is presented in **Table 23**. This demonstrates that at least two monitoring locations were used to validate aircraft noise along each route, which is in accordance with CAA Policy.

Table 23: Noise Monitoring Locations Relating to Approach and Departure Routes

Monitoring Location	07 Approaches	25 Approaches	07 Departures	25 Departures
LTN_KNS	✓			
LTN_CAD	✓			
LTN_DGN	✓			
LTN_MRK				✓
LTN_FLM				✓
LTN_STV		✓		
LTN_BG		✓	✓	
LTN_SLTN	✓			✓
LTN_PPR				✓
NMT01		✓	✓	
MNT02				✓
NMT03				✓

6.6.3 Measured SEL noise data is summarised in **Table 24** for approaches and for departures **Table 25**.

Table 24: Measured SEL Approach Data

Monitoring Location	Measured SEL dB					
	A20N	A21N	A319	A320	A321	B738
LTN_KNS	-	-	-	-	-	-
LTN_CAD	-	-	-	-	-	-
LTN_DGN	-	-	-	-	-	-
LTN_MRK	76.6	80.0	80.8	81.0	81.4	82.8
LTN_FLM	71.9	75.5	76.9	76.4	78.1	80.0
LTN_STV	-	-	-	-	-	-
LTN_BG	84.8	88.2	89.4	89.1	91.1	92.5
LTN_SLTN	82.6	84.9	86.6	86.2	88.1	89.6
LTN_PPR	82.0	86.0	84.6	85.4	87.0	87.1
NMT01	80.9	83.8	83.6	84.3	85.7	86.4
MNT02	81.0	83.1	83.6	83.9	85.0	86.4
NMT03	83.9	83.4	84.3	84.2	85.4	87.0

Table 25: Measured SEL Departure Data

Monitoring Location	Measured SEL dB					
	A20N	A21N	A319	A320	A321	B738
LTN_KNS	81.8	83.2	82.6	82.4	82.3	82.4
LTN_CAD	83.7	85.3	85.0	84.5	84.1	85.8
LTN_DGN	75.6	75.7	75.7	76.0	75.8	76.3
LTN_MRK	-	-	-	-	-	-
LTN_FLM	-	-	-	-	-	-
LTN_STV	77.0	77.2	77.9	78.1	77.6	78.1
LTN_BG	82.4	83.7	84.2	83.6	82.9	86.1
LTN_SLTN	80.1	81.9	82.1	81.3	80.5	84.6
LTN_PPR	-	-	-	-	-	-
NMT01	83.7	84.6	84.8	84.5	84.3	85.7
MNT02	-	-	-	-	-	-
NMT03	-	-	-	-	-	-

6.6.4 A complication of automated monitoring of aircraft noise is distinguishing aircraft noise from background noise. In order to derive the SEL from an aircraft movement, the sound pressure level needs to increase by at least 10 dB. Where ambient sound levels are typically high, it becomes harder to obtain suitable SEL data. This has been identified as an issue at NMT3, which is located in close proximity to the M1 and is influenced by road traffic noise.

6.7 Weather Data

6.7.1 There is inherent variability in aircraft noise measurements that may be attributed to factors such as aircraft weights, flight operating procedures and atmospheric conditions. The main influence due to weather conditions is on the propagation of noise and aircraft climb rates. To minimise variability due to weather conditions during measurement of SEL data, validation predictions were undertaken using weather data provided by LLAOL, which is summarised in **Table 26**.

Table 26: Validation Weather Data

Monitoring Location	Period	Temperature (° F)	Pressure (millibars)	Humidity (%)
LTN_KNS	Apr-Jun 2019	53.1	1012.1	76.0
LTN_CAD	Apr-Jul 2019	56.1	1012.4	74.5
LTN_DGN	May-Jul 2019	59.0	1012.8	73.8
LTN_MRK	Jun-Oct 2019	59.1	1011.7	77.6
LTN_FLM	Jun-Oct 2019	59.1	1011.7	77.6
LTN_STV	Aug-Oct 2019	57.1	1011.3	79.8
LTN_BG	Oct-Dec 2019	45.0	998.4	91.5
LTN_SLTN	Oct-Dec 2019	45.0	998.4	91.5
LTN_PPR	Feb-Mar 2020	42.8	993.3	81.4
NMT01	Q4 2020	46.2	990.2	90.4
MNT02	Q4 2020	46.2	990.2	90.4
NMT03	Q4 2020	46.2	990.2	90.4

6.8 Approach Noise Testing

6.8.1 Results comparing measured and predicted noise levels for aircraft approaches are presented in **Table 27** to **Table 31.**

Table 27: A319 Approach Noise Prediction Testing

Runway	Location	Measured	Predicted	Difference
07	LTN_DGN	75.7	75.6	-0.1
	LTN_KNS	82.6	84.1	1.5
	LTN_CAD	85.0	86.1	1.1
	LTN_SLTN	82.1	87.3	5.2
25	LTN_STV	77.9	78.7	0.8
	NMT01	84.8	85.2	0.4
	LTN_BG	84.2	81.4	-2.8

Table 28: A320 Approach Noise Prediction Testing

Runway	Location	Measured	Predicted	Difference
07	LTN_DGN	76.0	76.7	0.7
	LTN_KNS	82.4	83.8	1.4
	LTN_CAD	84.5	85.7	1.2
	LTN_SLTN	81.3	86.8	5.5
25	LTN_STV	78.1	79.1	1.0
	NMT01	84.5	84.9	0.4
	LTN_BG	83.6	81.5	-2.1

Table 29: A320neo Approach Noise Prediction Testing

Runway	Location	Measured	Predicted	Difference
07	LTN_DGN	75.6	73.6	-2.0
	LTN_KNS	81.8	82.2	0.4
	LTN_CAD	83.7	84.0	0.3
	LTN_SLTN	80.1	84.8	4.7
25	LTN_STV	77.0	76.3	-0.7
	NMT01	83.7	83.3	-0.4
	LTN_BG	82.4	79.8	-2.6

Table 30: A321 Approach Noise Prediction Testing

Runway	Location	Measured	Predicted	Difference
07	LTN_DGN	75.8	75.2	-0.6
	LTN_KNS	82.3	83.4	1.1
	LTN_CAD	84.1	85.4	1.3
	LTN_SLTN	80.5	86.6	6.1
25	LTN_STV	77.6	78.3	0.7
	NMT01	84.3	84.7	0.4
	LTN_BG	82.9	81.1	-1.8

Table 31: B737-800 Approach Noise Prediction Testing

Runway	Location	Measured	Predicted	Difference
07	LTN_DGN	76.3	78.5	2.2
	LTN_KNS	82.4	84.1	1.7
	LTN_CAD	85.8	85.9	0.1
	LTN_SLTN	84.6	86.9	2.3
25	LTN_STV	78.1	80.5	2.4

	NMT01	85.7	85.2	-0.5
	LTN_BG	86.1	81.7	-4.4

6.8.2 There is some uncertainty over the results at LTN_SLTN and LTN_BG. Whereas all other locations are reasonably consistent, a trend of overpredictions are noted at LTN_SLTN and a trend of underpredictions are noted at LTN_BG.

6.8.3 As both locations are the closest to the runway thresholds and located laterally (to the north) of approach tracks, some correlation in the difference between measured and predicted levels may be expected. However, as this correlation is not observed, there is some uncertainty over the measured noise data. As such, LTN_SLTN and LTN_BG have been omitted from the approach validation exercise.

6.8.4 As 07 and 25 runway approaches will use the same procedures when flying over monitoring locations, the average of the difference between measured and predicted levels has been used to determine an approach noise correction for each aircraft. Corrections applied to individual aircraft types, so approach noise predictions are more representative of measured data are presented in **Table 32.**

Table 32: Approach Noise Corrections

Aircraft	Approach Correction dB
A319	-0.7
A320	-0.9
A320neo	+0.5
A321	-0.6
B737-800	-1.2

6.9 Departure Profile Testing

6.9.1 Testing of AEDT departure profiles was undertaken to determine the best fit with average departure profiles from radar data for each aircraft. The results of analysis are presented in **Inset 5** to **Inset 9**.

6.9.2 As A319, A320 and A321 use approximately similar departure profiles whether they are departing from either 07 or 25 runway, it is considered appropriate to use one profile for operations on both runways. As the B37-800 uses a different departure profile for 07 or 25 runways, separate departure profiles were determined to be appropriate. The departure profiles and stage lengths used in noise modelling are presented in **Table 33**. Assigned departure profiles are considered to be appropriate for equivalent next generation aircraft.

6.9.3 The stage length determines the weight of the aircraft on departure based on the distance to destination. Although aircraft departing from the airport do not tend to travel further than the distance range defined by stage length 4, it should be noted that aircraft weights in AEDT are determined using a load factor of

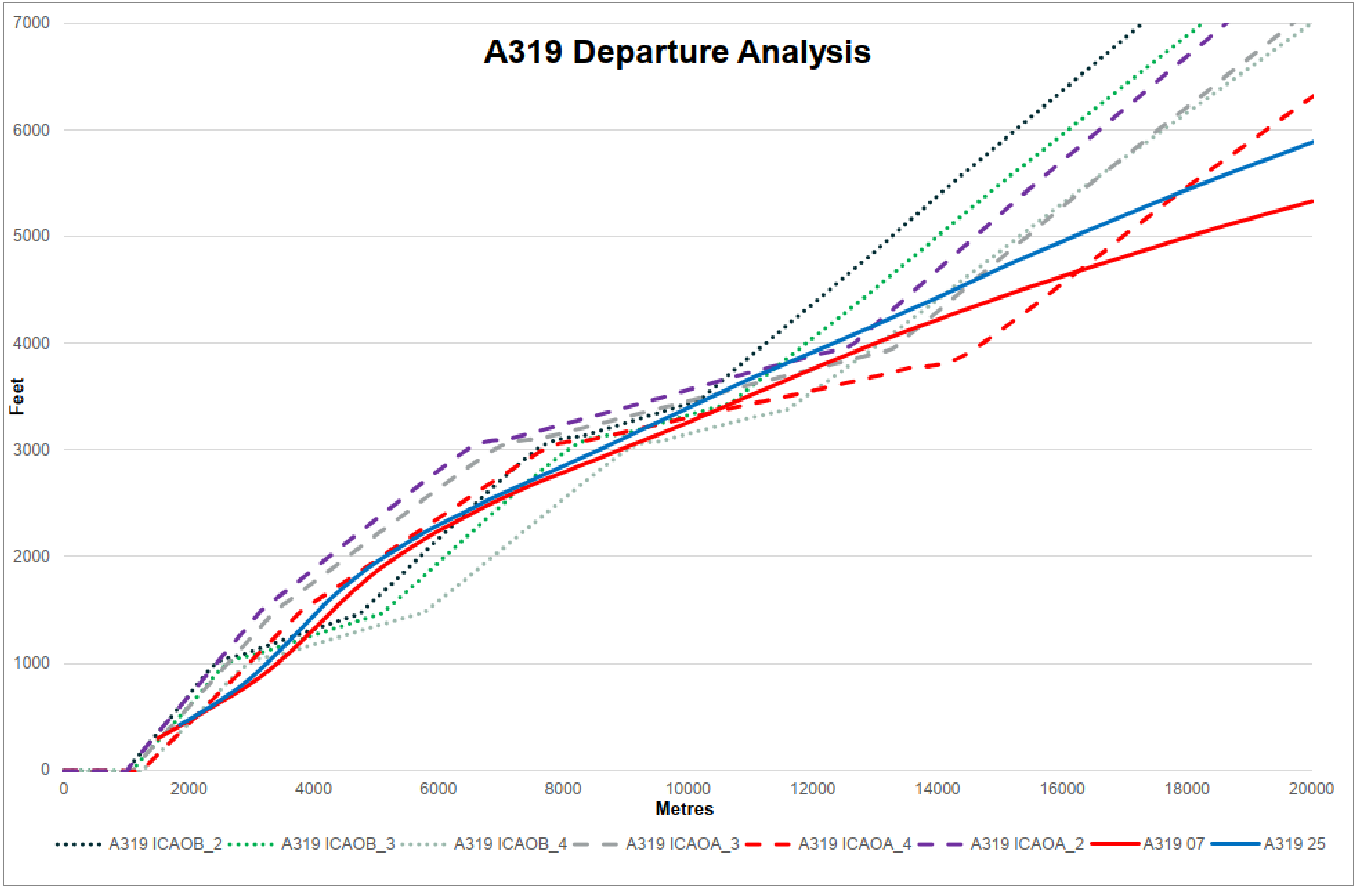
65%. As, in reality, aircraft are likely to have a load factor of greater than 65%, assigning higher stage length than what may be considered average for each aircraft is reasonable.

