Appendix 13

Ardmore Park Quarry – Modification 3

Notes on Noise Compliance Matters

prepared by

Benbow Environmental Pty Ltd

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Benbow
ENVIRONMENTAL
A.B.N. 17 160 013 641

Head Office:
13 Daking Street
North Parramatta
NSW 2151 Australia
P.O. Box 687 Parramatta
NSW 2124 Australia
Telephone: +61 2 9890 5099
Facsimile: +61 2 9890 5399

Regional Office:
Wollongong
Telephone: 0421 177 825
Facsimile: (02) 9890 5399

Visit our website at:
www.benbowenviro.com.au

E-mail:
admin@benbowenviro.com.au

RTB/PG
Ref: 181023-03_PRP_Rev2
19 July 2018

ATTN: Stefan Press
Unit Head, South East Region
Environment Protection Authority
Level 3/11 Farrer Place,
QUEANBEYAN NSW 2620

Dear Stefan,

RE: Comments on the Draft Pollution Reduction Program for Multiquip Aggregates, 5152 Oallen Ford Road, Bungonia.

Recently you wrote to Michael Cox of CEAL Limited (Multiquip) regarding Noise Compliance Matters for the Ardmore Park Quarry at 5152 Oallen Ford Road. In particular, in response to alleged non-compliance at the quarry, a draft Pollution Reduction Program (PRP) was proposed by the EPA.

The EPA invited Multiquip to provide comment on the draft PRP. Benbow Environmental and Multiquip have the following comments on the PRP.

U1 Noise Assessment Program

U1.1 The licensee must undertake a noise assessment of the quarry operations excluding hard rock processing (unless condition U1.1a below applies), including an assessment of all noise-emitting machinery used at the premises and determine if any equipment and/or operation is causing exceedances of the licence noise limits in condition L3.1. The noise assessment must include activities undertaken during all hours of operation as permitted by the licence and must be representative of current maximum levels of production at the premises.

U1.1a If the licensee achieves compliance with Project Approval 07_0155 prior to the commencement of the noise assessment described in Condition U1.1, the hard rock processing operations must be included in the noise assessment.

Comment: Benbow Environmental are prepared to undertake a noise assessment on the Multiquip operations. It is pointed out that Benbow Environmental previously conducted a noise compliance assessment on the Multiquip Aggregates (181023_Noise_Rep4) facility on the 7th March 2018 and 8th March 2018. During this assessment, the sand extraction and hard rock processing operations of Multiquip Aggregates were found to be inside the site criteria. During this assessment, both sand and rock processing were taking place, as well as several additional pieces of hired plant carrying out construction activities.

U1.2 The assessment referred to in Condition U1.1 must also include a period of not less than 14 days of continuous unattended noise monitoring at sensitive receiver locations Residence 3 and Residence 6 as described in condition L3.1 of the licence. The assessment must be prepared by a suitably qualified and experienced acoustical practitioner and be undertaken in accordance with the NSW Industrial Noise Policy.

Comment: Section 7.1 of the Noise Policy for Industry (EPA, 2017) states the following "*The preferred method of determining compliance with a noise limit is operator-attended direct measurement of noise at a location identified for compliance, using a sound level meter. Where the compliance location is dominated by noise from the industrial premises under investigation, this can be an effective and simple exercise. However many locations are not controlled by a single noise source, and techniques, including professional judgement, are often needed to determine the level of noise from the source under investigation*".

Benbow Environmental and our principal consultant Dick Benbow have over 40 years' experience in conducting acoustic compliance monitoring. The strong opinion of Benbow Environmental is that when attempting to quantify the contribution from a site, attended measurements are considerably more accurate than unattended measurements. The Noise Policy for Industry also states a preference for attended measurements, identifying that professional judgement is an indispensable technique in qualifying the contribution from a subject site.

The EPA recently conducted a Noise Investigation on the Ardmore Park Quarry. Benbow Environmental provides in depth comments on this investigation in a separate correspondence (181023-03_Investigation_Let1). However in short, Benbow Environmental believes some issues with the unattended survey were as follows:

- Over a three month investigation, only one attended measurement had taken place.
- The attended measurement that did take place was well compliant with the criteria. i.e. no attended measurements were observed to be over the criteria.
- Despite the attended measurement notes stating that the quarry was inaudible and complied with the criteria, the overall L_{Aeq} for the 15 minute period was 40 dB(A). The fact that the quarry complied while the L_{Aeq} noise level from all sources was over the criteria highlights the need for attended measurements.
- A low pass filter (to exclude insect noise) and a high pass filter (to exclude wind noise) was applied to measurements. Frequency spectrums are matched against a range to theoretically obtain segments of quarry noise. While clearly a lot of analysis has taken place, there is no guarantee that for the identified periods, all noise in that period is due to quarrying from the site.

By the EPA's own admission "*Most frogs, birds and insects, for example, emit higher-frequency noise above about 2 kHz and applying a low pass filter approach at this frequency band* largely discounted *their contribution. Similarly, noise contributions from wind were* generally removed *by screening out frequencies below the 31.5 Hz 1/3-octave frequency band*" (our emphasis). The EPA acknowledges that the frequency filtering "largely discounts" and "generally removes" the contribution of frogs, bird, insects and wind. However it would not exclude any contributions between 31.5 Hz and 2 kHz.

The experience of Benbow Environmental is that attended measurements conducted by a qualified engineer are more accurate at determining the site contribution than post analysis tools.

- Unattended measurements were taken over a 1 minute period. The compliance period is 15 minutes. Benbow believes that the L_{Aeq} must be measured over the 15 minute period to determine compliance. It is very conceivable that noise levels are elevated over a one minute period, or even a 5 minute period, but are lower on average over the 15 minute period. In fact, Benbow Environmental has conducted attended measurements at the Inverary Park property in which selected 1 minute periods showed L_{Aeq} noise levels 5 dB above the 15 minute L_{Aeq} levels.

- 53 individual 1 minute periods were identified as potential 1 minute exceedance periods. It is unclear if the audio data was listened to for all of these 53 x 1 minute periods to further evaluate if the quarry was the only dominant noise source at the mid frequency range.

- The report concludes that activities from the site are often elevated between 7am and 8am. From discussions with the proponent, the site generally does not operate significantly differently between 7am and 8am compared to the rest of the day. This raises the question of whether other factors, such as meteorological factors are impacting on the results during the morning period. Temperature inversions although most common during winter can occur occasionally all year. Given the hours of operation of the site from 7am to 6pm, if temperature inversions were to impact an hour of the site's operations, it would be most likely between 7am to 8am.

- The report states that calibration was verified with the field calibrator before deployment and checked on retrieval. It is not clear if this means that calibration only occurred at the start and at the end of the 71 day span. The logging period on the face of it seems a long time for a logger to be outdoors and not experience drift.

Each of the issues mentioned above would be resolved or improved using attended measurements. It would appear that the only downside of using attended measurements over unattended measurements is that it takes significant time and manpower to conduct the attended measurements.

Benbow Environmental therefore proposes an extensive program of attended measurements in place of the 14 days of continuous unattended noise monitoring. Measurements are proposed to take place for sand extraction activities for two full days, one in September and one in December. On each of the two days, measurements will be taken over at least a six hour period (a minimum of 12, 15 minute measurements per day). To measure as many 15 minute periods as possible at the worst case locations on those days, measurements will be conducted at just the two requested locations, R3 and R6.

Should operational rock processing be conducted before the report is due, the rock processing activities will also be assessed for two separate full days in line with the sand extraction activities.

U1.3 If exceedances of the noise limits in Condition L3.1 are detected, the assessment referred to in Condition U1.1 must include a strategy for a reduction in noise limits at surrounding sensitive receptors to comply with licence noise limits. This strategy must detail what actions will be taken at the premises including, but not limited to, potential relocation of noise sources, operational arrangements to avoid unnecessary noise impacts at sensitive receivers, a timeframe for implementation of management measures, and short-term options which can be implemented immediately to reduce noise impacts.

Benbow Environmental agrees with this clause remaining unchanged. If exceedances in the criteria are found, Benbow Environmental will work with Multiquip to identify the causes for the exceedances and investigate options to remedy the site.

U1.4 The assessment referred to in Condition U1.1 must be completed by 31 August 2018 and a report outlining the finding of the assessment must be submitted to the EPA no later than 28 September 2018.

Benbow Environmental requests that the wording in condition U1.4 be altered to the following "*Condition U1.1 must be completed by 31 December 2018 and a report outlining the findings of the assessment must be submitted to the EPA no later than 31 December 2018*".

The request is due to the potential impacts of temperature inversions in the area. Benbow Environmental has experience with numerous jobs in the Goulburn-Marulan region such as the Johnniefelds site in Marulan, Wakefield Park in Tirrannaville and the proposed Collector Shooting Range. Through working on these projects, Benbow Environmental has observed that strong temperature inversions occur in the region. While temperature inversions can occur throughout the year, they are particularly strong in winter. For example, an inversion increased noise levels by 15 dB at some receivers surrounding Wakefield Park Raceway on 2 July 2017.

Analysis of the region shows that inversions were present on 21% of days during the 2016 winter and 20% of days during the 2017 winter period. This is lower than the 30% of winter days that the Industrial Noise Policy or the Noise Policy for Industry consider needing to be triggered to warrant inclusion in a noise impact assessment.

As temperature inversions are not required to be included, it would be preferable to measure during conditions when temperature inversions are less likely. For this reason, Benbow Environmental propose to conduct measurements in September and December.

Conclusion

Benbow Environmental requests that the draft PRP be amended to the following.

U1 Noise Assessment Program

U1.1 The licensee must undertake a noise assessment of the quarry operations excluding hard rock processing (unless condition U1.1a below applies), including an assessment of all noise-emitting machinery used at the premises and determine if any equipment and/or operation is causing exceedances of the licence noise limits in condition L3.1. The noise assessment must include activities undertaken during all hours of operation as permitted by the licence and must be representative of current maximum levels of production at the premises.

U1.1a If the licensee achieves compliance with Project Approval 07_0155 prior to the commencement of the noise assessment described in Condition U1.1, the hard rock processing operations must be included in the noise assessment.

U1.2 The assessment referred to in Condition U1.1 must also include

- *a period of not less than 14 days of continuous unattended noise monitoring at sensitive receiver locations Residence 3 and Residence 6 as described in condition L3.1 of the licence. OR*
- *attended measurements for two full days (a minimum of 12, 15 minute measurements per day) at sensitive receiver locations Residence 3 and Residence 6 as described in condition L3.1 of the licence*

The assessment must be prepared by a suitably qualified and experienced acoustical practitioner and be undertaken in accordance with the NSW Industrial Noise Policy.

U1.3 If exceedances of the noise limits in Condition L3.1 are detected, the assessment referred to in Condition U1.1 must include a strategy for a reduction in noise limits at surrounding sensitive receptors to comply with licence noise limits. This strategy must detail what actions will be taken at the premises including, but not limited to, potential relocation of noise sources, operational arrangements to avoid unnecessary noise impacts at sensitive receivers, a timeframe for implementation of management measures, and short-term options which can be implemented immediately to reduce noise impacts.

U1.4 The assessment referred to in Condition U1.1 must be completed by 31 December 2018 and a report outlining the finding of the assessment must be submitted to the EPA no later than 31 December 2018.

Note: Following the receipt of the noise assessment, the EPA will require the implementation of all reasonable and feasible measures as identified by the noise assessment. The EPA will also require a compliance noise assessment to be undertaken annually during periods of normal operations.

If you require additional information, please do not hesitate to contact our office at any time.

Yours faithfully,

R T Benbow
Principal Consultant

Benbow ENVIRONMENTAL
A.B.N. 17 160 013 641

Head Office:
13 Daking Street
North Parramatta
NSW 2151 Australia
P.O. Box 687 Parramatta
NSW 2124 Australia
Telephone: +61 2 9890 5099
Facsimile: +61 2 9890 5399

Regional Office:
Wollongong
Telephone: 0421 177 825
Facsimile: (02) 9890 5399

Visit our website at:
www.benbowenviro.com.au

E-mail:
admin@benbowenviro.com.au

RTB/PG
Ref: 181023-03_Investigation_Rev2
19 July 2018

ATTN: Stefan Press
Unit Head, South East Region
Environment Protection Authority
Level 3/11 Farrer Place,
QUEANBEYAN NSW 2620

Dear Stefan,

RE: Comments on the EPA Noise Investigation – Ardmore Park Quarry (EPL 13213)

Recently the EPA conducted a Noise Investigation on the Ardmore Park Quarry to determine compliance with Environment Protection Licence No 13213. The investigation took place following noise complaints from an adjacent resident.

Benbow Environmental has reviewed the noise investigation and provides the following comments.

1. Method – non notification

Comment: The EPA noise investigation states that *"The EPA conducted noise monitoring at a nearby residence to the premises. The licensee was not notified of the noise monitoring".*

Response: The EPA is within its rights to conduct unattended noise monitoring of sites. However, in this instance, a key part of a noise compliance assessment would include knowing what equipment was running, and at what location. At best, noise levels could be variable depending on the equipment type and location. At worst, the so-called reference curve would be different depending on what equipment is operating and where. Much of the assessment relies on the reference curve of the site

Benbow Environmental recommends conducting a noise compliance assessment with attended measurements and a list of equipment that is operational on site.

2. Method – Calibration

Comment: The EPA noise investigation states that *"Calibration of the logger was verified with the field calibrator before deployment and checked on retrieval".*

Response: It is not clear if calibration only occurred at the start and end of the 71 day period. The 71 day period appears to be a long period for equipment to operate non-stop. If equipment was stopped briefly to change batteries etc., calibration could have occurred at those points. If the equipment did operate for the 71 day span non-stop, it would appear to be a significant period for a logger to be outdoors and not experience drift.

3. Results – Attended Measurements

Comment: The EPA noise investigation states that *"From Table 2, the estimated noise levels from the premise are below the licence noise limits of 35 dB(A)".*

Response: Benbow Environmental agrees with the conclusion drawn from the attended measurement. Benbow Environmental makes the additional comments that during the attended measurement, noise levels from the site were inaudible and complied with the criteria, yet the overall L_{Aeq} for the 15 minute period was 40 dB(A), well over the 35 dB(A) limit. This measurement highlights the significant background noise sources from wind, birds, roosters and planes that impact measurements taken at this location. It also highlights the power and value of attended measurements against unattended measurements.

4. Unattended Monitoring Results – General Comments

Response: The EPA noise investigation conducted a single attended noise measurement which demonstrated compliance with the site criteria. The EPA also conducted an extensive unattended noise survey. The EPA's conclusion that the site is not in compliance with the EPL licence therefore comes from the unattended survey.

Section 7.1 of the Noise Policy for Industry (EPA, 2017) states the following *"The preferred method of determining compliance with a noise limit is operator-attended direct measurement of noise at a location identified for compliance, using a sound level meter. Where the compliance location is dominated by noise from the industrial premises under investigation, this can be an effective and simple exercise. However many locations are not controlled by a single noise source, and techniques, including professional judgement, are often needed to determine the level of noise from the source under investigation".*

Benbow Environmental and our principal consultant Dick Benbow have over 40 years' experience in conducting acoustic compliance monitoring. The strong opinion of Benbow Environmental is that when attempting to quantify the contribution from a site, attended measurements are considerably more accurate than unattended measurements. The Noise Policy for Industry also states a preference for attended measurements, identifying that professional judgement is an indispensable technique in qualifying the contribution from a subject site.

5. Unattended Noise Monitoring Results Discussion – Frequency filtering

Comment: The EPA noise investigation states that *"Most frogs, birds and insects, for example, emit higher-frequency noise above about 2 kHz and applying a low pass filter approach at this frequency band largely discounted their contribution. Similarly, noise contributions from wind were generally removed by screening out frequencies below the 31.5 Hz 1/3-octave frequency band".*

Response: A low pass filter was implemented to exclude insect noise. A high pass filter was implemented to exclude wind noise. The EPA acknowledges that the frequency filtering "largely discounts" and "generally removes" the contribution of frogs, bird, insects and wind. However it would not exclude any contributions from these anthropogenic noise sources between 31.5 Hz and 2 kHz.

The experience of Benbow Environmental is that attended measurements conducted by a qualified engineer are more accurate at determining the site contribution than post analysis tools.

6. Unattended Noise Monitoring Results Discussion – Time based filtering

Comment: The EPA noise investigation states that "*Time based filtering is better suited to non-continuous sources of noise such as fauna noise, vehicular traffic, aircraft and weather induced noise such as wind in trees. It was not possible to find a 'clean' 15 minute period that did not contain at least one of the above events*".

Response: The fact that the EPA was unable to find a clean 15 minute measurement period in 71 days' worth of measurements strengthens the case for attended measurements. As previously mentioned, the strong opinion of Benbow Environmental is that when attempting to quantify the contribution from a site, attended measurements are considerably more accurate than unattended measurements. During each 15 minute period, the operator can identify noise sources and note the levels of the noise sources. The post-analysis undertaken is not considered to be as accurate as a trained experienced engineer conducting the measurement.

7. Unattended Noise Monitoring Results Discussion – Time based filtering

Comment: The EPA noise investigation states that "*It was not possible to find a 'clean' 15 minute period that did not contain at least one of the above events, hence the one-minute noise logging period results were used. Using one-minute data periods increased the probability of finding relatively 'clean' measurements samples, not overly tainted by extraneous noise events*".

Response: The EPA noise investigation utilised unattended measurements over a 1 minute period. The compliance period is 15 minutes. Benbow believes that the L_{Aeq} must be measured over the 15 minute period to determine compliance. It is very conceivable that noise levels are elevated over a one minute period, or even a 5 minute period, but are lower on average over the 15 minute period. In fact, Benbow Environmental has conducted attended measurements at the Inverary Park property in which selected 1 minute periods showed L_{Aeq} noise levels 5 dB above the 15 minute L_{Aeq} levels.

By shortening the compliance period to 1 minute, this induces a significant bias into the survey. As the 1 minute periods were not selected at random but were selected when the site was clearly audible compared to background noise, the 1 minute periods almost certainly represent periods where the noise from the site would be elevated. This is a significant error in the compliance survey. In summary, if the EPA noise investigation had difficulty filtering 15 minute unattended data, the approach should have been changed to attended measurements, not induce bias in the results by shortening the period to be 1 minute.

8. Unattended Noise Monitoring Results Discussion – Audio Data

Comment: The EPA noise investigation states that *"The complainant's notes described a number of occasions where noise attributed to the quarry was clearly audible, for example on 7, 8, 13, 14 December and 8, 22 January. The EPA listened to the audio recordings captured on these occasions…"*

Response: It is stated in the noise investigation that 53 individual 1 minute periods were identified as potential 1 minute exceedance periods. The report does not clarify if the audio data was listened to for all of these 53 x 1 minute periods to further evaluate if the quarry was the only dominant noise source at the considered mid frequency range. As previously mentioned, the experience of Benbow Environmental is that the best way to identify and quantify site contribution is by attended measurements conducted by a qualified engineer.

9. Unattended Noise Monitoring Results Discussion – Reference Curve

Comment: The EPA noise investigation states that *"The EPA examined the $L_{A90(1\ minute)}$ spectra from 31.5Hz to 2kHz for the 'clean' audio samples, in this case between 6:55am and 7:48 am. The EPA aggregated this data to develop a 'reference curve' considered representative of operations at the premises".*

Response: Section 7.1 of the Noise Policy for Industry (EPA, 2017) states *"The preferred method of determining compliance with a noise limit is operator-attended direct measurement of noise at a location identified for compliance, using a sound level meter*". Beyond conducting attended measurements, the Noise Policy for Industry further lays out some techniques that can be used to isolate noise from a facility such as pausing, frequency filtering, noise descriptors, and directional monitoring.

Benbow Environmental does not believe that the use of a reference curve is mentioned as a technique in the EPA's own guidelines (Noise Policy for Industry and the Industrial Noise Policy). Furthermore, Benbow Environmental is not aware of a literature study which recommends the technique as a primary noise compliance monitoring tool.

Without attended measurements, there is no guarantee that the reference curve has been derived entirely of noise from the site. Furthermore, without attended measurements, there is no guarantee that identified periods within the reference curve period are from site noise.

10. Unattended Noise Monitoring Results Discussion – Morning Analysis

Comment: The EPA noise investigation states that *"The 7am to 8am period typically coincides with higher noise levels, suggesting that early morning activities are often more intense*".

Response: The report states that activities from the site are often elevated between 7am and 8am. The EPA makes the assumption that the elevated noise levels are due to increased site activity. However, they have not conducted any attended measurements in this period to back up this observation, or have a documented list of what equipment was operational before 8am and after 8am. From discussions with the proponent, they believe the site generally does not operate significantly differently between 7am and 8am compared to the rest of the day.

The Industrial Noise Policy (EPA, 2000) states that under certain meteorological conditions "*effects typically increase noise levels by 5 to 10 dB, and have been known to increase noise levels by as much as 20 dB in extreme conditions..*" Whilst it is possible that activities at the site are more intensive before 8am, it is also possible that there are meteorological conditions that impact the site in the mornings. Such conditions could be wind conditions in the mornings, or temperature inversions.

Temperature inversions, although most common during winter, can occur occasionally all year. Given the hours of operation of the site from 7am to 6pm, if temperature inversions were to impact an hour of the site's operations, it would be most likely between 7am to 8am.

Benbow Environmental has experience with numerous jobs in the Goulburn-Marulan region such as the Johnniefelds site in Marulan, Wakefield Park in Tirrannaville and the proposed Collector Shooting Range. By conducting these projects, Benbow Environmental has observed that strong temperature inversions occur in the region. While temperature inversions can occur throughout the year, they are particularly strong in winter. For example, an inversion increased noise levels by 15 dB at some receivers surrounding Wakefield Park Raceway on 2 July 2017.

Benbow Environmental believes that if the EPA wish to make the assumption that site activities are more intensive in the morning period, it is a claim that needs to be more deeply investigated.

11. Unattended Noise Monitoring Results Discussion – Wind Direction Distribution

Comment: The EPA noise investigation shows that wind directions at the site are predominantly easterly (wind blowing from the site, away from the receiver, from the perspective of R3) or westerly (wind blowing from the site, towards the receiver, from the perspective of R3). The report states "*When spectra matching operations at the premises were identified, the associated wind direction at that time was predominantly from the west...*" (wind blowing from the site, towards the receiver, from the perspective of R3). "*...This chart further supports the validity of the matched spectra as being representative of contributed noise from operations at the premises*".

Response: From the chart, it is clear that when the EPA identifies the 1 minute periods as exceeding the criteria, the wind direction is from the site towards R3. Therefore under neutral weather conditions, exceedances of the criteria are far rarer.

The previous noise assessment for the site concluded that the location did not require temperature inversions and wind to be considered as the frequency of adverse weather conditions were less than 30% of the time as per the Noise Policy for Industry and are not considered to be a feature of the area. Therefore this compliance assessment should be undertaken during neutral weather conditions. It is generally understood that a site may exceed under a specific wind conditions if these conditions occur less than 30% of the time as per the Noise Policy for Industry 2017. Therefore it is unreasonable to say it is non-compliant with the criteria during the adverse weather conditioned reported during the EPA noise investigation where the wind direction was playing a large role in the so-called exceedances that were apparently identified.

Conclusion

Benbow Environmental is of the view that for the EPA to claim Multiquip has exceeded the noise limits outlined in EPL 13213, this has to be justified with a more accurate noise assessment. By conducting unattended measurements instead of attended measurements, the EPA have relied on the method that is less preferred, according to their own standard (Noise Policy for Industry 2017). Time and frequency filtering and other post processing tools are not as accurate as a trained engineer on site identifying the noise sources and contributions through attended measurements. The reference curve method is not listed as a post processing tool in any EPA policy.

Benbow Environmental believes that the amount of 'exceedances' have been overestimated due to:

- The use of 1 minute periods instead of 15 minute periods;
- Not ruling out meteorological conditions as the cause of elevated morning noise levels; and
- Exceedances predominately occurring during source to receiver wind conditions which are not considered to be a feature of the area.

Benbow Environmental proposes an extensive program of attended measurements in place of the 14 days continuous unattended noise monitoring outlined in the EPA's draft Pollution Reduction Program. While the methodology and justification of this are the subject of an additional communication (Ref 181023_PRP), the scope of the monitoring program can be summarised as two full days of at least 12 x 15 minute attended noise surveys at Receivers 3 and 6 to be held in September and December 2018.

If you require additional information, please do not hesitate to contact our office at any time.

Yours faithfully,

R T Benbow
Principal Consultant

SF17/43577; DOC18/243157

Mr Michael Cox
CEAL Limited
PO Box 4
AUSTRAL NSW 2171

Dear Mr Cox

Ardmore Park Quarry – Noise compliance matters

I am writing to you regarding CEAL Limited's (trading as Multiquip) Ardmore Park Quarry at 5152 Oallen Ford Road, Bungonia and recent communication received by the EPA from the NSW Department of Planning and Environment (DP&E) concerning compliance action it has taken. I am also writing about a noise monitoring project initiated by the EPA of which you were previously advised in the EPA's correspondence of 17 April 2018 (Document SF17/40581).

As you are aware, I discussed these matters with you on 22 June 2018.

BACKGROUND

Environment Protection Licence No. 13213 (the licence) is issued under the *Protection of the Environment Operations Act 1997* (POEO Act) and authorises the carrying out of crushing, grinding or separating, and extractive activities at the Ardmore Park Quarry at 5152 Oallen Ford Road, Bungonia (the premises). The licence is held by CEAL Limited, trading as Multiquip.

It is understood that DP&E has issued Multiquip with a Penalty Infringement Notice for failing to comply with certain conditions of approval for the Ardmore Park Quarry (Project Approval 07_0155). Additional to this, the EPA understands that DP&E intends to issue Multiquip with a Development Control Order to remedy the non-compliance. The EPA understands that the non-compliance relates to the physical layout and location of the hard rock processing operations, and that Multiquip has been advised to cease hard rock processing operations until the non-compliance has been remedied. The EPA understands from DP&E that their compliance action does not relate to the sand extraction activities undertaken at the premises.

NON-COMPLIANCE WITH LICENCE

Relevant to this matter is Condition A3.1 of the licence, which states that "*Works and activities must be carried out in accordance with the proposal contained in the licence application*". In July 2013, the EPA received a licence application from Multiquip, referencing Project Approval 07_0155 as well as other management documents. On 21 August 2013, the licence was issued by the EPA, thereby binding the licensee to all conditions of the licence, including Condition A3.1.

Given that the EPA has been made aware that Multiquip has been allegedly operating in breach of the Project Approval, the EPA believes that should Multiquip not cease hard rock processing activities as

PO Box 622 Queanbeyan NSW 2620
Level 3/11 Farrer Place Queanbeyan NSW 2620
Tel: (02) 6229 7002 Fax: (02) 6229 7006
ABN 43 692 285 758
www.epa.nsw.gov.au

instructed by DP&E this would likely constitute a breach of Condition A3.1 of the licence, specifically with reference to the location and operation of the hard rock processing.

As such, the EPA request that prior to any recommencement of hard rock processing activities at the premises that Multiquip provide sufficient documentation to the EPA to demonstrate that it is fully compliant with the conditions of Project Approval 07_0155.

NOISE MONITORING

With regard to noise monitoring, you may be aware that the EPA conducted unattended noise monitoring between November 2017 and February 2018. This was as a result of concerns being raised by the community about noise emissions from the premises.

The preliminary results of this noise monitoring project were relayed by the EPA to Mr Steve Wall and Mr Alexander Cox of Multiquip on 27 March 2018 during an inspection of the premises. A copy of the project report is provided in **Attachment A** to this letter, but the results are summarily explained below.

The EPA noise monitoring analysis indicates that the noise contribution from the quarry exceeded the premises' licence limits at certain times during the monitoring period. Some of these exceedances occurred prior to 7am, which is outside the quarry's licensed operating hours. The EPA will address the hours of operation non-compliances (early starts prior to 7am) in separate correspondence to this letter.

Examples of where noise from the premises exceeded the noise limits in the licence during permitted hours of operations were:

- 10:53 to 11:20, 11:54, 14:17, 16:04, 17:28 on 6 December 2017
- 11:37, 12:50, 14:11, 14:52, 15:13, 16:00 on 7 December 2017
- 08:30, 08:50, 10:38 to 11:35 on 8 December 2017

ACTION REQUIRED

It is noted that the EPA's noise monitoring was carried out whilst the premises was not compliant with the Project Approval. Ordinarily in the case where EPA noise monitoring identifies potential exceedances of licence noise limits, the EPA's approach would be to require the licensee to undertake a comprehensive noise validation assessment of the premises. The purpose of such an assessment would be to confirm if the noise limits in the licence, which are based on the environmental assessment conducted as part of the planning assessment process for the Project Approval, are being complied with. Where a noise validation assessment identifies non-compliance(s) with licence noise limits, the licensee is required to address this by identifying feasible and reasonable noise mitigation measures to be implemented in order to provide compliance with licence limits. Post implementation of any required feasible and reasonable noise mitigation measures, the EPA requires a further noise validation assessment be undertaken to confirm that compliance with licence limits is being achieved.

In this instance, given Multiquip's current alleged non-compliance with the Project Approval, it would not be appropriate for Multiquip to carry out a comprehensive noise validation assessment which is inclusive of the hard rock plant and equipment in operation. (Note: In the event that compliance with the Project Approval is achieved in the near future, the noise validation assessment would need to include all operations.)

The EPA is however proposing that Multiquip be required to undertake a noise impact assessment of the sand extraction, washing and transport activities carried on at the premises (but also acknowledging the note above). This noise impact assessment will need to demonstrate if compliance with the relevant noise limits is being achieved at all identified residential receivers at maximum levels of production for sand processing operations and during all permitted operating hours. Should the results of the noise impact assessment identify any non-compliances with noise limits in the licence, as outlined above Multiquip would be required to identify feasible and reasonable noise mitigation measures to be implemented at the premises.

As you may also be aware, the EPA is receiving ongoing complaints from the community concerning noise emissions from the premises. The EPA has referred each of these complaints to Multiquip's Mr Alexander Cox for investigation and reply to the EPA. The noise validation assessment will provide a further level of information to both Multiquip and the EPA regarding noise emissions from the premises and whether such emissions are compliant with noise limits in the licence.

A draft Pollution Reduction Program (PRP) which includes the proposed noise validation assessment is at **Attachment B** to this letter. The EPA invites Multiquip to provide comment on the draft PRP by **6 July 2018**. Any comments will be considered and the draft PRP modified if deemed appropriate. If no response is received by this time, the EPA will vary EPL 13213 to include the draft PRP and will enforce those conditions as appropriate.

Please note, once Multiquip satisfies DP&E that the hard rock processing operations are consistent with the Project Approval, the EPA will require at this point in time that Multiquip undertaken a further noise validation to confirm that the hard rock operation activities at the premises comply with the licence noise limits.

It should be further noted that a summary of the noise monitoring will also be provided to DP&E, and will also be provided to the community members who raised the noise concerns with the EPA. If you have any questions about this matter, or wish to discuss this letter, please contact Michael Heinze on 6229 7002.

Yours sincerely

Press. 25/06/18

STEFAN PRESS
Unit Head, South East Region
Environment Protection Authority

Attachment B

Draft PRP for EPL 13213 – Ardmore Park Quarry

U1 Noise Assessment Program

U1.1 The licensee must undertake a noise assessment of the quarry operations excluding hard rock processing (unless condition U1.1a below applies), including an assessment of all noise-emitting machinery used at the premises and determine if any equipment and/or operation is causing exceedances of the licence noise limits in condition L3.1. The noise assessment must include activities undertaken during all hours of operation as permitted by the licence and must be representative of current maximum levels of production at the premises.

U1.1a If the licensee achieves compliance with Project Approval 07_0155 prior to the commencement of the noise assessment described in Condition U1.1, the hard rock processing operations must be included in the noise assessment.

U1.2 The assessment referred to in Condition U1.1 must also include a period of not less than 14 days of continuous unattended noise monitoring at sensitive receiver locations Residence 3 and Residence 6 as described in condition L3.1 of the licence. The assessment must be prepared by a suitably qualified and experienced acoustical practitioner and be undertaken in accordance with the NSW Industrial Noise Policy.

U1.3 If exceedances of the noise limits in Condition L3.1 are detected, the assessment referred to in Condition U1.1 must include a strategy for a reduction in noise impacts at surrounding sensitive receptors to comply with licence noise limits. This strategy must detail what actions will be taken at the premises including, but not limited to, potential relocation of noise sources, operational arrangements to avoid unnecessary noise impacts at sensitive receivers, a timeframe for implementation of management measures, and short-term options which can be implemented immediately to reduce noise impacts.

U1.4 The assessment referred to in Condition U1.1 must be completed by 31 August 2018 and a report outlining the finding of the assessment must be submitted to the EPA no later than 28 September 2018.

Note: Following the receipt of the noise assessment, the EPA will require the implementation of all reasonable and feasible measures as identified by the noise assessment. The EPA will also require a compliance noise assessment to be undertaken annually during periods of normal operations.

EPA NOISE INVESTIGATION - ARDMORE PARK QUARRY (EPL 13213)

SUMMARY

- The EPA monitored noise levels for 71 consecutive days at a nearby residence to the Ardmore Park Quarry.

- The objective of this monitoring was to estimate the level of noise at this residence, in response to complaints from the residents about activities at the nearby Ardmore Park Quarry. CEAL Limited (the licensee) holds Environment Protection Licence No. 13213 (the licence) which permits land based extractive activities at the Ardmore Park Quarry, 5152 Oallen Ford Road, Bungonia NSW 2580 (the premises).

- Analysis of the EPA's unattended monitoring data, supplemented with operator-attended noise measurements, indicate some potential noise levels above the licence noise limits.

  Some of the potential noise levels above the licence limits occur prior to 7am, the quarry's permitted start time.

  Noise emissions during the early morning 7am to 8am period have the most potential for impact. There should be a focus on feasible and reasonable mitigation efforts on activities taking place during this period first. These measures may also be beneficial in reducing noise at other times.

- The EPA will require Multiquip to undertake a noise assessment of their operations and propose measures for mitigating noise levels above licence limits.

AIM

To investigate noise from Ardmore Park Quarry, Environment Protection Licence 13213 (the licence), in response to complaints received from nearby residents.

BACKGROUND

The EPA has been receiving complaints alleging unacceptable noise as a result of activities at Ardmore Park Quarry, Bungonia (the premises). The licence conditions relating to noise for the premises are:

L3 Noise limits

L3.1 Noise generated at the premises must not exceed the noise limits presented in the table below:

Noise Assessment Location	Address	LAeq (15 minute)
Residence 1	"Reevesdale" 346 Inverary Road, Bungonia, NSW 2580	35
Residence 2	"Inverary" 590 Inverary Road, Bungonia, NSW 2580	35
Residence 3	"Inverary Park" 550 Inverary Road, Bungonia, NSW 2580	35
Residence 4	"Damar Lodge" 5025 Oallen Ford Road, Bungonia, NSW 2580	35
Residence 5	"The Osiers" 5028 Oallen Ford Road, Bungonia, NSW 2580	35
Residence 6	"Lochmoor Lodge" 5046 Oallen Ford Road, Bungonia, NSW 2580	36
Residence 8	"Lumley Park" Bungonia, NSW 2580	35
Residence 9	The primary private residence at 5199 Oallen Ford Road, Bungonia, NSW 2580	36

Note: The Noise Assessment Locations as shown in the table above are as detailed in the "Modified 'Ardmore Park' Quarry Project Noise and Vibration Impact Assessment", prepared by Heggies Pty Ltd, May 2008.

L3.2 Noise generated by the project is to be measured in accordance with the relevant requirements of the NSW Industrial Noise Policy.

L4 Hours of operation

L4.1 The licensee must comply with the operating hours in the Table below:

Activity	Day	Time
Construction Work	Monday - Friday Saturday Sunday and Public Holidays	7.00am to 6.00pm 8.00am to 1.00pm None
Quarrying, processing (including overburden removal) and product transportation	Monday - Friday Saturday Sunday and Public Holidays	7.00am to 6.00pm 7.00am to 1.00pm None

The applicable noise limits for 'Inverary Park' are consequently $L_{Aeq(15minute)}$ 35 dB(A) during the daytime period.

METHOD

The EPA conducted noise monitoring at a nearby residence to the premises. The licensee was not notified of the noise monitoring. The monitoring comprised a campaign of unattended noise measurements, using a Bruel and Kjaer Type 3659 noise logger from Thursday 23 November 2017 to Thursday 1 February 2018.

The logger was placed in the yard adjacent to a fence approximately 20 metres from the residence, facing the quarry. The logger was configured to record all available parameters for both a one minute and a 15-minute logging interval.

Calibration of the logger was verified with the field calibrator before deployment and checked on retrieval. This calibration data was stored in the logger's calibration database.

The key parameter from the measured data was the $L_{Aeq(15\ minute)}$ level, for comparison with the premises' licence limits. This is a level that if steady over a measurement interval, would have the same acoustic energy as a level that varied over the same interval. It is sometimes referred to as the "ambient" level. The A frequency weighting is a standardised adjustment by an electronic filter that approximates the response of the human ear at lower noise levels.

The unattended logger collects data continuously over weeks, but it cannot discriminate between noise sources, so that high levels reported in the measurement results could be from a distant loud source or from a source that is quieter, but closer to the microphone. Therefore, when measured levels are less than the licence limit it is possible to say that the limit is not being exceeded, **but when measured levels are more than the licence limit it may not be as a result of noise from activity at the monitored premises exceeding the limit.**

As the licensee was unaware of the monitoring being carried out, records of activities at the premises during the monitoring period were not available. Parameters that can provide useful information and that were extracted to assist in interpretation of the results, for each 15-minute measurement period, were:

- The A frequency weighted level that was exceeded for 13 minutes and 30 seconds, being ninety percent of the time ($L_{A90(15minute)}$). This approximates what used to be described as the "average minimum" noise level, and is commonly referred to (in Australia) as the "background" level;
- The difference between the C frequency weighted equivalent continuous level (L_{Ceq}) and the corresponding L_{Aeq} at the logger location.
- The L_{Amax} is the A frequency weighted maximum level in any 125 milliseconds within the measurement period (15 minutes in this case).

The C frequency weighting is a standardised adjustment like the A frequency weighting but it approximates the response of the human ear at higher noise levels. The arithmetic difference between the C and the A weighted levels can be an indicator of the relative proportion of low frequency content in the measured noise. When noise has a high proportion of low frequency noise it is commonly referred to as "unbalanced" and can be more annoying than a sound at the same level but without the high proportion of low frequency content. Low frequency noise can also cause building elements to vibrate, resulting in secondary noise from household objects rattling – a source of annoyance on its own.

Attended noise monitoring was also carried out at the logger location using a Sinus Soundbook during deployment of the noise logger. The attended monitoring serves to augment the unattended logger data by providing information about the various sources of noise at the monitoring locations, together with their character and relative contributions.

The EPA's general approach to compliance and enforcement is summarised in the EPA Compliance Policy (EPA, 2013) The EPA applies a risk-based approach to its regulatory functions, and escalates its regulatory response according to:

- the risk to the environment and human health;
- the seriousness of the non-compliance;
- the apparent attitude of the licensee to compliance; and
- the compliance history and frequency of issues arising.

The EPA considers measured noise levels attributable from activities at a premises greater than the noise limits in its licence to constitute a non-compliance. In considering the seriousness of the incident and its potential or actual risk of environmental harm, however, the EPA recognises that:

- an increase in noise level of up to 2 dB represents a minor impact that is considered barely perceptible to the average person; and
- the typical accuracy of environmental noise measurements is approximately ±2 dB.

As such, the EPA considers in this instance that a non-compliance that would warrant regulatory intervention occurs where noise levels attributable from the premises exceed 37 dB(A) at the residence of the complainant.

RESULTS

Attachment A contains extracts of the monitored data from the complainant's residence presented graphically as one page to each 24 hour period, labelled by date.

The results of operator attended noise monitoring are shown in Table 1 below. During the operator-attended monitoring the meter operator critically listened and observed the meter display. The numbers in the 'Comments' column are the instantaneous values read from the meter's display, assigned to a specific noise source or sources, based on the subjective aural assessment of the meter operator.

Table 1. Operator-attended monitoring results

Location / Date / Time Weather Conditions	L_{Amax} dB(A)	L_{A1} dB(A)	L_{A10} dB(A)	L_{Aeq} dB(A)	L_{A90} dB(A)	Comments (numbers are dB(A) levels)
Complainant residence 23 Nov 17 12:53-13:08 24degC, partly cloudy Wind light & variable	64.1	50.7	41.4	39.6	26.6	Ardmore Park Sources ***Quarry inaudible, <35*** Non-Ardmore Park Sources Distant conversation 39-40 Wind in trees 27-30 Birds 42-45, 64 Rooster ~50 Plane at high altitude ~35

DISCUSSION – ATTENDED MONITORING RESULTS

From Table 2, the estimated noise levels from the premise are below the premises' licence noise limits of 35 dB(A) at the complainants residence.

UNATTENDED MONITORING RESULTS DISCUSSION

A discussion of the unattended noise logging results at the complainant's residence is detailed in Attachment B. This includes details of the assessment methodology developed and employed by the EPA to match noise levels from the premises using both frequency based and time-based filtering. This resulted in the EPA developing a reference curve considered representative of operations at the premises for the purposes of determining the attributable noise levels from the premises at the monitoring location.

CONCLUSIONS

The unattended noise monitoring analysis indicates:

- approximately 12% of matched noise levels from the premises are up to 2 dB(A) above the 35 dB(A) licence limit
- approximately 5% of matched noise levels from the premises exceed 37 dB(A). These occurred for a total duration of 53 minutes or 0.1% of the total 71 day period that the noise monitoring was undertaken
- approximately 83% of matched noise levels from the premises are below the 35dB(A) licence limit

The monitoring also identified instances of activities occurring at the premises occurring prior to 7am, outside the premises' licensed operating hours. Examples are:

- 6:46 to 6:59 on 7 December 2017
- 6:26 to 6:47 8 December 2017
- 6:45 to 6:58 on 18 January 2018

Based on the above results, there do appear to be some potential noise levels above the premises' licence noise limits. Examples of time when these occur are:

- 10:53 to 11:20, 11:54, 14:17, 16:04, 17:28 on 6 December 2017
- 11:37, 12:50, 14:11, 14:52, 15:13, 16:00 on 7 December 2017
- 8:30, 8:50, 10:38 to 11:35 on 8 December 2017

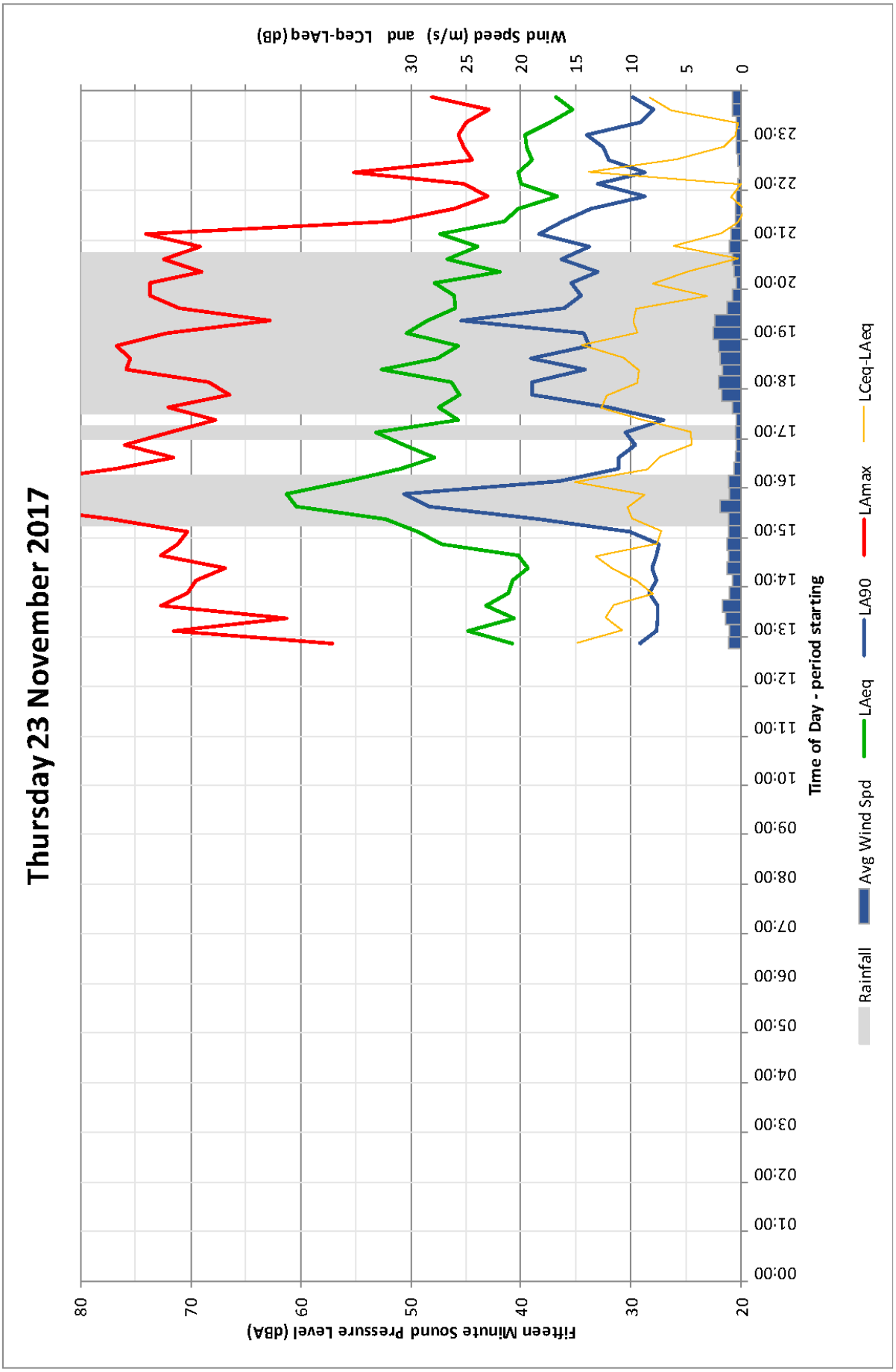
Operations at the premises were not significantly visible from the monitoring location during monitoring and it was not possible to observe what was causing those noise emissions.

From this analysis, the period of key interest is during the more sensitive early morning period, from 7am to 8am. The EPA considers that this is when increased noise levels from activities at the premises have the most potential for adverse impact on residents.