Table 33: Departure Profiles

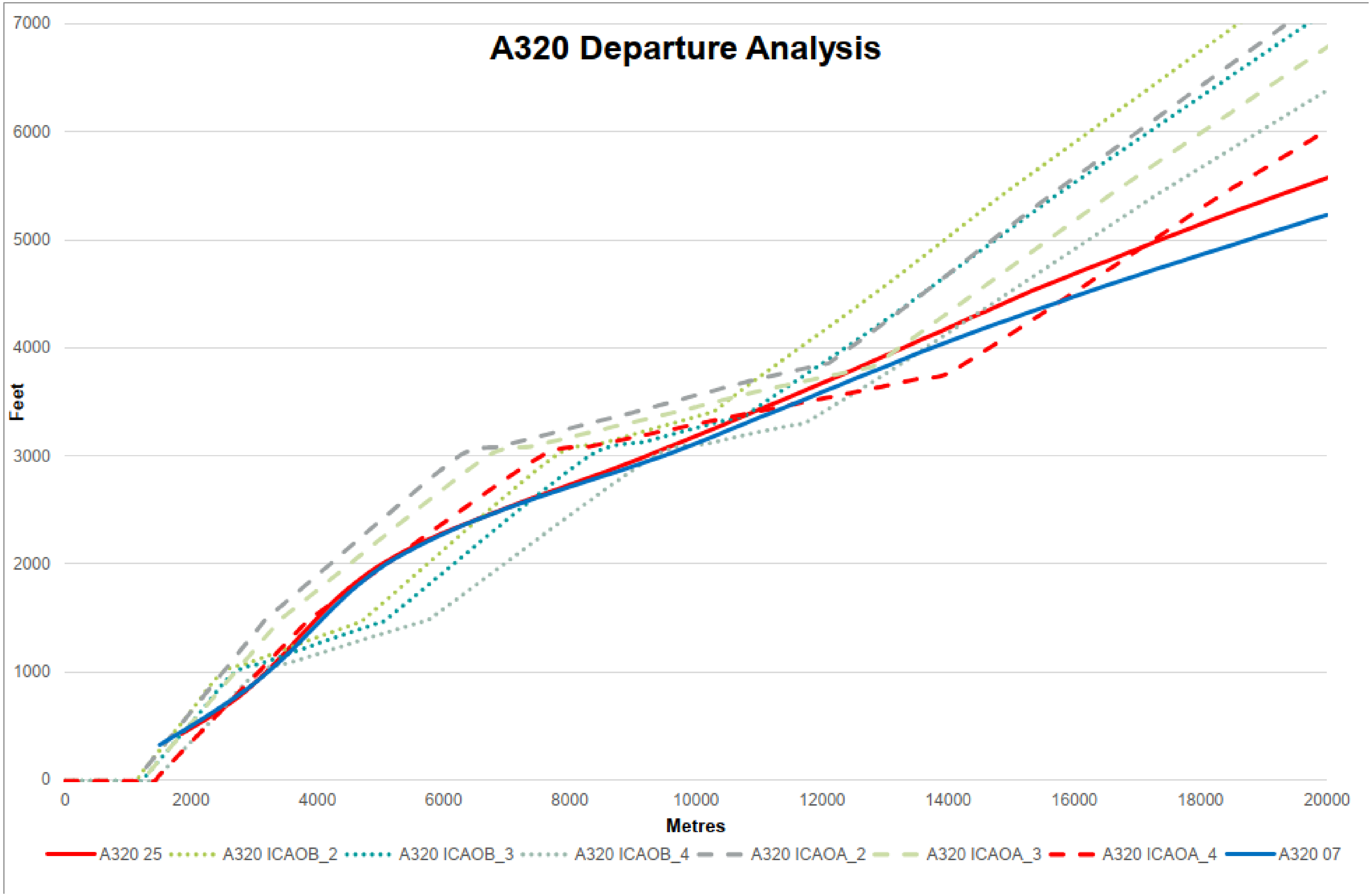
Aircraft	Profile	Stage Length
A319	ICAO_A	4
A320	ICAO_A	4
A321	ICAO_A	4
B737-800 – 07 runway	ICAO_A	4
B737-800 – 25 runway	ICAO_B	4

6.9.4 Testing adjustments to departure profiles to better fit the average profile from radar data was undertaken. As approval from the Federal Aviation Authority is required in the US to use user-defined profiles, adjustments were only adopted if they were simple to apply and provided benefits in noise predictions. As no clear benefits could be obtained by making adjustments to the A319, A320 and A321 departure profiles, these were left as default.

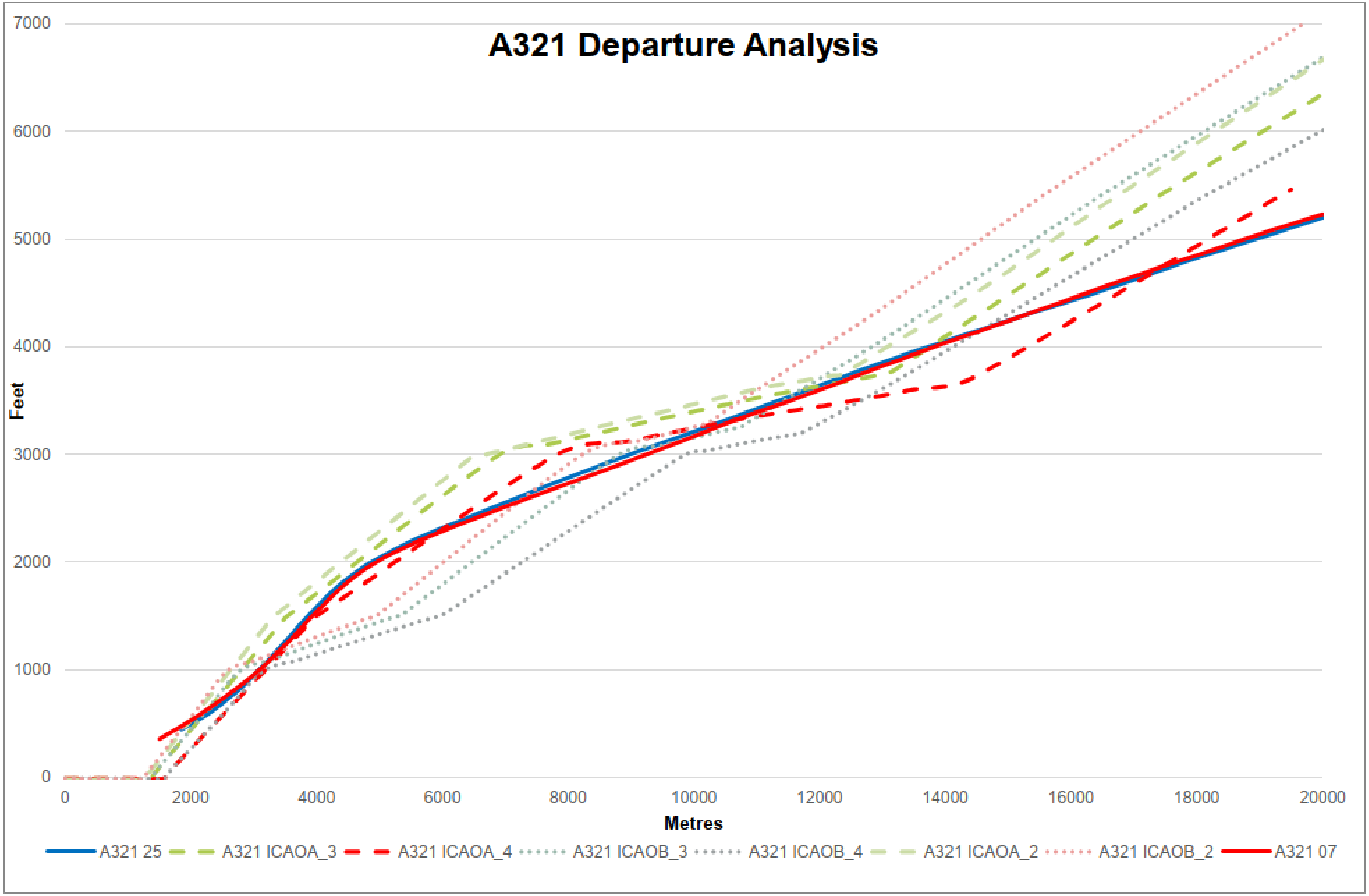
6.9.5 It was noted that a minor adjustment could be made to the B737-800 profile to align better with the average profile for 07-departures. Additionally, adjustments were made to the B737-800 25-departure profile to better match the average departure profile. Adjusted departure profiles are presented in **Inset 10** and **Inset 11**.



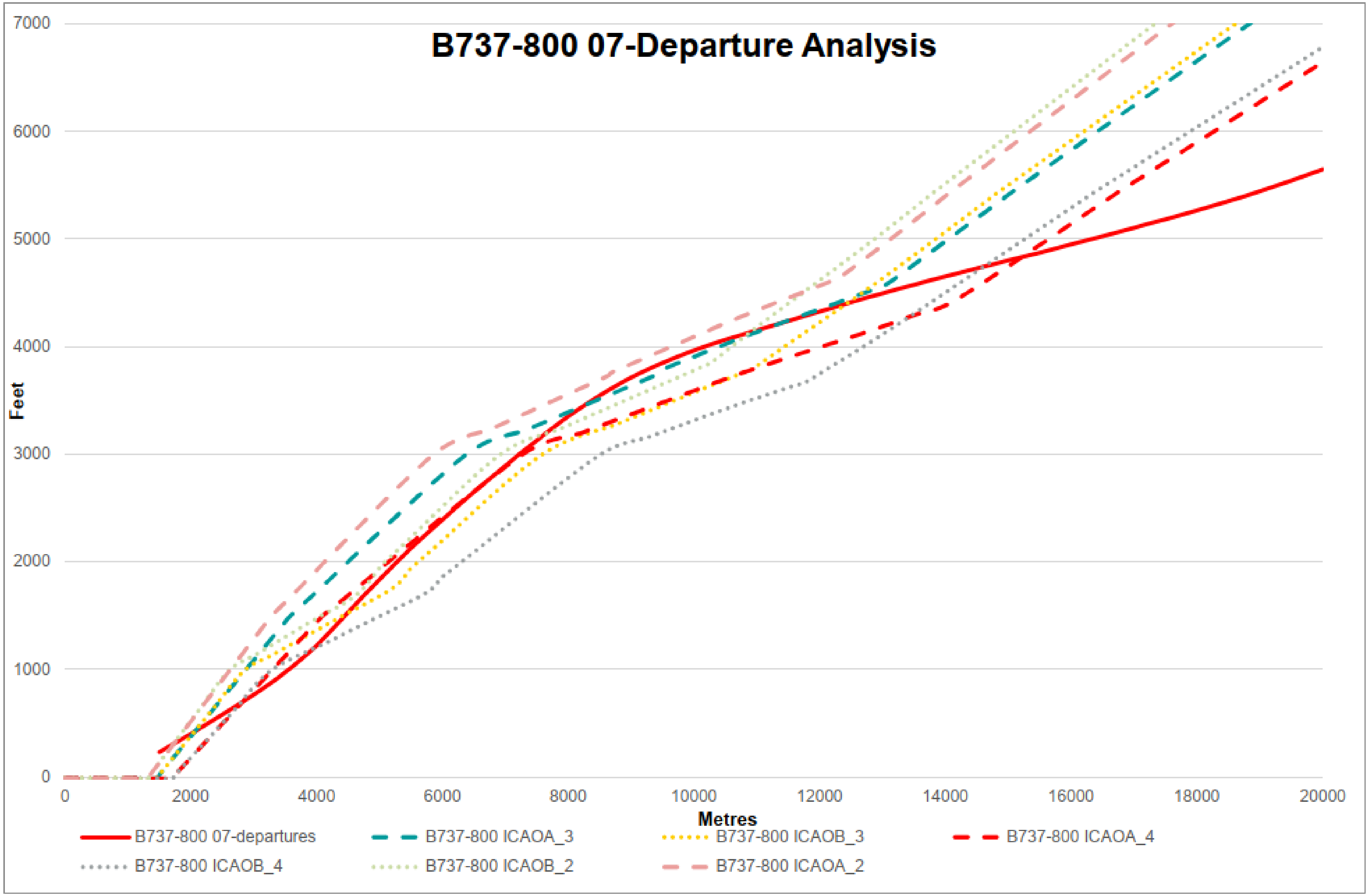
Inset 5: A319 Departure Profile Analysis