ATTACHMENT A

GRAPHICAL PRESENTATION OF UNATTENDED MONITORING DATA

It is important to note that the graphical representations following include **all** noise sources (anthropogenic and natural), and cannot be interpreted as a single or sole contribution from Ardmore Park Quarry at the monitoring point. As way of example, graphs for Public Holidays (Christmas, New Years and Australia Day) all show periods where the 35 dB(A) limit was exceeded, even though it is considered there would have been no operations at the premises on those days.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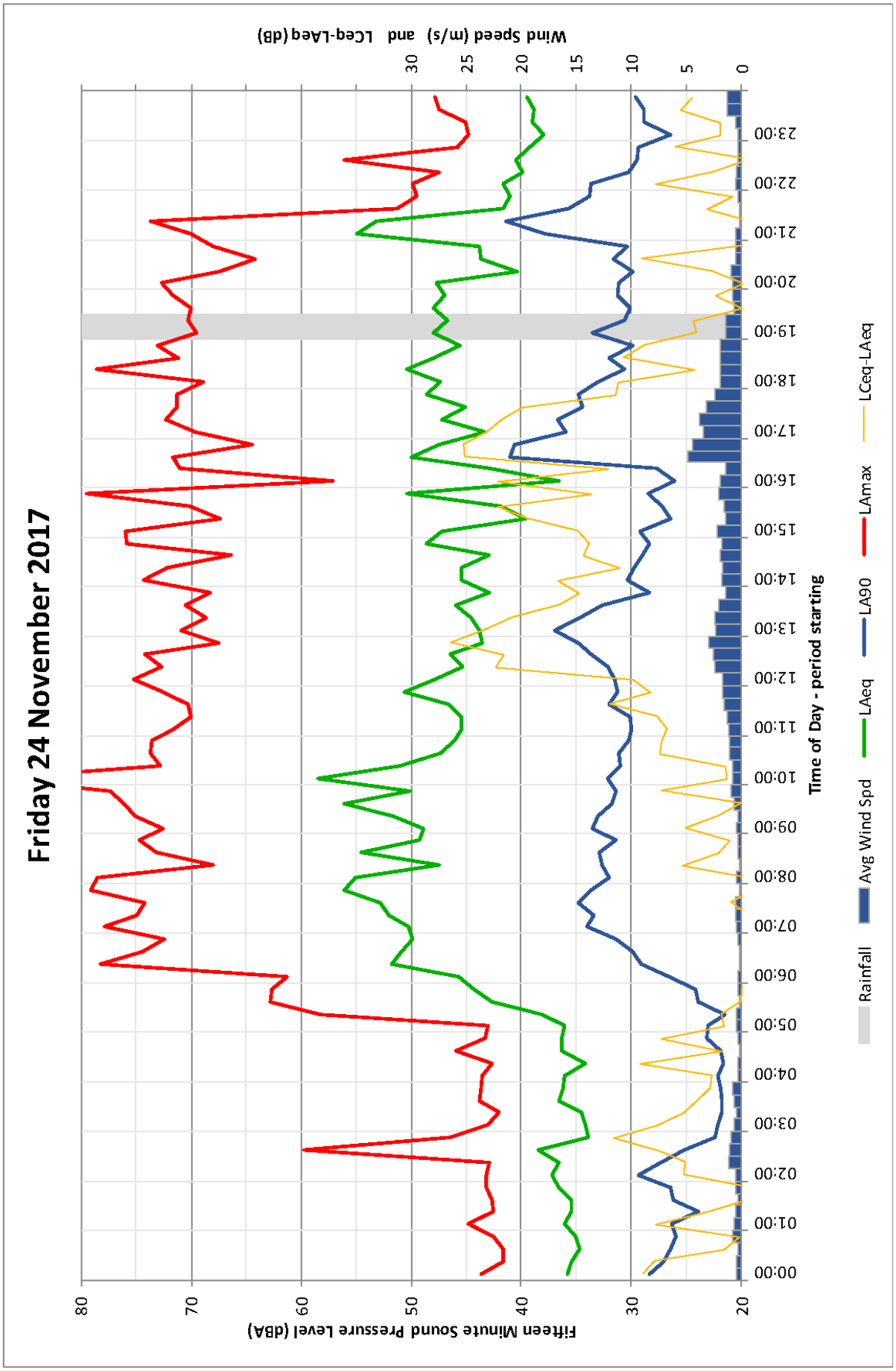
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq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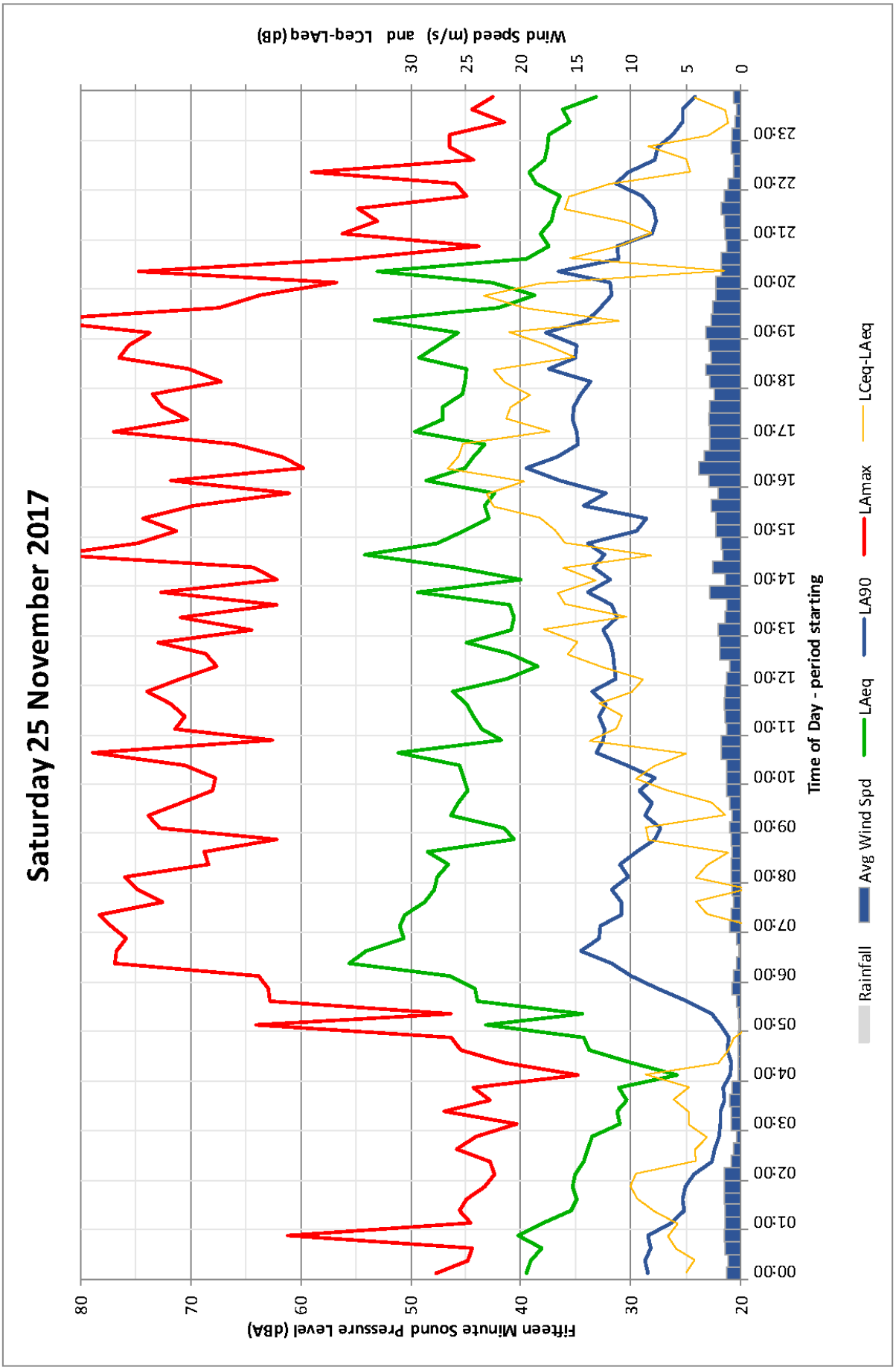
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall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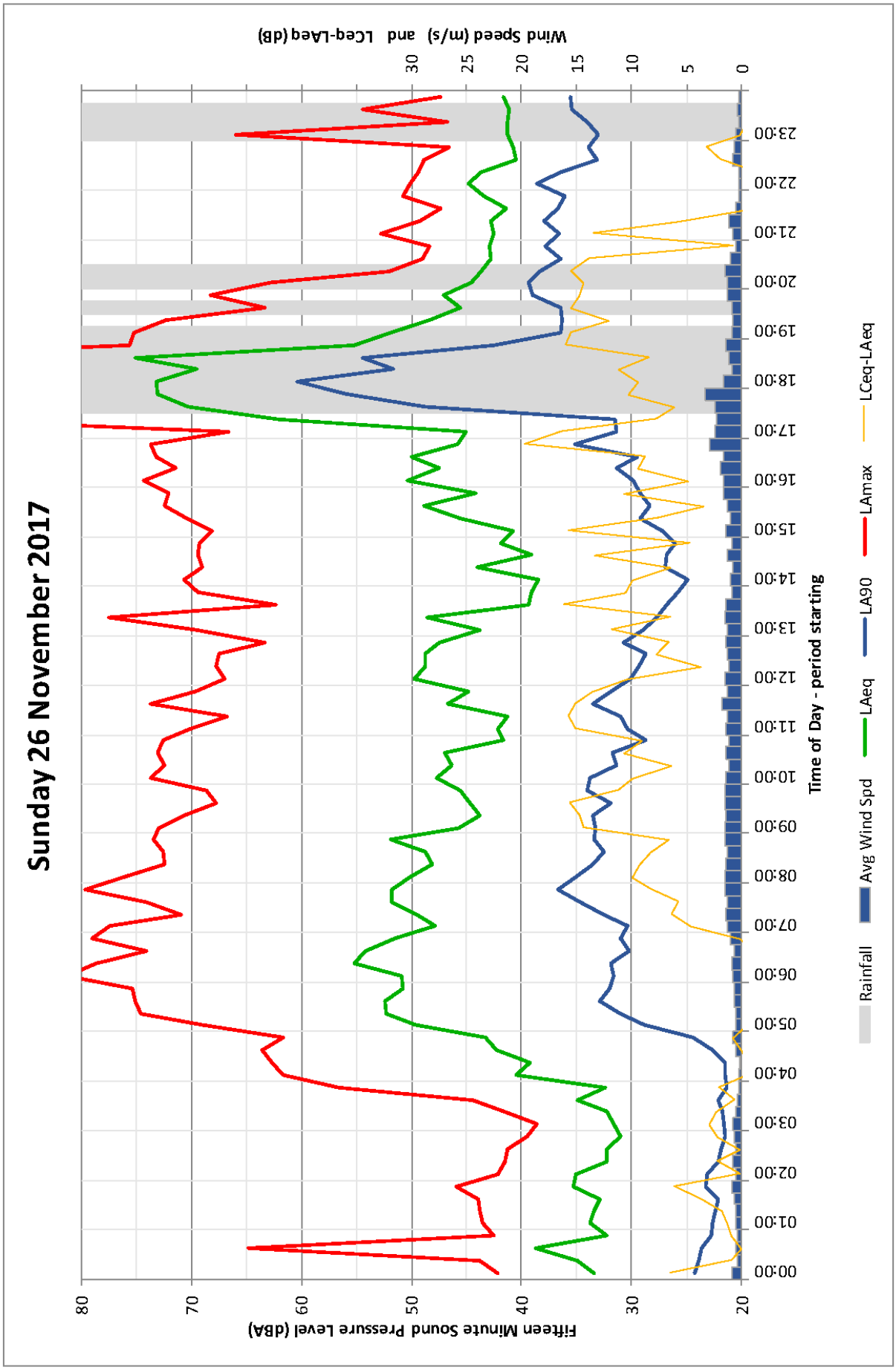
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq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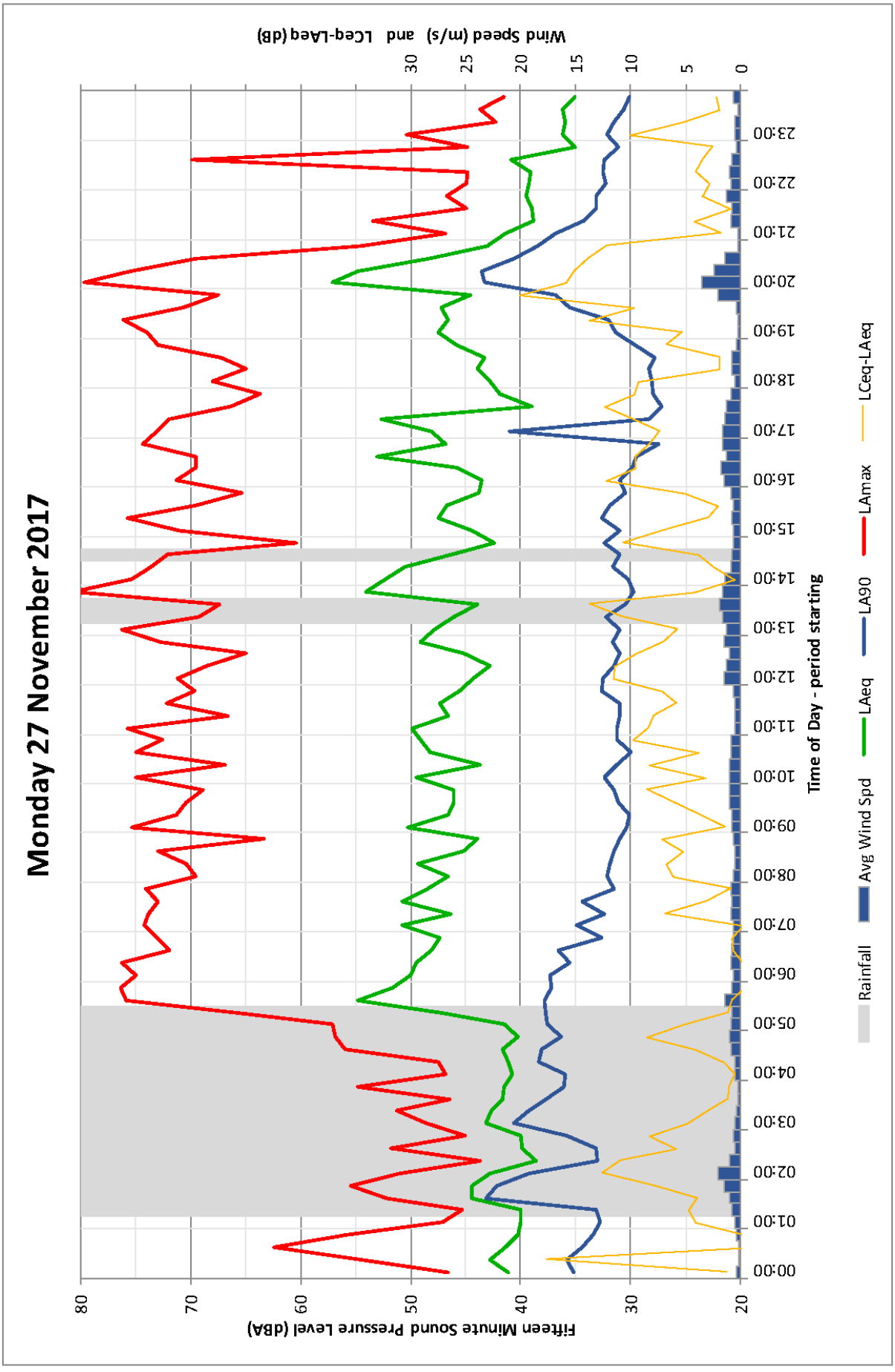
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq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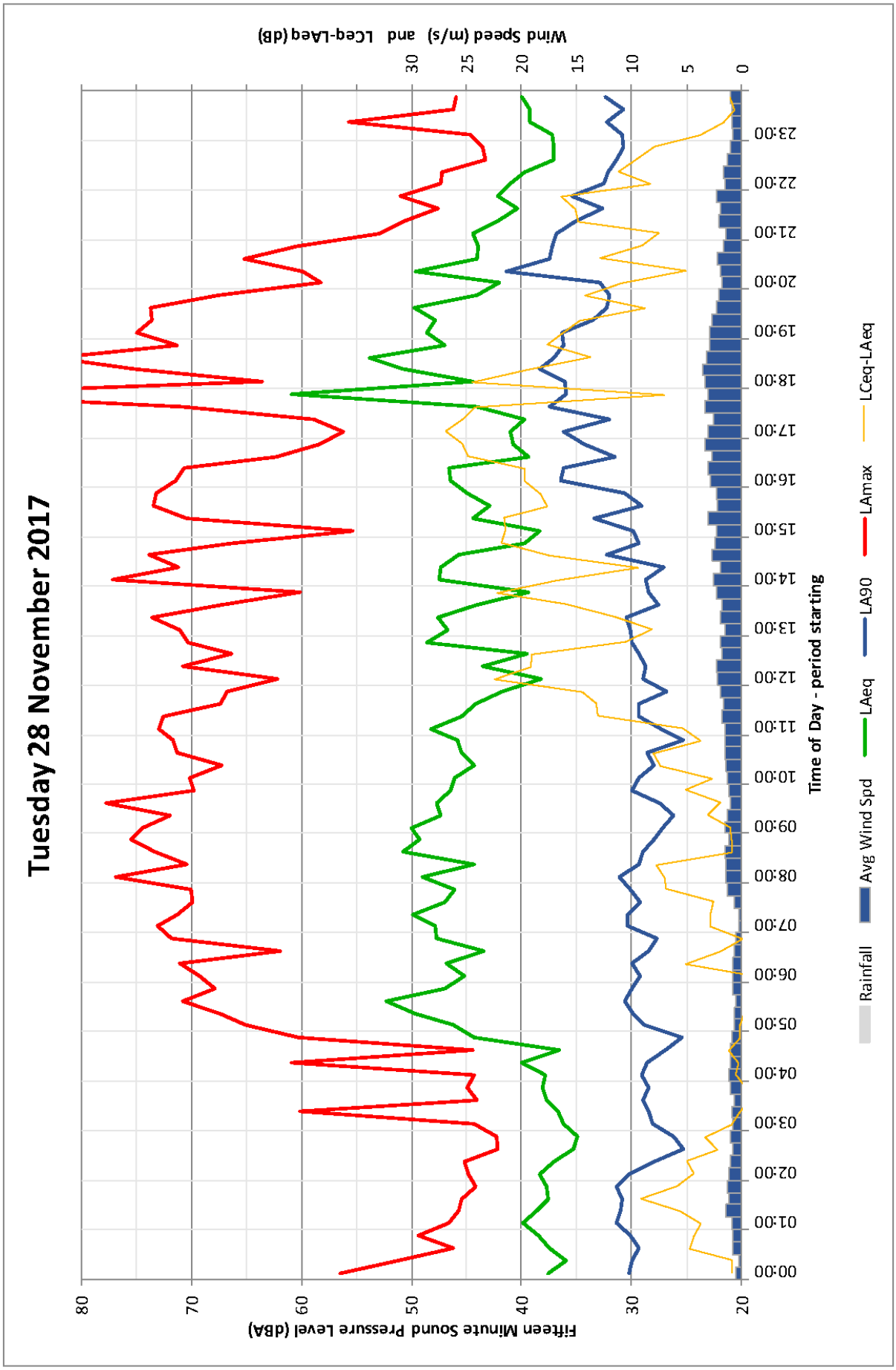
Time of Day - period starting
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall
LCeq-LAeq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Time of Day - period starting
LCeq-LAeq
LAmax
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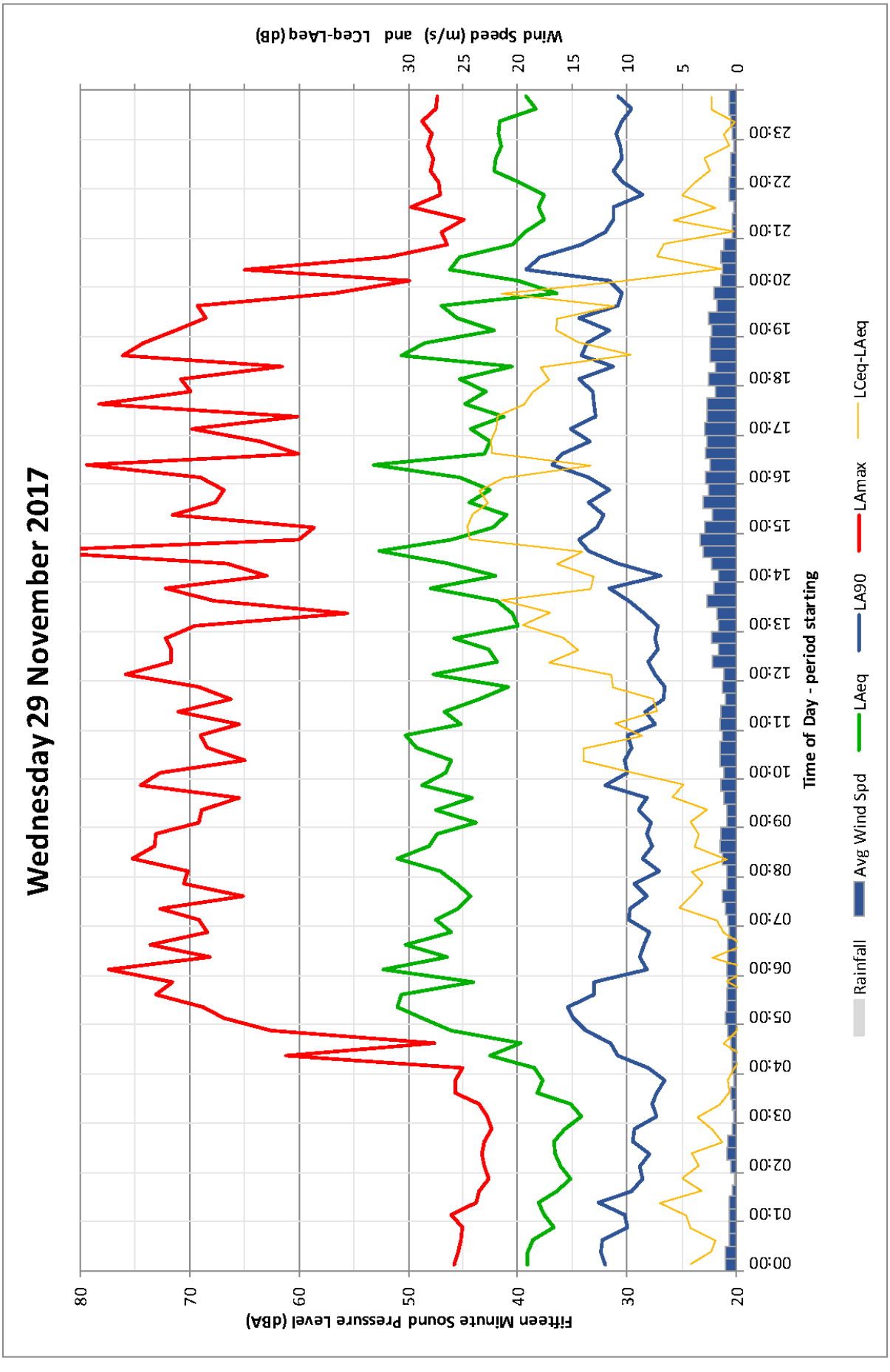
LAeq
Avg Wind Spd
Rainfall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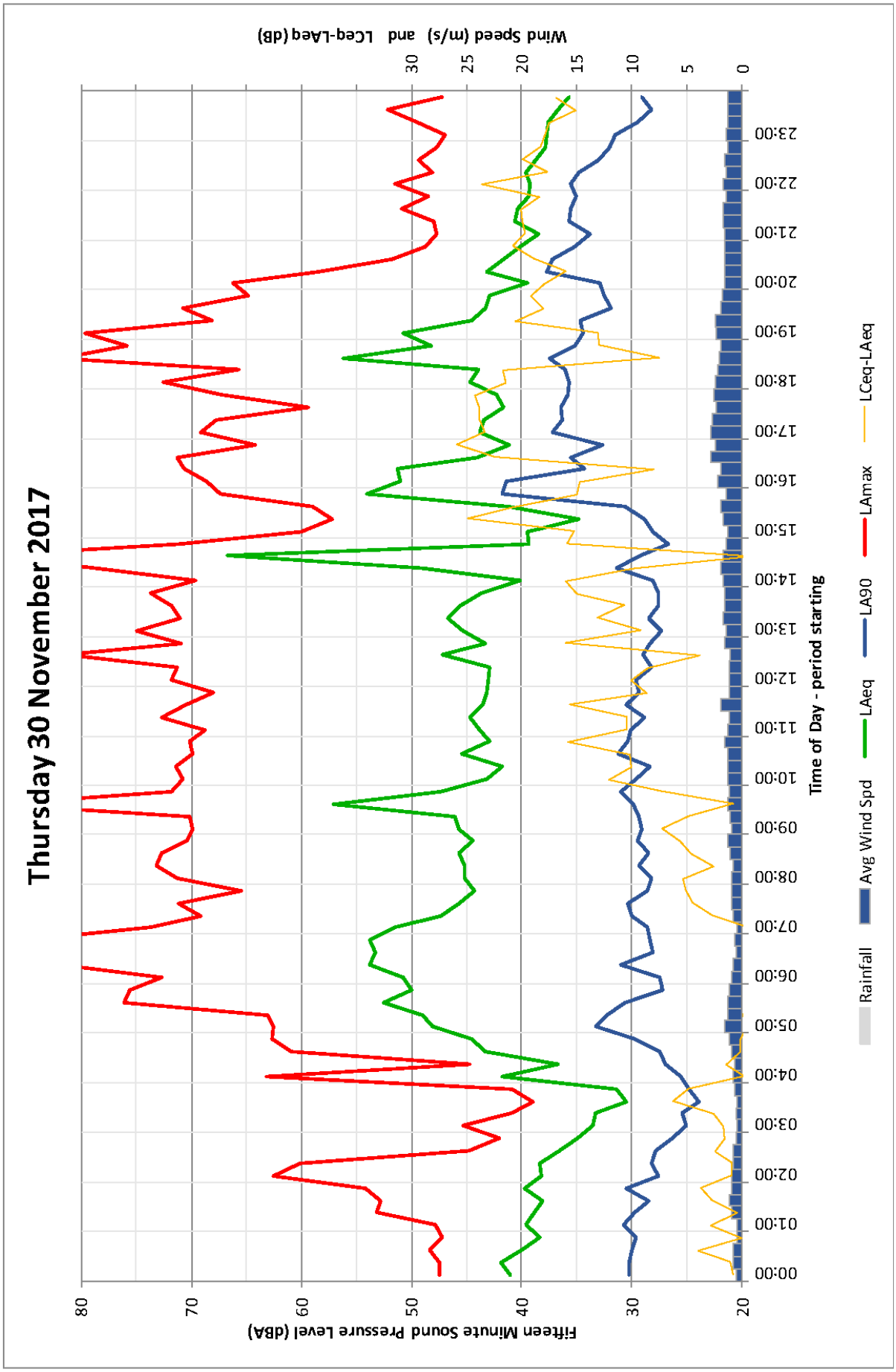
Time of Day - period starting
LAeq
LA90
LAmax
LCeq-LAeq
Avg Wind Spd
Rainfall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Time of Day - period starting
LCeq-LAeq
LAmax
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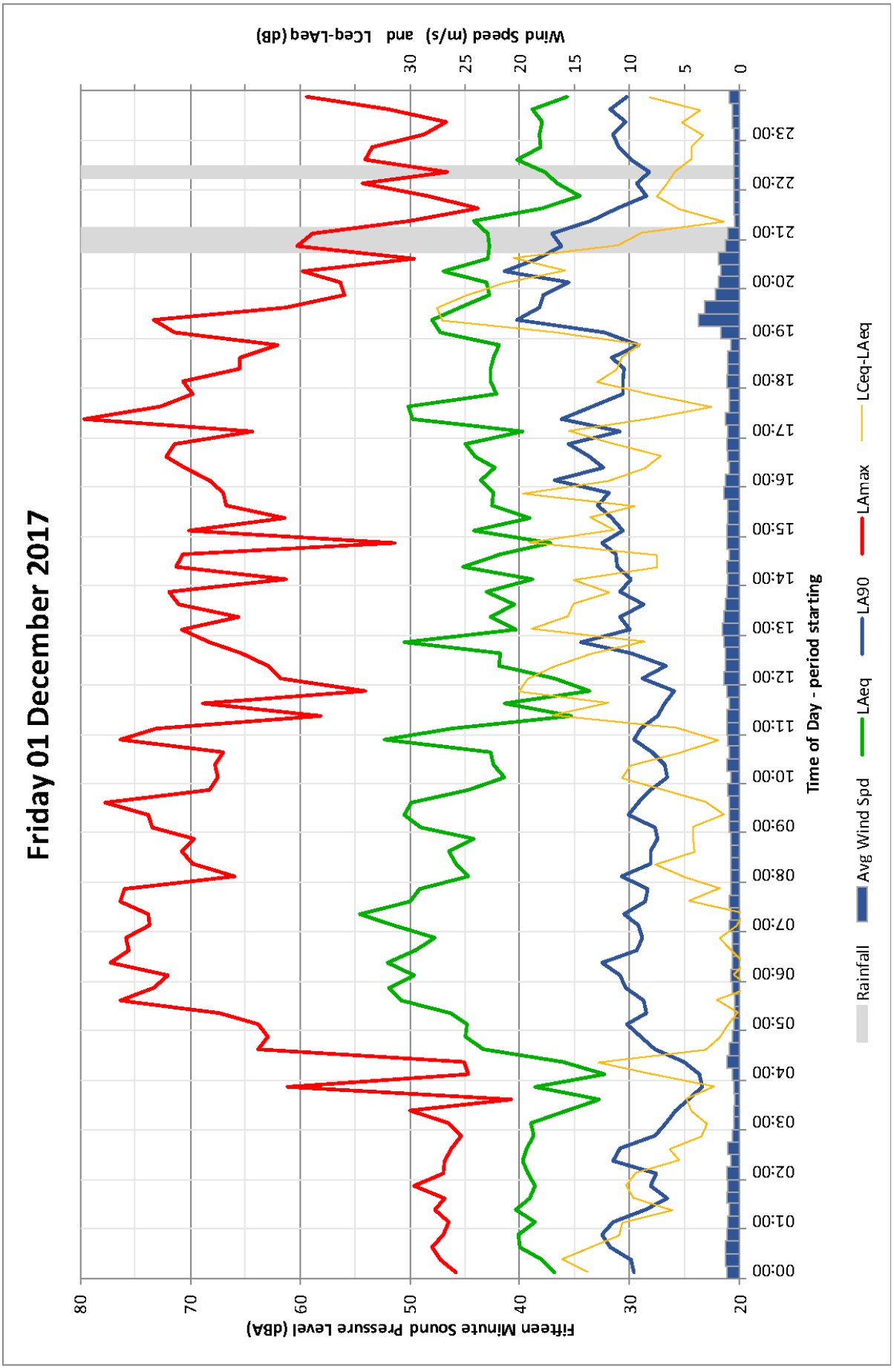
LAeq
Avg Wind Spd
Rainfall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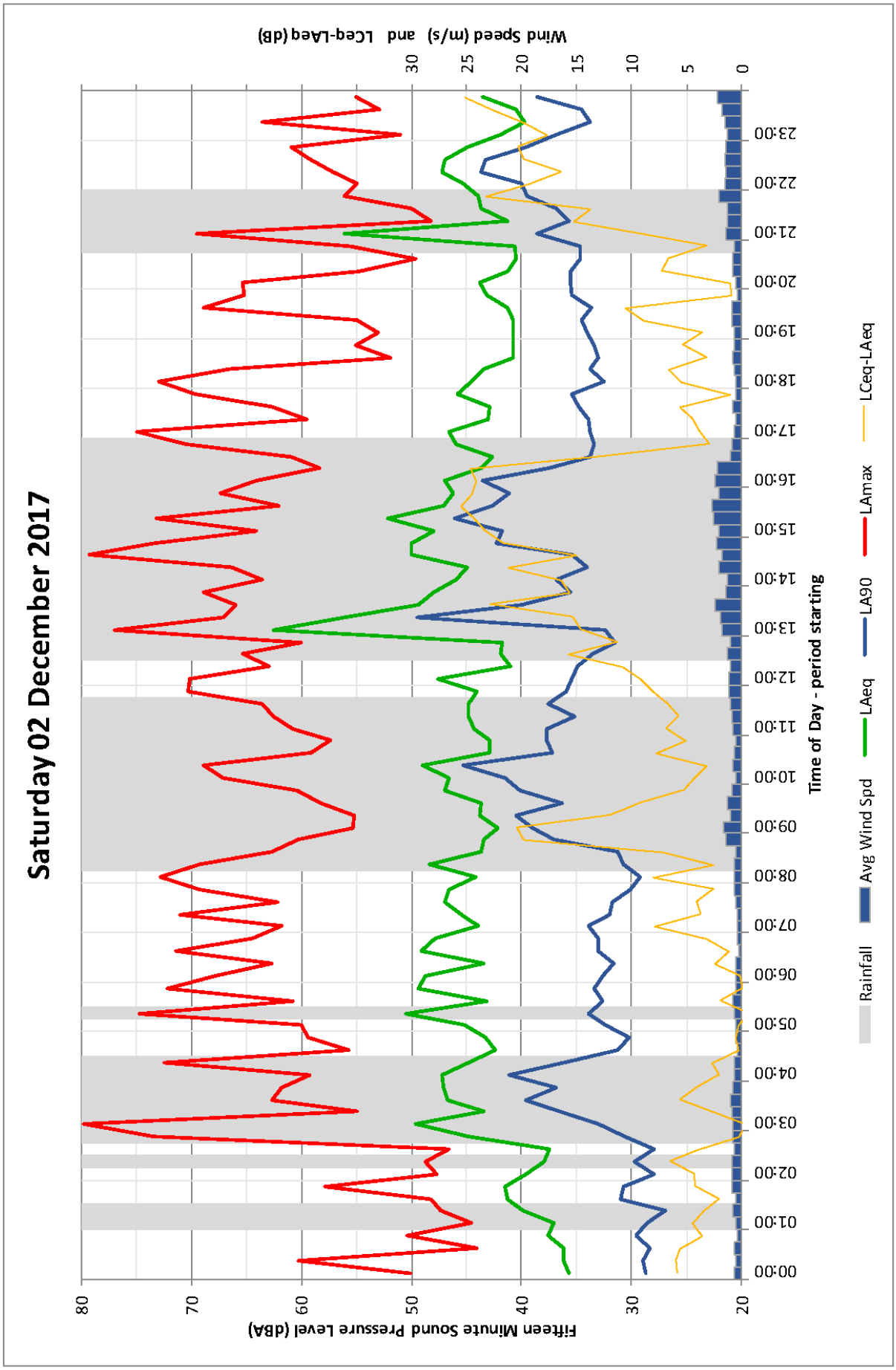
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LAeq
LA90
LAmax
LCeq-LAeq
Avg Wind Spd
Rainfall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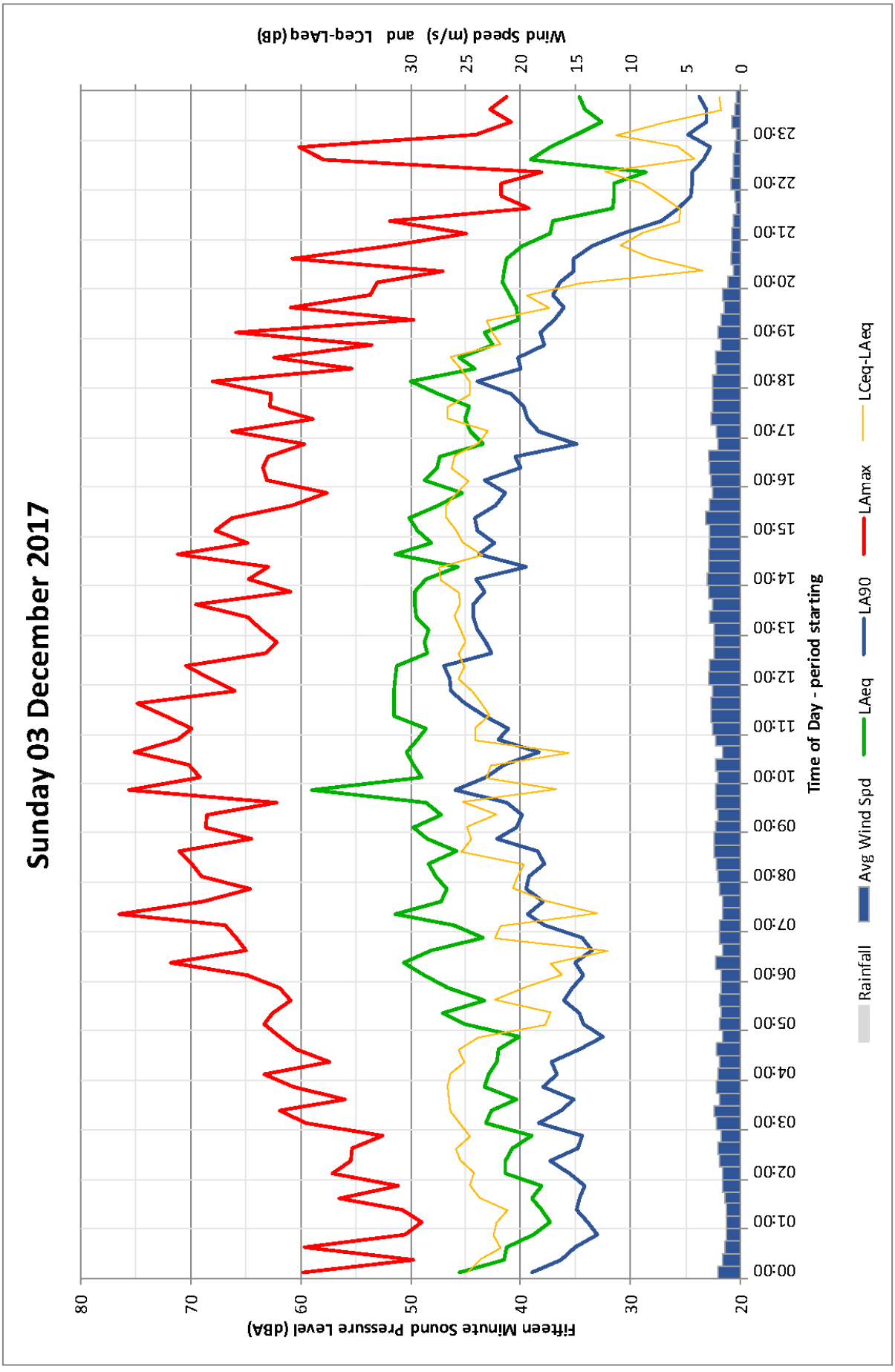
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall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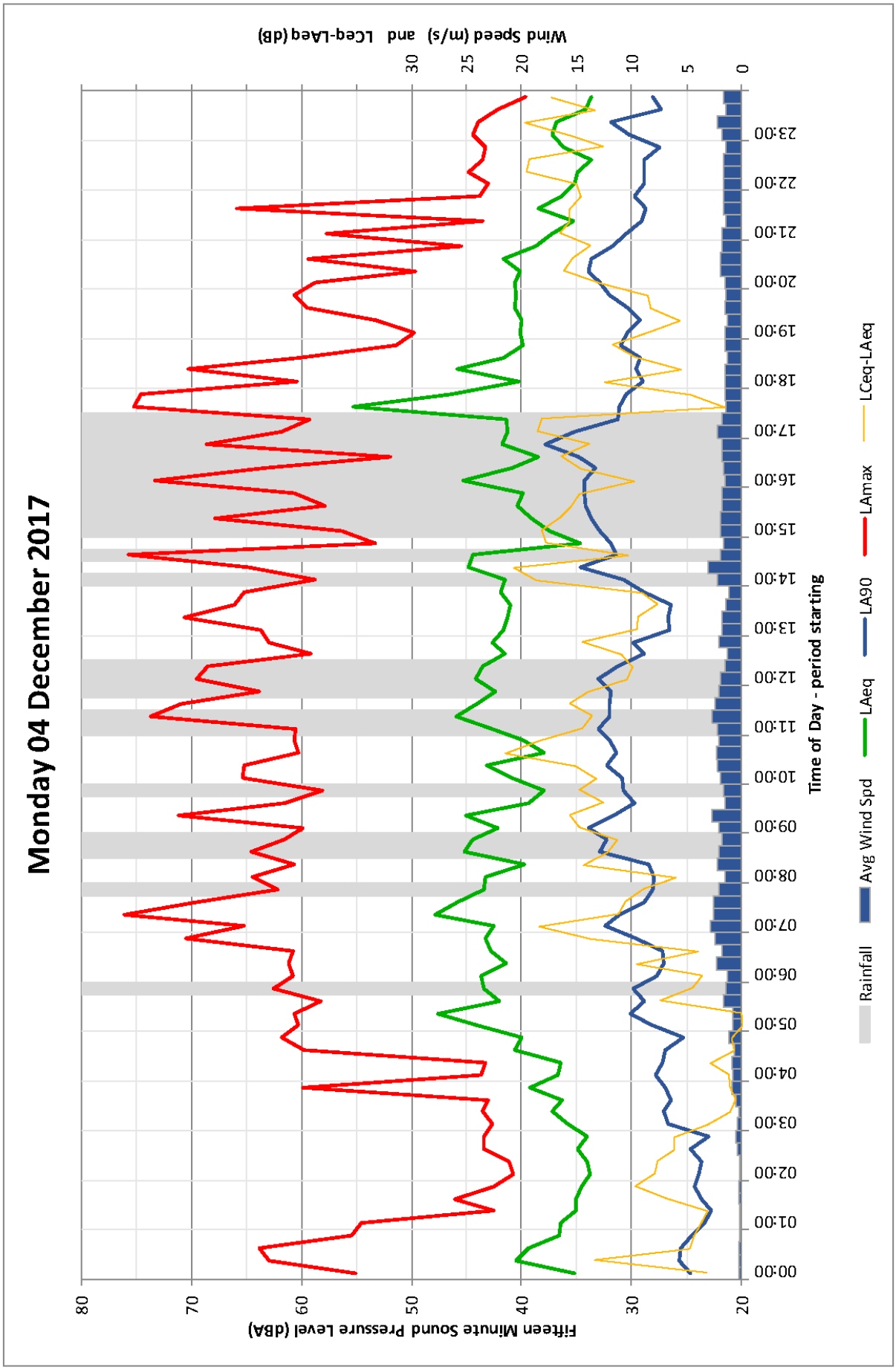
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LAmax
LA90
LAeq
LCeq-LAeq
Avg Wind Spd
Rainfall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Time of Day - period starting
LCeq-LAeq
LAmax
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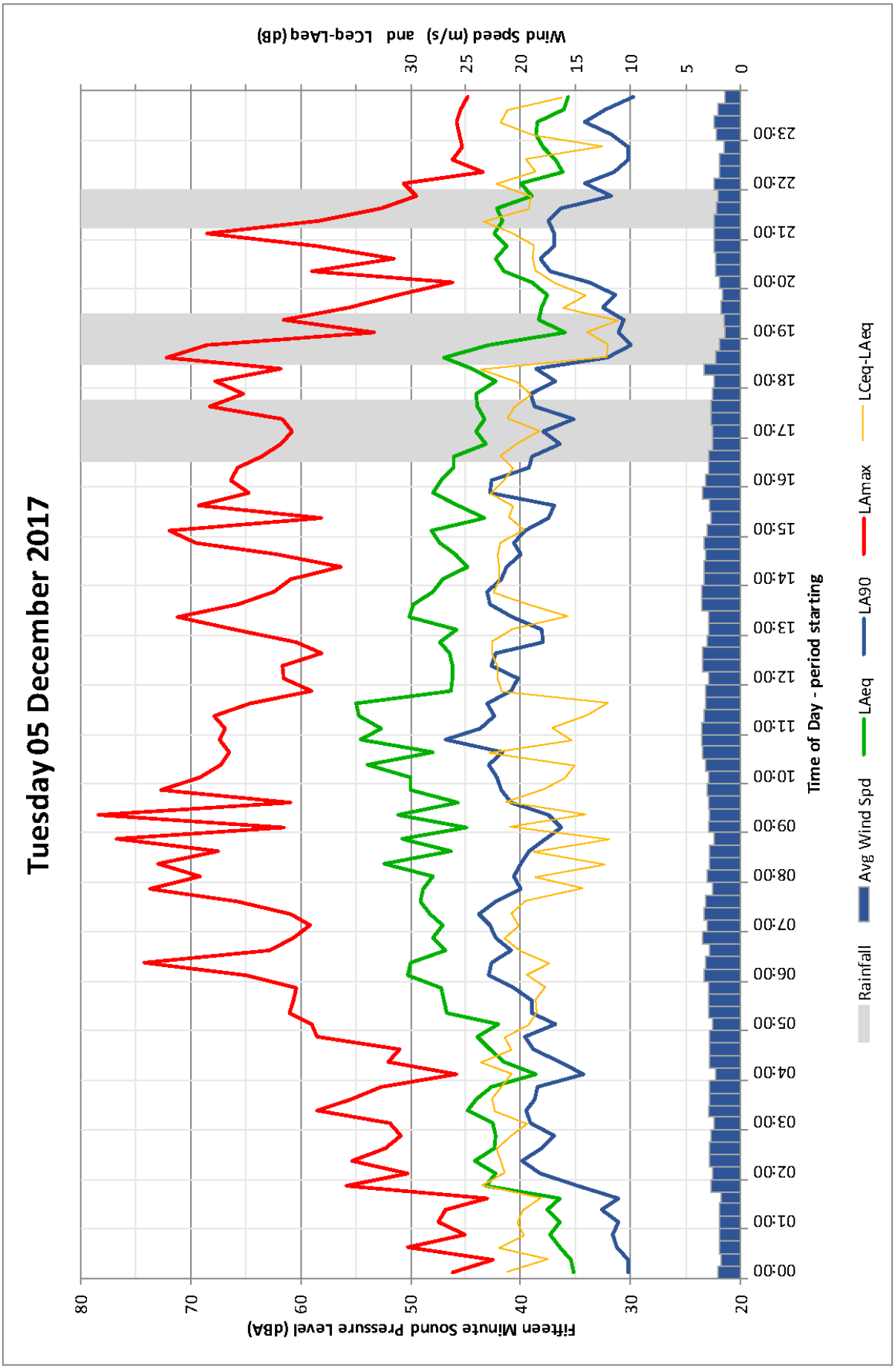
LAeq
Avg Wind Spd
Rainfall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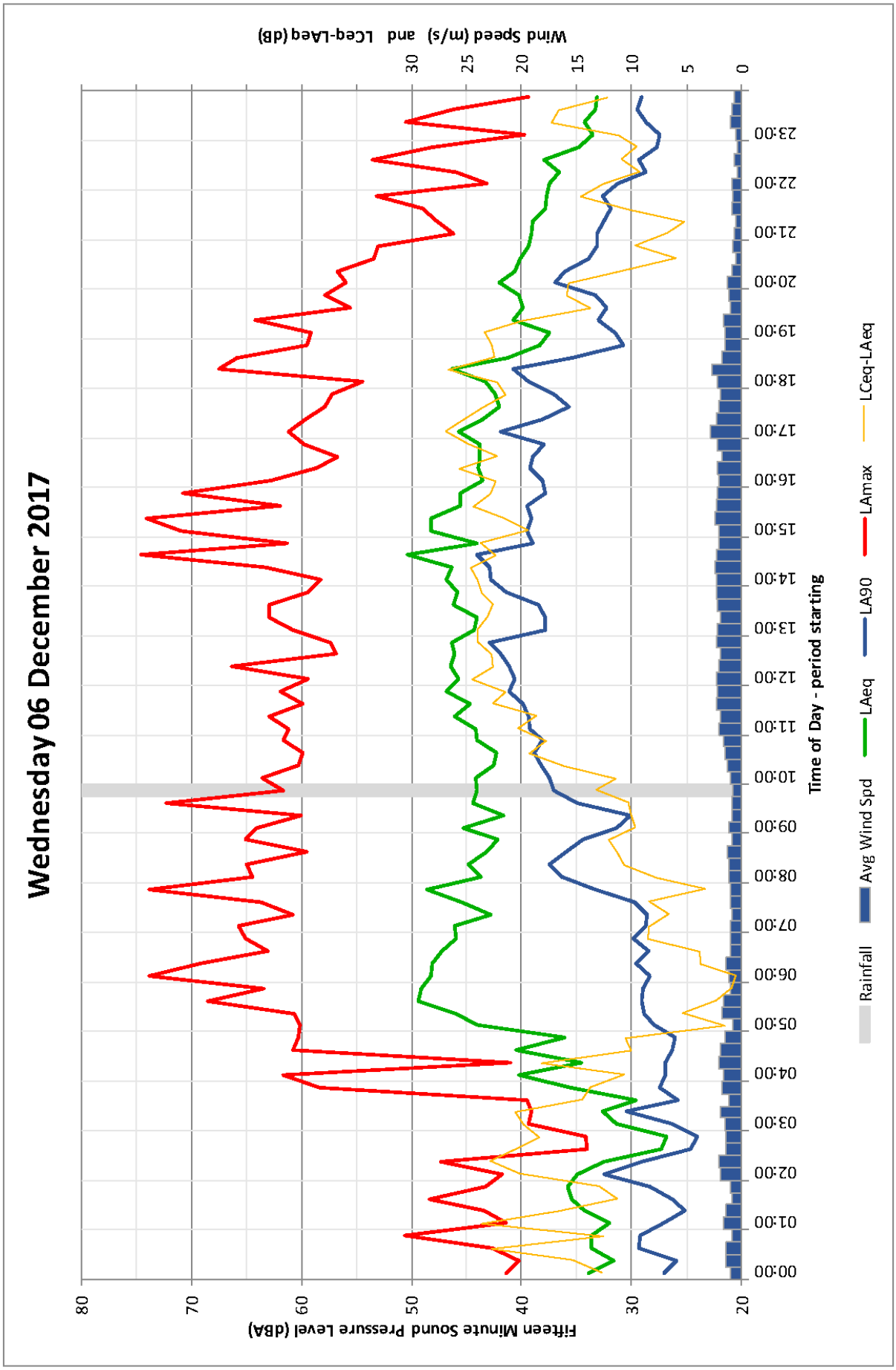
Time of Day - period starting
LAeq
LA90
LAmax
LCeq-LAeq
Avg Wind Spd
Rainfall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LCeq-LAeq
LAmax
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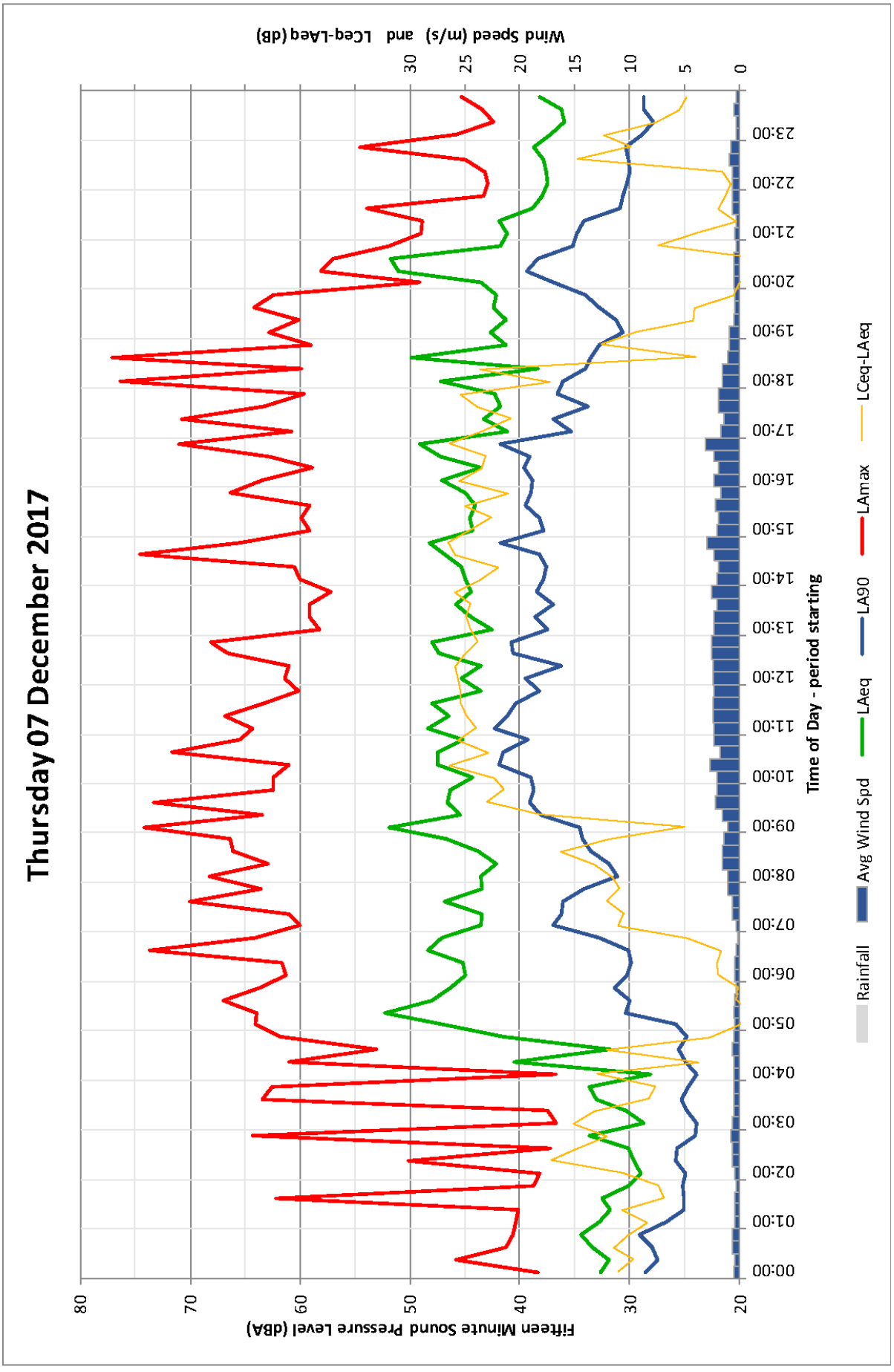
LAeq
Avg Wind Spd
Rainfall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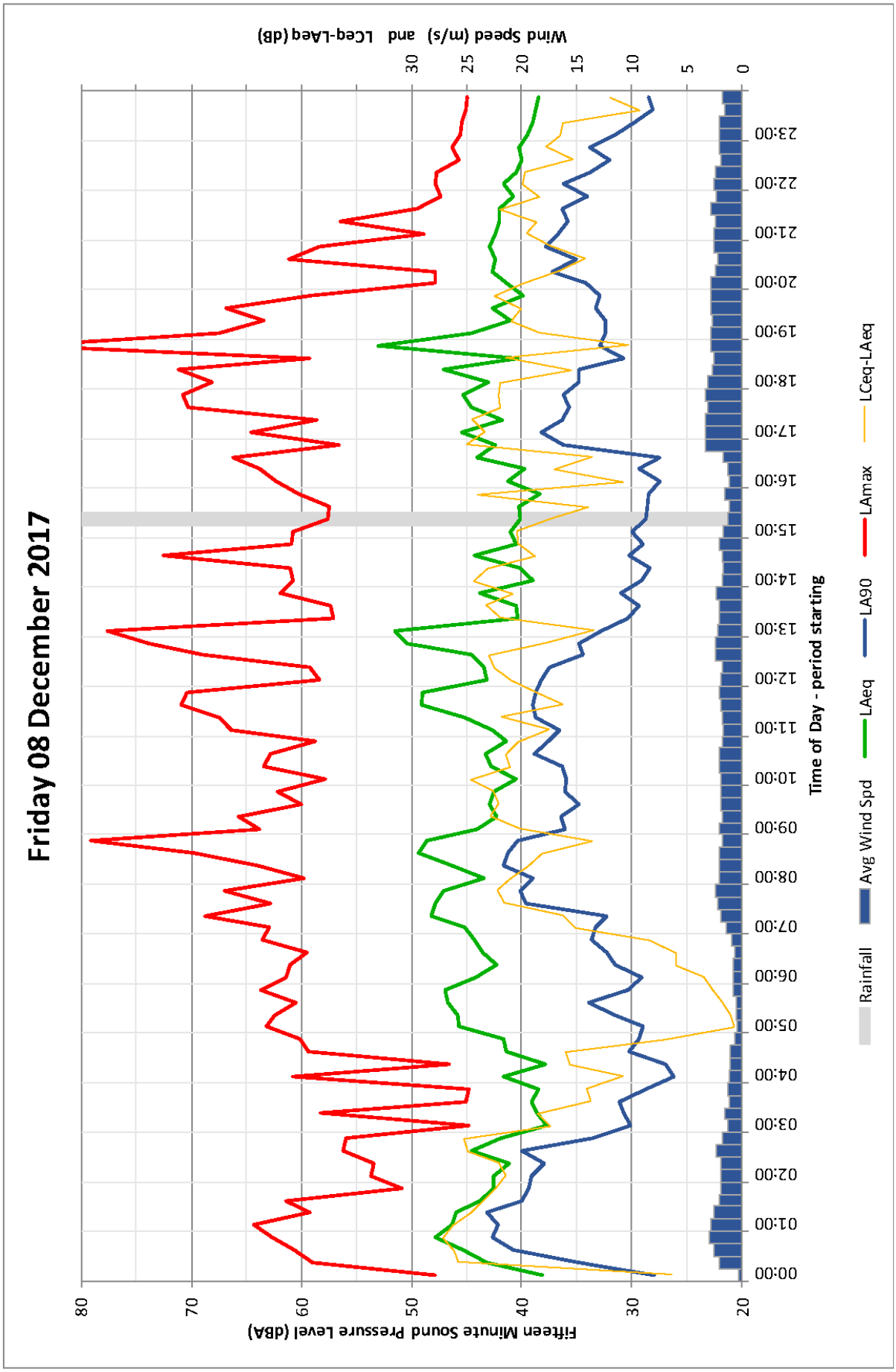
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq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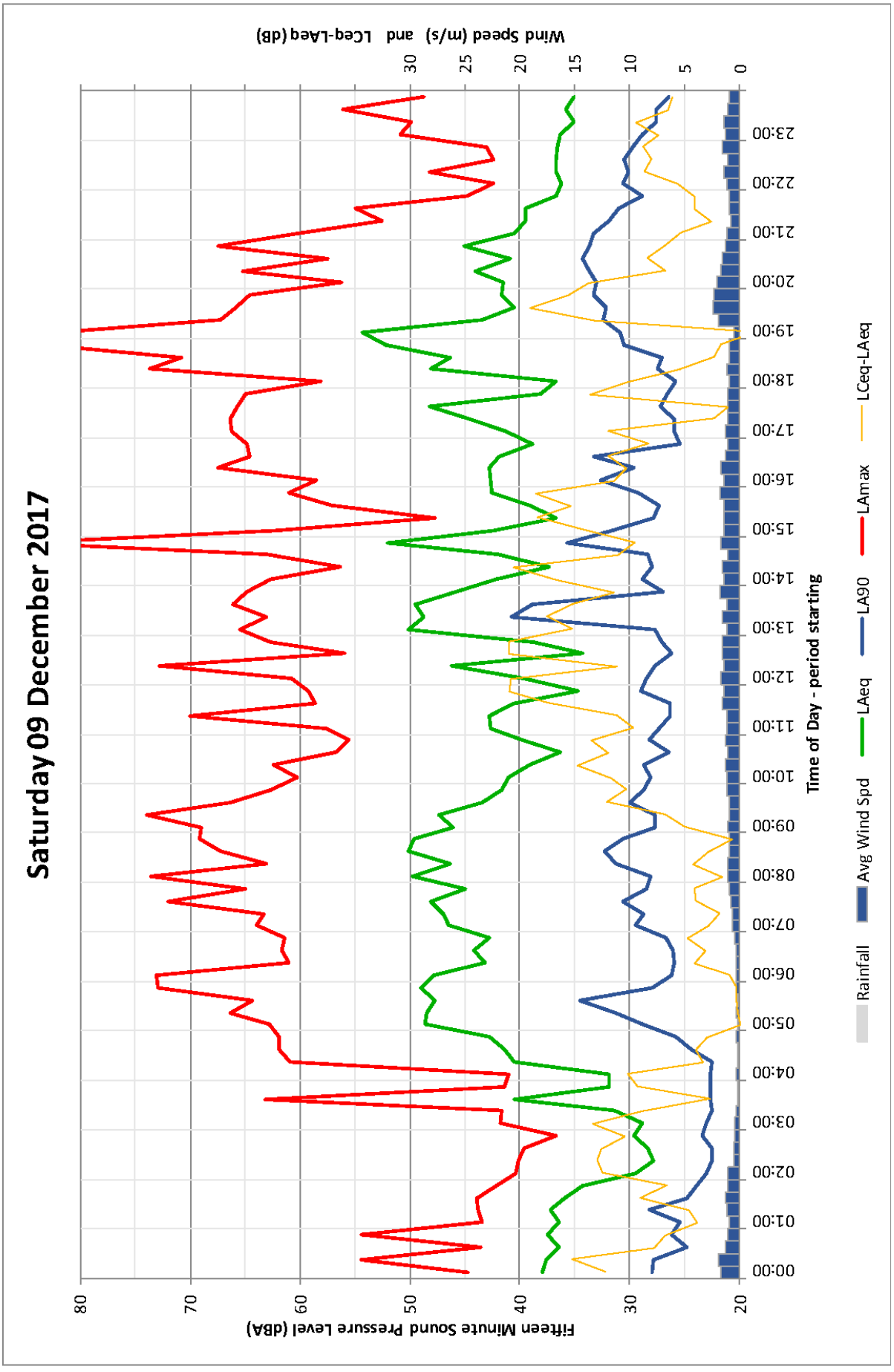
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall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Time of Day - period starting
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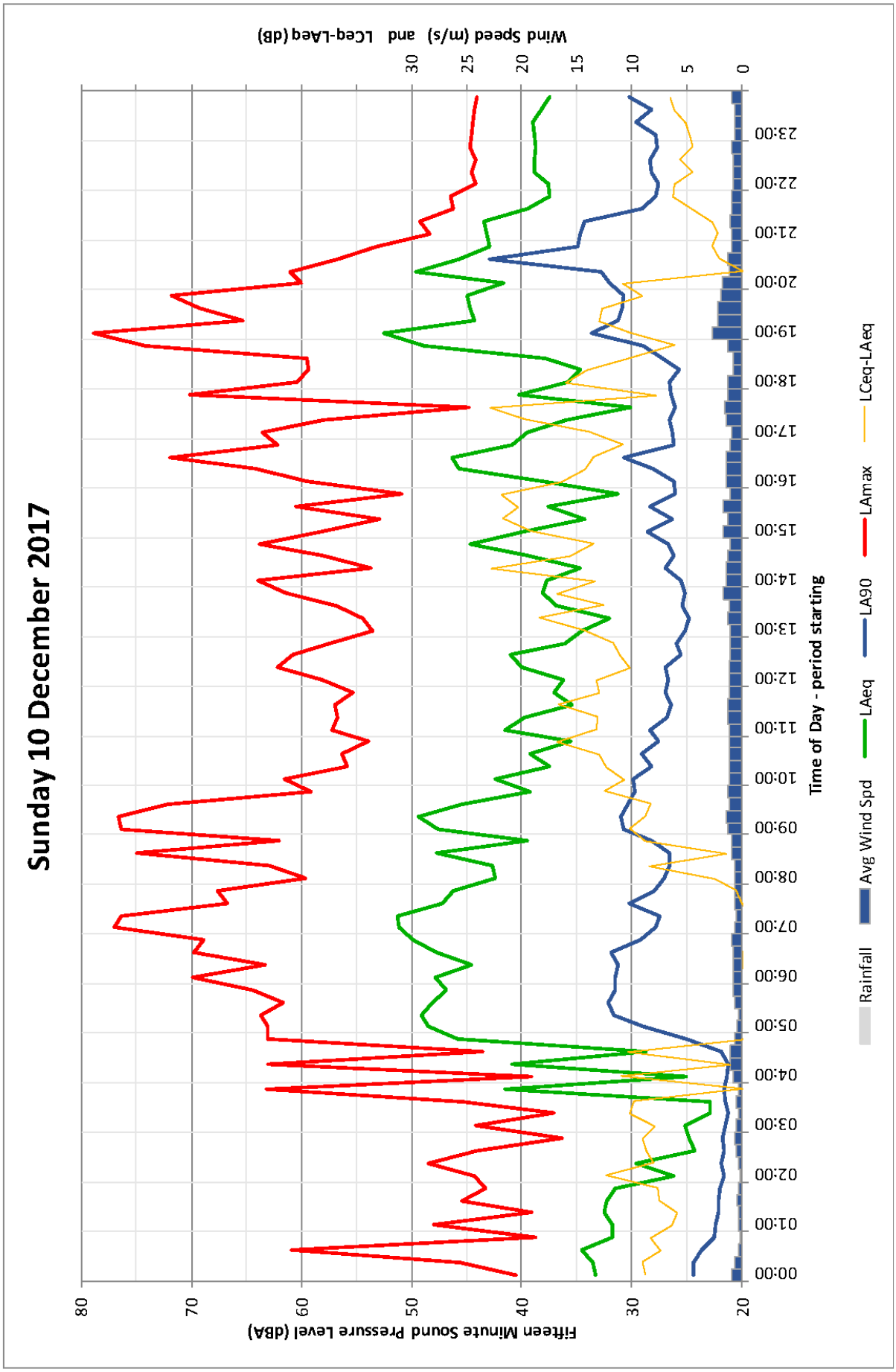
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq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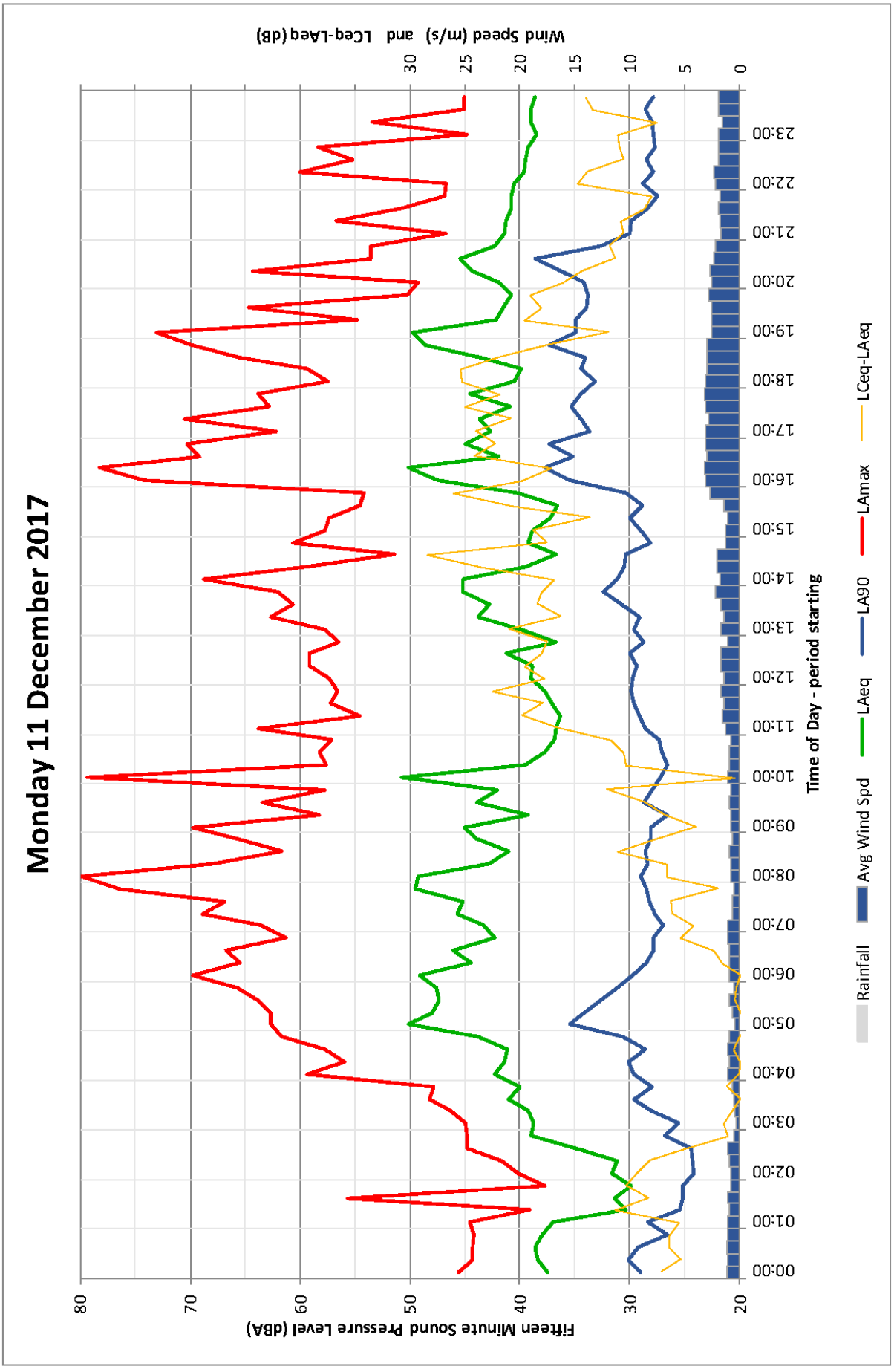
Time of Day - period starting
LAeq
LA90
LAmax
LCeq-LAeq
Avg Wind Spd
Rainfall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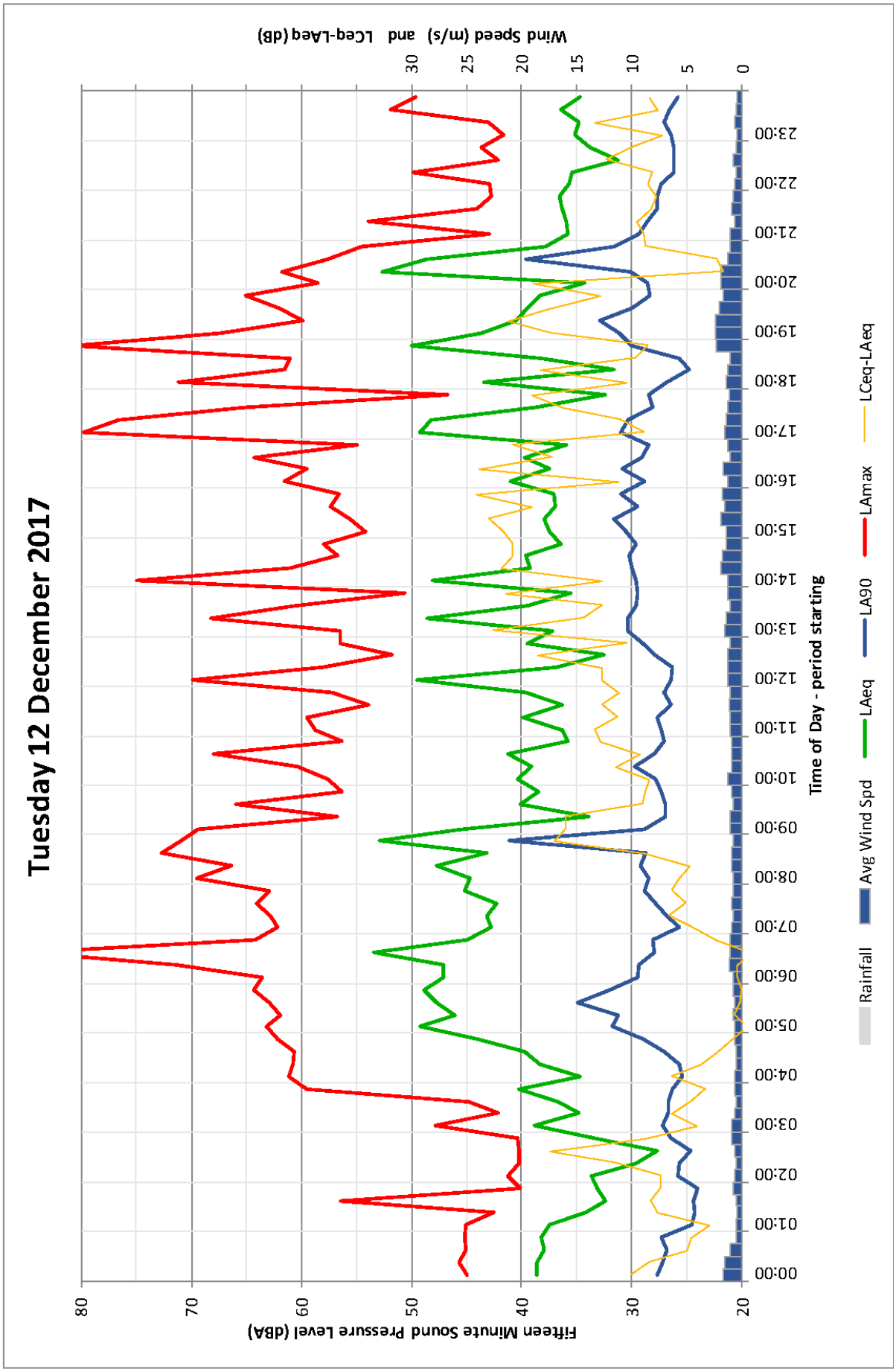
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq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LCeq-LAeq
LAmax
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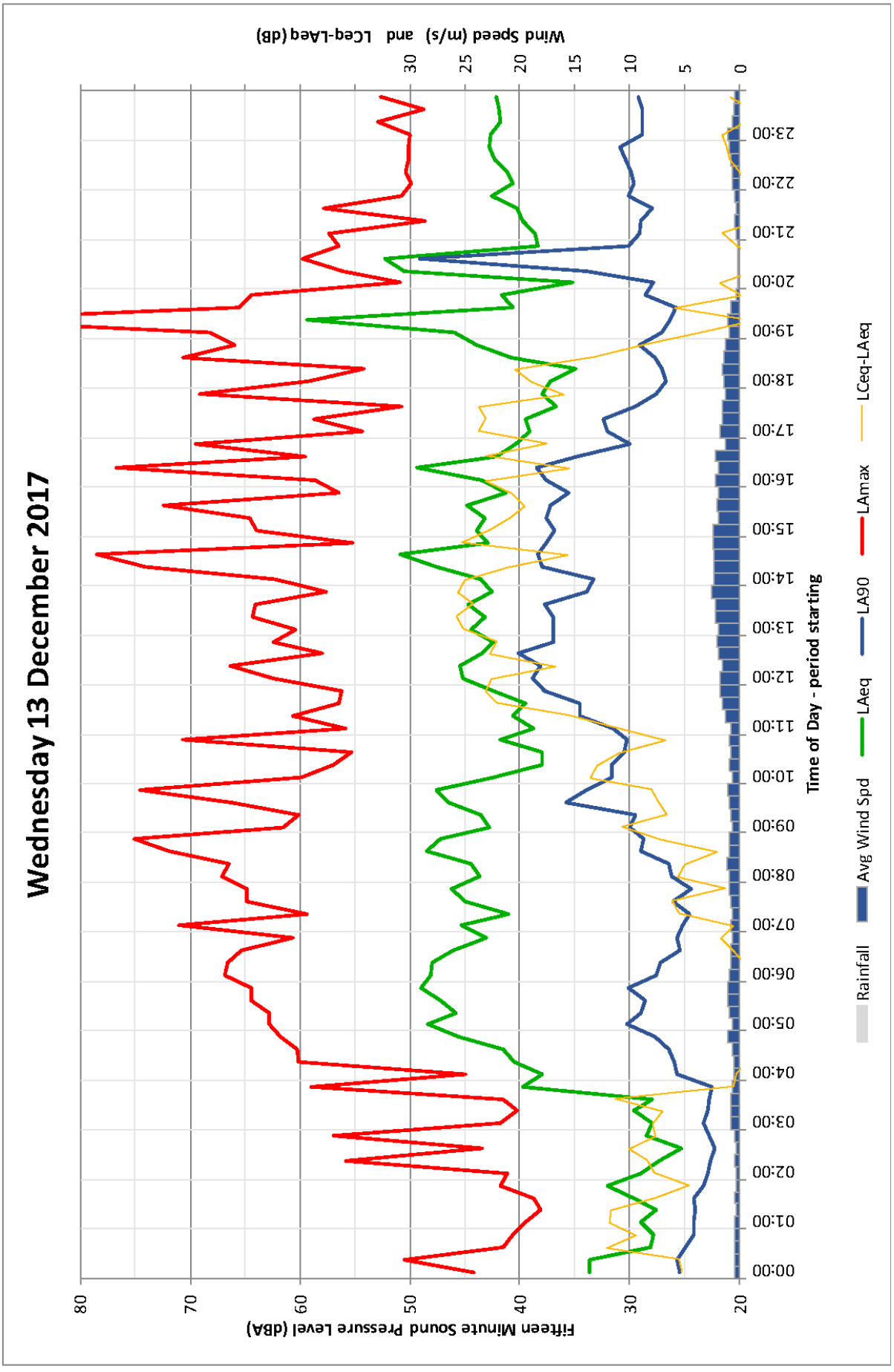
LAeq
Avg Wind Spd
Rainfall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Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
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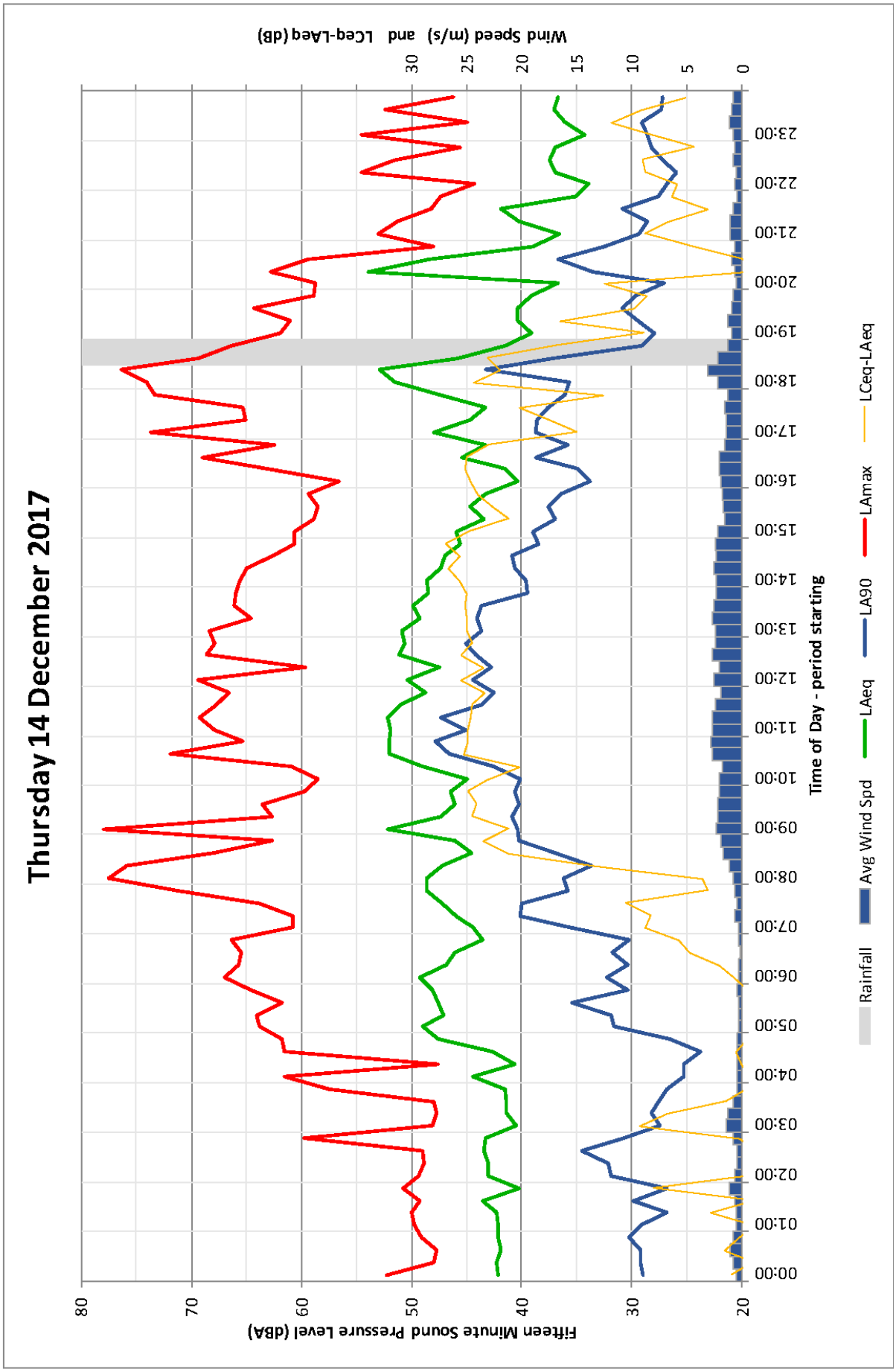
LA90
LAmax
LCeq-LAeq