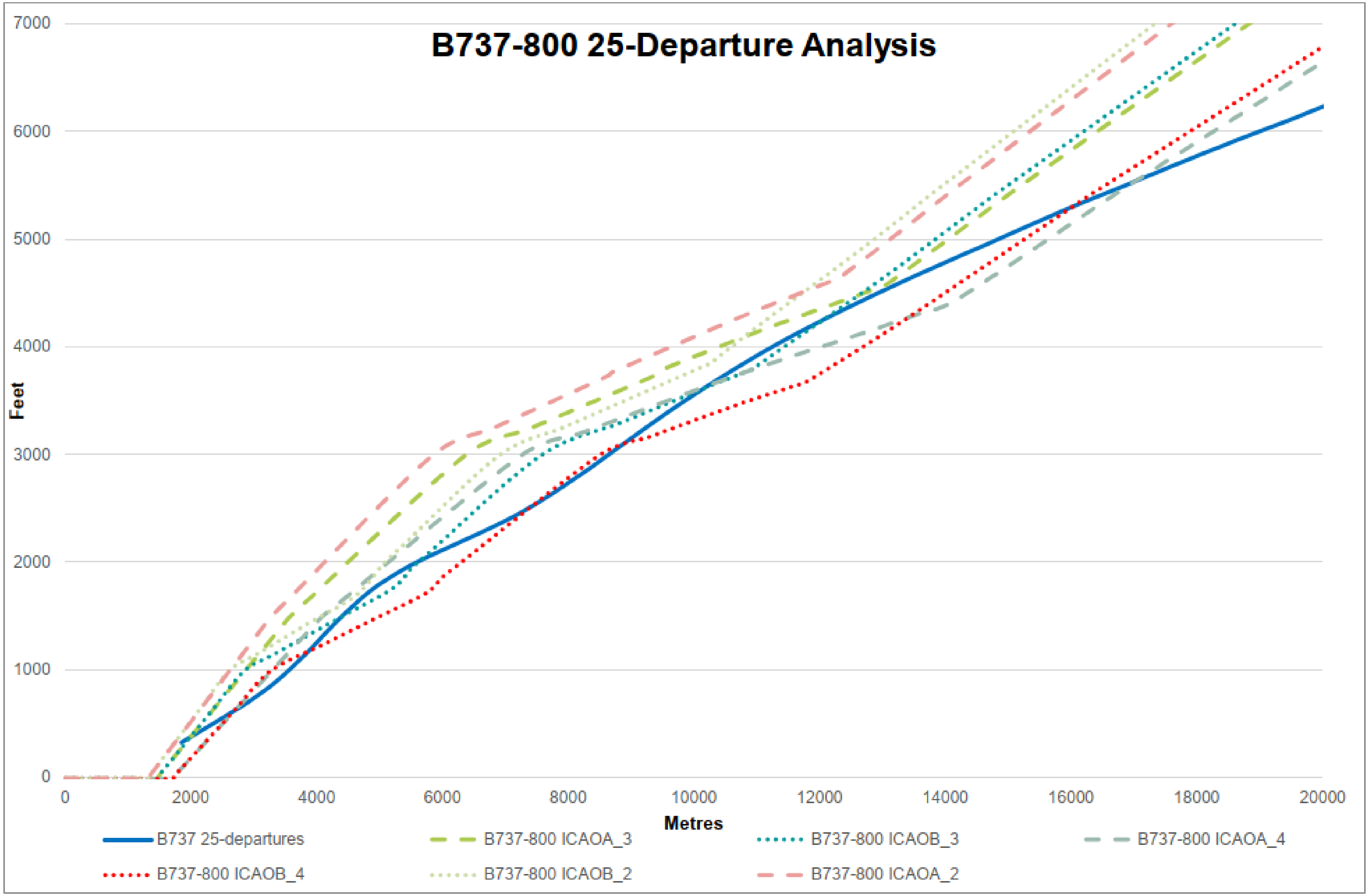
Inset 6: A320 Departure Profile Analysis



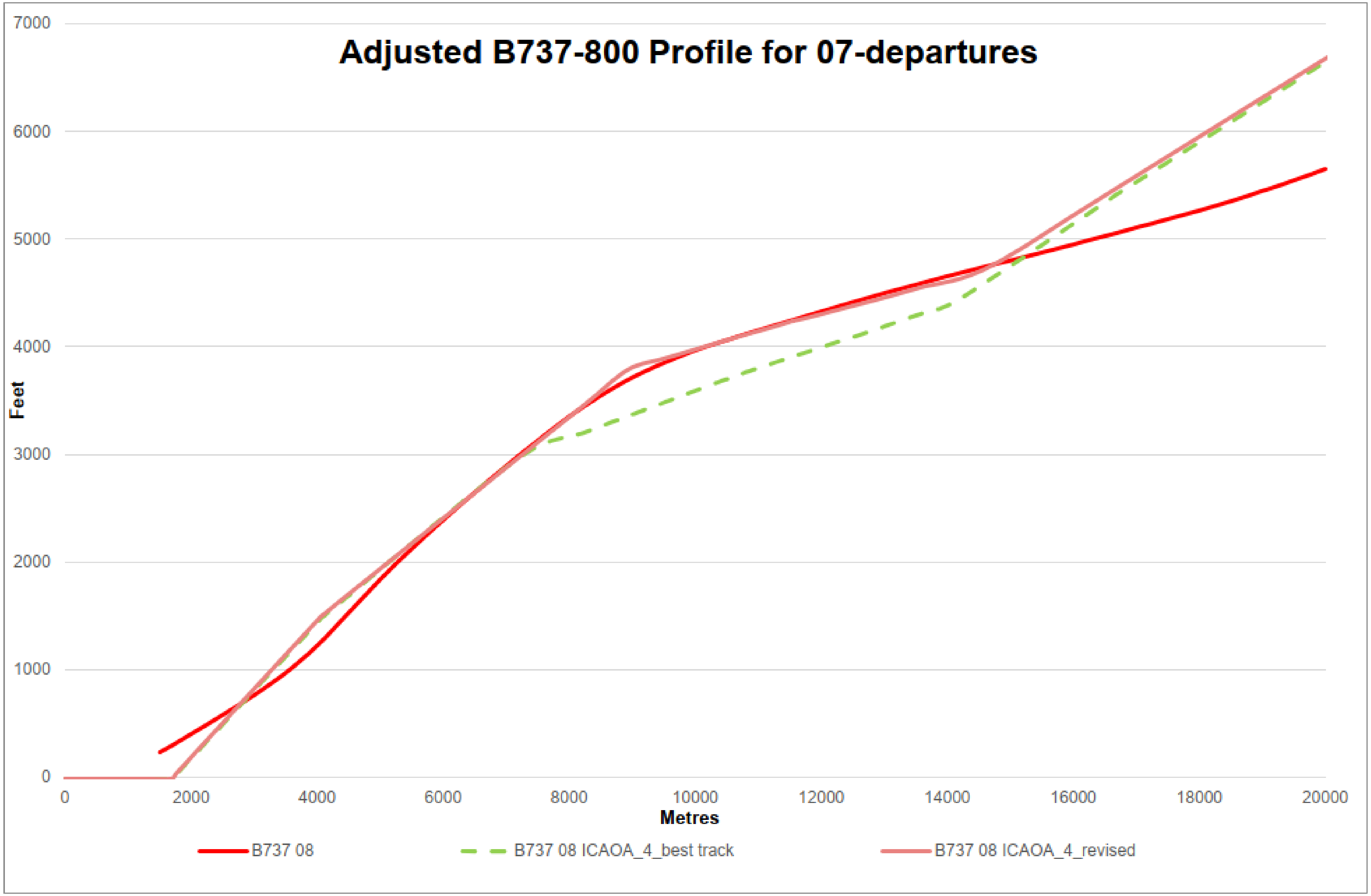
Inset 7: A321 Departure Profile Analysis



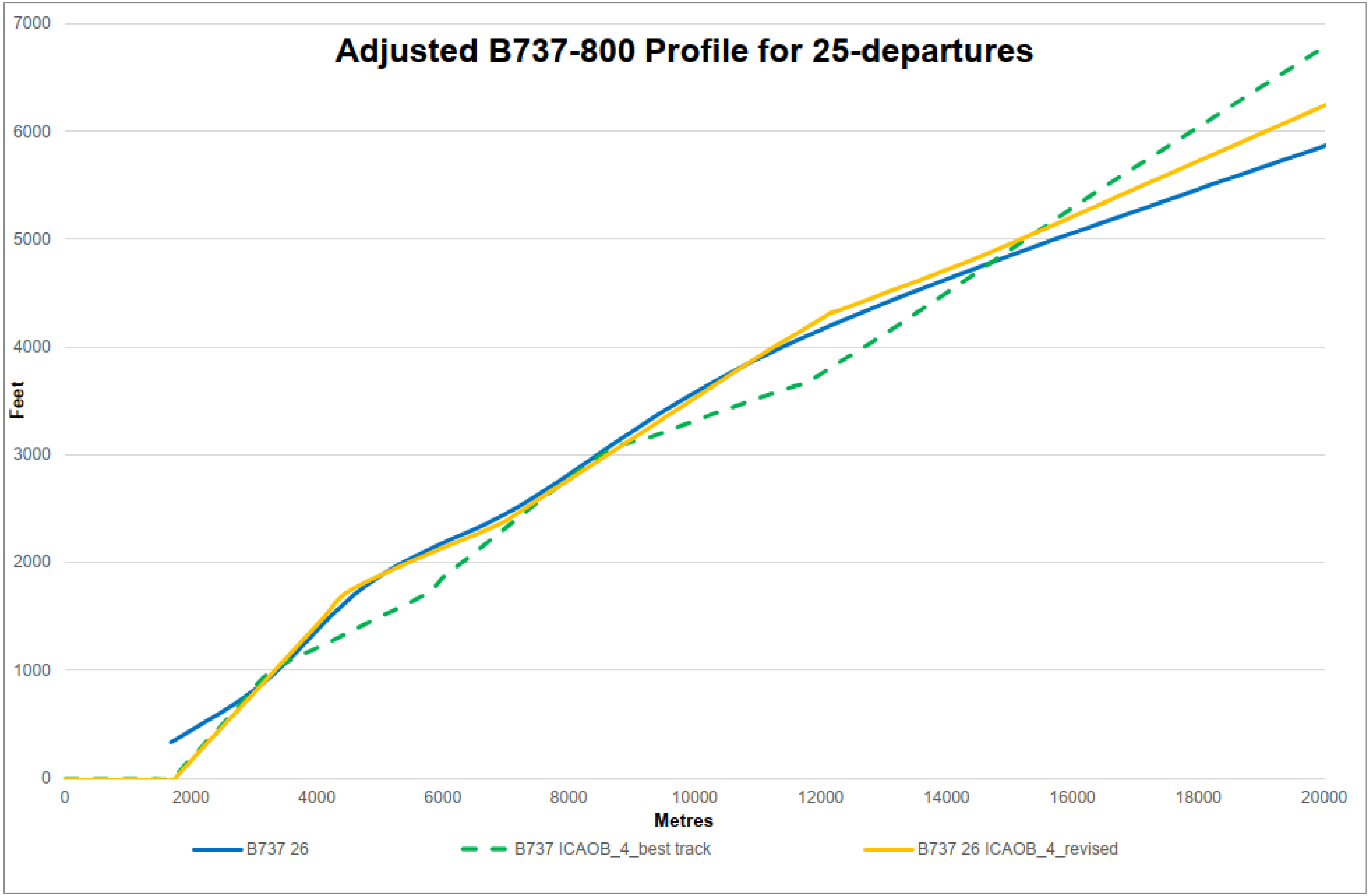
Inset 8: B737-800 07-runway Departure Profile Analysis



Inset 9: B737-800 25-runway Departure Profile Analysis



Inset 10: B737-800 07-runway Adjusted Profile



Inset 11: B737-800 25-runway Adjusted Profile

6.10 Departure Noise Testing

6.10.1 Results comparing measured and predicted noise levels for aircraft departures are presented in **Table 34 to Table 38**.

Table 34: A319 Departure Noise Prediction Testing

Runway	Location	Measured	Predicted	Difference
7	LTN_BG	89.4	86.1	-3.3
	NMT1	83.6	81.9	-1.7
25	LTN_SLTN	86.6	85.0	-1.6
	LTN_PPR	84.6	83.9	-0.7
	NMT2	83.6	81.6	-2.0
	NMT3	84.3	78.7	-5.6
	LTN_MRK	80.8	79.3	-1.5
	LTN_FLM	76.9	76.8	-0.1

Table 35: A320 Departure Noise Prediction Testing

Runway	Location	Measured	Predicted	Difference
7	LTN_BG	89.1	88.3	-0.8
	NMT1	84.3	85.1	0.8
25	LTN_SLTN	86.2	87.2	1.0
	LTN_PPR	85.4	86.0	0.6
	NMT2	83.9	84.6	0.7
	NMT3	84.2	81.9	-2.3
	LTN_MRK	81.0	82.1	1.1
	LTN_FLM	76.4	79.2	2.8

Table 36: A320neo Departure Noise Prediction Testing

Runway	Location	Measured	Predicted	Difference
7	LTN_BG	84.8	85.0	0.2
	NMT1	80.9	81.4	0.5
25	LTN_SLTN	82.6	83.5	0.9
	LTN_PPR	82.0	82.9	0.9
	NMT2	81.0	81.0	0.0
	NMT3	83.9	79.4	-4.5
	LTN_MRK	76.6	78.0	1.4
	LTN_FLM	71.9	75.9	4.0

Table 37: A321 Departure Noise Prediction Testing

Runway	Location	Measured	Predicted	Difference
7	LTN_BG	91.1	89.5	-1.6
	NMT1	85.7	85.2	-0.5
25	LTN_SLTN	88.1	88.6	0.5
	LTN_PPR	87.0	86.6	-0.4
	NMT2	85.0	85.0	0.0
	NMT3	85.4	82.1	-3.3
	LTN_MRK	81.4	82.4	1.0
	LTN_FLM	78.1	79.3	1.2

Table 38: B737-800 Departure Noise Prediction Testing

Runway	Location	Measured	Predicted	Difference
7	LTN_BG	92.5	91.9	-0.6
	NMT1	86.4	87.6	1.2
25	LTN_SLTN	89.6	90.7	1.1
	LTN_PPR	87.1	90.3	3.2
	NMT2	86.4	88.5	2.1
	NMT3	87.0	85.7	-1.3
	LTN_MRK	82.8	84.1	1.3
	LTN_FLM	80.0	81.9	1.9

6.10.2 It is noted that there is a trend for underpredicting at NMT3. This may be due to the fact that the noise monitor is located in close proximity to the M1 and, therefore, the SEL of aircraft may not be detected that are either quiet or fly along the 25-departure route swathe at a significant distance from NMT3. Consequently, NMT3 is not considered to be a key location for validating departure noise.