Thursday 14 December 2017
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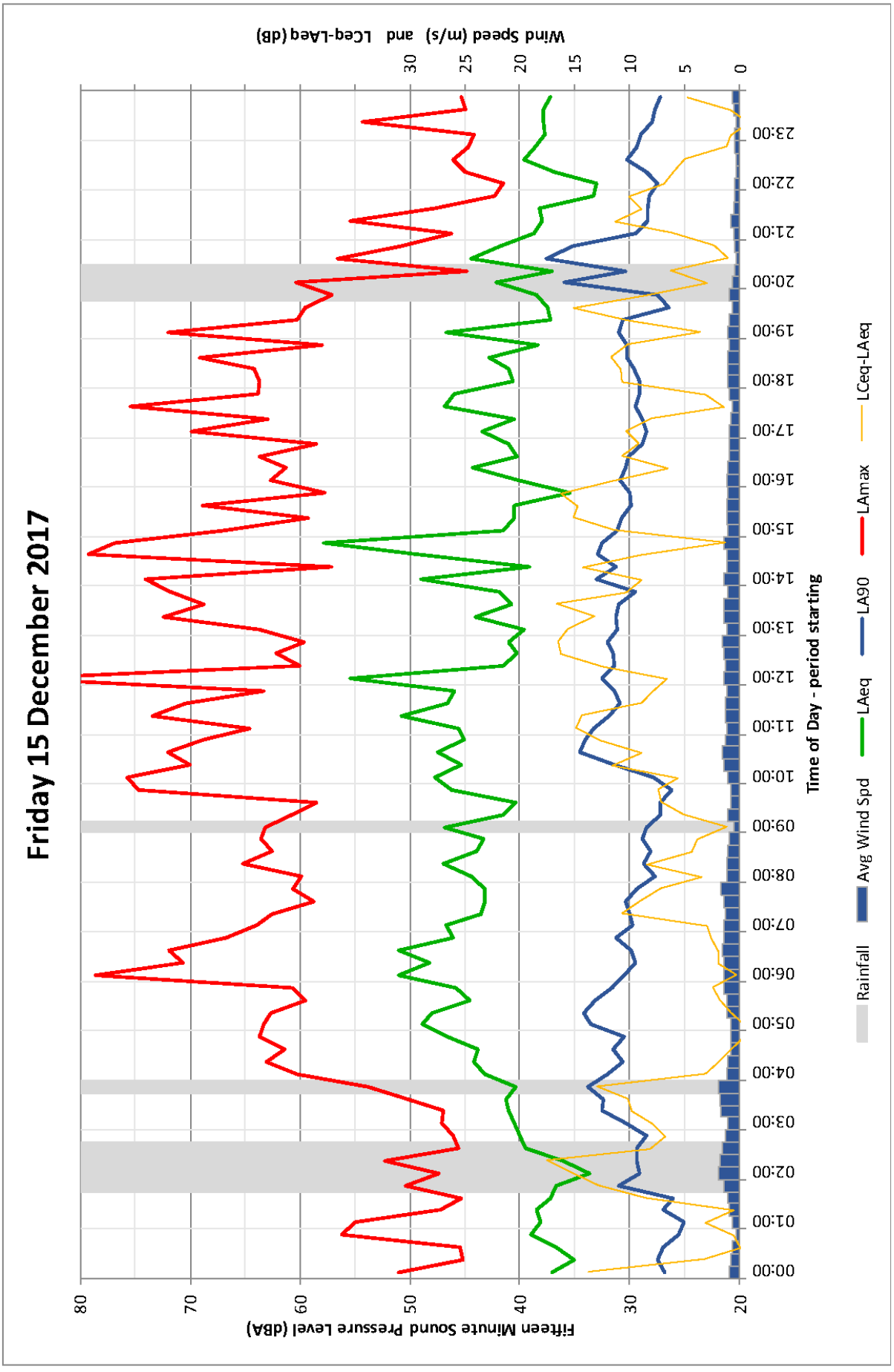
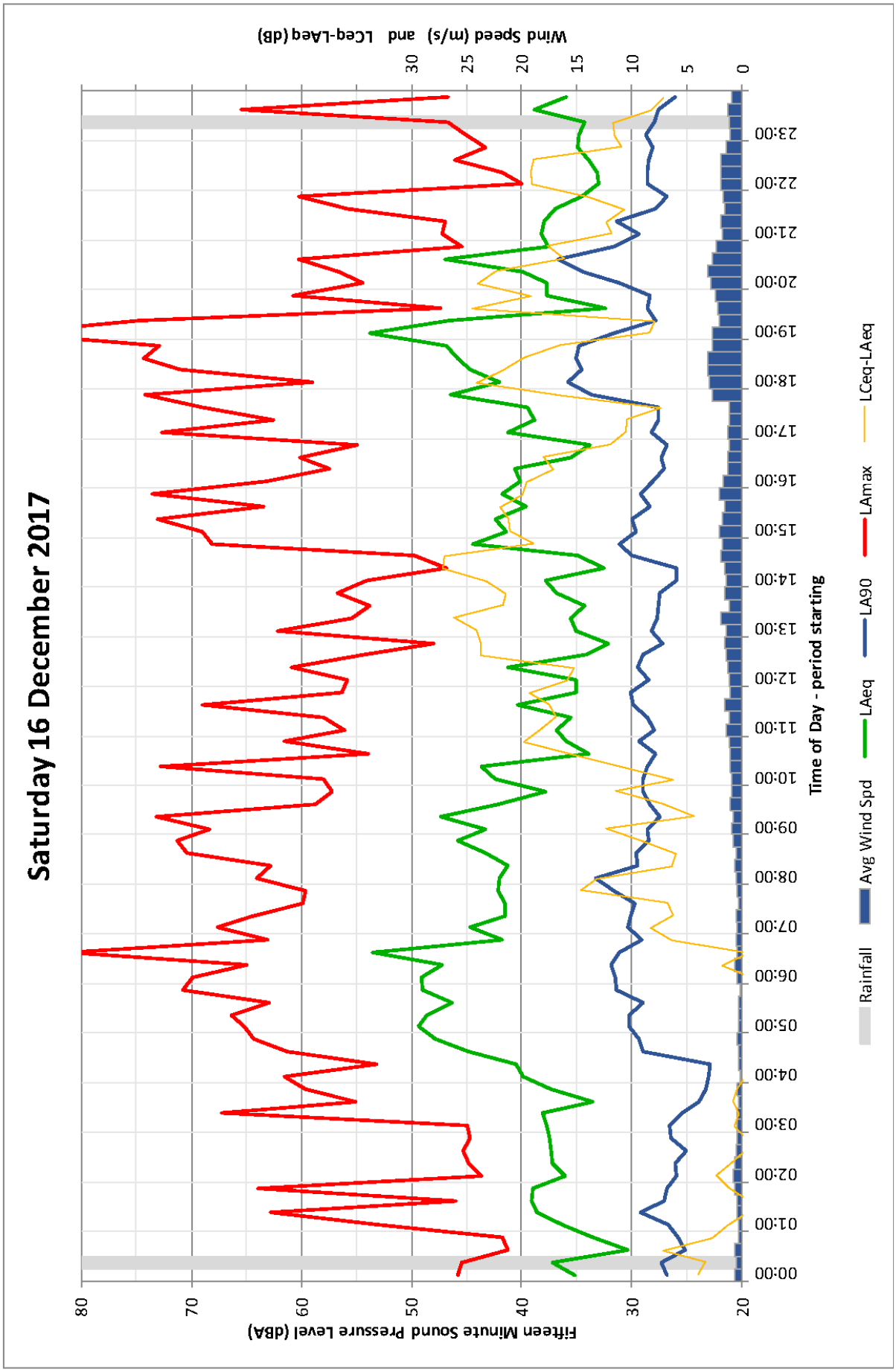
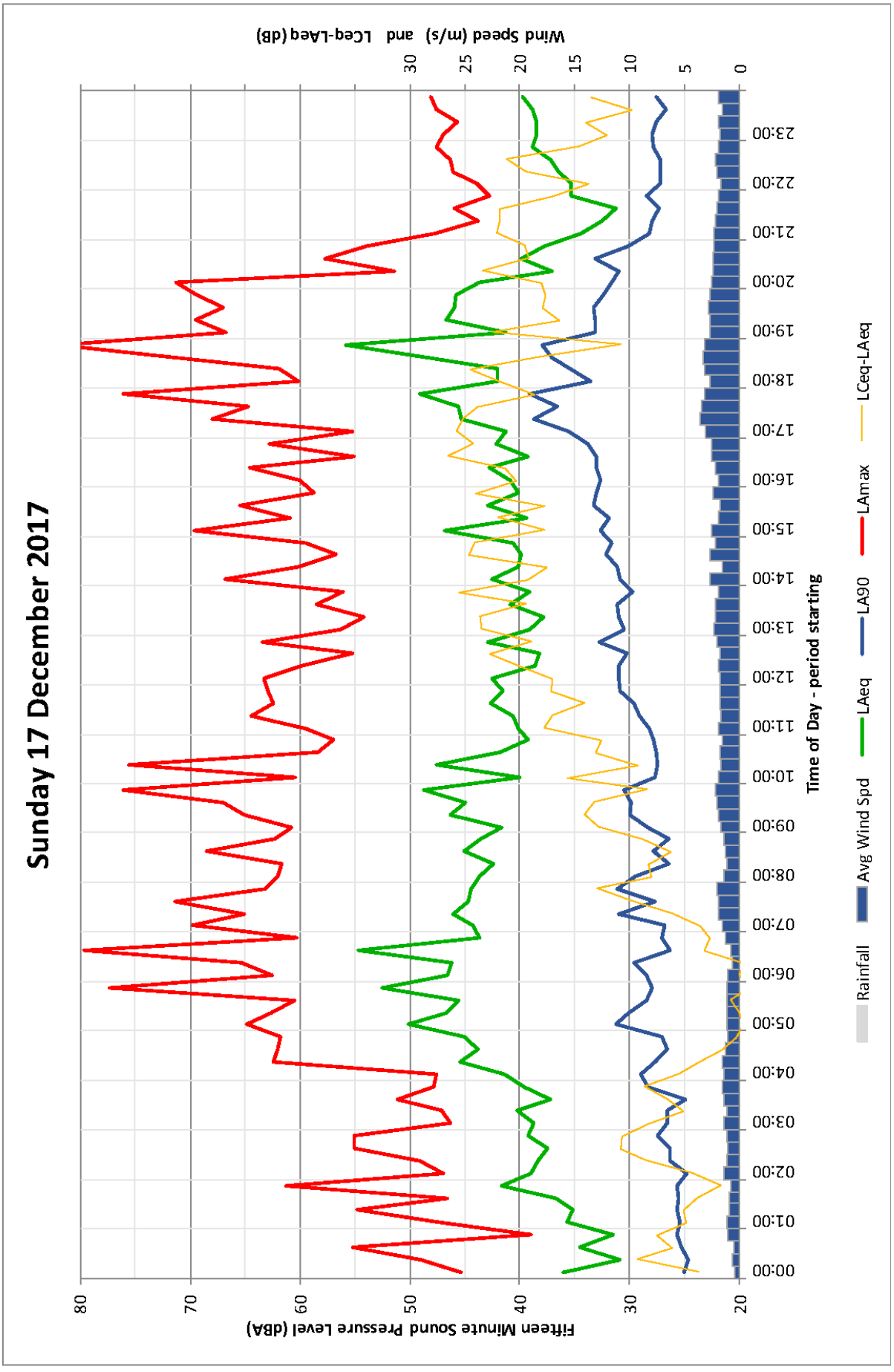
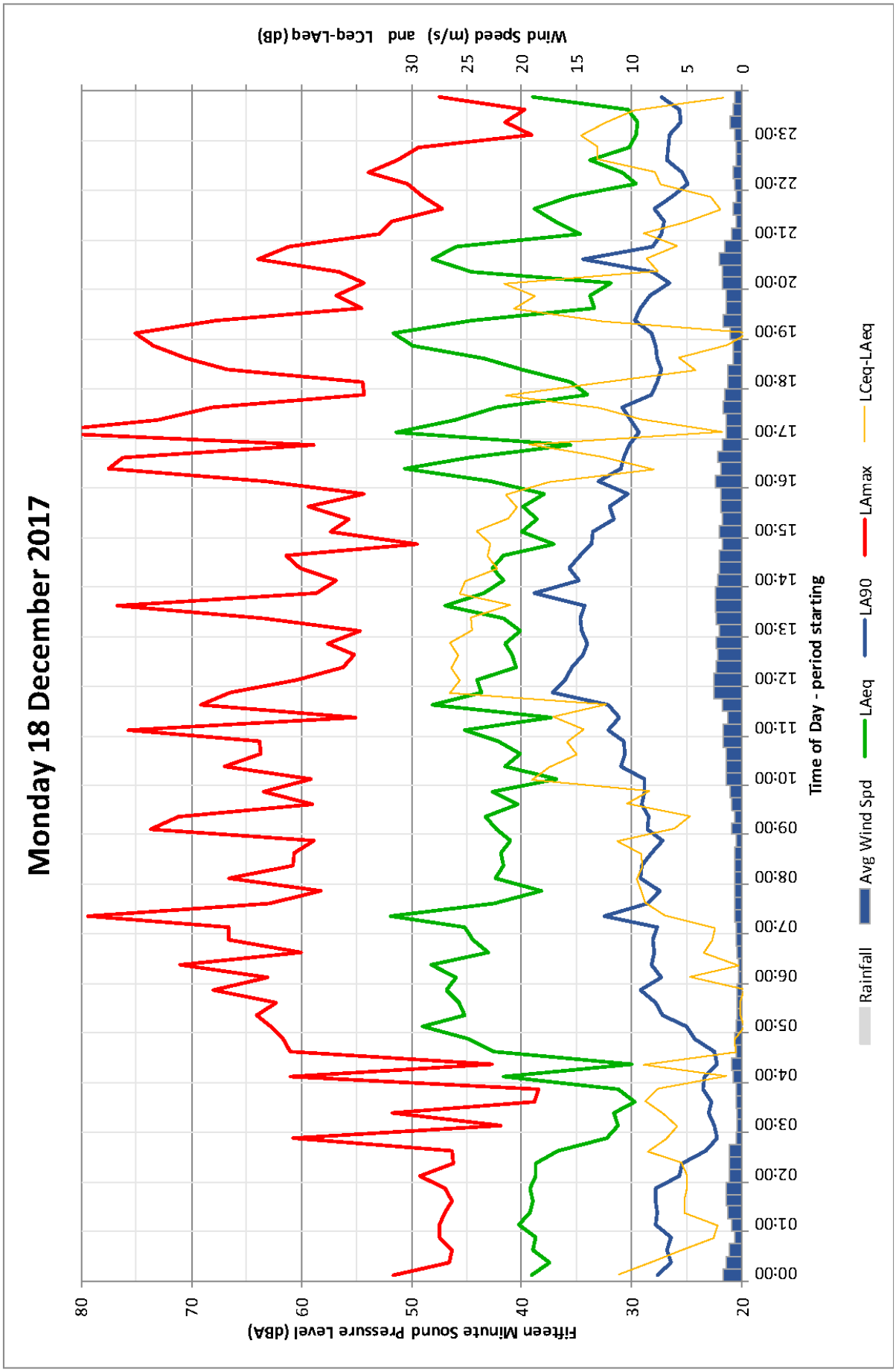
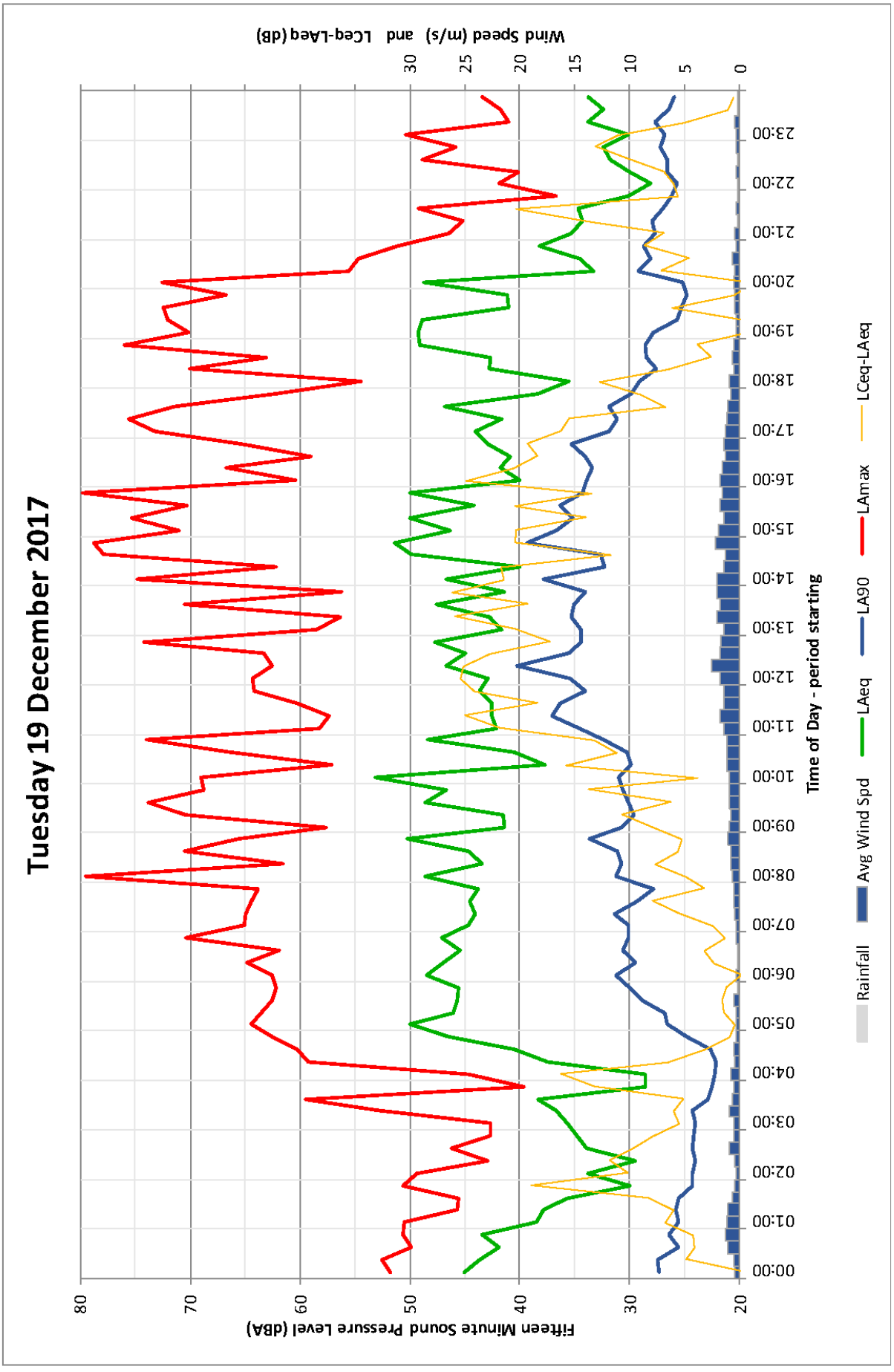
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

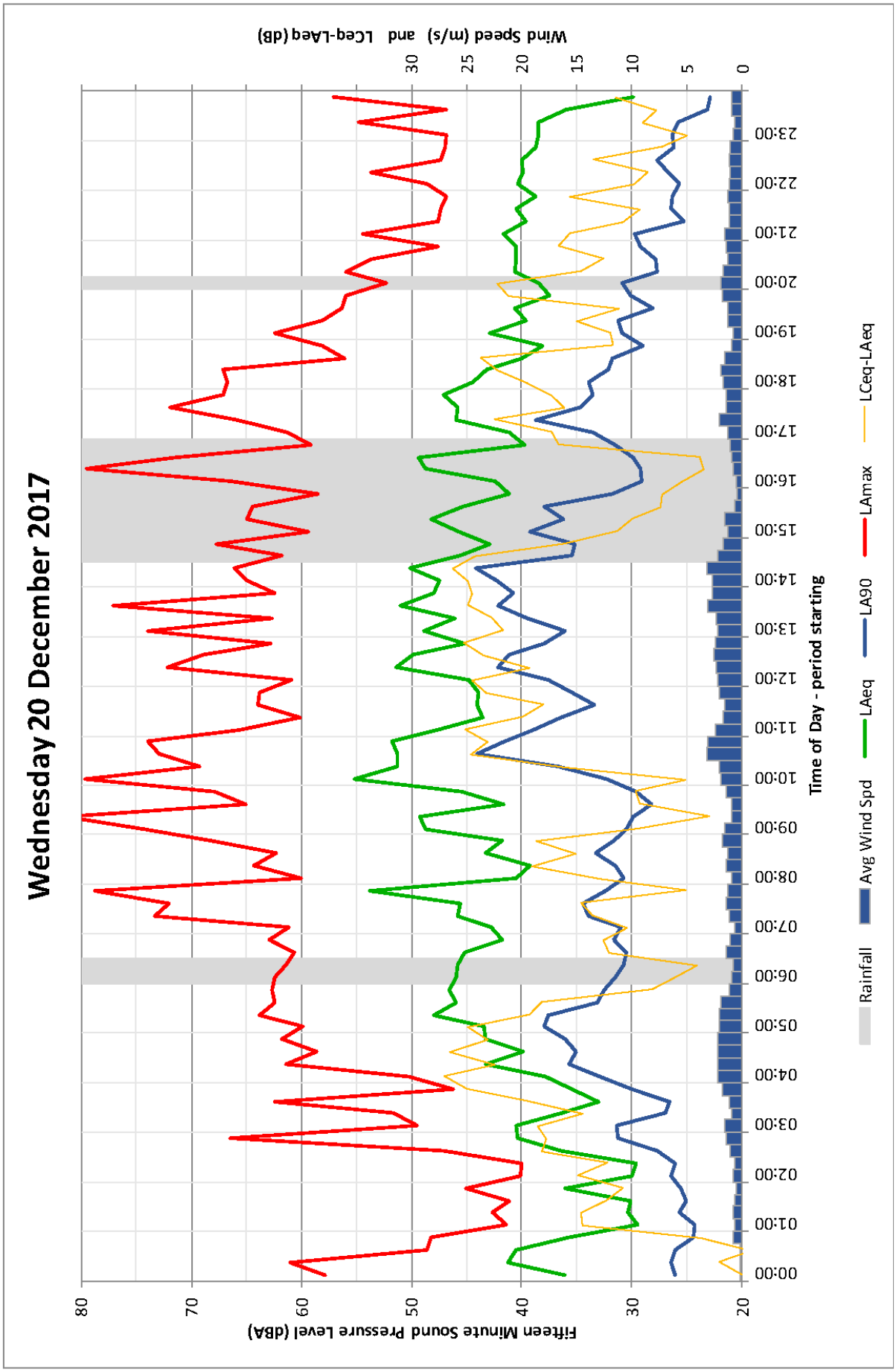

Friday 15 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

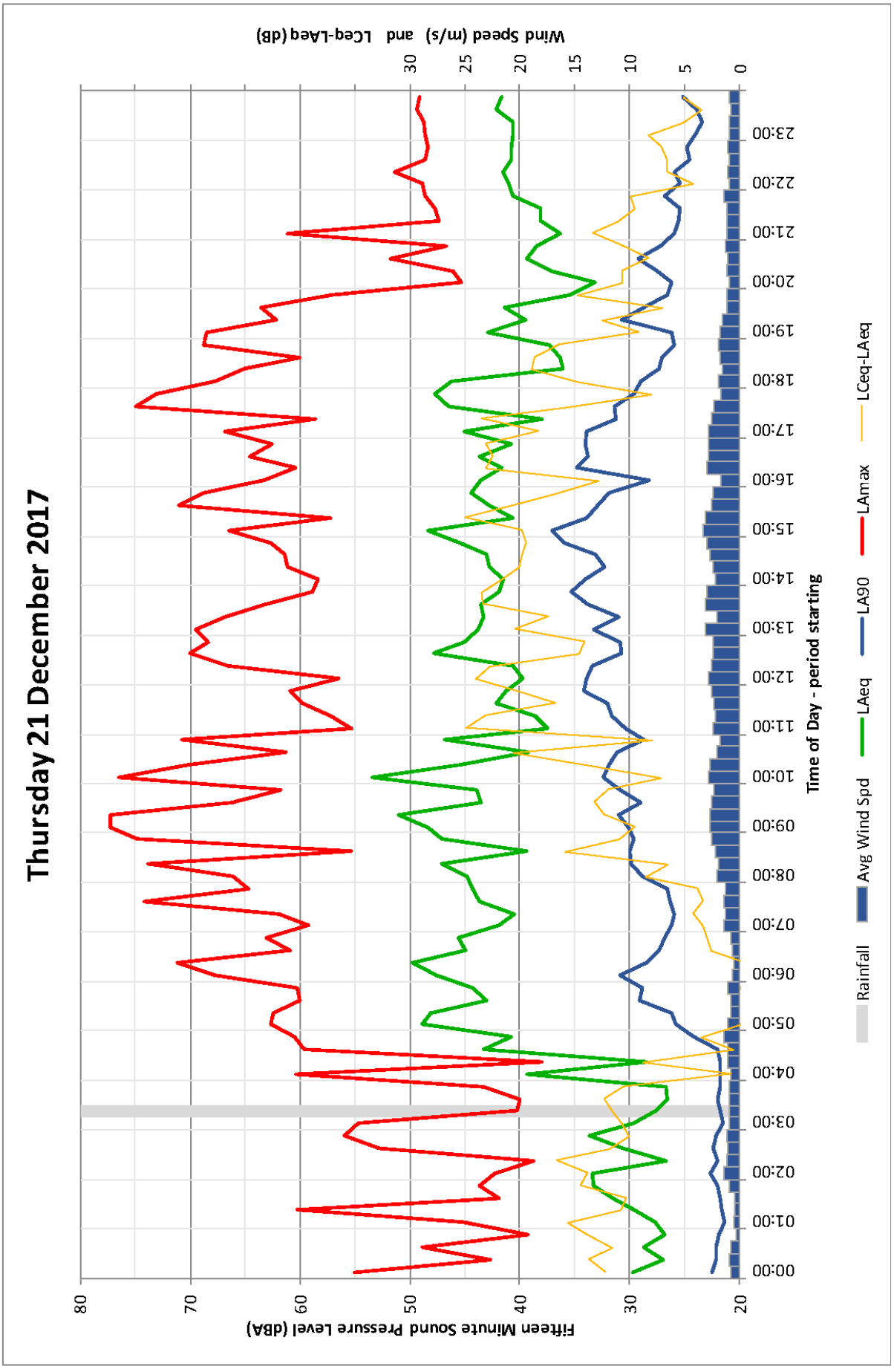

Saturday 16 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

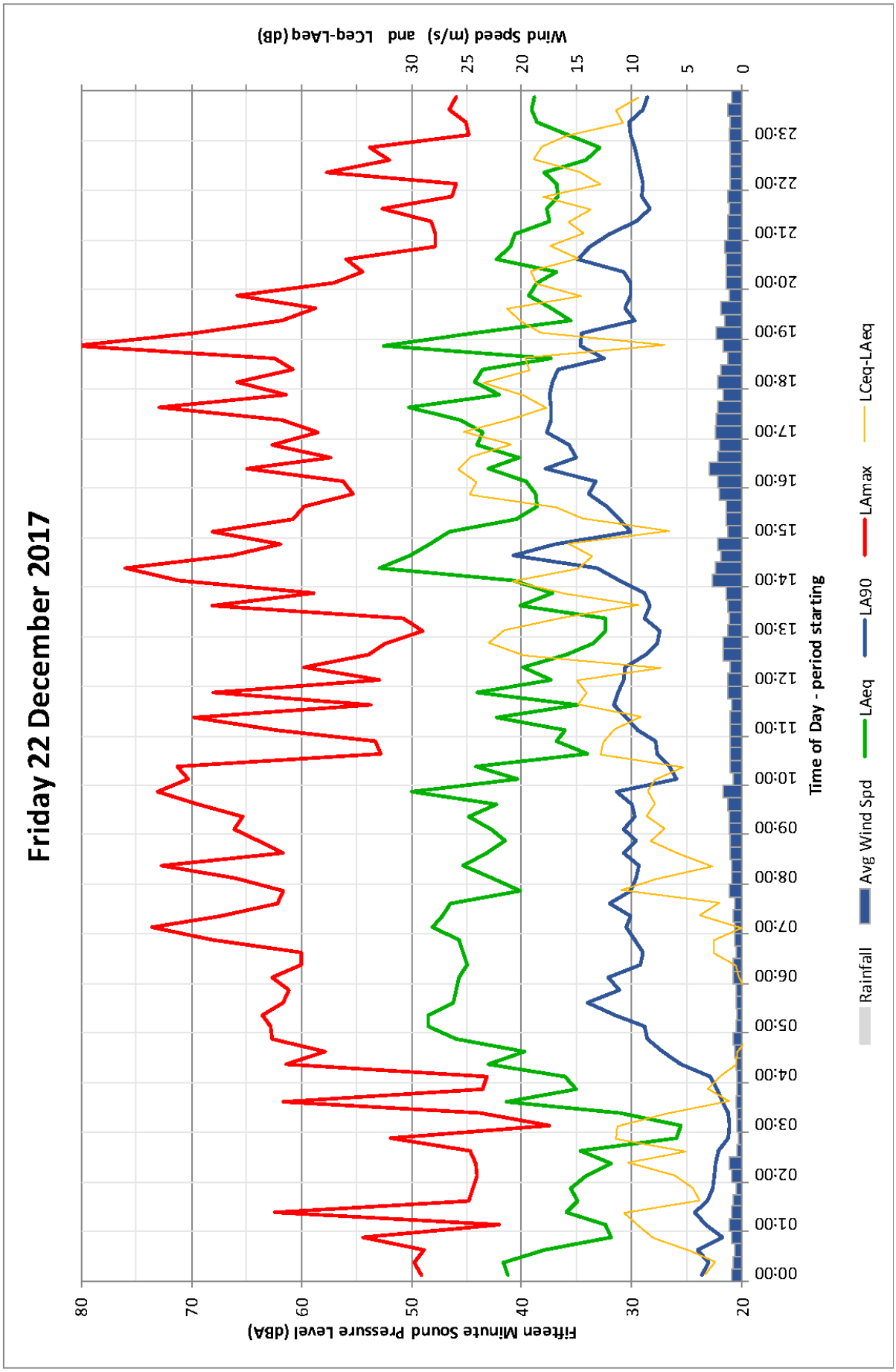

Sunday 17 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

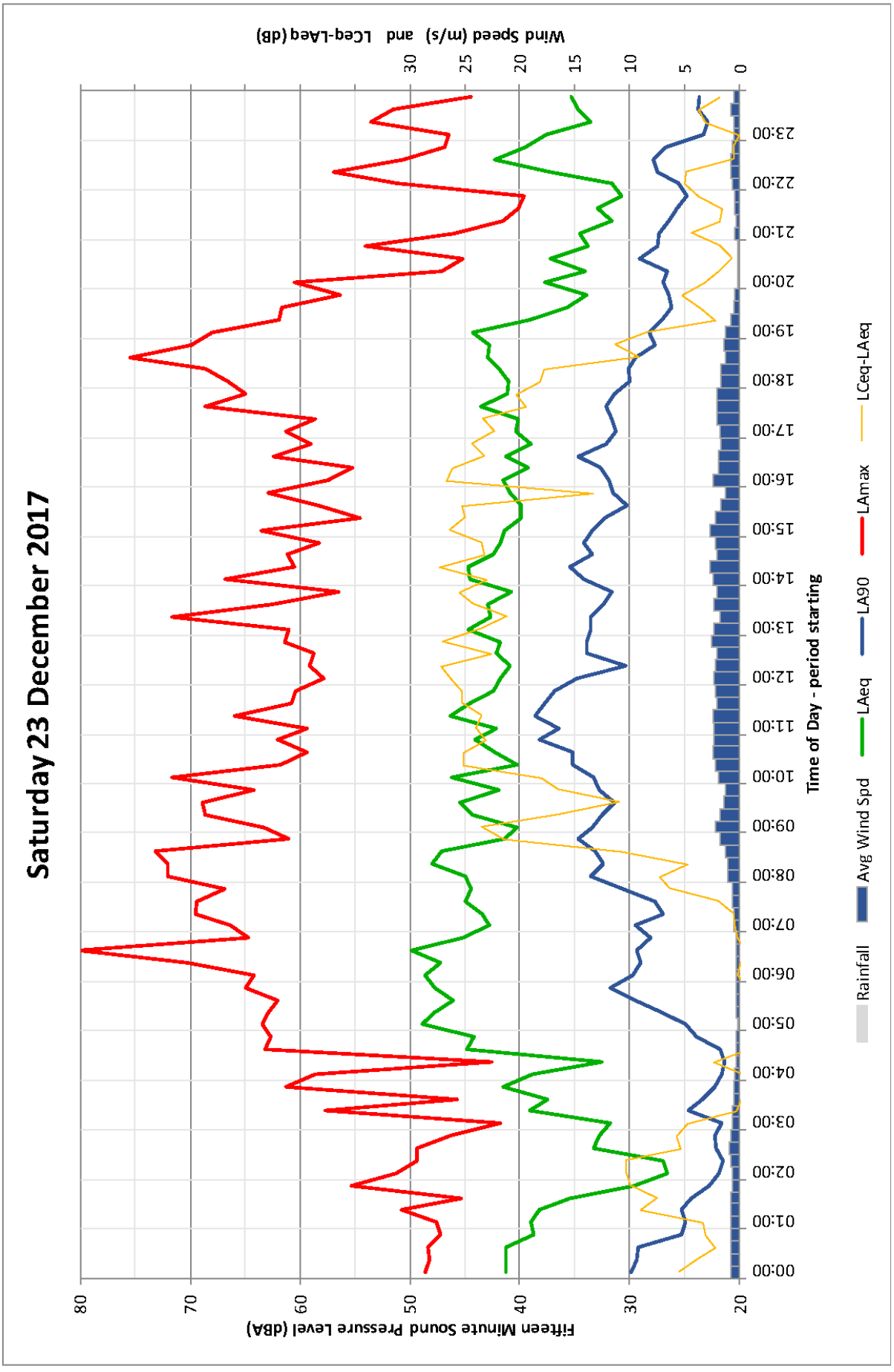

Monday 18 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall
LCeq-LAeq

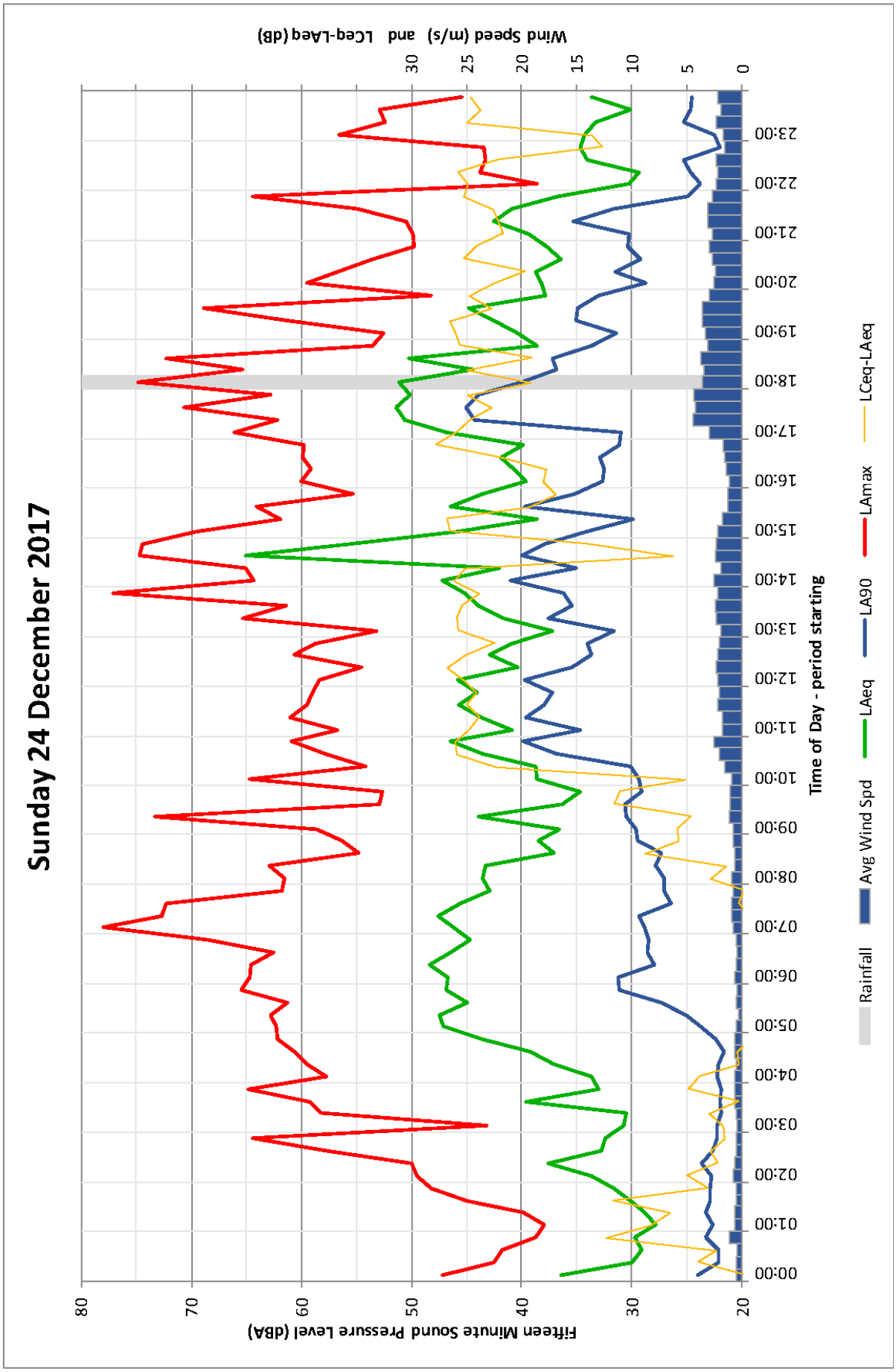

Tuesday 19 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

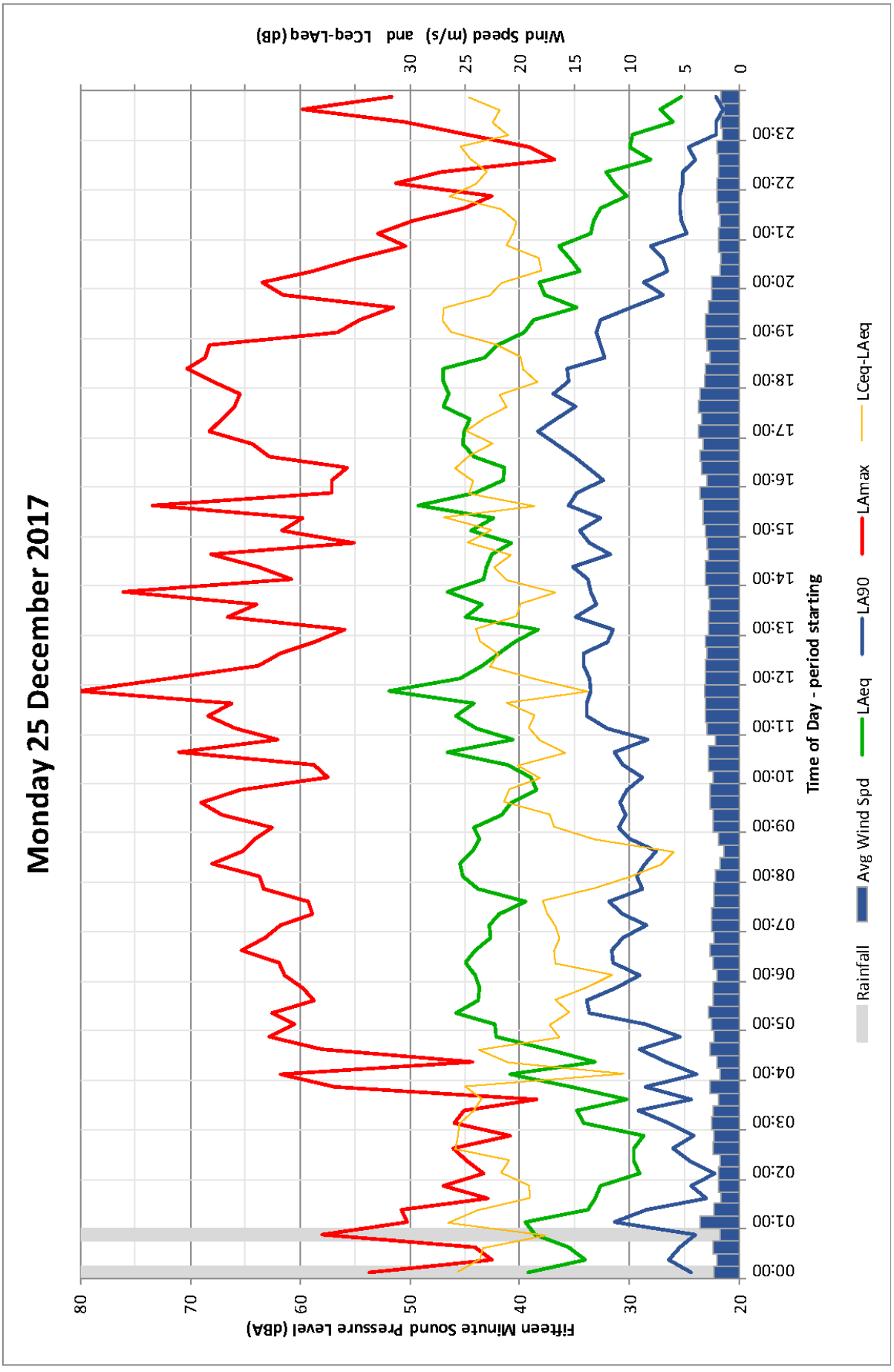

Wednesday 20 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

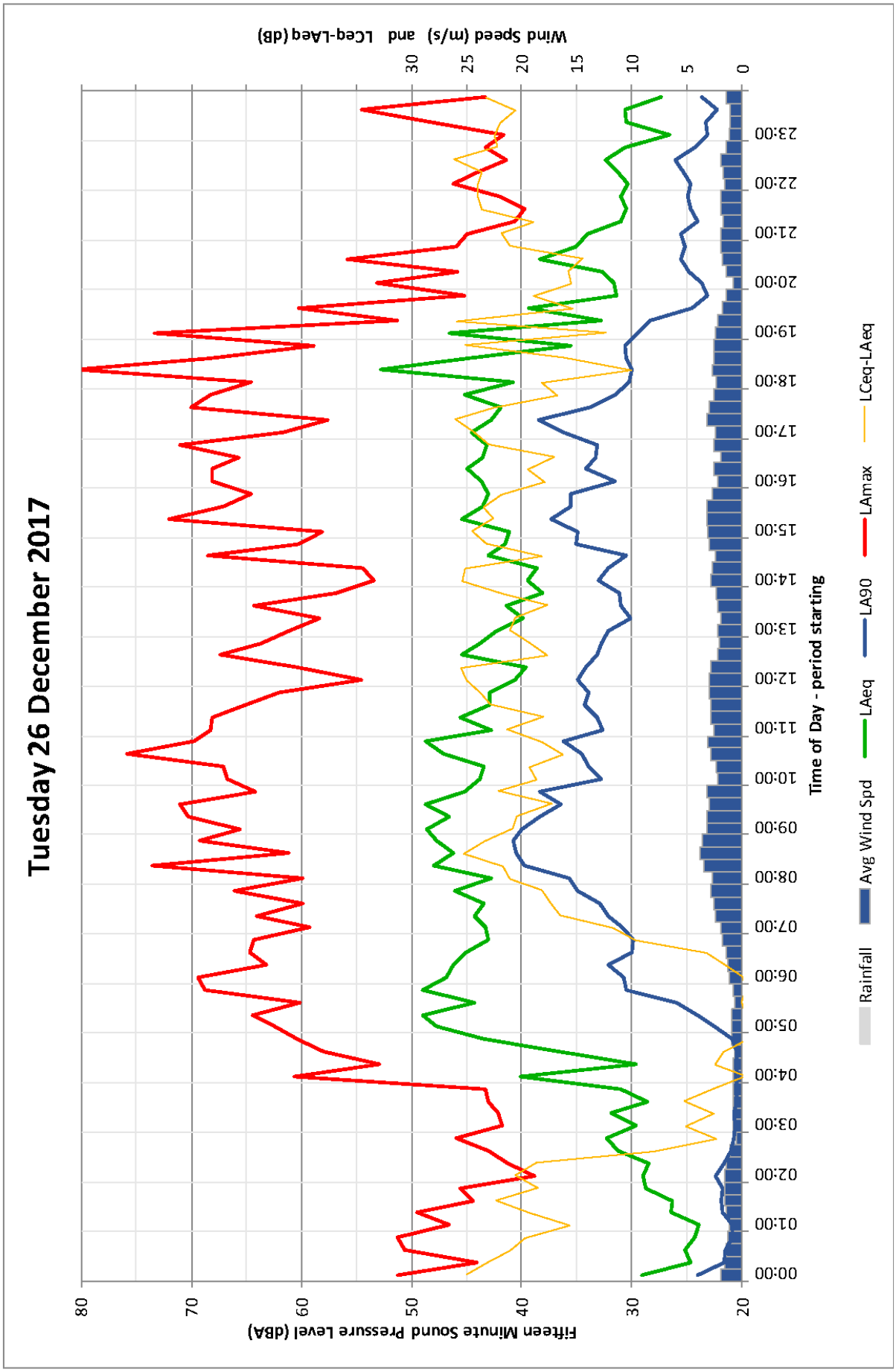

Thursday 21 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

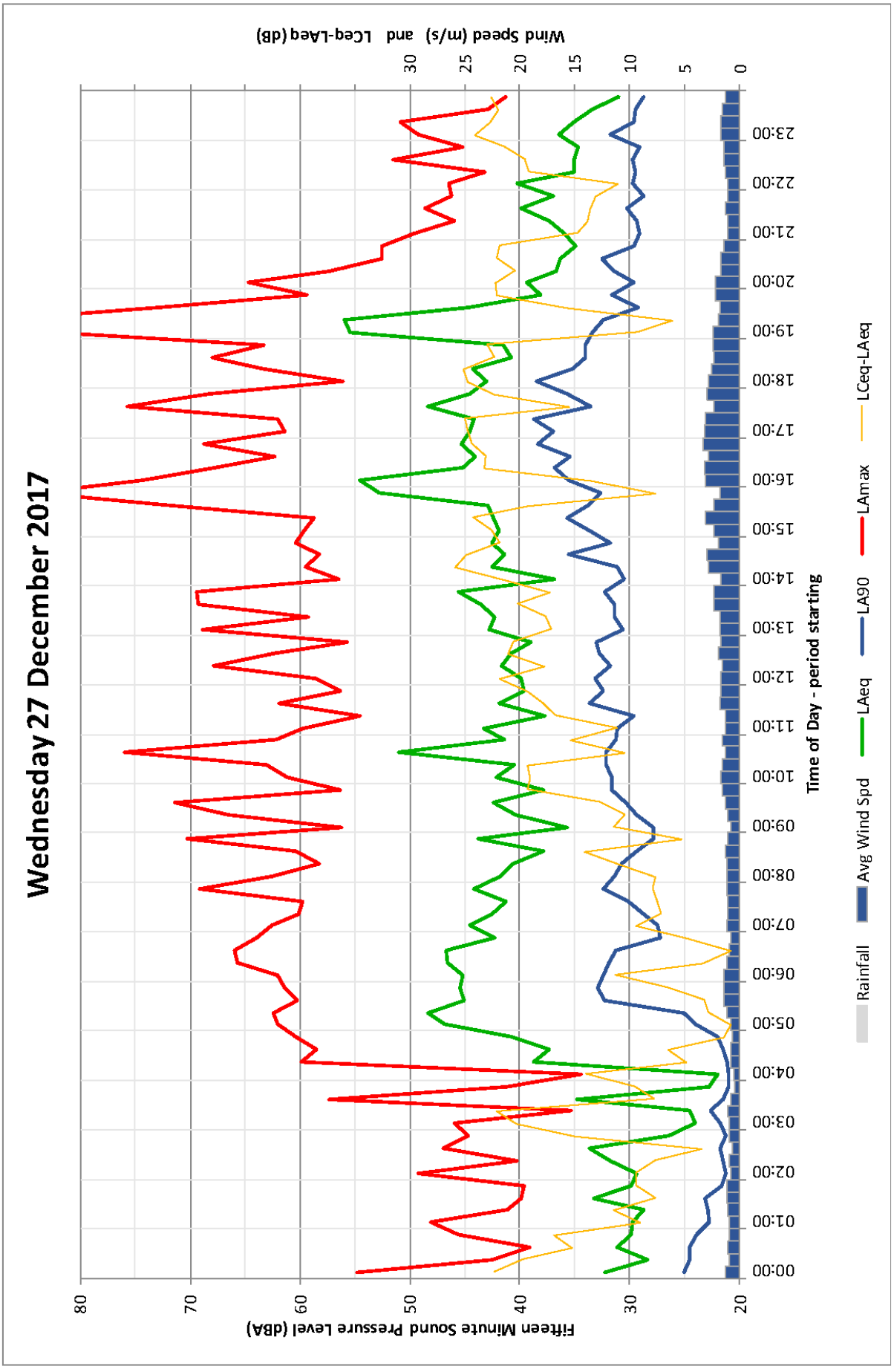

Friday 22 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall
LCeq-LAeq

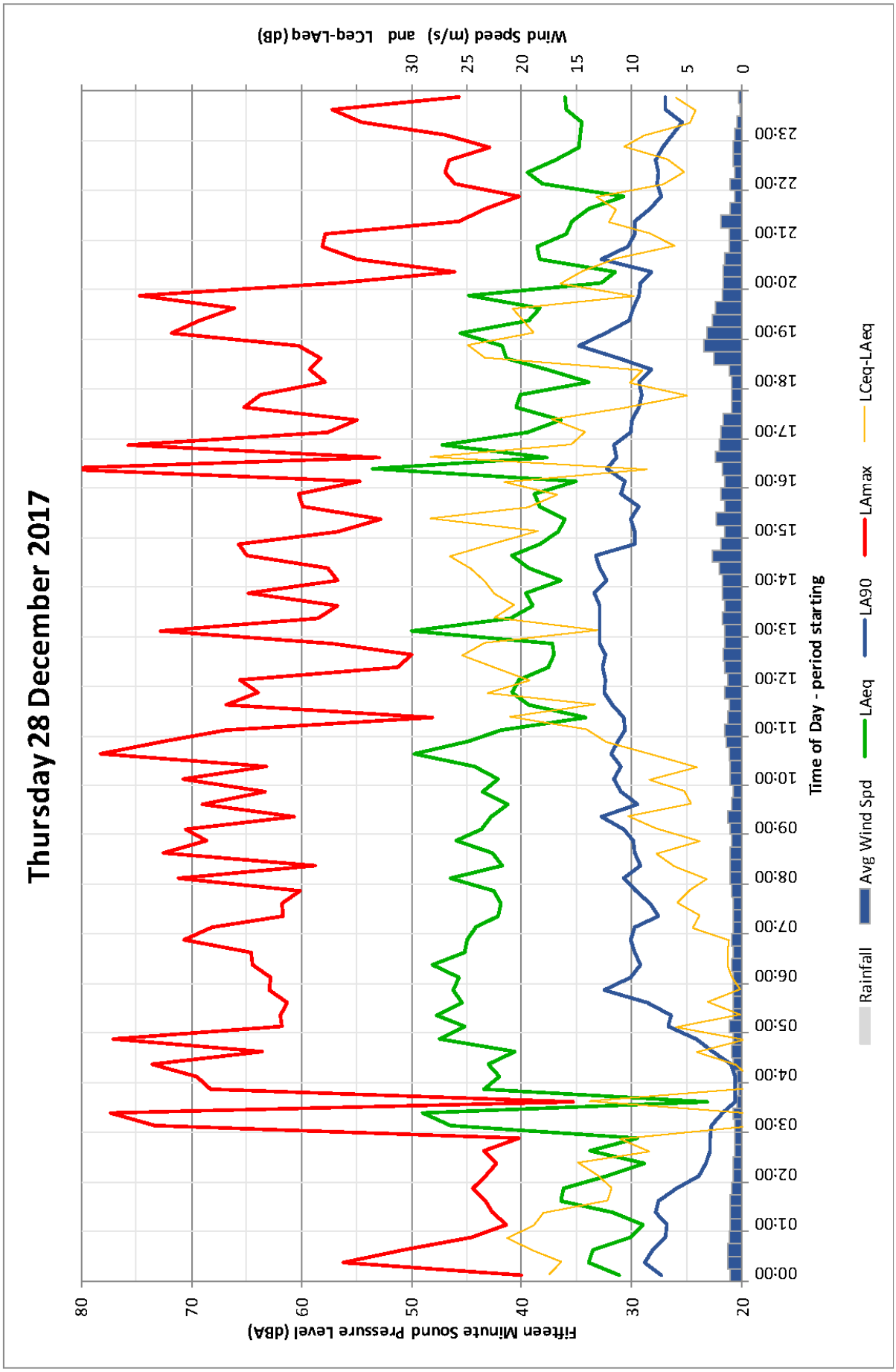

Saturday 23 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

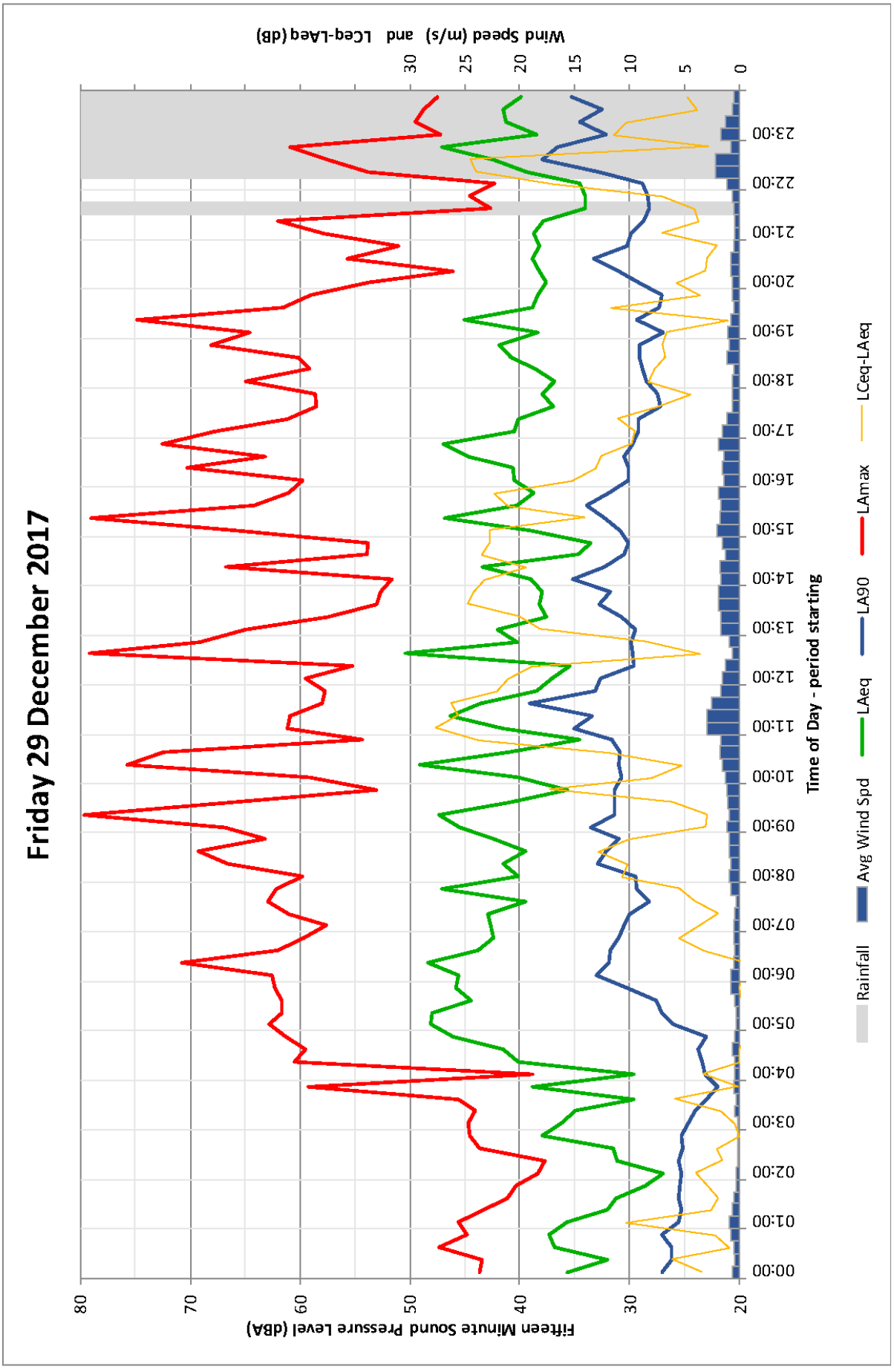

Sunday 24 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

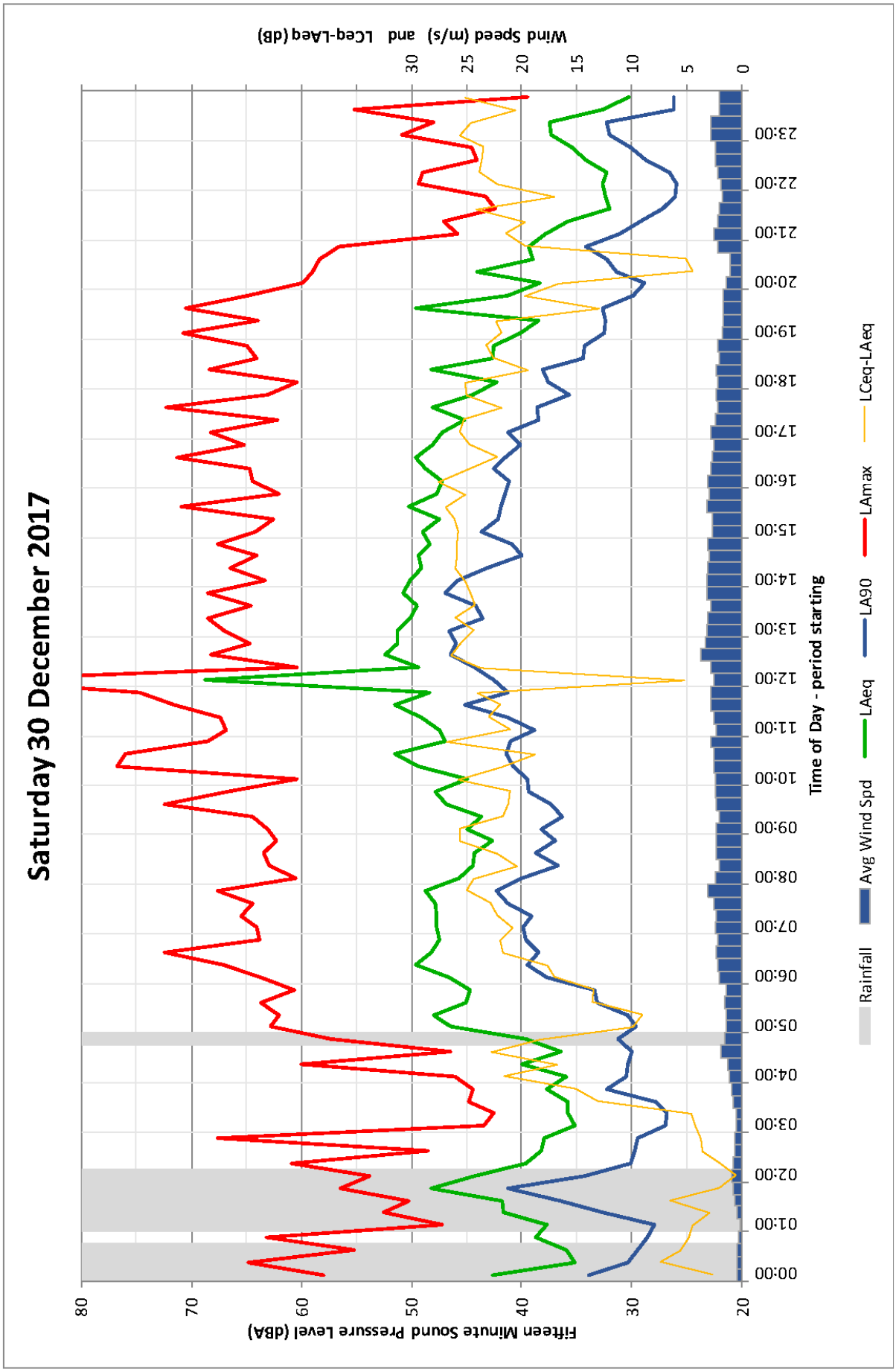

Monday 25 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

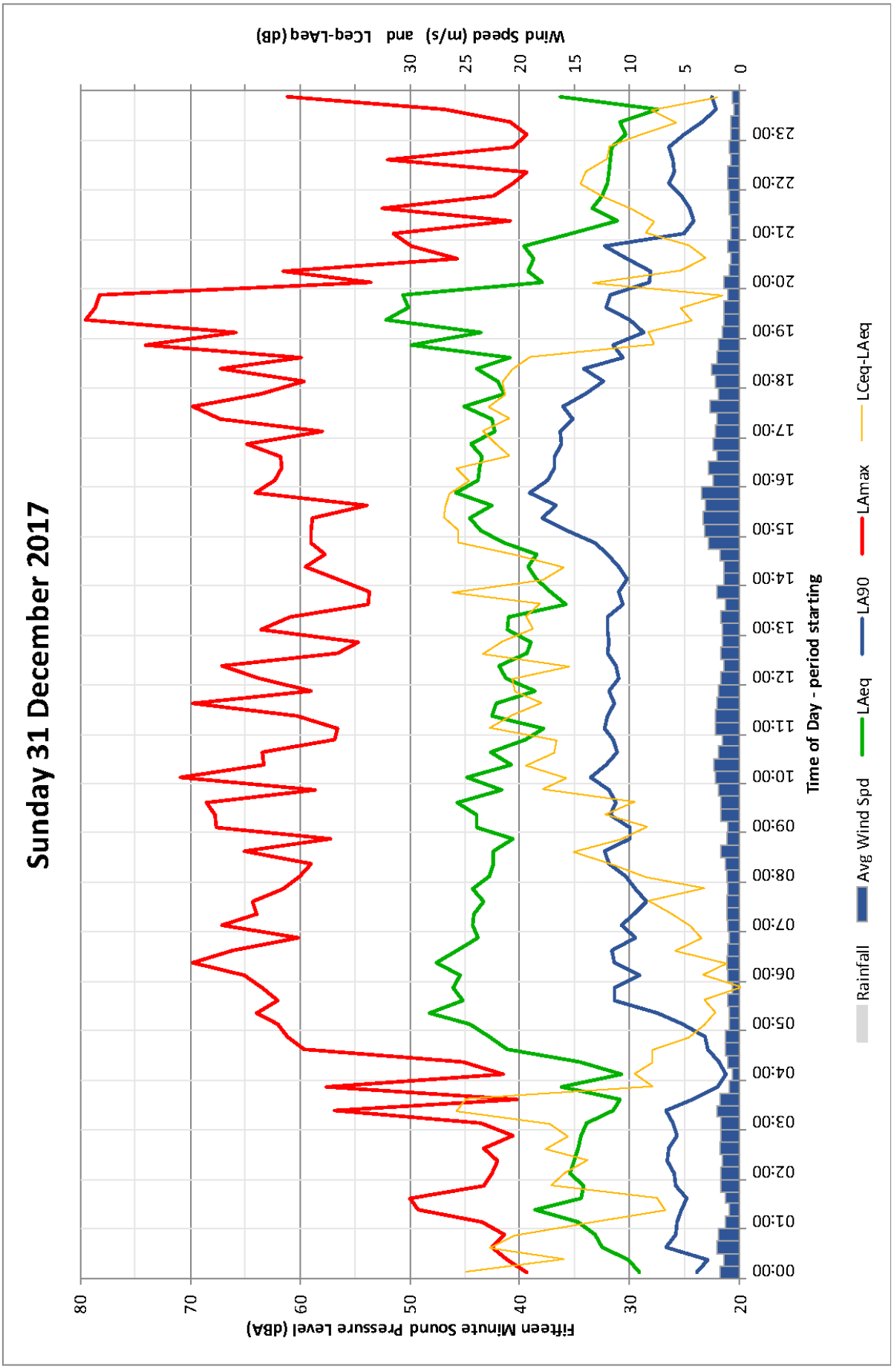

Tuesday 26 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

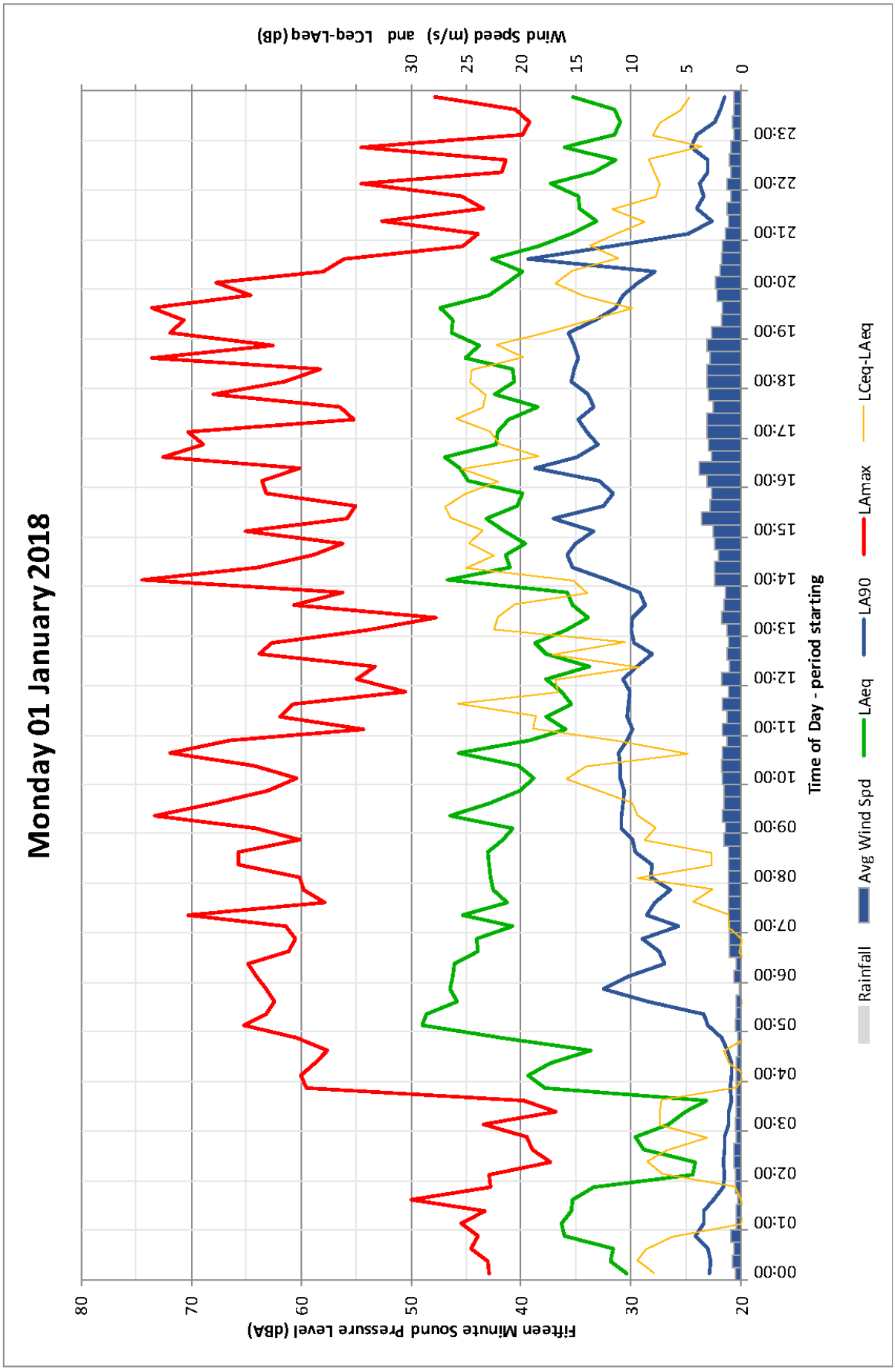

Wednesday 27 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

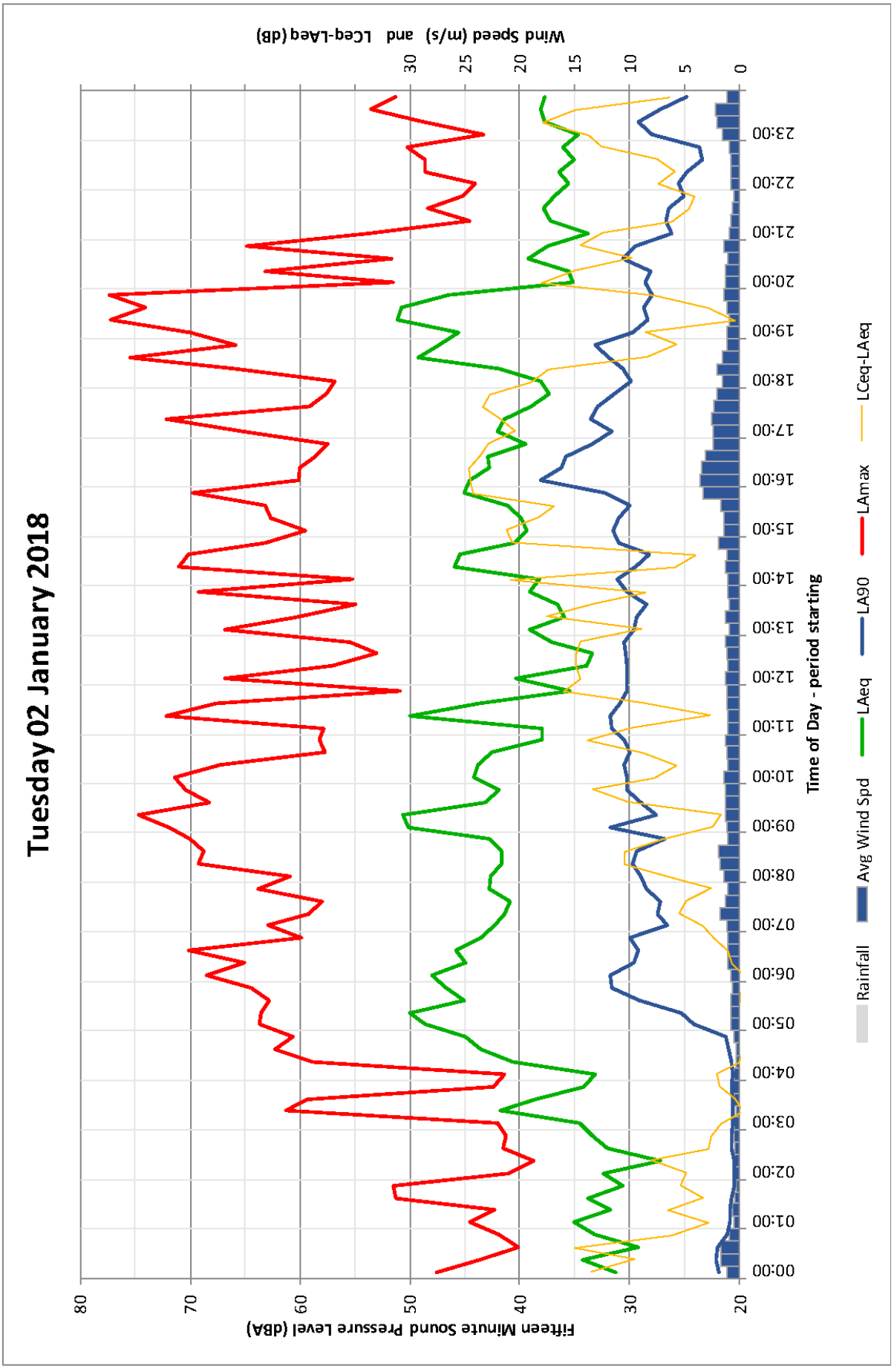

Thursday 28 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

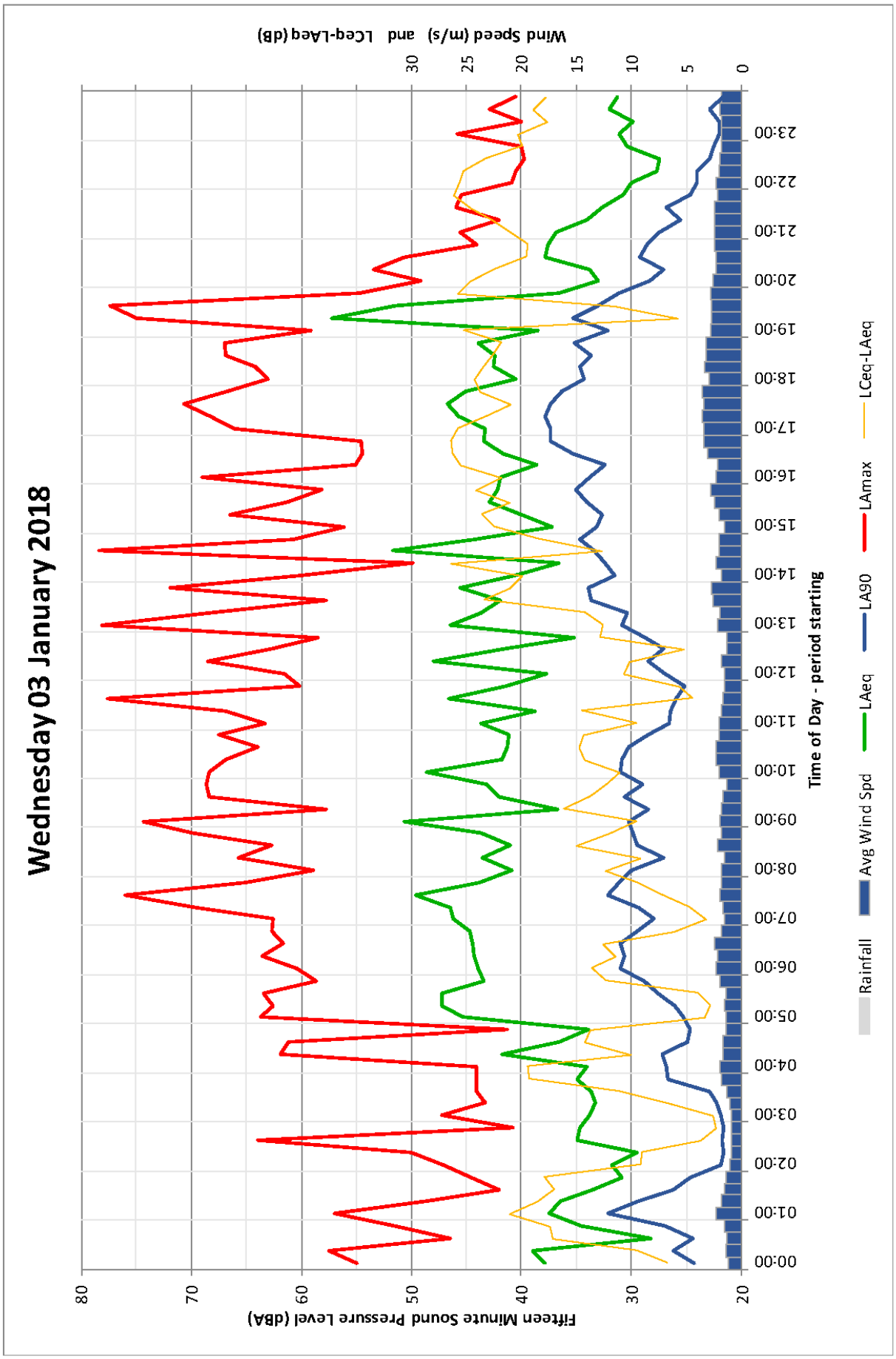