6.10.3 Corrections applied to aircraft departure noise data are presented in **Table 39**. It is important to note that corrections apply only to the specific profile and stage length for each aircraft in **Table 33**. Consequently, although the B737-800 is the same aircraft on 07 and 25 departures, different corrections are applied to match noise generated from the specific departure profiles.

Table 39: Departure Noise Corrections

Aircraft	Departure Correction dB
A319	+2.5
A320	-0.5
A320neo	0.0
A321	+0.8

B737-800 – 07 runway	-0.4
B737-800 – 25 runway	-1.9

6.11 Aircraft Fleet Information

6.11.1 Aircraft movement forecasts used in air noise predictions are presented in **Table 40** for 2017 baseline, **Table 41** for Do-Nothing scenarios and **Table 42** for Do-Something scenarios.

Table 40: 2019 Average Summer Day Aircraft Movement Data

Aircraft	Day	Night
Airbus A319	58.2	9.0
Airbus A320	61.9	10.2
Airbus A320	54.6	11.2
Airbus A320 neo	11.7	3.3
Airbus A321	0.1	0.0
Airbus A321	49.8	6.5
Airbus A321 neo	5.1	0.0
Boeing 737-300	0.3	0.0
Boeing 737-400	1.1	0.0
Boeing 737-500	0.7	0.0
Boeing 737-800	1.5	0.0
Boeing 737-800	0.8	0.3
Boeing 737-800	40.8	8.6
Boeing 737-max8	0.0	0.0
Boeing 737-900	2.0	0.5
Boeing 757-200	2.9	1.0
Boeing 767-300	0.1	0.0
Boeing 777-200	0.5	0.0
Boeing 787-8	0.0	0.0
Airbus a300-600 freighter	2.5	1.6
Boeing 737-400	0.2	1.1
Boeing 757-200	0.0	0.5
Boeing 757-200	0.0	1.0
Airbus a330-200 freighter	0.1	0.0
Boeing 737-300	0.0	0.0
General aviation	79.5	0.2

Table 41: Do-Nothing Average Summer Day Aircraft Movement Data

Aircraft	2027		2039		2043	
	Day	Night	Day	Night	Day	Night
Airbus A319	0.0	0.0	0.0	0.0	0.0	0.0
Airbus A320	49.3	8.0	0.0	0.0	0.0	0.0
Airbus A320Neo	116.7	18.9	166.0	26.8	166.0	26.8
Airbus A321	29.7	4.8	0.0	0.0	0.0	0.0
Airbus A321LR	0.0	0.0	0.0	0.0	0.0	0.0
Airbus A321neo	38.0	6.2	71.3	11.5	71.3	13.7
Airbus A350-900	0.0	0.0	0.0	0.0	0.0	0.0
Boeing 737-400	0.0	0.0	0.0	0.0	0.0	0.0
Boeing 737-800W	32.5	5.2	8.4	1.4	8.4	1.4
Boeing 737-900W	2.0	0.0	0.0	0.0	0.0	0.0
Boeing 737-Max10	0.0	0.0	0.0	0.0	0.0	0.0
Boeing 737-Max8	15.4	2.5	38.9	6.3	39.0	6.3
Boeing 737-Max9	0.0	0.0	2.0	0.0	2.0	0.0
Boeing-787-10	0.0	0.0	0.0	0.0	0.0	0.0
Boeing-787-8	0.0	0.0	0.0	0.0	0.0	0.0
Boeing-787-9	0.0	0.0	0.0	0.0	0.0	0.0
Dash-8-Q400	0.0	0.0	0.0	0.0	0.0	0.0
Embraer E190-E2	0.0	0.0	0.0	0.0	0.0	0.0
Airbus A300-600F	1.0	2.1	0.0	0.0	0.0	0.0
Airbus A330-200F	0.0	0.0	1.0	2.1	1.0	2.1
Boeing-737-800F	0.0	0.0	1.0	2.1	1.0	2.1
Boeing-737-400F	0.5	1.0	0.0	0.0	0.0	0.0
Boeing-757-200F	0.5	1.1	0.0	0.0	0.0	0.0
Airbus A319CJ	0.4	0.0	0.0	0.0	0.0	0.0
Airbus A319Neo CJ	0.6	0.0	1.0	0.0	1.0	0.0
Agusta 109 Helicopter	1.7	0.0	1.7	0.0	1.7	0.0
Beechcraft King Air 350	1.6	0.0	1.6	0.0	1.6	0.0
Boeing-737-BBJ7	0.4	0.0	0.0	0.0	0.0	0.0
Boeing-737-BBJ Max7	0.6	0.0	1.0	0.0	1.0	0.0
Bombardier Global Express 6000	12.3	0.1	12.3	0.1	12.4	0.0
Canadair Challenger 605	11.6	0.1	11.6	0.1	11.7	0.0
Cessna 680 Sovereign	21.3	0.2	21.3	0.2	21.5	0.0
Dassault Falcon FA8X	8.9	0.1	8.9	0.1	8.9	0.0

Embraer Legacy 650E	5.7	0.0	5.7	0.0	5.8	0.0
Embraer Phenom 300E	2.7	0.0	2.7	0.0	2.7	0.0
Gulfstream 400	7.3	0.1	7.3	0.1	7.3	0.0
Gulfstream 650	10.7	0.1	10.7	0.1	10.8	0.0

Table 42: Do-Something Average Summer Day Aircraft Movement Data

Aircraft	2027		2039		2043	
	Day	Night	Day	Night	Day	Night
Airbus A319	0.0	0.0	0.0	0.0	0.0	0.0
Airbus A320	63.9	3.0	0.0	0.0	0.0	0.0
Airbus A320Neo	125.4	33.4	184.0	37.8	192.9	42.2
Airbus A321	37.1	3.0	0.0	0.0	0.0	0.0
Airbus A321LR	0.0	0.0	1.0	1.0	1.0	1.0
Airbus A321neo	44.8	7.0	118.0	18.3	147.1	21.5
Airbus A350-900	0.0	0.0	2.0	0.0	2.0	0.0
Boeing 737-400	0.0	0.0	0.0	0.0	0.0	0.0
Boeing 737-800W	36.0	8.0	9.8	0.0	5.9	0.0
Boeing 737-900W	2.0	0.0	0.0	0.0	0.0	0.0
Boeing 737-Max10	0.0	0.0	4.0	3.6	9.5	6.2
Boeing 737-Max8	17.3	3.8	52.1	8.2	65.1	9.2
Boeing 737-Max9	0.0	0.0	2.0	0.0	2.0	0.0
Boeing-787-10	0.0	0.0	3.9	0.0	5.9	0.0
Boeing-787-8	0.0	0.0	4.9	1.0	9.7	4.0
Boeing-787-9	0.0	0.0	1.0	1.0	2.9	1.0
Dash-8-Q400	0.0	0.0	15.7	0.0	13.7	0.0
Embraer E190-E2	0.0	0.0	0.0	0.0	7.8	0.0
Airbus A300-600F	1.0	2.1	0.0	0.0	0.0	0.0
Airbus A330-200F	0.0	0.0	1.0	2.1	1.0	2.1
Boeing-737-800F	0.0	0.0	1.0	2.1	1.0	2.1
Boeing-737-400F	0.5	1.0	0.0	0.0	0.0	0.0
Boeing-757-200F	0.5	1.1	0.0	0.0	0.0	0.0
Airbus A319CJ	0.4	0.0	0.0	0.0	0.0	0.0
Airbus A319Neo CJ	0.6	0.0	1.0	0.0	1.0	0.0
Agusta 109 Helicopter	1.7	0.0	1.7	0.0	1.7	0.0
Beechcraft King Air 350	1.6	0.0	1.6	0.0	1.6	0.0
Boeing-737-BBJ7	0.4	0.0	0.0	0.0	0.0	0.0
Boeing-737-BBJ Max7	0.6	0.0	1.0	0.0	1.0	0.0

Bombardier Global Express 6000	12.3	0.1	12.3	0.1	12.4	0.0
Canadair Challenger 605	11.6	0.1	11.6	0.1	11.7	0.0
Cessna 680 Sovereign	21.3	0.2	21.3	0.2	21.5	0.0
Dassault Falcon FA8X	8.9	0.1	8.9	0.1	8.9	0.0
Embraer Legacy 650E	5.7	0.0	5.7	0.0	5.8	0.0
Embraer Phenom 300E	2.7	0.0	2.7	0.0	2.7	0.0
Gulfstream 400	7.3	0.1	7.3	0.1	7.3	0.0
Gulfstream 650	10.7	0.1	10.7	0.1	10.8	0.0

6.12 Route Usage

6.12.1 Noise contours were produced assuming a 30% use of runway 07 and 70% use of runway 25. The splits of movements across departure routes that was applied in noise modelling are presented in **Table 43**.

Table 43: Departure Route Splits

Runway	Olney	Compton	Detling
07	6%	9%	15%
25	14%	21%	35%

6.13 Aircraft Noise Modelling Results

6.13.1 The results of noise predictions undertaken for 2027 Do Nothing (DN) and Do Something (DS) scenarios are presented in **Table 44**. The results are presented for the daytime $L_{Aeq,16h}$ period from 07:00 to 23:00 and the night-time $L_{Aeq,8h}$ from 23:00 to 07:00. Receptors experiencing exceedance of the SOAEL in the DS scenario are marked in red and receptors in the DS scenario experiencing exceedances of the LOAEL are marked in green.

Table 44: 2027 92-day Summer Average Aircraft Noise Prediction Result

Receptor ID	DN $L_{Aeq,16h}$ dB	DS $L_{Aeq,16h}$ dB	Change in $L_{Aeq,16h}$ dB	DN $L_{Aeq,8h}$ dB	DS $L_{Aeq,8h}$ dB	Change in $L_{Aeq,8h}$ dB
AR1	61.1	61.6	0.5	56.4	57.0	0.6
AR2	63.4	64.0	0.6	58.6	59.2	0.6
AR3	50.3	50.9	0.6	45.5	46.3	0.8
AR4	56.9	57.5	0.6	52.1	52.8	0.7
AR5	61.0	61.6	0.6	56.5	57.1	0.6
AR7	49.0	49.5	0.5	44.3	45.2	0.9
AR8	45.3	45.9	0.6	40.6	41.1	0.5
AR9	54.6	55.1	0.5	49.6	50.4	0.8

AR10	48.0	48.6	0.6	43.4	44.3	0.9
AR11	55.6	56.1	0.5	50.9	51.8	0.9
AR12	58.8	59.3	0.5	53.8	54.7	1.0
AR13	63.5	64.2	0.6	58.7	59.1	0.3
AR14	49.5	50.1	0.5	44.8	45.5	0.7
AR15	49.0	49.6	0.6	44.1	44.8	0.7
AR16	51.0	51.5	0.5	46.2	46.9	0.8
AR17	51.6	52.3	0.6	47.1	47.7	0.6
AR18	46.8	47.4	0.6	42.0	42.6	0.6
AR19	50.5	51.0	0.5	45.5	46.3	0.8
AR20	48.7	49.3	0.6	43.8	44.2	0.4
AR21	43.6	44.1	0.5	38.7	39.9	1.2
AR22	46.7	47.3	0.6	42.2	42.6	0.4
AR30	41.4	42.1	0.6	36.9	37.3	0.4
AR31	53.7	54.2	0.6	48.9	49.7	0.8
AR32	58.7	59.3	0.6	53.9	54.4	0.5
AR33	52.7	53.2	0.6	47.9	48.7	0.8
AR34	48.6	49.2	0.5	44.0	45.0	1.0
AR35	51.6	52.2	0.6	47.0	47.6	0.6
AR36	46.5	47.1	0.6	41.7	42.4	0.8
AR37	60.1	60.7	0.6	55.4	56.1	0.7
AR38	54.7	55.3	0.6	50.2	50.9	0.7
AR39	57.5	58.0	0.5	52.4	53.4	1.0
AR40	65.6	66.2	0.7	60.8	61.1	0.3

6.13.2 The results of noise predictions undertaken for 2039 DN and DS scenarios are presented in **Table 45**. The results are presented for the daytime $L_{Aeq,16h}$ period from 07:00 to 23:00 and the night-time $L_{Aeq,8h}$ from 23:00 to 07:00. Receptors experiencing exceedance of the SOAEL in the DS scenario are marked in red and receptors in the DS scenario experiencing exceedances of the LOAEL are marked in green.

Table 45: 2039 92-day Summer Average Aircraft Noise Prediction Result

Receptor ID	DN $L_{Aeq,16h}$ dB	DS $L_{Aeq,16h}$ dB	Change in $L_{Aeq,16h}$ dB	DN $L_{Aeq,8h}$ dB	DS $L_{Aeq,8h}$ dB	Change in $L_{Aeq,8h}$ dB
AR1	59.7	61.0	1.3	55.0	56.2	1.2
AR2	61.9	63.2	1.3	57.4	58.9	1.5
AR3	49.1	50.3	1.2	44.7	46.1	1.4
AR4	55.2	56.5	1.3	50.6	52.0	1.3

AR5	60.3	61.5	1.2	55.7	57.4	1.7
AR7	47.5	48.8	1.3	43.0	44.2	1.2
AR8	44.4	45.7	1.3	40.1	41.8	1.7
AR9	53.1	54.3	1.3	48.3	49.7	1.3
AR10	47.3	48.6	1.2	42.9	44.5	1.6
AR11	54.7	55.9	1.2	50.1	51.6	1.5
AR12	57.3	58.5	1.2	52.4	53.8	1.3
AR13	61.9	63.3	1.4	57.2	58.7	1.6
AR14	47.8	49.2	1.4	43.3	44.5	1.1
AR15	47.1	48.5	1.4	42.7	43.8	1.1
AR16	49.2	50.5	1.3	44.7	45.8	1.1
AR17	51.3	52.5	1.2	47.0	48.7	1.8
AR18	45.6	46.9	1.3	41.4	43.0	1.6
AR19	48.9	50.2	1.3	44.2	45.5	1.3
AR20	46.8	48.1	1.3	42.3	43.5	1.2
AR21	42.1	43.3	1.2	37.7	38.9	1.2
AR22	46.1	47.4	1.3	41.8	43.6	1.8
AR30	40.9	42.2	1.3	36.5	38.4	1.9
AR31	52.6	53.8	1.2	48.1	49.6	1.5
AR32	57.1	58.5	1.4	52.3	53.8	1.5
AR33	51.2	52.6	1.3	46.6	48.0	1.4
AR34	47.5	48.7	1.2	43.0	44.3	1.4
AR35	50.0	51.4	1.4	45.6	46.8	1.2
AR36	44.5	45.9	1.4	40.2	41.2	1.0
AR37	58.7	60.0	1.3	54.2	55.6	1.5
AR38	54.2	55.4	1.2	49.8	51.5	1.7
AR39	56.0	57.2	1.2	51.2	52.5	1.3
AR40	64.0	65.4	1.4	59.3	60.8	1.6

6.13.3 The results of noise predictions undertaken for 2043 DN and DS scenarios are presented in **Table 46**. The results are presented for the daytime $L_{Aeq,16h}$ period from 07:00 to 23:00 and the night-time $L_{Aeq,8h}$ from 23:00 to 07:00. Receptors experiencing exceedance of the SOAEL in the DS scenario are marked in red and receptors in the DS scenario experiencing exceedances of the LOAEL are marked in green.

Table 46: 2043 92-day Summer Average Aircraft Noise Prediction Result

Receptor ID	DN $L_{Aeq,16h}$ dB	DS $L_{Aeq,16h}$ dB	Change in $L_{Aeq,16h}$ dB	DN $L_{Aeq,8h}$ dB	DS $L_{Aeq,8h}$ dB	Change in $L_{Aeq,8h}$ dB

AR1	59.7	61.8	2.1	55.3	56.6	1.4
AR2	61.9	63.9	2.0	57.7	59.6	1.9
AR3	49.1	50.9	1.9	44.9	46.9	2.0
AR4	55.2	57.2	2.0	51.0	52.6	1.6
AR5	60.3	62.1	1.9	55.8	58.3	2.5
AR7	47.6	49.6	2.0	43.3	44.6	1.4
AR8	44.4	46.4	2.0	40.1	42.9	2.7
AR9	53.1	55.0	2.0	48.6	50.1	1.5
AR10	47.4	49.2	1.9	43.0	45.3	2.3
AR11	54.7	56.6	1.9	50.2	52.3	2.1
AR12	57.3	59.2	1.8	52.7	54.2	1.5
AR13	61.9	64.0	2.1	57.5	59.4	1.9
AR14	47.9	50.0	2.2	43.7	44.9	1.3
AR15	47.1	49.2	2.2	43.0	44.3	1.3
AR16	49.2	51.3	2.1	45.0	46.3	1.3
AR17	51.4	53.2	1.8	47.0	49.7	2.7
AR18	45.6	47.6	2.0	41.5	43.9	2.4
AR19	48.9	50.9	1.9	44.5	45.9	1.4
AR20	46.8	48.8	2.0	42.7	44.0	1.3
AR21	42.1	43.9	1.9	37.9	39.5	1.6
AR22	46.1	48.1	2.1	41.8	44.6	2.8
AR30	40.9	43.0	2.1	36.5	39.5	3.0
AR31	52.6	54.4	1.9	48.2	50.3	2.1
AR32	57.1	59.2	2.1	52.7	54.4	1.7
AR33	51.2	53.3	2.0	46.9	48.5	1.6
AR34	47.5	49.5	2.0	43.2	44.9	1.8
AR35	50.0	52.2	2.2	45.9	47.2	1.3
AR36	44.5	46.7	2.2	40.6	41.8	1.2
AR37	58.7	60.6	1.9	54.4	56.4	2.0
AR38	54.2	56.1	1.9	49.8	52.4	2.6
AR39	56.0	57.9	1.9	51.5	53.0	1.5
AR40	64.0	66.1	2.1	59.6	61.6	2.0

6.14 Population Analysis

6.14.1 To analyse the noise contours, population and household census data were downloaded from NOMIS at the Output Area level (the smallest census output area available). This output area dataset was then intersected with the residential buildings from Addresspoint Premium 2020 data to show exactly where the population and households were located within each output area. The census data was proportioned across the building dataset. This was then intersected with the PEIR baseline noise contour outputs to show the total population and number of households within each contour. Results of household and population analysis are rounded to the nearest 50.

6.14.2 It should be noted that there are differences in the household and population counts from LLAOL's household and population counts in their 2019 AMR and household and population counts from AEDT noise contours in the following section. This is due to noise contours covering different areas; however, there are differences in the methodology used to obtain the results for the population and number of households affected. It is, therefore, to be expected that there are differences between the two sets of results.

6.15 Aircraft Noise Modelling Results Comparison with 2019 Baseline

Phase 1

6.15.1 The comparison of the 2027 DN and DS scenarios represents a worst-case as the extent of noise contours for the 2027 DN scenario is less than the 2019 baseline due to the future fleet comprising quieter aircraft. However, to provide additional context, the results of the 2027 DS scenario have been compared to the 2019 baseline scenario. The results of analysis are presented in the following tables below:

a. analysis of area coverage by 2019 baseline and Phase 1 2027 DS air noise contours are presented in **Table 47** for daytime LAeq,16h (see **Figure 16.13** and **Figure 16.15** in Volume 4 of this PEIR) and **Table 50** for night-time LAeq,8h (see **Figure 16.14** and **Figure 16.16** in Volume 4 of this PEIR);

b. analysis of households within 2019 baseline and Phase 1 2027 DS air noise contours are presented in **Table 48** for daytime LAeq,16h and **Table 51** for night-time LAeq,8h; and

c. analysis of population within 2019 baseline and Phase 1 2027 DS air noise contours are presented in **Table 49** for daytime LAeq,16h and **Table 50** for night-time LAeq,8h.

Table 47: Daytime 2019 Baseline v DS 2027 Air Noise Analysis – Area

$L_{Aeq,16h}$ dB Noise Contour	2019 Baseline Cumulative Area (km^2)	2027 DS Cumulative Area (km^2)	Change in Cumulative Area (km^2)
51	64.2	60.5	-3.7
54	38.4	36.1	-2.3
57	20.6	19.4	-1.2
60	11.0	10.2	-0.8

$L_{Aeq,16h}$ dB Noise Contour	2019 Baseline Cumulative Area (km^2)	2027 DS Cumulative Area (km^2)	Change in Cumulative Area (km^2)
63	6.1	5.6	-0.5
66	3.5	3.1	-0.4
69	1.9	1.7	-0.2

Table 48: Daytime 2019 Baseline v DS 2027 Air Noise Analysis – Households

$L_{Aeq,16h}$ dB Noise Contour	2019 Baseline Cumulative Number of Households	2027 DS Cumulative Number of Households	Change in Cumulative Number of Households
51	22,350	22,450	+100
54	11,150	10,050	-1,100
57	6,050	5,000	-1,050
60	2,700	2,250	-450
63	800	600	-200
66	50	0	-50
69	0	0	0

Table 49: Daytime 2019 Baseline v DS 2027 Air Noise Analysis – Population

$L_{Aeq,16h}$ dB Noise Contour	2019 Baseline Cumulative Population	2027 DS Cumulative Population	Change in Cumulative Population
51	52,100	51,950	-150
54	25,900	23,600	-2,300
57	14,600	12,300	-2,300
60	7,150	6,000	-1,150
63	2,150	1,600	-550
66	100	50	-50
69	0	0	0

Table 50: Night-time 2019 Baseline v DS 2027 Air Noise Analysis – Area

$L_{Aeq,8h}$ dB Noise Contour	2019 Baseline Cumulative Area (km^2)	2027 DS Cumulative Area (km^2)	Change in Cumulative Area (km^2)
45	88.6	74.9	-13.7
48	52.3	46.1	-6.2
51	30.0	26.1	-3.9
54	15.7	13.9	-1.8

$L_{Aeq,8h}$ dB Noise Contour	2019 Baseline Cumulative Area (km^2)	2027 DS Cumulative Area (km^2)	Change in Cumulative Area (km^2)
55	12.8	11.2	-1.4
57	8.4	7.2	-1.2
60	4.8	3.9	-0.9
63	2.7	2.1	-0.6
66	1.5	1.2	-0.3
69	0.9	0.8	-0.1

Table 51: Night-time 2019 Baseline v DS 2027 Air Noise Analysis – Households

$L_{Aeq,8h}$ dB Noise Contour	2019 Baseline Cumulative Number of Households	2027 DS Cumulative Number of Households	Change in Cumulative Number of Households
45	36,650	30,550	-6,100
48	16,200	13,300	-2,900
51	8,750	6,600	-2,150
54	4,200	3,150	-1,050
55	3,300	2,250	-1,050
57	1,850	900	-950
60	400	150	-250
63	0	0	0
66	0	0	0
69	0	0	0

Table 52: Night-time 2019 Baseline v DS 2027 Air Noise Analysis – Population

$L_{Aeq,8h}$ dB Noise Contour	2019 Baseline Cumulative Population	2027 DS Cumulative Population	Change in Cumulative Population
45	90,900	72,800	-18,100
48	37,400	31,000	-6,400
51	20,400	15,800	-4,600
54	10,550	8,200	-2,350
55	8,450	6,050	-2,400
57	4,950	2,450	-2,500
60	1,000	350	-650
63	0	0	0
66	0	0	0
69	0	0	0

Phase 2a

6.15.2 The comparison of the 2039 DN and DS scenarios represents a worst-case as the extent of noise contours for the 2039 DN scenario is less than the 2019 baseline due to the future fleet comprised of quieter aircraft. However, to provide additional context, the results of the 2039 DS scenario have been compared to the 2019 baseline scenario. The results of analysis are presented in the following tables below:

a. Analysis of area coverage by 2019 baseline and Phase 2a 2039 DS air noise contours are presented in **Table 53** for daytime $L_{Aeq,16h}$ (see **Figure 16.13** and **Figure 16.15**, Volume 4 of this PEIR) and **Table 56** for night-time $L_{Aeq,8h}$ (see **Figure 16.14** and **Figure 16.16**, Volume 4 of this PEIR);

b. Analysis of households within 2019 baseline and Phase 2a 2039 DS air noise contours are presented in **Table 54** for daytime $L_{Aeq,16h}$ and **Table 57** for night-time $L_{Aeq,8h}$; and

c. Analysis of population within 2019 baseline and Phase 2a 2039 DS air noise contours are presented in **Table 55** for daytime $L_{Aeq,16h}$ and **Table 58** for night-time $L_{Aeq,8h}$.