Friday 29 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

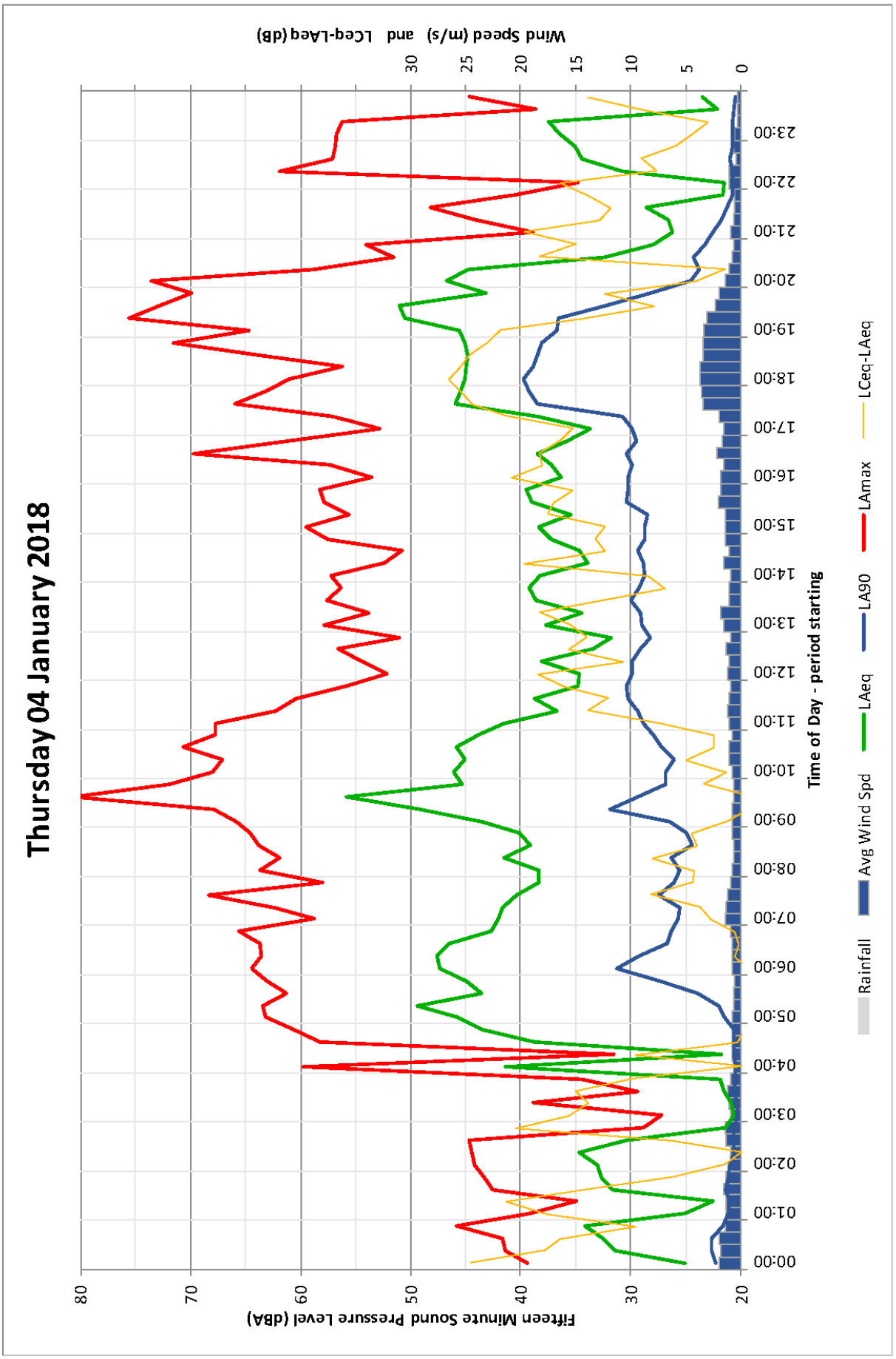

Saturday 30 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

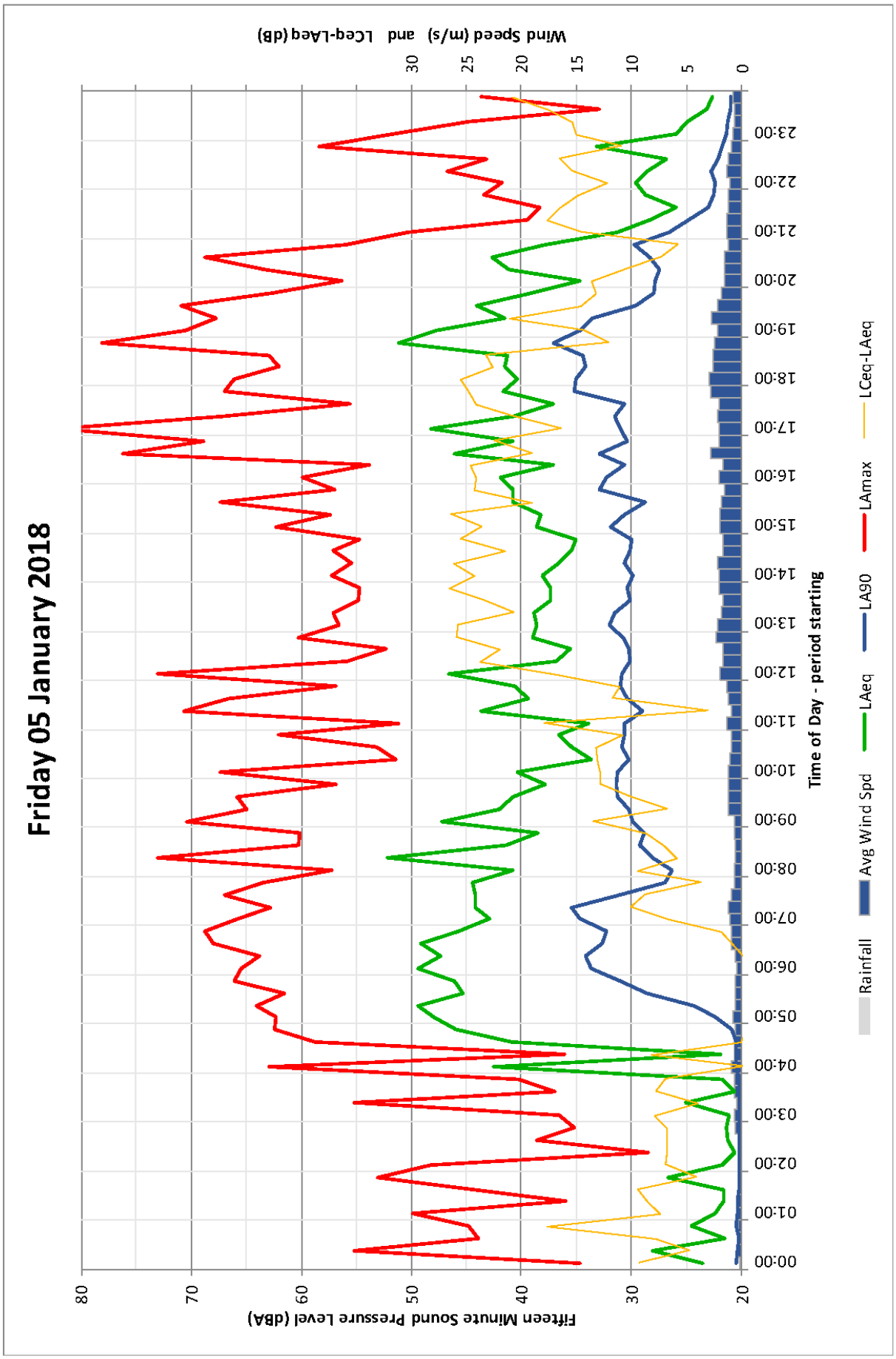

Sunday 31 December 2017
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

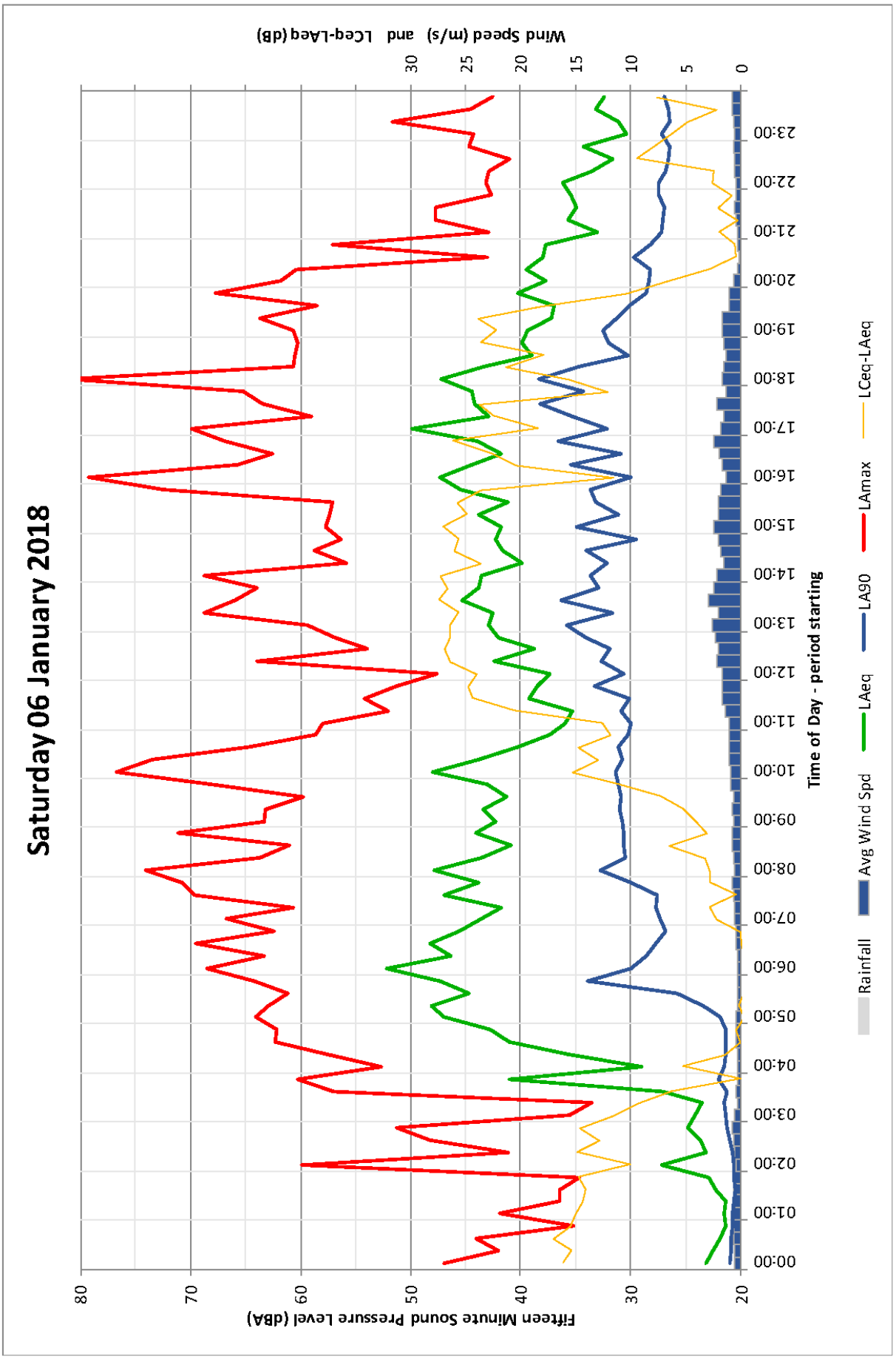

Monday 01 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall
LCeq-LAeq

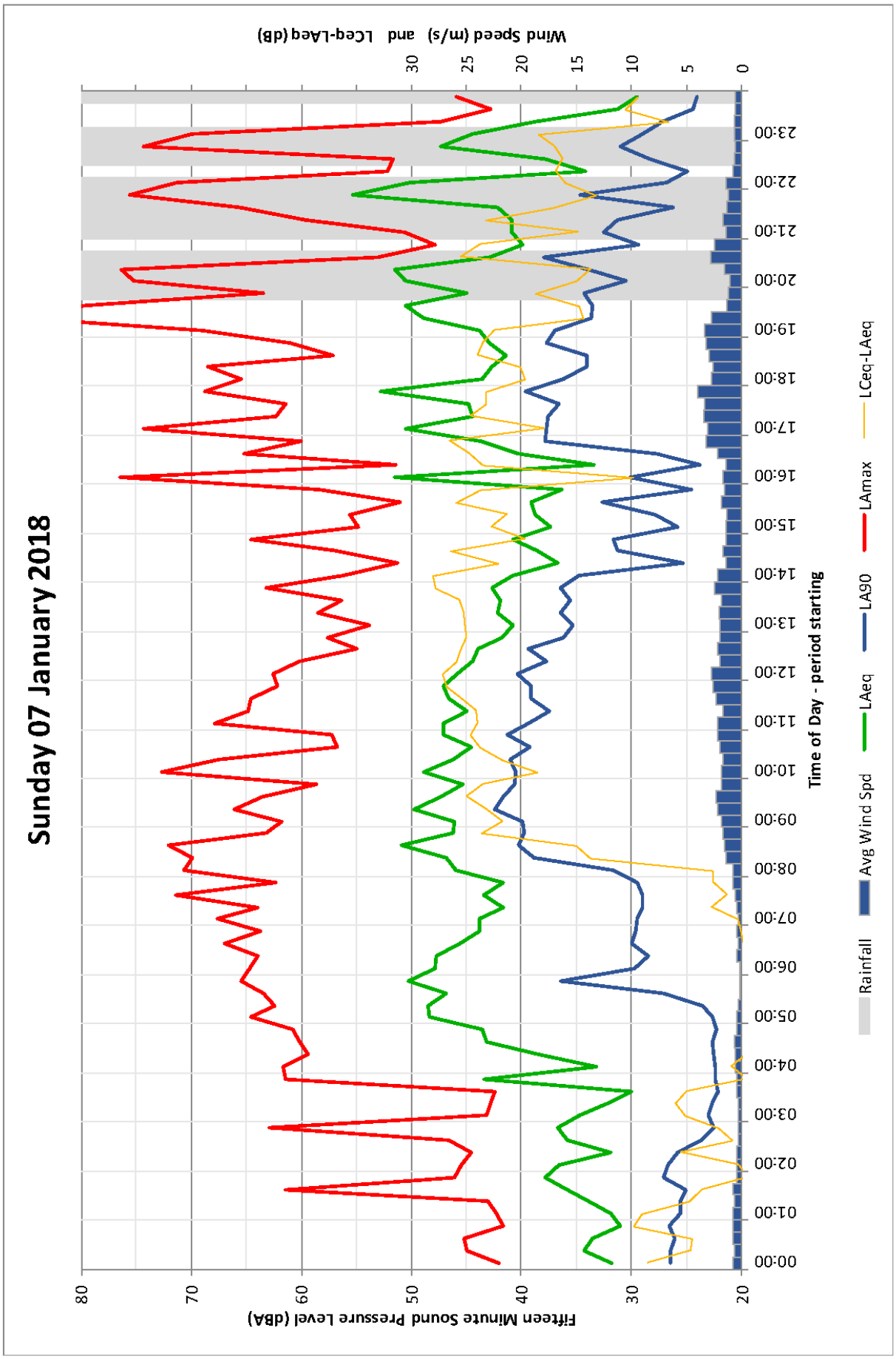

Tuesday 02 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

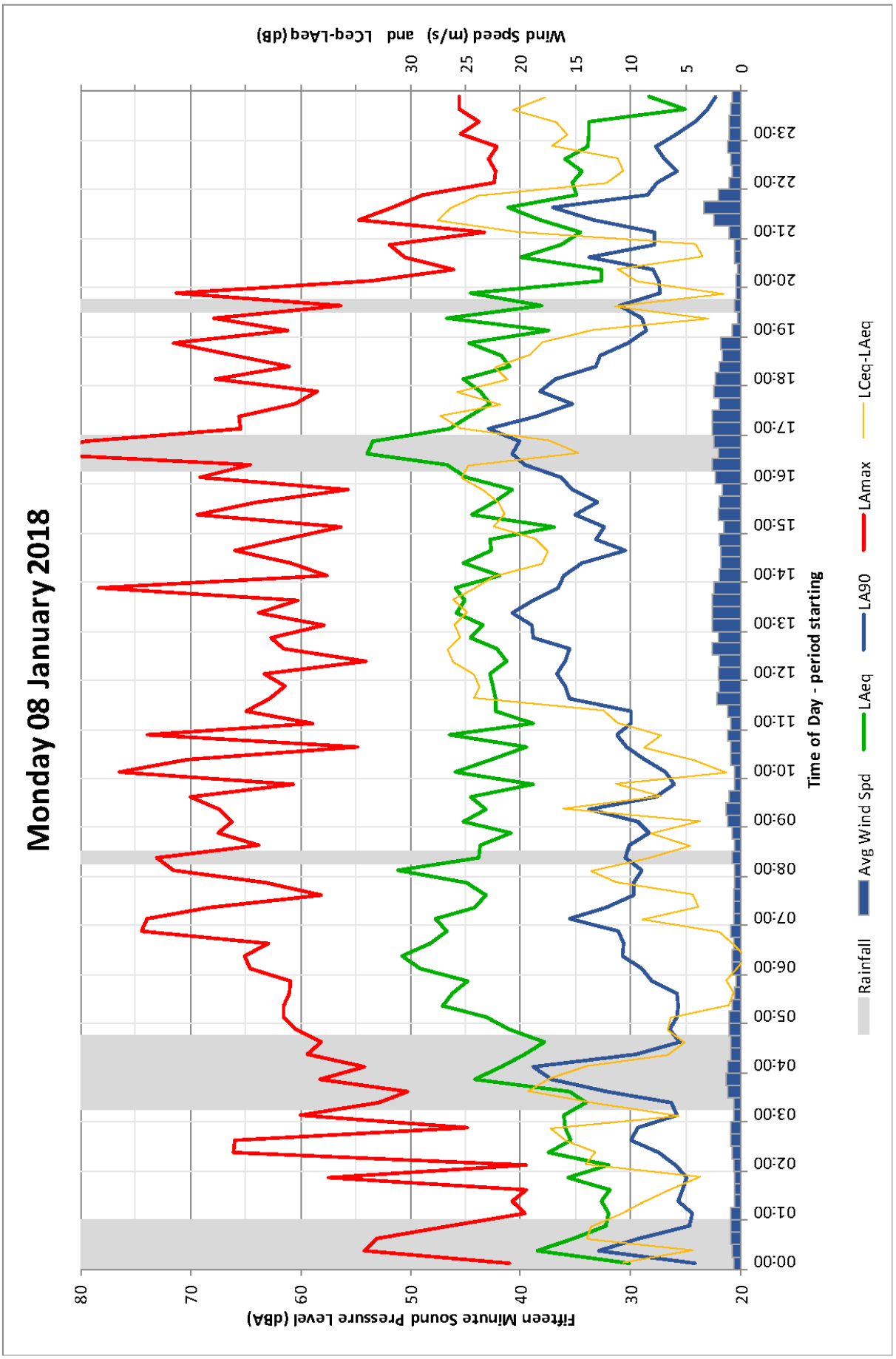

Wednesday 03 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall
LCeq-LAeq

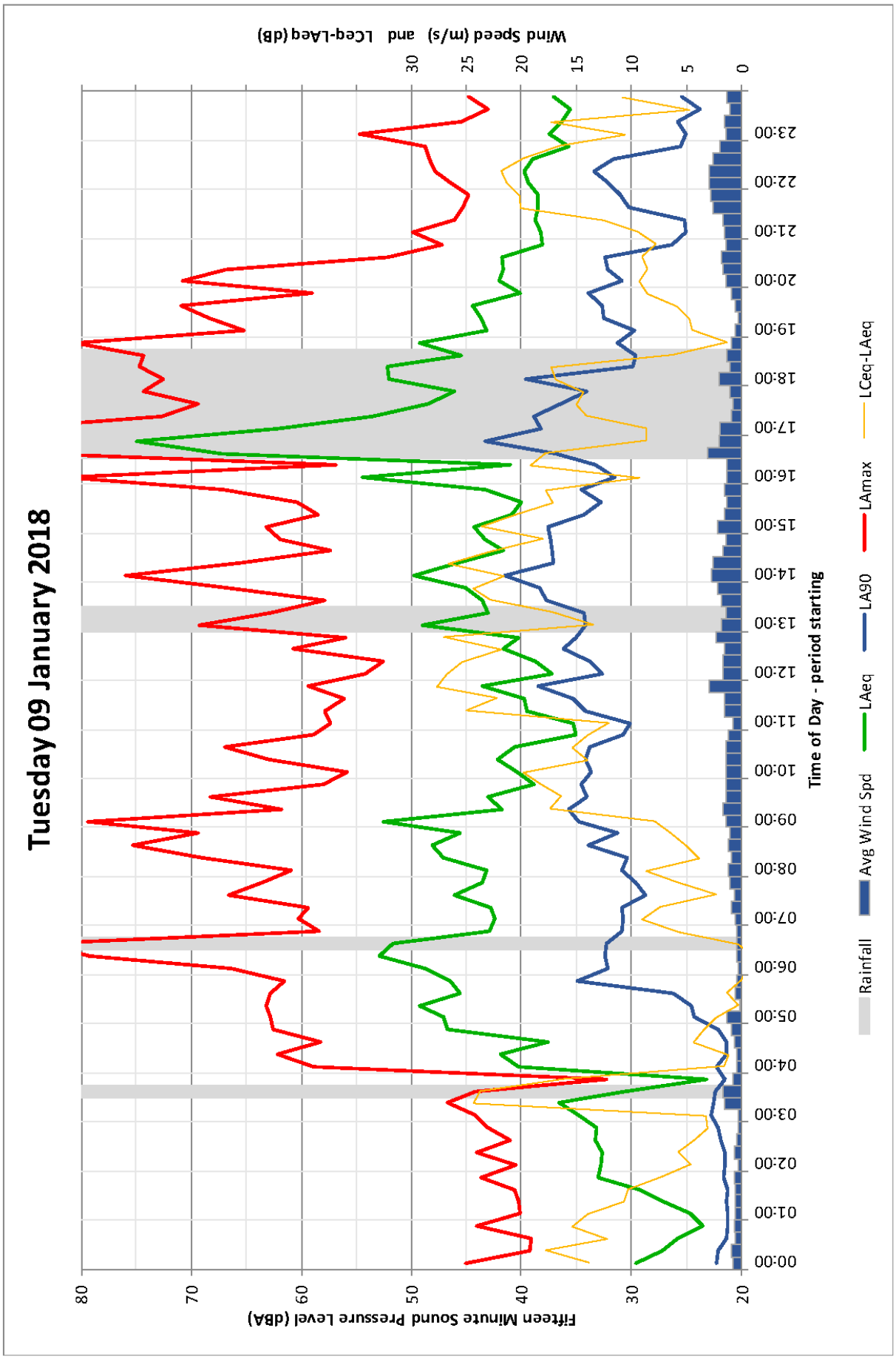

Thursday 04 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

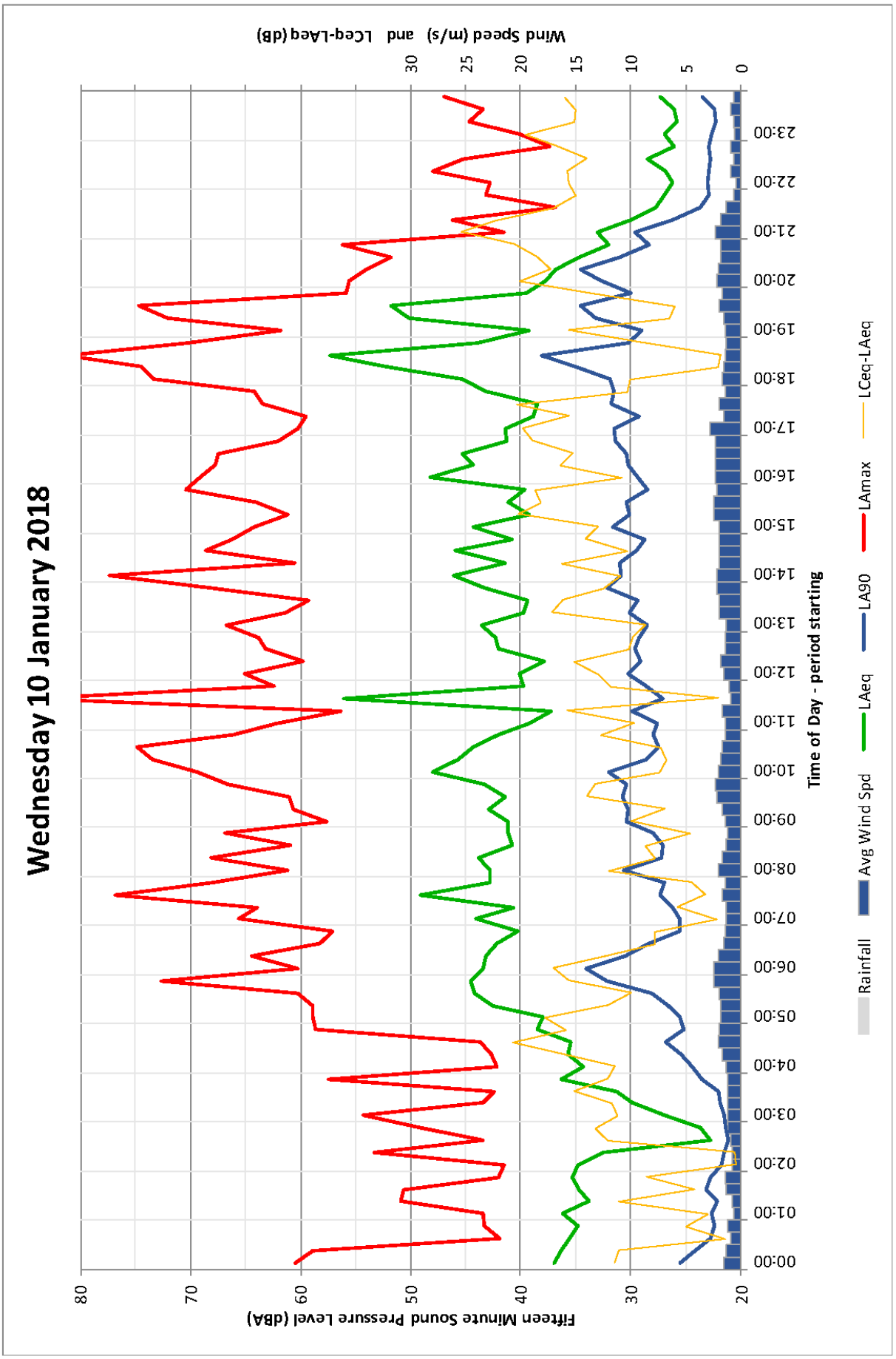

Friday 05 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LAmax
LCeq-LAeq
LA90
LAeq
Avg Wind Spd
Rainfall

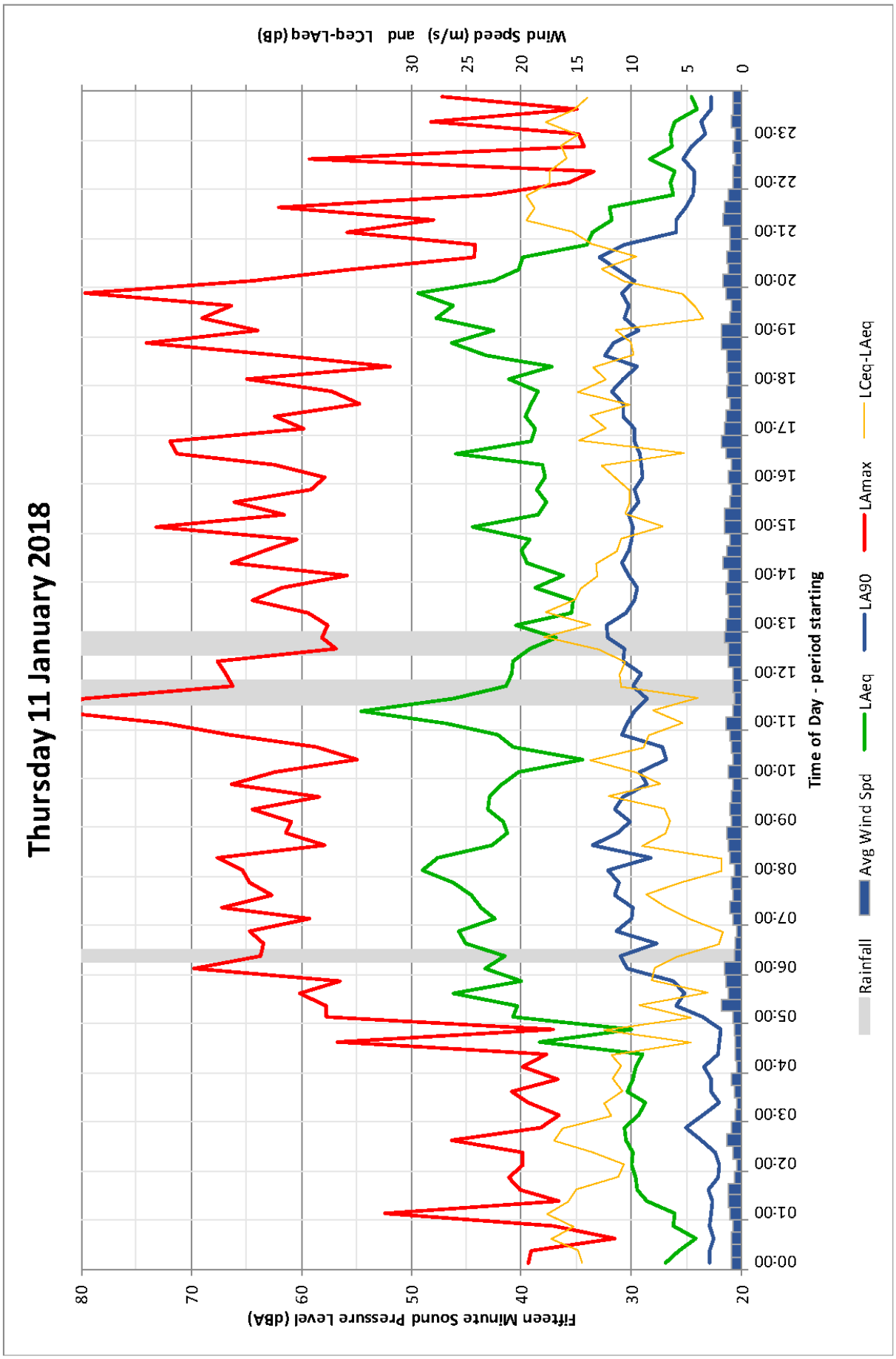

Saturday 06 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

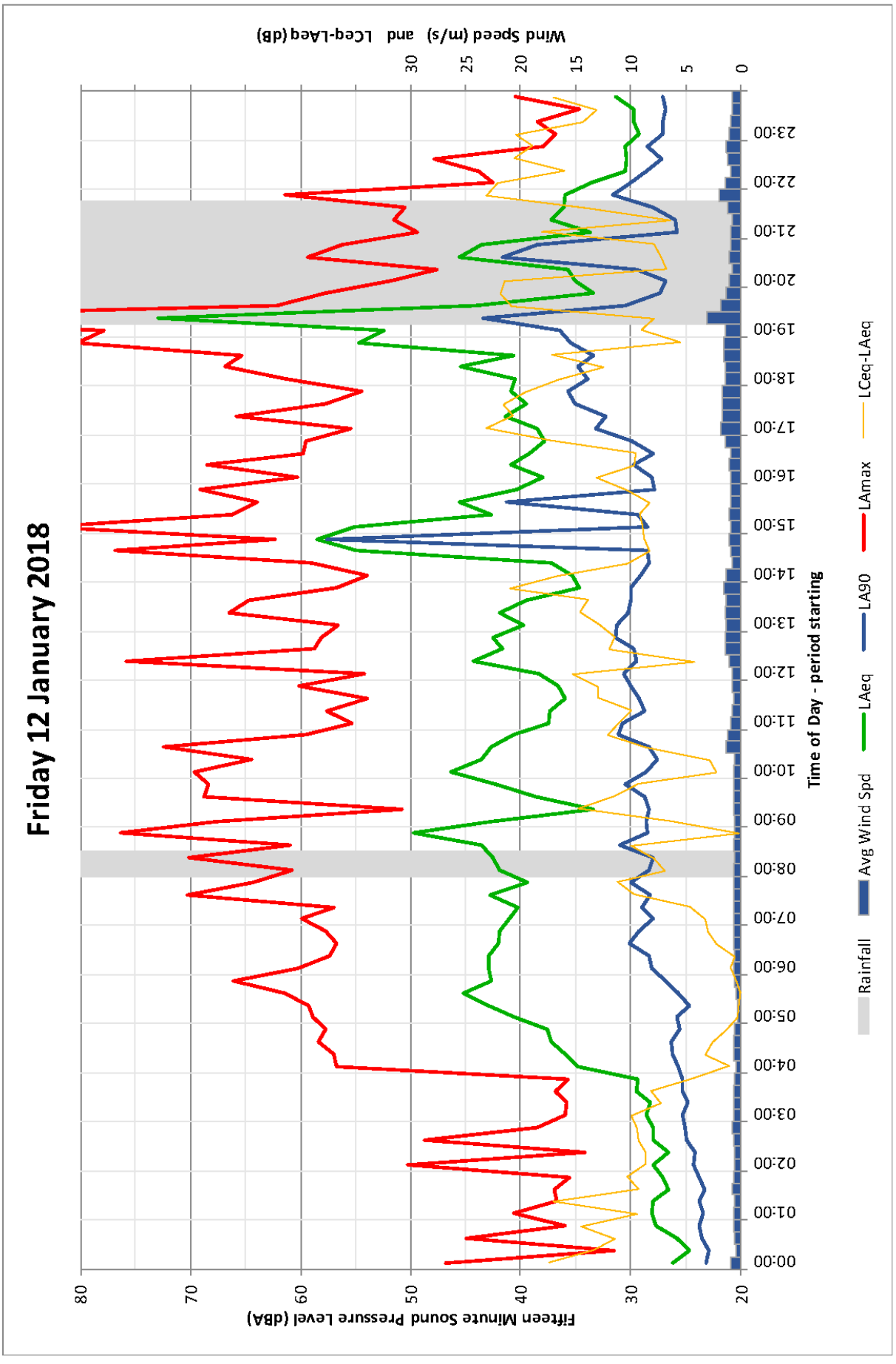

Sunday 07 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall
LCeq-LAeq

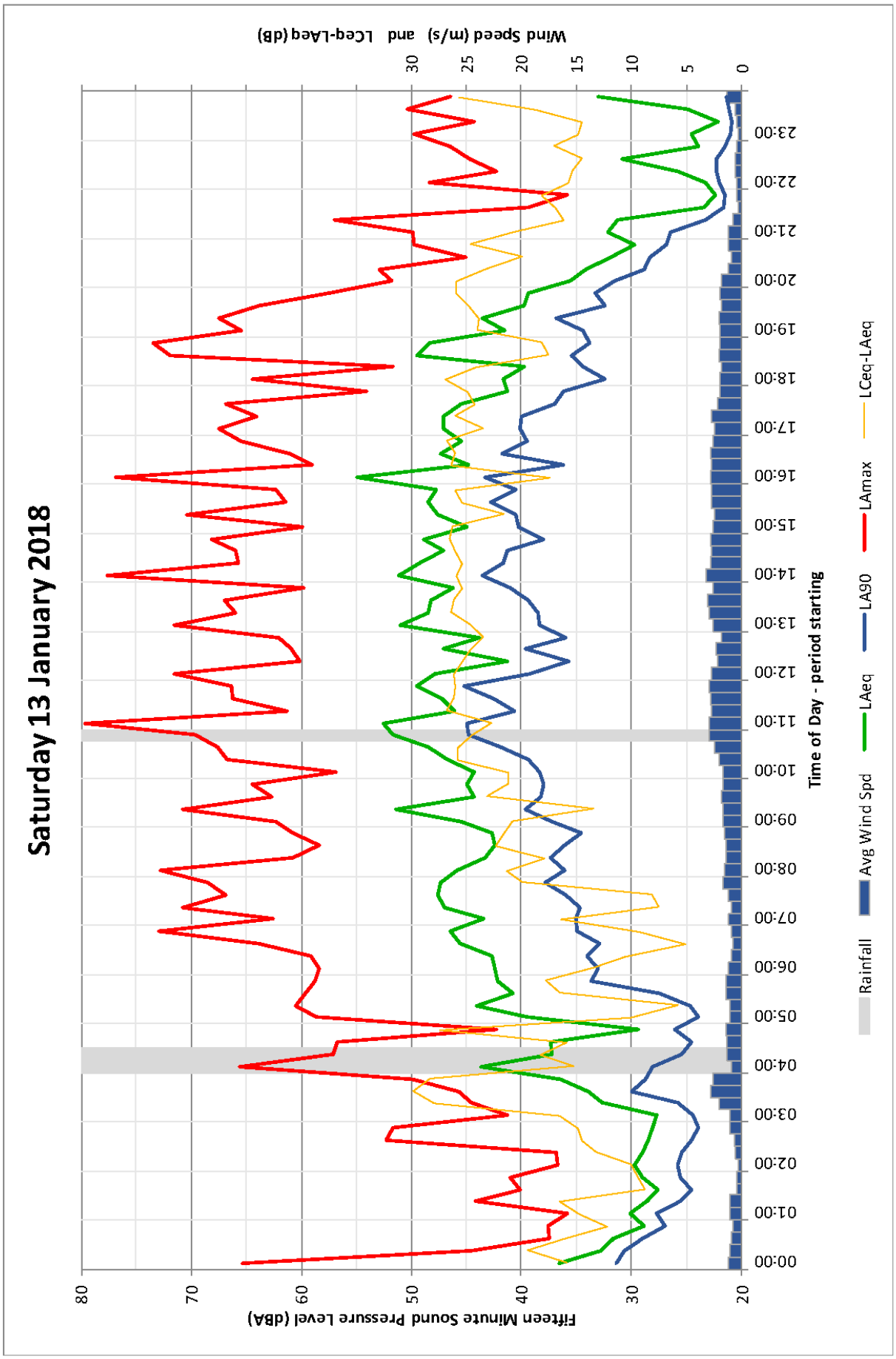

Monday 08 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

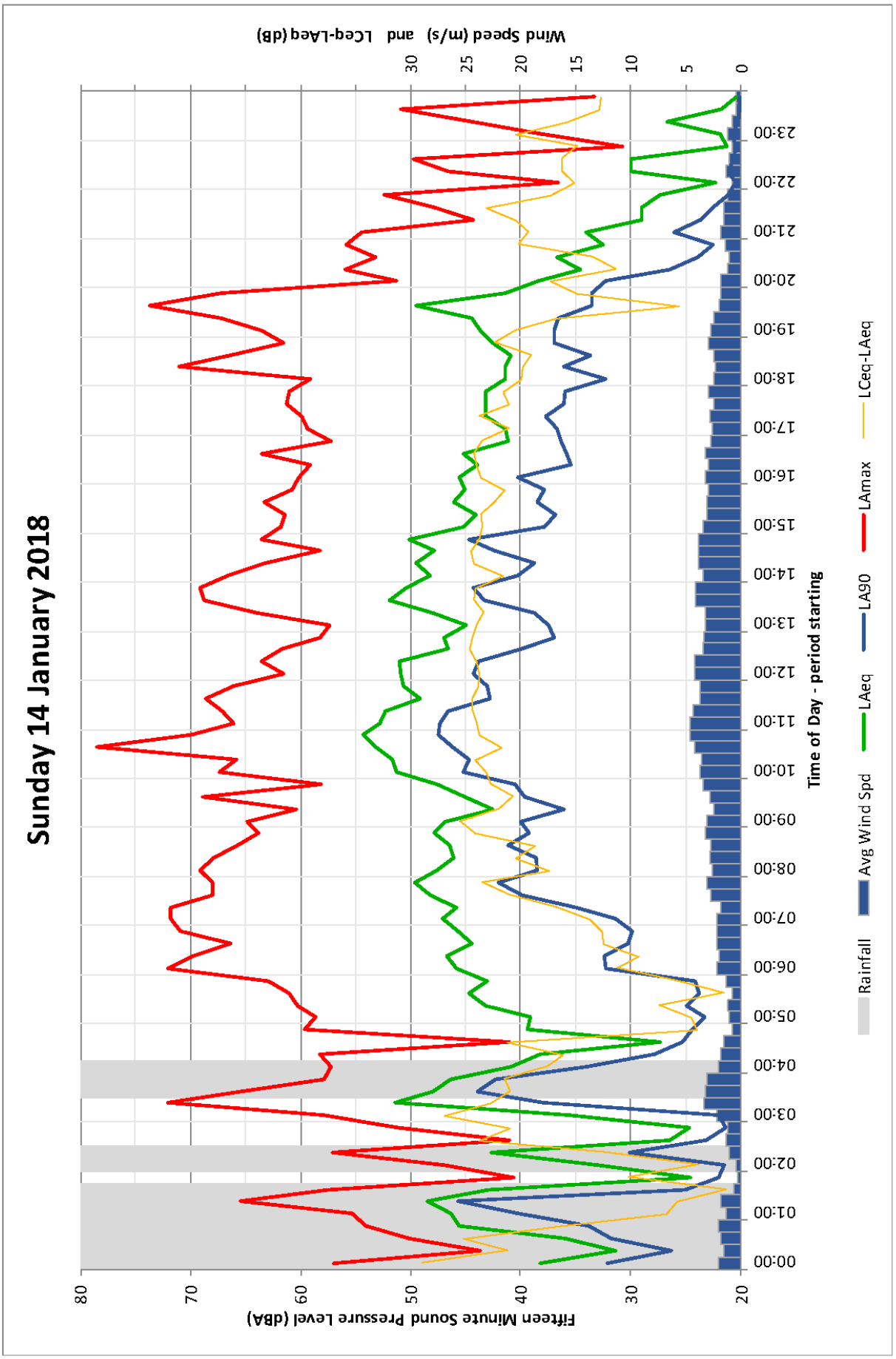

Tuesday 09 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

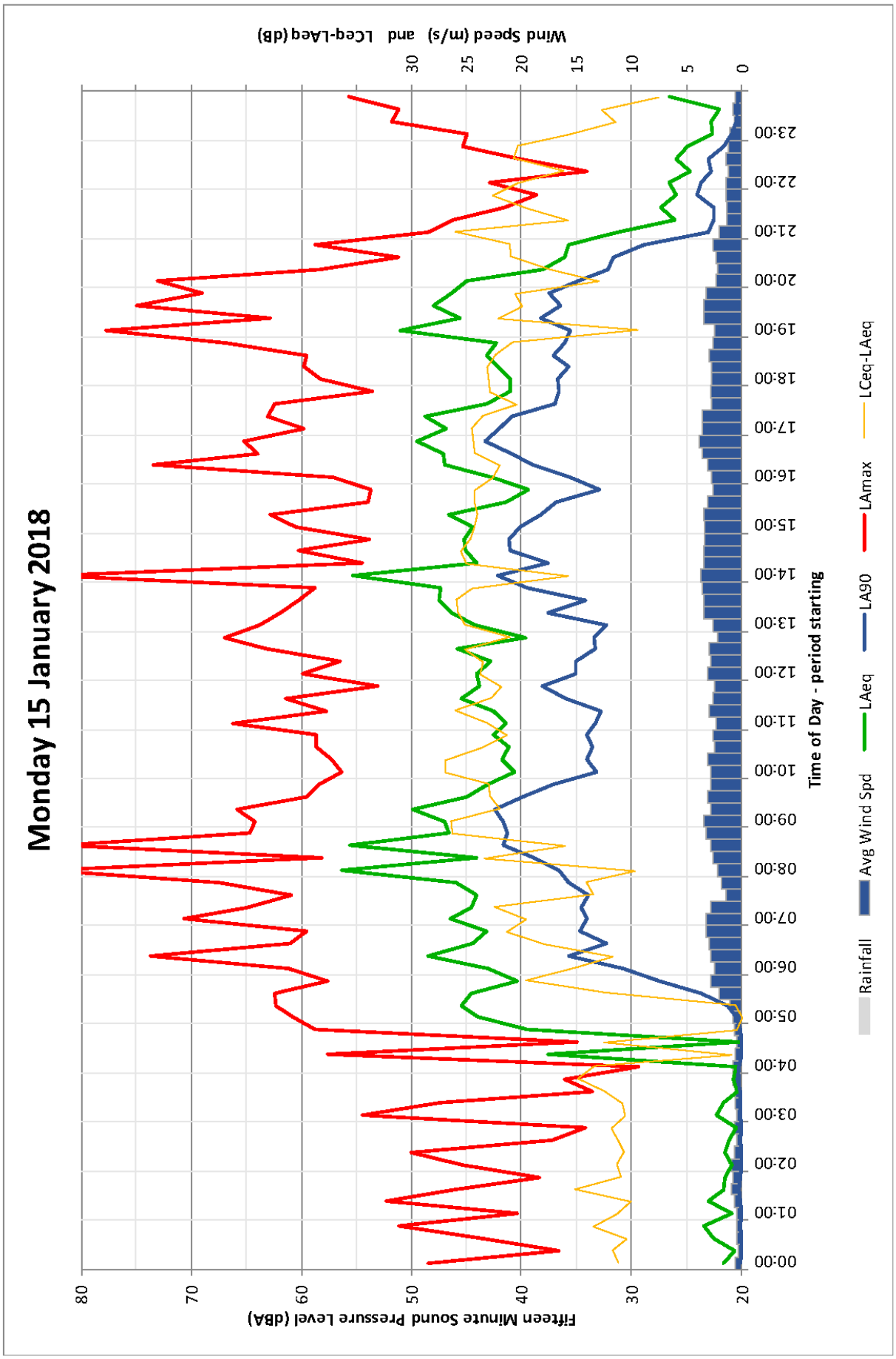

Wednesday 10 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

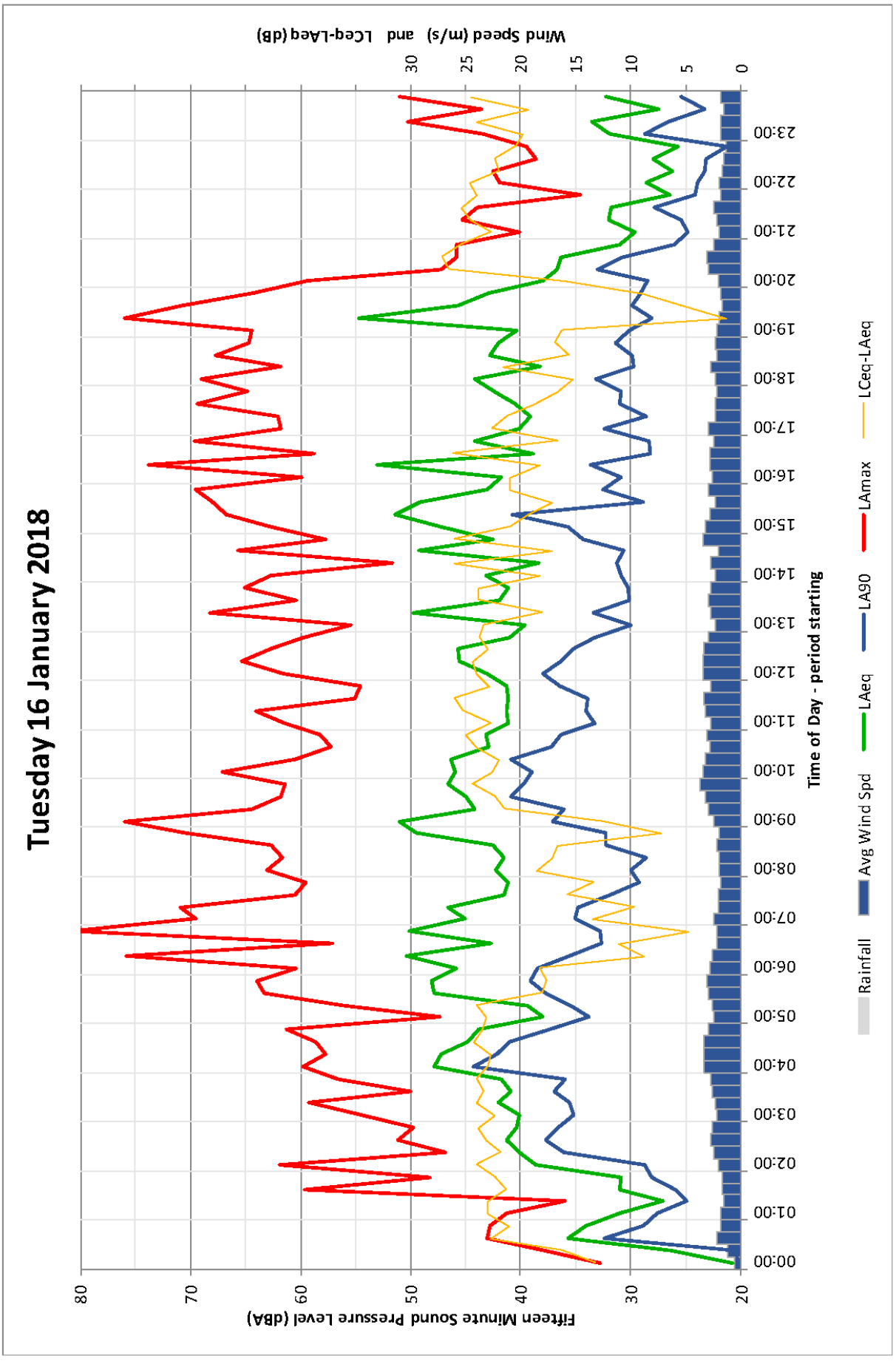

Thursday 11 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LAmax
LCeq-LAeq
LA90
LAeq
Avg Wind Spd
Rainfall