Table 53: Daytime 2019 Baseline v DS 2039 Air Noise Analysis – Area

$L_{Aeq,16h}$ dB Noise Contour	2019 Baseline Cumulative Area (km^2)	2039 DS Cumulative Area (km^2)	Change in Cumulative Area (km^2)
51	64.2	55.5	-8.7
54	38.4	32.4	-6.0
57	20.6	17.4	-3.2
60	11.0	9.1	-1.9
63	6.1	4.9	-1.2
66	3.5	2.6	-0.9
69	1.9	1.4	-0.5

Table 54: Daytime 2019 Baseline v DS 2039 Air Noise Analysis – Households

$L_{Aeq,16h}$ dB Noise Contour	2019 Baseline Cumulative Number of Households	2039 DS Cumulative Number of Households	Change in Cumulative Number of Households
51	22,350	20,200	-2,150
54	11,150	8,800	-2,350
57	6,050	4,150	-1,900
60	2,700	1,550	-1,150
63	800	350	-450
66	50	0	-50
69	0	0	0

Table 55: Daytime 2019 Baseline v DS 2039 Air Noise Analysis – Population

$L_{Aeq,16h}$ dB Noise Contour	2019 Baseline Cumulative Population	2039 DS Cumulative Population	Change in Cumulative Population
51	52,100	46,700	-5,400
54	25,900	20,700	-5,200
57	14,600	10,450	-4,150
60	7,150	4,100	-3,050
63	2,150	950	-1,200
66	100	0	-100
69	0	0	0

Table 56: Night-time 2019 Baseline v DS 2039 Air Noise Analysis – Area

$L_{Aeq,8h}$ dB Noise Contour	2019 Baseline Cumulative Area (km^2)	2039 DS Cumulative Area (km^2)	Change in Cumulative Area (km^2)
45	88.6	72.5	-16.1
48	52.3	44.0	-8.3
51	30.0	24.5	-5.5
54	15.7	12.8	-2.9
55	12.8	10.2	-2.6
57	8.4	6.7	-1.7
60	4.8	3.6	-1.2
63	2.7	1.9	-0.8
66	1.5	1.1	-0.4
69	0.9	0.7	-0.2

Table 57: Night-time 2019 Baseline v DS 2039 Air Noise Analysis – Households

$L_{Aeq,8h}$ dB Noise Contour	2019 Baseline Cumulative Number of Households	2039 DS Cumulative Number of Households	Change in Cumulative Number of Households
45	36,650	32,550	-4,100
48	16,200	14,300	-1,900
51	8,750	6,250	-2,500
54	4,200	2,500	-1,700
55	3,300	2,000	-1,300
57	1,850	800	-1,050
60	400	50	-350
63	0	0	0

$L_{Aeq,8h}$ dB Noise Contour	2019 Baseline Cumulative Number of Households	2039 DS Cumulative Number of Households	Change in Cumulative Number of Households
66	0	0	0
69	0	0	0

Table 58: Night-time 2019 Baseline v DS 2039 Air Noise Analysis – Population

$L_{Aeq,8h}$ dB Noise Contour	2019 Baseline Cumulative Population	2039 DS Cumulative Population	Change in Cumulative Population
45	90,900	76,250	-14,650
48	37,400	32,800	-4,600
51	20,400	15,050	-5,350
54	10,550	6,650	-3,900
55	8,450	5,250	-3,200
57	4,950	2,100	-2,850
60	1,000	150	-850
63	0	0	0
66	0	0	0
69	0	0	0

Phase 2b

6.15.3 The comparison of the 2043 DN and DS scenarios represents a worst-case as the extent of noise contours for the 2043 DN scenario is less than the 2019 baseline due to the future fleet comprised of quieter aircraft. However, to provide additional context, the results of the 2043 DS scenario have been compared to the 2019 baseline scenario. The results of analysis are presented in the following tables below:

a. Analysis of area coverage by 2019 baseline and Phase 2b 2043 DS air noise contours are presented in **Table 59** for daytime $L_{Aeq,16h}$ (see **Figure 16.13** and **Figure 16.15**, Volume 4 of this PEIR) and **Table 62** for night-time $L_{Aeq,8h}$ (see **Figure 16.14** and **Figure 16.16**, Volume 4 of this PEIR);

b. Analysis of households within 2019 baseline and Phase 2b 2043 DS air noise contours are presented in **Table 60** for daytime $L_{Aeq,16h}$ and **Table 63** for night-time $L_{Aeq,8h}$; and

c. Analysis of population within 2019 baseline and Phase 2b 2043 DS air noise contours are presented in **Table 61** for daytime $L_{Aeq,16h}$ and **Table 64** for night-time $L_{Aeq,8h}$.

Table 59: Daytime 2019 Baseline v DS 2043 Air Noise Analysis – Area

$L_{Aeq,16h}$ dB Noise Contour	2019 Baseline Cumulative Area (km^2)	2043 DS Cumulative Area (km^2)	Change in Cumulative Area (km^2)
51	64.2	61.9	-2.3
54	38.4	37.0	-1.4
57	20.6	20.2	-0.4
60	11	10.5	-0.5
63	6.1	5.6	-0.5
66	3.5	3.0	-0.5
69	1.9	1.6	-0.3

Table 60: Daytime 2019 Baseline v DS 2043 Air Noise Analysis – Households

$L_{Aeq,16h}$ dB Noise Contour	2019 Baseline Cumulative Number of Households	2043 DS Cumulative Number of Households	Change in Cumulative Number of Households
51	22,350	25,000	+2,650
54	11,150	10,350	-800
57	6,050	4,850	-1,200
60	2,700	2,150	-550
63	800	550	-250
66	50	0	-50
69	0	0	0

Table 61: Daytime 2019 Baseline v DS 2043 Air Noise Analysis – Population

$L_{Aeq,16h}$ dB Noise Contour	2019 Baseline Cumulative Population	2043 DS Cumulative Population	Change in Cumulative Population
51	52,100	58,200	+6,100
54	25,900	24,250	-1,650
57	14,600	12,000	-2,600
60	7,150	5,800	-1,350
63	2,150	1,550	-600
66	100	50	-50
69	0	0	0

Table 62: Night-time 2019 Baseline v DS 2043 Air Noise Analysis – Area

$L_{Aeq,8h}$ dB Noise Contour	2019 Baseline Cumulative Area (km^2)	2043 DS Cumulative Area (km^2)	Change in Cumulative Area (km^2)
45	88.6	81.2	-7.4
48	52.3	49.7	-2.6
51	30.0	28.0	-2.0
54	15.7	14.8	-0.9
55	12.8	11.8	-1.0
57	8.4	7.7	-0.7
60	4.8	4.1	-0.7
63	2.7	2.2	-0.5
66	1.5	1.2	-0.3
69	0.9	0.8	-0.1

Table 63: Night-time 2019 Baseline v DS 2043 Air Noise Analysis – Households

$L_{Aeq,8h}$ dB Noise Contour	2019 Baseline Cumulative Number of Households	2043 DS Cumulative Number of Households	Change in Cumulative Number of Households
45	36,650	36,650	0
48	16,200	19,500	+3,300
51	8,750	6,950	-1,800
54	4,200	3,000	-1,200
55	3,300	2,300	-1,000
57	1,850	950	-900
60	400	250	-150
63	0	0	0
66	0	0	0
69	0	0	0

Table 64: Night-time 2019 Baseline v DS 2043 Air Noise Analysis – Population

$L_{Aeq,8h}$ dB Noise Contour	2019 Baseline Cumulative Population	2043 DS Cumulative Population	Change in Cumulative Population
45	90,900	86,500	-4,400
48	37,400	44,850	+7,450
51	20,400	16,650	-3,750
54	10,550	7,900	-2,650
55	8,450	6,150	-2,300

$L_{Aeq,8h}$ dB Noise Contour	2019 Baseline Cumulative Population	2043 DS Cumulative Population	Change in Cumulative Population
57	4,950	2,550	-2,400
60	1,000	600	-400
63	0	0	0
66	0	0	0
69	0	0	0

7 GROUND NOISE ASSESSMENT

7.1 Ground Noise Calculation Methodology

7.1.1 Noise predictions of ground noise activities have been undertaken using Cadna-A noise modelling software, which applies the prediction methodology set out in ISO 9613-2 (Ref. 38). This methodology is referenced in Annex II of the Environmental Noise Directive (Ref. 39) for the calculation of transport infrastructure noise, which includes aircraft ground noise.

7.1.2 For the purposes of assessing ground-based aircraft noise sources, aircraft were grouped into categories. Sound power data for each category of aircraft was estimated from AEDT predictions of aircraft at 10 % power. Taxiing aircraft have been calculated at a speed of 20 km/h.

7.1.3 Ground Power Unit (APU) noise has been based on manufacturer's information for a Guinault type GA GPU. The on-time for GPUs at each stand has been based on the average number of aircraft at each stand during the 92-day summer period and the average hourly GPU use per aircraft. The average hourly GPU use is calculated from the total GPU use of 171,148 for 2017 divided by the total number of movements for 2017 of 135,518. Terminal 2 stands will use fixed electrical ground power and will not require GPUs.

7.1.4 Ground-running is estimated to last for 25 minutes at 7% power and 10 minutes at 100% power during a reasonable worst-case day. The typical operating aircraft is the A320neo, so it has been used to model a representative engine test during the day. Sound power data for ground running aircraft was estimated from AEDT predictions.

7.1.5 Noise source data applied in ground noise modelling are presented in **Table 65**.

Table 65: Ground Noise Data

Noise Source	Sound Power Level, LwA (dB)
Taxiing small aircraft (general aviation)	133
Taxiing medium aircraft (commercial next gen)	132
Taxiing medium aircraft (commercial)	136
Taxiing large aircraft (freight)	142
Ground running aircraft A320neo	145
GPU	88

7.2 Ground Noise Modelling Results

7.2.1 Ground noise predictions were undertaken at multiple points and heights around sensitive receptors. Consequently, when presenting the results of nose predictions, the values presented are the highest from all the prediction locations. Consequently, the difference between the prediction locations where the highest DN and DS values were obtained from is unlikely to correlate with the prediction location that experiences the highest change in noise level. For some receptor groups, the highest predicted noise level decreases from the DN to DS scenarios; however, there is still a prediction location in the receptor group that experiences an increase in noise.

7.2.2 The results of 2027 ground noise predictions are presented in **Table 66**. The results show the highest predicted ground noise level at an individual property from the groups of properties within each set of receptors for the DN and DS scenarios, and the worst-case change in noise level. Receptors experiencing exceedance of the SOAEL in the DS scenario are marked in red and receptors in the DS scenario experiencing exceedances of the LOAEL are marked in green.

Table 66: 2027 Ground Noise Prediction Results

Receptor Group	Daytime $L_{Aeq,16h}$ dB			Night-time $L_{Aeq,8h}$ dB		
	Highest DN	Highest DS	Worst-case Change	Highest DN	Highest DS	Worst-case Change
GR1	57.9	57.9	+0.1	51.5	51.8	+0.4
GR2	52.5	52.3	+0.2	47.3	47.3	+0.4
GR3	55.4	55.4	+0.1	48.1	48.4	+0.4
GR4	61.3	61.4	+0.6	53.7	53.3	-0.3
GR5	60.6	60.0	+0.1	53.8	53.6	0.0
GR6	55.6	55.5	+0.3	48.4	49.0	+0.7
GR7	53.3	52.8	+0.2	45.1	45.4	+0.3
GR8	51.9	52.1	+0.3	43.9	44.4	+0.6
GR9	53.9	53.5	+0.3	45.6	45.9	+0.5
GR10	54.4	53.9	+0.2	46.2	46.5	+0.4
GR11	56.8	56.3	+0.2	49.2	49.4	+0.4
GR12	56.8	55.8	-0.2	49.9	50.0	+0.3
GR13	55.4	55.1	+0.0	50.2	50.4	+0.4
GR14	55.5	55.5	+0.2	51.3	51.3	+0.3
GR15	55.6	55.6	+0.3	51.5	51.6	+0.3
GR16	56.8	56.8	+0.1	52.9	52.9	+0.2
GR17	57.1	57.1	+0.1	53.3	53.4	+0.2
GR18	57.9	58.0	+0.2	54.3	54.4	+0.2
GR19	58.4	58.4	+0.3	54.8	54.9	+0.2
GR20	58.3	58.5	+0.2	54.5	54.6	+0.2
GR21	58.9	59.1	+0.3	54.9	55.0	+0.1
GR22	59.7	59.7	+0.3	55.0	55.1	+0.3
GR23	59.2	59.5	+0.3	54.7	54.9	+0.2
GR24	59.7	59.7	+0.1	55.0	55.1	+0.2

7.2.3 The results of 2039 ground noise predictions are presented in **Table 67**. The results show the highest predicted ground noise level at an individual property from the groups of properties within each set of receptors for the DN and DS scenarios, and the worst-case change in noise level. Receptors experiencing exceedance of the SOAEL in the DS scenario are marked in red and receptors in the DS scenario experiencing exceedances of the LOAEL are marked in green.

Table 67: 2039 Ground Noise Prediction Results

Receptor Group	Daytime $L_{Aeq,16h}$ dB			Night-time $L_{Aeq,8h}$ dB		
	Highest DN	Highest DS	Worst-case Change	Highest DN	Highest DS	Worst-case Change
GR1	57.3	57.1	+0.2	50.6	51.9	+1.4
GR2	51.8	51.3	+0.2	46.5	47.7	+1.6
GR3	54.9	54.6	+0.6	47.1	48.2	+1.2
GR4	60.8	61.7	+1.7	52.7	52.9	+0.4
GR5	59.9	60.9	+1.1	52.7	52.6	+0.2
GR6	55.0	53.9	-0.2	47.3	47.6	+0.9
GR7	52.8	50.7	-1.4	44.1	44.1	+0.4
GR8	51.4	50.0	-1.4	42.9	43.2	+0.6
GR9	53.5	51.2	-1.5	44.6	44.8	+0.6
GR10	54.0	51.6	-1.5	45.3	45.2	+0.6
GR11	56.4	54.5	-1.0	48.4	48.5	+0.6
GR12	56.3	54.8	+0.3	49.1	49.1	+0.5
GR13	54.7	55.0	+1.0	49.3	49.5	+0.6
GR14	54.6	55.2	+1.4	50.6	50.2	+0.6
GR15	54.6	55.2	+1.3	50.8	50.4	+0.4
GR16	55.9	56.3	+0.7	52.2	52.3	+0.3
GR17	56.2	56.6	+0.6	52.6	52.7	+0.2
GR18	57.0	57.5	+0.6	53.6	53.8	+0.2
GR19	57.5	57.6	+0.4	54.1	54.3	+0.2
GR20	57.4	57.5	+0.2	53.8	53.9	+0.2
GR21	58.1	58.1	+0.1	54.2	54.4	+0.2
GR22	58.9	58.2	-0.1	54.3	54.4	+0.4
GR23	58.4	58.0	-0.4	54.0	54.2	+0.2
GR24	58.9	58.2	-0.7	54.3	54.4	+0.2

7.2.4 The results of 2043 ground noise predictions are presented in **Table 68**. The results show the highest predicted ground noise level at an individual property from the groups of properties within each set of receptors for the DN and DS scenarios, and the worst-case change in noise level. Receptors experiencing exceedance of the SOAEL in the DS scenario are marked in red and receptors in the DS scenario experiencing exceedances of the LOAEL are marked in green.

Table 68: 2043 Ground Noise Prediction Results

Receptor Group	Daytime $L_{Aeq,16h}$ dB			Night-time $L_{Aeq,8h}$ dB		
	Highest DN	Highest DS	Worst-case Change	Highest DN	Highest DS	Worst-case Change
GR1	57.3	57.9	+1.4	50.7	52.6	+2.0
GR2	51.8	52.2	+1.1	46.6	48.3	+2.1
GR3	54.9	54.9	+1.0	47.2	48.8	+1.7
GR4	60.8	61.9	+1.9	52.8	53.4	+0.7
GR5	59.9	61.8	+2.0	52.9	53.4	+0.8
GR6	55.0	55.6	+1.2	47.5	48.8	+1.5
GR7	52.8	51.8	-0.1	44.2	44.6	+1.0
GR8	51.4	51.2	-0.2	43.0	44.0	+1.3
GR9	53.5	51.9	-0.8	44.7	45.6	+1.2
GR10	54.0	51.0	-2.2	45.4	45.9	+1.1
GR11	56.4	52.8	-2.6	48.5	48.9	+1.2
GR12	56.3	53.4	-1.0	49.2	49.6	+1.1
GR13	54.7	53.6	-0.3	49.4	49.9	+1.0
GR14	54.5	54.1	+0.3	50.7	50.5	+1.0
GR15	54.6	54.4	+0.5	50.8	50.8	+0.8
GR16	55.9	56.4	+0.8	52.2	52.6	+0.6
GR17	56.2	56.7	+0.7	52.7	53.0	+0.5
GR18	57.0	57.7	+0.8	53.7	54.2	+0.6
GR19	57.5	57.9	+0.7	54.2	54.6	+0.5
GR20	57.4	57.7	+0.4	53.9	54.2	+0.5
GR21	58.1	58.3	+0.3	54.3	54.7	+0.4
GR22	58.9	58.4	+0.1	54.3	54.7	+0.5
GR23	58.4	58.2	-0.2	54.0	54.5	+0.5
GR24	58.9	58.4	-0.5	54.3	54.7	+0.4

8 SENSITIVITY TESTING

8.1.1 Additional noise modelling was required for the following sensitivity test scenarios:

a. Faster Growth; and
b. A321 Neo noise not reduced for future scenarios. .

8.2 Faster Growth

8.2.1 The faster growth scenario reaches a higher Stage 1 throughput in 2029 then faster growth continues to 2038 and 2042. As the 2038 faster growth scenario is equivalent to the 2039 core case scenario and the 2042 faster growth scenario is equivalent to the 2043 core case scenario, additional studies have not been undertaken. However, the 2029 faster growth scenario provides different results to the 2027 scenario so has been tested. It is assumed that the 2027 DN scenario is equivalent to the 2029 DN scenario.

8.2.2 The results of faster growth sensitivity testing for the Phase 1 2029 scenario are presented in **Table 69** to **Table 71** for daytime noise and **Table 72** to **Table 74** for night-time noise.

Table 69: Faster Growth – Phase 1 2029 Daytime Air Noise Analysis – Area

$L_{Aeq,16h}$ dB Noise Contour	2027 DN Cumulative Area (km^2)	2029 DS Faster Growth Cumulative Area (km^2)	Change in Cumulative Area (km^2)
51	55.1	64.8	+9.7
54	32.3	39.1	+6.8
57	17.2	21.2	+4.0
60	9.0	11.1	+2.1
63	5.0	6.0	+1.0
66	2.8	3.4	+0.6
69	1.5	1.8	+0.3

Table 70: Faster Growth – Phase 1 2029 Daytime Air Noise Analysis – Households

$L_{Aeq,16h}$ dB Noise Contour	2027 DN Cumulative Number of Households	2029 DS Faster Growth Cumulative Number of Households	Change in Cumulative Number of Households
51	17,950	24,550	6,600
54	9,000	11,050	2,050
57	4,350	5,950	1,600
60	1,650	2,600	+950
63	400	750	+350

$L_{Aeq,16h}$ dB Noise Contour	2027 DN Cumulative Number of Households	2029 DS Faster Growth Cumulative Number of Households	Change in Cumulative Number of Households
66	0	50	+50
69	0	0	0

Table 71: Faster Growth – Phase 1 2029 Daytime Air Noise Analysis – Population

$L_{Aeq,16h}$ dB Noise Contour	2027 DN Cumulative Number of Population	2029 DS Faster Growth Cumulative Number of Population	Change in Cumulative Number of Population
51	41,300	57,350	+16,050
54	21,050	25,850	+4,800
57	10,900	14,300	+3,500
60	4,500	6,900	+2,400
63	1,100	2,050	+950
66	0	100	+100
69	0	0	0

Table 72: Faster Growth – Phase 1 2029 Night-time Air Noise Analysis – Area

$L_{Aeq,8h}$ dB Noise Contour	2027 DN Cumulative Area (km^2)	2029 DS Faster Growth Cumulative Area (km^2)	Change in Cumulative Area (km^2)
45	67.0	80.2	+13.2
48	40.6	49.3	+8.7
51	22.4	28.2	+5.8
54	11.8	15.0	+3.2
55	9.6	12.1	+2.5
57	6.4	7.9	+1.5
60	3.5	4.3	+0.8
63	1.9	2.3	+0.4
66	1.1	1.2	+0.1
69	0.7	0.8	+0.1

Table 73: Faster Growth – Phase 1 2029 Night-time Air Noise Analysis – Households

$L_{Aeq,8h}$ dB Noise Contour	2027 DN Cumulative Number of Households	2029 DS Faster Growth Cumulative Number of Households	Change in Cumulative Number of Households
45	26,850	34,100	+7,250
48	11,650	14,600	+2,950
51	6,050	7,100	+1,050
54	2,550	3,750	+1,200
55	2,000	2,550	+550
57	800	1,100	+300
60	50	300	+250
63	0	0	0
66	0	0	0
69	0	0	0

Table 74: Faster Growth – Phase 1 2029 Night-time Air Noise Analysis – Population

$L_{Aeq,8h}$ dB Noise Contour	2027 DN Cumulative Number of Population	2029 DS Faster Growth Cumulative Number of Population	Change in Cumulative Number of Population
45	62,900	83,850	+10,950
48	27,200	33,800	+6,600
51	14,500	16,900	+2,400
54	6,850	9,550	+2,700
55	5,400	6,800	+1,400
57	2,150	2,950	+800
60	100	750	+650
63	0	0	0
66	0	0	0
69	0	0	0

8.3 A321 Neo Noise not Reduced in Future Years

8.3.1 The results of sensitivity testing of the A321neo noise performance for the Phase 2a 2039 scenario are presented in **Table 75** to **Table 77** for the daytime period and in **Table 78** to **Table 80** for the night0time period.

Table 75: A321neo Testing – Phase 2a 2039 Daytime Air Noise Analysis – Area

$L_{Aeq,16h}$ dB Noise Contour	Future A321neo 2039 Cumulative Area (km²)	Current A321neo 2039 Cumulative Area (km²)	Change in Cumulative Area (km²)
51	55.5	60.1	+4.6
54	32.4	35.8	+3.4
57	17.4	19.5	+2.1
60	9.1	10.2	+1.1
63	4.9	5.5	+0.6
66	2.6	3.0	+0.4
69	1.4	1.6	+0.2

Table 76: A321neo Testing – Phase 2a 2039 Daytime Air Noise Analysis – Households

$L_{Aeq,16h}$ dB Noise Contour	Future A321neo 2039 Cumulative Number of Households	Current A321neo 2039 Cumulative Number of Households	Change in Cumulative Number of Households
51	20,200	23,400	+3,200
54	8,800	9,950	+1,150
57	4,150	4,850	+700
60	1,550	2,150	+600
63	350	550	+200
66	0	0	0
69	0	0	0

Table 77: A321neo Testing – Phase 2a 2039 Daytime Air Noise Analysis – Population

$L_{Aeq,16h}$ dB Noise Contour	Future A321neo 2039 Cumulative Number of Population	Current A321neo 2039 Cumulative Number of Population	Change in Cumulative Number of Population
51	46,700	54,350	+7,650
54	20,700	23,400	+2,700
57	10,450	11,900	+1,450
60	4,100	5,750	+1,650
63	950	1,550	+600
66	0	50	+50
69	0	0	0

Table 78: A321neo Testing – Phase 2a 2039 Night-time Air Noise Analysis – Area

$L_{Aeq,8h}$ dB Noise Contour	Future A321neo 2039 Cumulative Area (km^2)	Current A321neo 2039 Cumulative Area (km^2)	Change in Cumulative Area (km^2)
45	72.5	77.2	+4.7
48	44.0	47.4	+3.4
51	24.5	26.7	+2.2
54	12.8	14.0	+1.2
55	10.2	11.3	+1.1
57	6.7	7.4	+0.7
60	3.6	4.0	+0.4
63	1.9	2.1	+0.2
66	1.1	1.2	+0.1
69	0.7	0.7	0.0

Table 79: A321neo Testing – Phase 2a 2039 Night-time Air Noise Analysis – Households

$L_{Aeq,8h}$ dB Noise Contour	Future A321neo 2039 Cumulative Number of Households	Current A321neo 2039 Cumulative Number of Households	Change in Cumulative Number of Households
45	32,550	34,550	+3,000
48	14,300	16,650	+2,350
51	6,250	6,800	+550
54	2,500	2,950	+450
55	2,000	2,250	+250
57	800	950	+150
60	50	200	+150
63	0	0	0
66	0	0	0
69	0	0	0

Table 80: A321neo Testing – Phase 2a 2039 Night-time Air Noise Analysis – Population

$L_{Aeq,8h}$ dB Noise Contour	Future A321neo 2039 Cumulative Number of Population	Current A321neo 2039 Cumulative Number of Population	Change in Cumulative Number of Population
45	76,250	81,650	+15,450
48	32,800	38,100	+5,300
51	15,050	16,300	+1,250

$L_{Aeq,8h}$ dB Noise Contour	Future A321neo 2039 Cumulative Number of Population	Current A321neo 2039 Cumulative Number of Population	Change in Cumulative Number of Population
54	6,650	7,750	+1,100
55	5,250	6,050	+800
57	2,100	2,550	+450
60	150	550	+400
63	0	0	0
66	0	0	0
69	0	0	0

8.3.2 There will be 7,650 more people experiencing noise levels between LOAEL and SOAEL during the Phase 2a daytime period and 600 more people experiencing noise levels exceeding the SOAEL. For the night-time period, 15,450 more people experience noise levels between LOAEL and SOAEL and 800 more people experience noise levels exceeding the SOAEL. There will be an increase in population of 3,850 experiencing **Minor Adverse** effects and 100 experiencing **Moderate Adverse** effects during the day period. During the night period, there will be a decrease in population of 550 experiencing **Minor Adverse** effects and a decrease of 250 experiencing **Moderate Adverse** effects.

8.3.3 The results of sensitivity testing of the A321neo noise performance for the Phase 2b 2043 scenario are presented in **Table 81 to Table 83** for the daytime period and in **Table 84 to Table 86** for the night-time period.

Table 81: A321neo Testing – Phase 2b 2043 Daytime Air Noise Analysis – Area

$L_{Aeq,16h}$ dB Noise Contour	Future A321neo 2043 Cumulative Area (km^2)	Current A321neo 2043 Cumulative Area (km^2)	Change in Cumulative Area (km^2)
51	61.9	67.3	+5.4
54	37.0	40.9	+3.9
57	20.2	22.6	+2.4
60	10.5	11.8	+1.3
63	5.6	6.3	+0.7
66	3.0	3.5	+0.5
69	1.6	1.9	+0.3

Table 82: A321neo Testing – Phase 2b 2043 Daytime Air Noise Analysis – Households

$L_{Aeq,16h}$ dB Noise Contour	Future A321neo 2043 Cumulative Number of Households	Current A321neo 2043 Cumulative Number of Households	Change in Cumulative Number of Households
51	25,000	27,950	+2,950
54	10,350	12,000	+1,650
57	4,850	6,100	+1,250
60	2,150	2,550	+400
63	550	800	+250
66	0	50	+50
69	0	0	0

Table 83: A321neo Testing – Phase 2b 2043 Daytime Air Noise Analysis – Population

$L_{Aeq,16h}$ dB Noise Contour	Future A321neo 2043 Cumulative Number of Population	Current A321neo 2043 Cumulative Number of Population	Change in Cumulative Number of Population
51	58,200	65,600	+7,400
54	24,250	27,850	+3,600
57	12,000	14,700	+2,700
60	5,800	6,750	+950
63	1,550	2,150	+600
66	50	100	+50
69	0	0	0

Table 84: A321neo Testing – Phase 2b 2043 Night-time Air Noise Analysis – Area

$L_{Aeq,8h}$ dB Noise Contour	Future A321neo 2043 Cumulative Area (km^2)	Current A321neo 2043 Cumulative Area (km^2)	Change in Cumulative Area (km^2)
45	81.2	86.7	+5.5
48	49.7	53.5	+3.8
51	28.0	30.5	+2.5
54	14.8	16.3	+1.5
55	11.8	13.1	+1.3
57	7.7	8.5	+0.8
60	4.1	4.6	+0.5
63	2.2	2.5	+0.3
66	1.2	1.3	+0.1

$L_{Aeq,8h}$ dB Noise Contour	Future A321neo 2043 Cumulative Area (km²)	Current A321neo 2043 Cumulative Area (km²)	Change in Cumulative Area (km²)
69	0.8	0.8	0.0

Table 85: A321neo Testing – Phase 2b 2043 Night-time Air Noise Analysis – Households

$L_{Aeq,8h}$ dB Noise Contour	Future A321neo 2043 Cumulative Number of Households	Current A321neo 2043 Cumulative Number of Households	Change in Cumulative Number of Households
45	36,650	39,400	+2,750
48	19,500	21,400	+1,900
51	6,950	7,600	+650
54	3,000	3,700	+700
55	2,300	2,700	+400
57	950	1,400	+450
60	250	300	+50
63	0	0	0
66	0	0	0
69	0	0	0

Table 86: A321neo Testing – Phase 2b 2043 Night-time Air Noise Analysis – Population

$L_{Aeq,8h}$ dB Noise Contour	Future A321neo 2043 Cumulative Number of Population	Current A321neo 2043 Cumulative Number of Population	Change in Cumulative Number of Population
45	86,500	95,550	+9,050
48	44,850	49,500	+4,650
51	16,650	18,100	+1,450
54	7,900	9,300	+1,800
55	6,150	7,200	+1,050
57	2,550	3,750	+1,200
60	600	850	+250
63	0	0	0
66	0	0	0
69	0	0	0

8.3.4 During Phase 2b, there will be 7,400 more people experiencing noise levels between LOAEL and SOAEL during the daytime period and 600 more people experiencing noise levels exceeding the SOAEL. For the night-time period, 9,050 more people experience noise levels between LOAEL and SOAEL and 1,050 more people experience noise levels exceeding the SOAEL. There will be an increase in population of 1,300 experiencing **Minor Adverse** effects and 100 experiencing **Moderate Adverse** effects during the day period. During the night period, there will be an increase in population of 2,650 experiencing **Minor Adverse** effects and decrease in population of 100 experiencing **Moderate Adverse** effects.

8.4 Next Generation Aircraft in Future Years

8.4.1 It is anticipated that, by 2039, a next generation of aircraft will be in service with technological improvements not yet available. The results of sensitivity testing of potential reductions in noise contour area due to next generation aircraft are presented in **Table 87** and **Table 88** for the Phase 2a 2039 scenario and **Table 89** and **Table 90** for the Phase 2b 2043 scenario. As no information on the potential noise performance of next generation aircraft is available, noise predictions were undertaken assuming next generation aircraft will reduce noise by a similar level to that provided by new generation aircraft i.e. departure noise reduces by 4 dB and approach noise reduces by 1 dB.

Table 87: Next Generation Aircraft Testing – Phase 2a 2039 Daytime Air Noise Analysis – Area

$L_{Aeq,16h}$ dB Noise Contour	2043 DS Core Case Cumulative Area (km^2)	2039 Next Generation Cumulative Area (km^2)	Change in Cumulative Area (km^2)
51	55.5	54.7	-0.8
54	32.4	31.9	-0.5
57	17.4	17.1	-0.3
60	9.1	8.9	-0.2
63	4.9	4.8	-0.1
66	2.6	2.6	0.0
69	1.4	1.4	0.0

Table 88: Next Generation Aircraft Testing – Phase 2a 2039 Night-time Air Noise Analysis – Area

$L_{Aeq,8h}$ dB Noise Contour	2043 DS Core Case Cumulative Area (km^2)	2039 Next Generation Cumulative Area (km^2)	Change in Cumulative Area (km^2)
45	72.5	71.5	-1.0
48	44.0	43.3	-0.7
51	24.5	24.1	-0.4
54	12.8	12.5	-0.3

$L_{Aeq,8h}$ dB Noise Contour	2043 DS Core Case Cumulative Area (km^2)	2039 Next Generation Cumulative Area (km^2)	Change in Cumulative Area (km^2)
55	10.2	10.0	-0.2
57	6.7	6.6	-0.1
60	3.6	3.5	-0.1
63	1.9	1.9	0.0
66	1.1	1.1	0.0
69	0.7	0.7	0.0

Table 89: Next Generation Aircraft Testing – Phase 2b 2043 Daytime Air Noise Analysis – Area

$L_{Aeq,16h}$ dB Noise Contour	2043 DS Core Case Cumulative Area (km^2)	2043 Next Generation Cumulative Area (km^2)	Change in Cumulative Area (km^2)
51	61.9	58.4	-3.5
54	37.0	34.5	-2.5
57	20.2	18.6	-1.6
60	10.5	9.7	-0.8
63	5.6	5.2	-0.4
66	3.0	2.8	-0.2
69	1.6	1.4	-.2

Table 90: Next Generation Aircraft Testing – Phase 2b 2043 Night-time Air Noise Analysis – Area

$L_{Aeq,8h}$ dB Noise Contour	2043 DS Core Case Cumulative Area (km^2)	2043 Next Generation Cumulative Area (km^2)	Change in Cumulative Area (km^2)
45	81.2	76.9	-4.3
48	49.7	46.7	-3.0
51	28.0	26.0	-2.0
54	14.8	13.7	-1.1
55	11.8	10.9	-0.9
57	7.7	7.1	-0.6
60	4.1	3.8	-0.3
63	2.2	2.0	-0.2
66	1.2	1.1	-0.1

$L_{Aeq,8h}$ dB Noise Contour	2043 DS Core Case Cumulative Area (km^2)	2043 Next Generation Cumulative Area (km^2)	Change in Cumulative Area (km^2)
69	0.8	0.7	-0.1

GLOSSARY AND ABBREVIATIONS

Term	Definition
AAWT	Average Annual Weekday Traffic
AEDT	Aviation Environmental Design Tool
ANP	Air Noise Performance
ANPS	Airports National Policy Statement
BNL	Basic Noise Level
BPM	Best Practicable Means
CAA	Civil Aviation Authority
CRTN	Calculation of Road Traffic Noise
dB	Decibel
DfT	Department for Transport
DN	Do-Nothing
DS	Do-Something
ECAC	European Civil Aviation Conference
END	Environmental Noise Directive
EPA	Environmental Protection Act
FAA	Federal Aviation Administration
ICAO	International Civil Aviation Organization
INM	Integrated Noise Model
LLAOL	London Luton Airport Operations Limited
LOAEL	Lowest Observable Adverse Effect Level
NEDG	Noise Envelope Design Group
NOEL	No Observed Effect Level
NPD	Noise-Power-Distance
NPPF	National Planning Policy Framework
NPSE	Noise Policy Statement for England
PPGN	Planning Practice Guidance: Noise
SEL	Sound Exposure Level
SOAEL	Significant Observed Adverse Effect Level
SoNA	Survey of Noise Attitudes
SPL	Sound Pressure Level
UAEL	Unacceptable Adverse Effect Level
WHO	World Health Organization

REFERENCES

Ref 1 Her Majesty's Stationery Office (1974), Control of Pollution Act.
Ref 2 Her Majesty's Stationery Office (1990); Environmental Protection Act.
Ref 3 Her Majesty's Stationery Office (2006), The Environmental Noise (England) Regulations.
Ref 4 London Luton Airport (2014), *Noise Action Plan 2019-2023.*
Ref 5 Her Majesty's Stationery Office (1975), Noise Insulation Regulations.
Ref 6 Her Majesty's Stationery Office (1973), Land Compensation Act.
Ref 7 Her Majesty's Stationery Office (1982), *Civil Aviation Act*.
Ref 8 Her Majesty's Stationery Office (2006), *Civil Aviation Act*.
Ref 9 Her Majesty's Stationery Office (2012), *Civil Aviation Act*.
Ref 10 European Parliament and Council of the European Union (2014), *Regulation (EU) No 598/2014.*]
Ref 11 International Civil Aviation Organization (2001), Assembly Resolutions in Force.
Ref 12 European Parliament and Council of the European Union (2014), Regulation (EU) No 598/2014.
Ref 13 Department for Transport (2018). Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England.
Ref 14 Department for Environment Food and Rural Affairs (2010), Noise Policy Statement for England.
Ref 15 Department for Communities and Local Government (2019), Planning Practice Guidance: Noise.
Ref 16 Paragraph 3.14 – HM Government (December 2018) Aviation 2050 the Future of UK Aviation
Ref 17 Her Majesty's Stationery Office (2013), The Aviation Policy Framework.
Ref 18 Department for Transport (2017), UK Airspace Policy: A framework for balanced decisions on the design and use of airspace.
Ref 19 Department for Transport (2017), Consultation Response on UK Airspace Policy: A framework for balanced decisions on the design and use of airspace.
Ref 20 Department for Transport. (December 2018) Aviation 2050 – the future of UK aviation. Paragraph 3.20, Aviation Strategy
Ref 21 British Standards Institute (2014), BS 5228-1:2009+A1:2014 – Code of practice for noise and vibration control on construction and open sites. Part 1: Noise. BSi, London.
Ref 22 British Standards Institute (2014), BS 5228-2 – Code of practice for Noise and Vibration control on construction and open sites. Vibration, BSi, London.
Ref.23 Department of Transport/Welsh Office (1998); Calculation of Road Traffic Noise.
Ref 24 Department for Transport (2017), Consultation Response on UK Airspace Policy: A framework for balanced decisions on the design and use of airspace.
Ref 25 Bristol Airport Limited (2018), *Development of Bristol Airport to Accommodate 12 Million Passengers Per Annum* (Reference 18/P/5118/ OUT).
Ref 26 Department for Transport, (2019); TAG Unit A3 Environmental Impact Appraisal.
Ref 27 Department of Transport/Welsh Office (1988), Calculation of Road Traffic Noise. Her Majesty's Stationery Office, London.
Ref 28 World Health Organisation (2018), Environmental Noise Guidelines for the European Region.
Ref 29 Q4 of Appendix A – Department for Transport (2018), Airspace Modernisation Supporting Document.
Ref 30 Civil Aviation Authority (2017), Survey of Noise Attitudes 2014, CAP 1506.
Ref 31 British Standards Institute (2003), BS 7445-1 – Description and Measurement of Environmental Noise. BSi, London.
Ref 32 Civil Aviation Authority, (2017); CAP 1616a: Airspace Design: Environmental Requirements Technical Annex.
Ref 33 European Civil Aviation Conference, (2016); Doc 29, 4th Edition, Report on Standard Method of Computing Noise Contours Around Civil Airports.
Ref 34 International Civil Aviation Organisation, (2008); Doc 9911 Recommended Method for Computing Noise Contours Around Airports Edition 1. 2018 2nd edition
Ref 35 Society of Automotive Engineers, (1995); Aerospace Information Report 1845, Procedure for the Calculation of Airplane Noise in the Vicinity of Airports.
Ref 36 Civil Aviation Authority, (20121); CAP 2061: CAA Policy on Minimum Standards for Noise Modelling.
Ref 37 EUROCONTROL Experimental Centre, (2020); Air Noise Performance Database v2.3
Ref 38 International Standards Organisation (1996), ISO 9613-2 Acoustics – Attenuation of sound during propagation outdoors: Part 2: General method of calculation.
Ref 39 Commission Directive (EU) 2015/996 of 19 May 2015 establishing common noise assessment methods according to Directive 2002/49/EC of the European Parliament and of the Council.