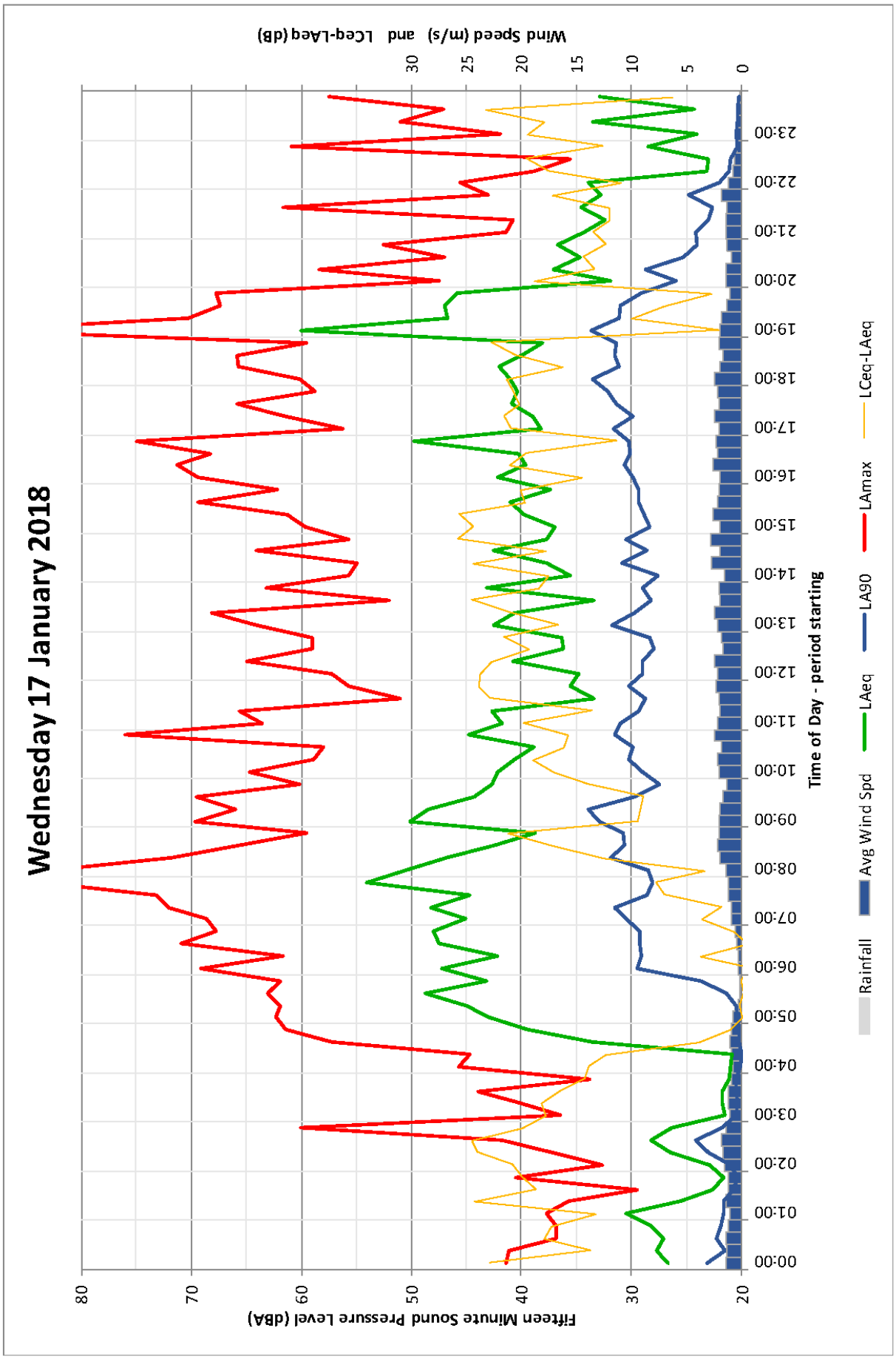

Friday 12 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

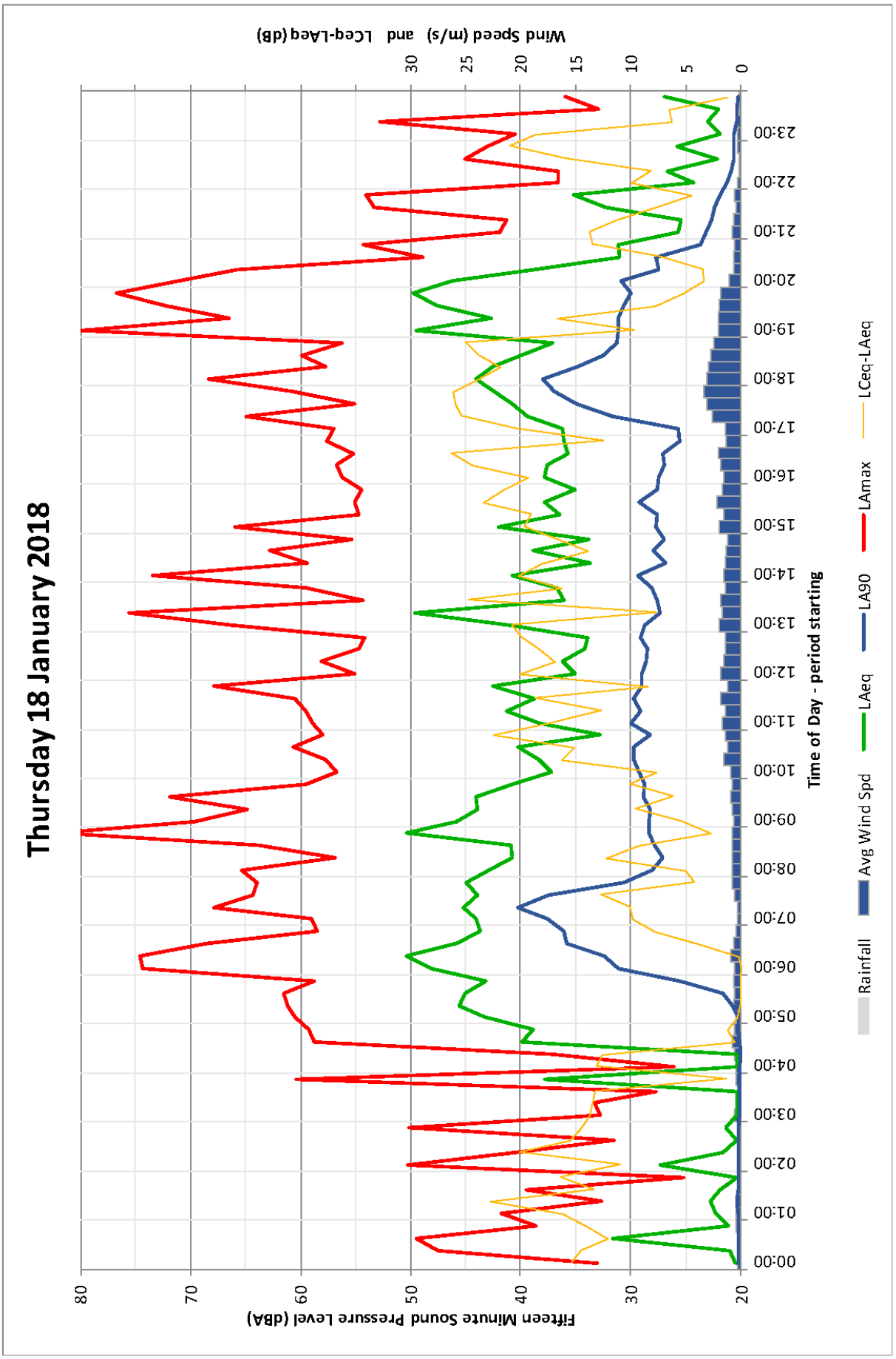

Saturday 13 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

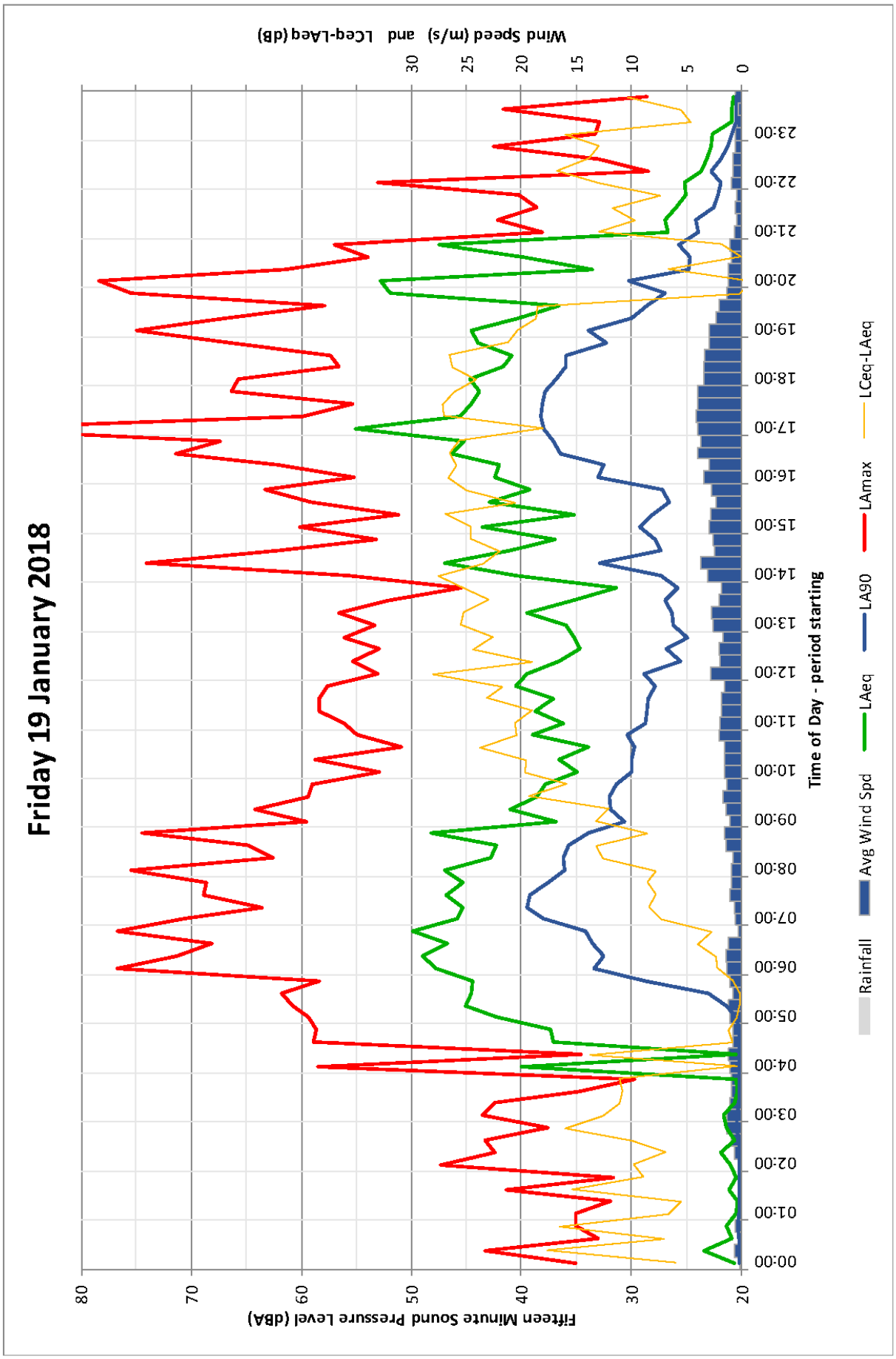

Sunday 14 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

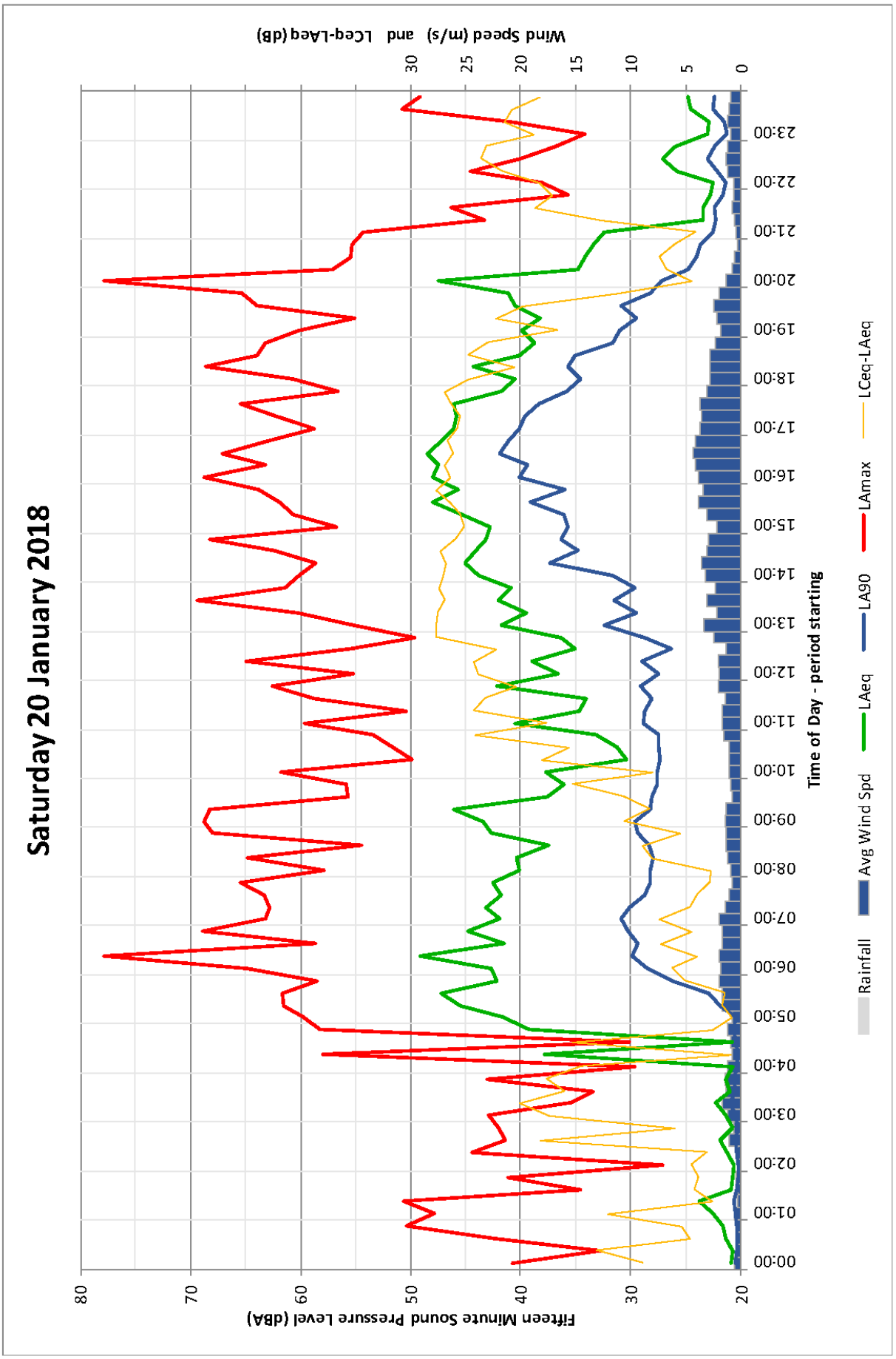

Monday 15 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

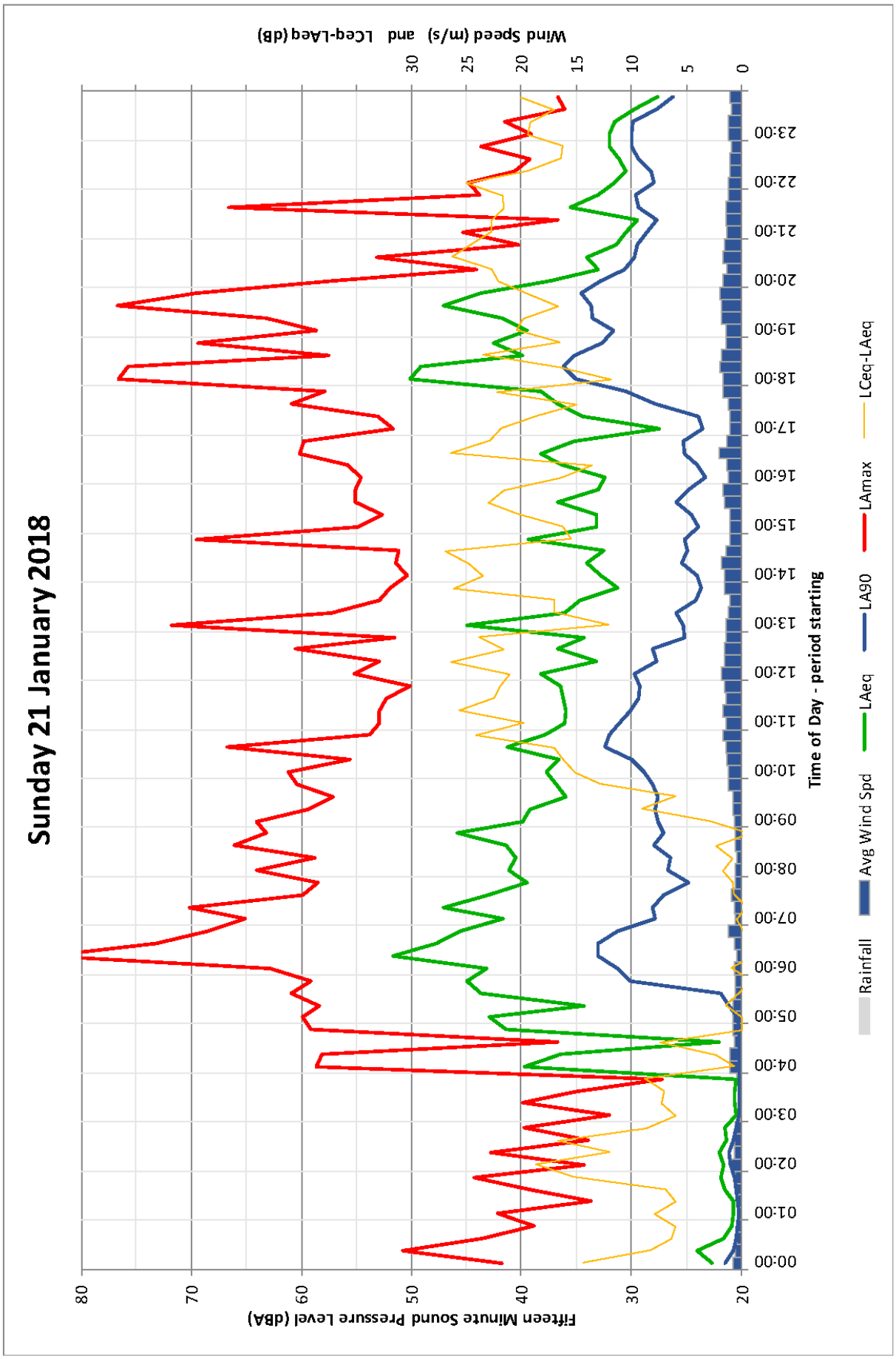

Tuesday 16 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

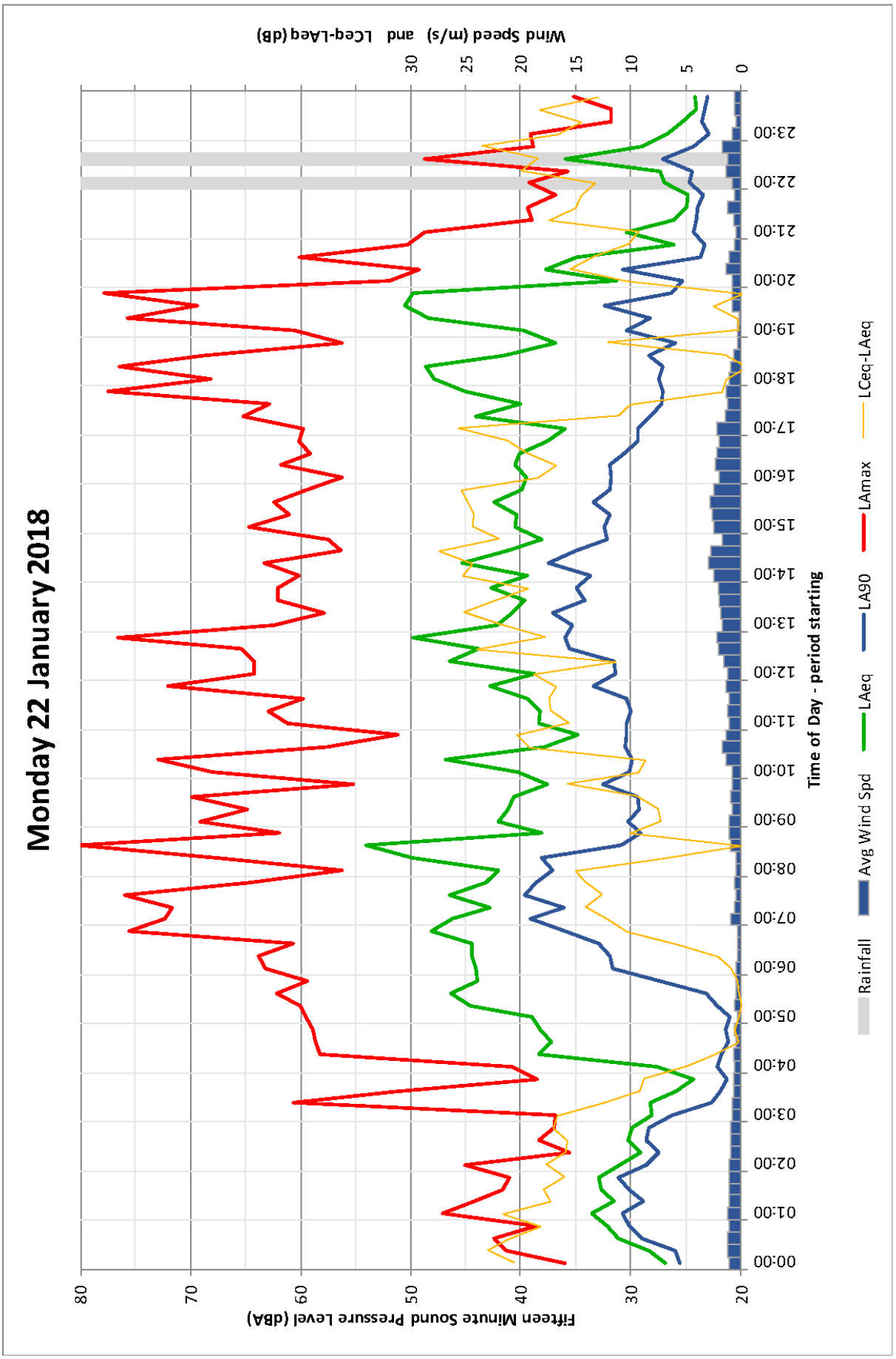

Wednesday 17 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

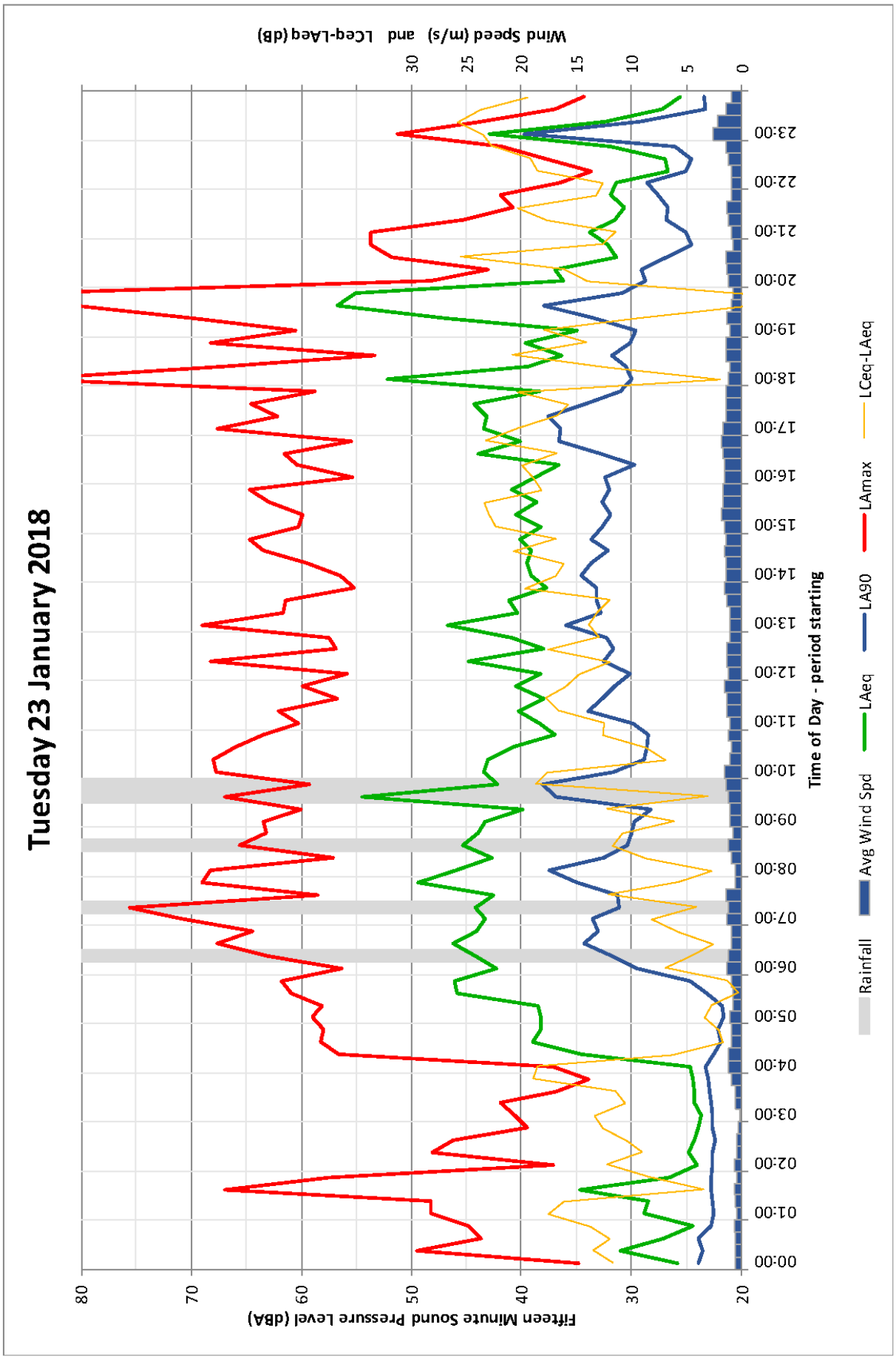

Thursday 18 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

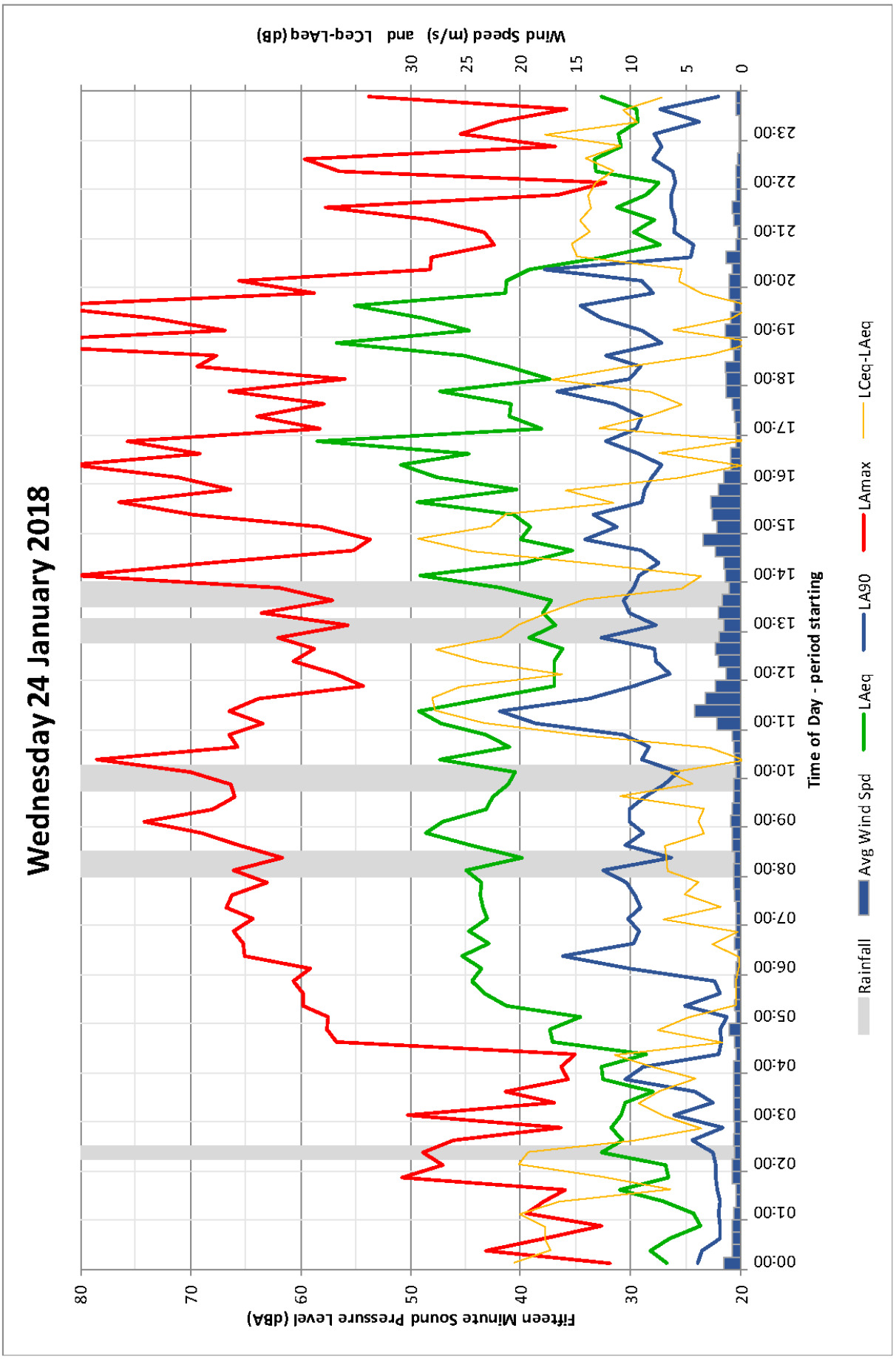

Friday 19 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

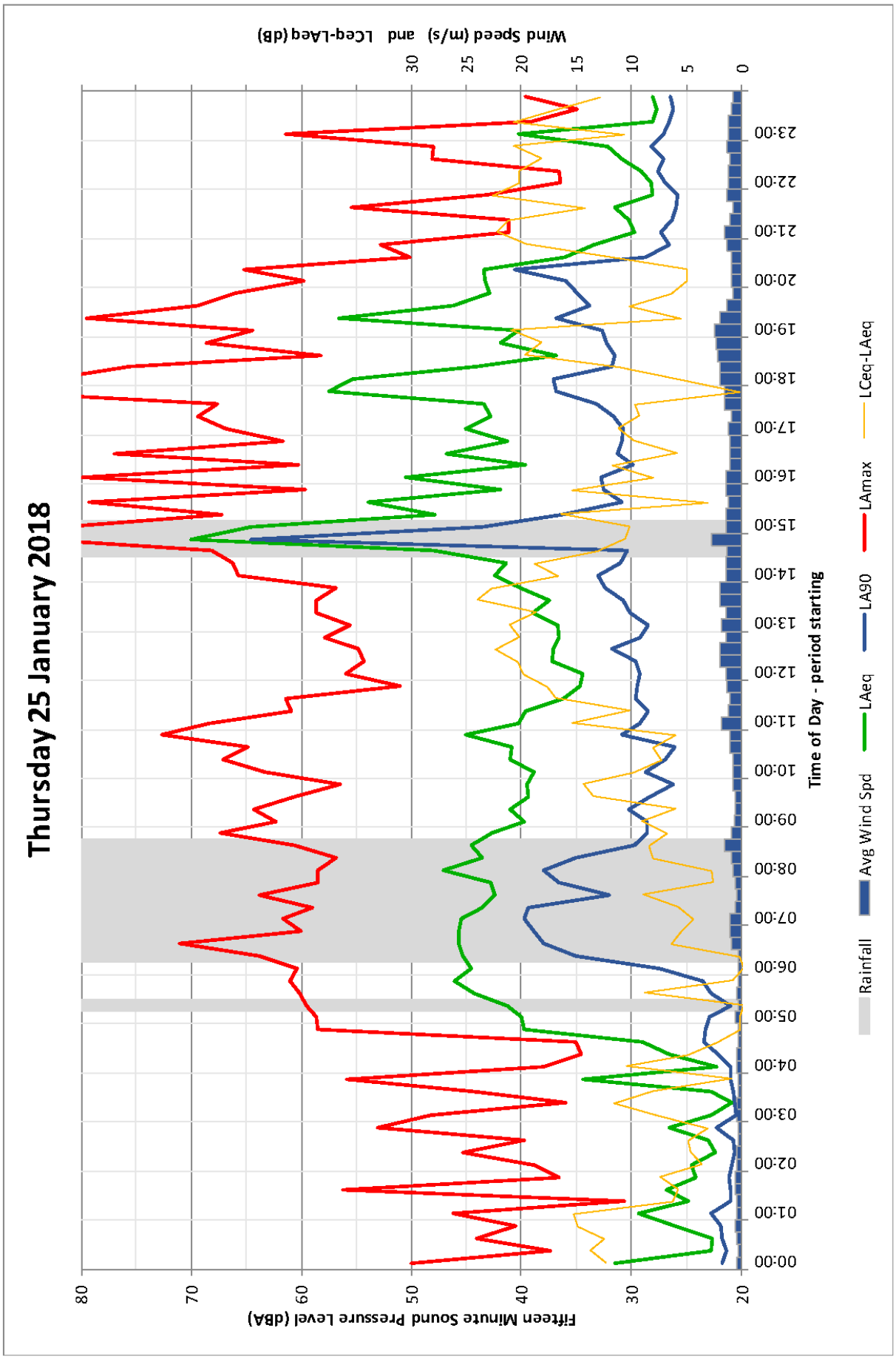

Saturday 20 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

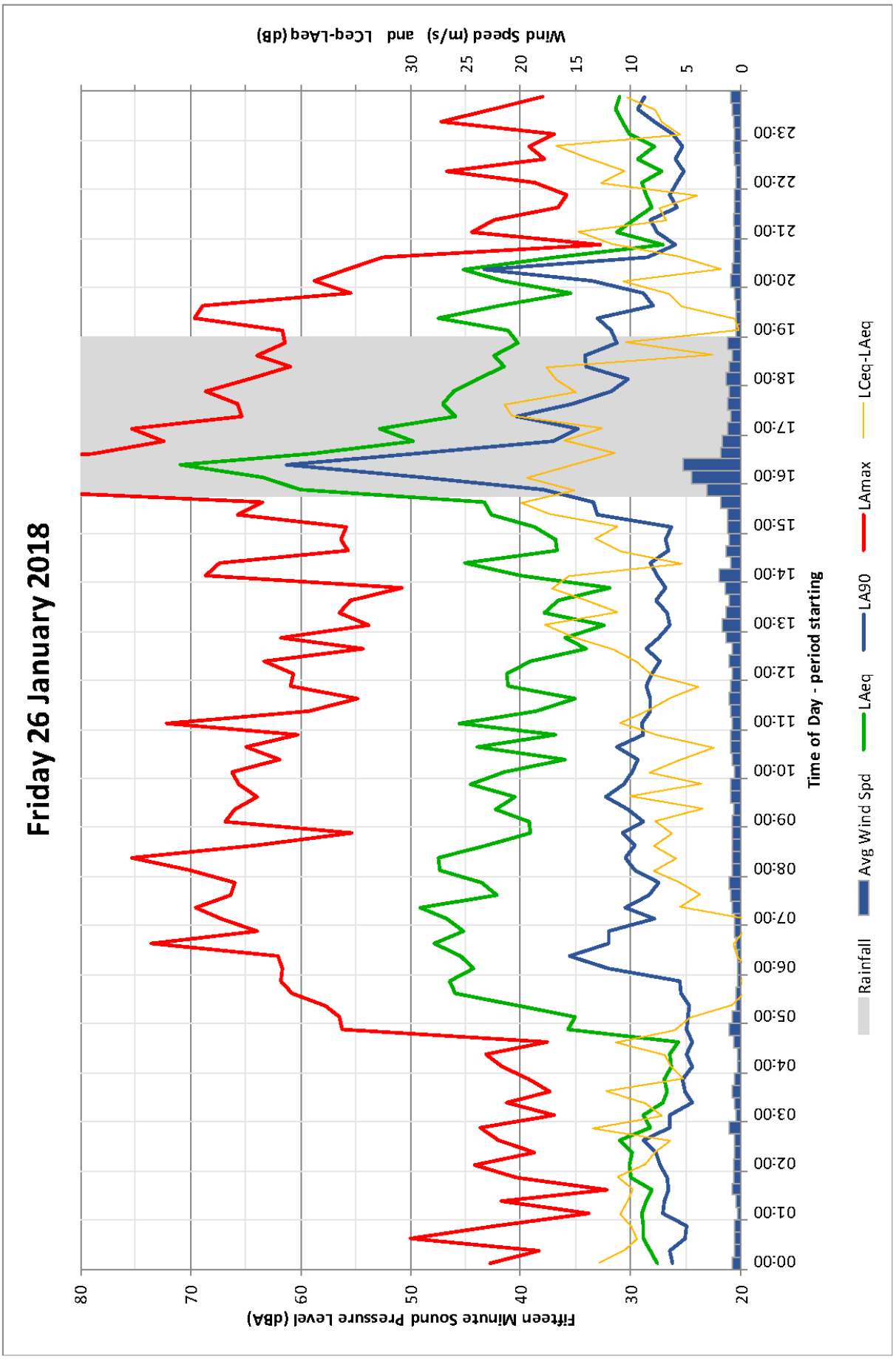

Sunday 21 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LAeq
LA90
LAmax
LCeq-LAeq
Avg Wind Spd
Rainfall

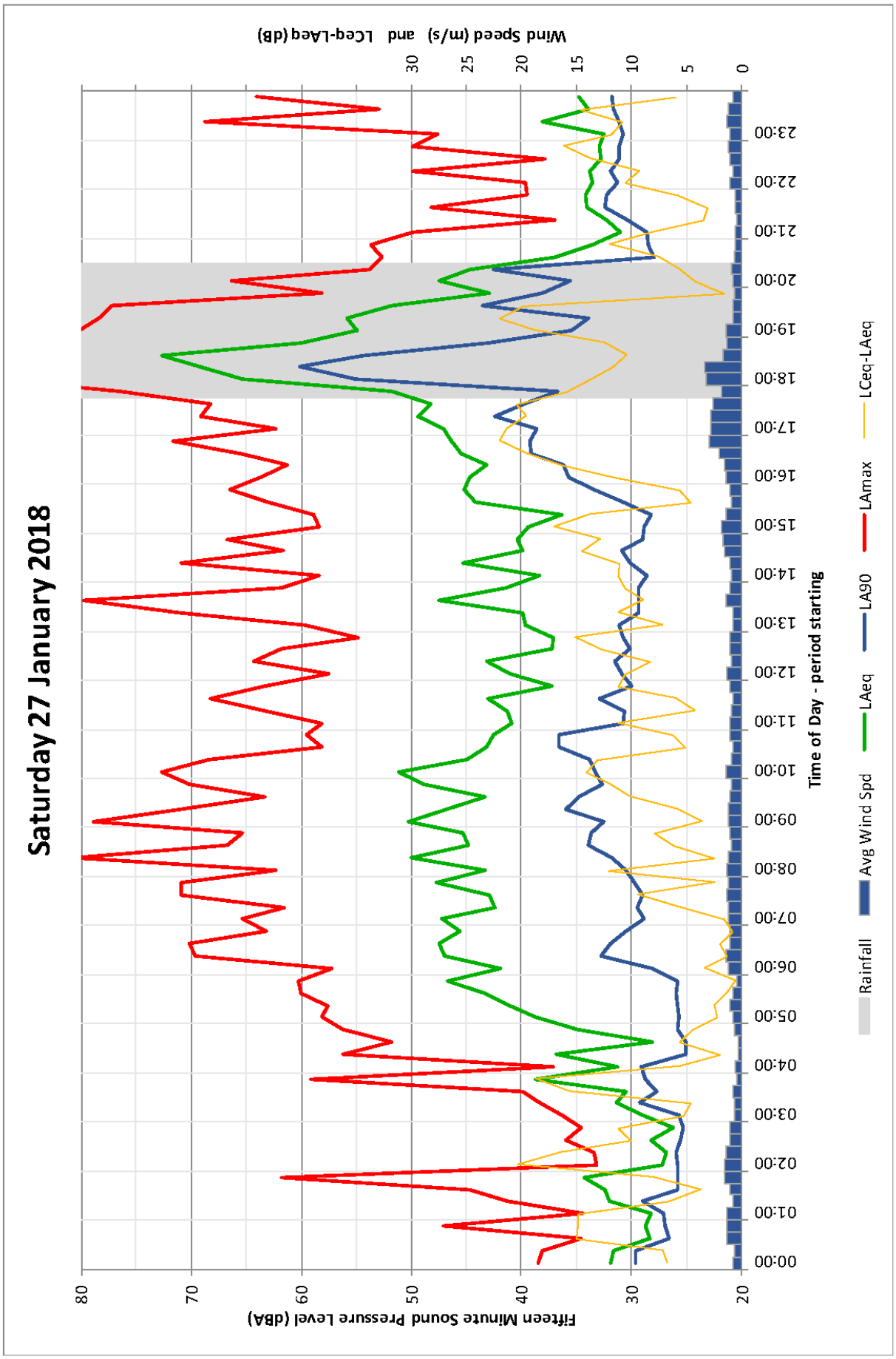

Monday 22 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

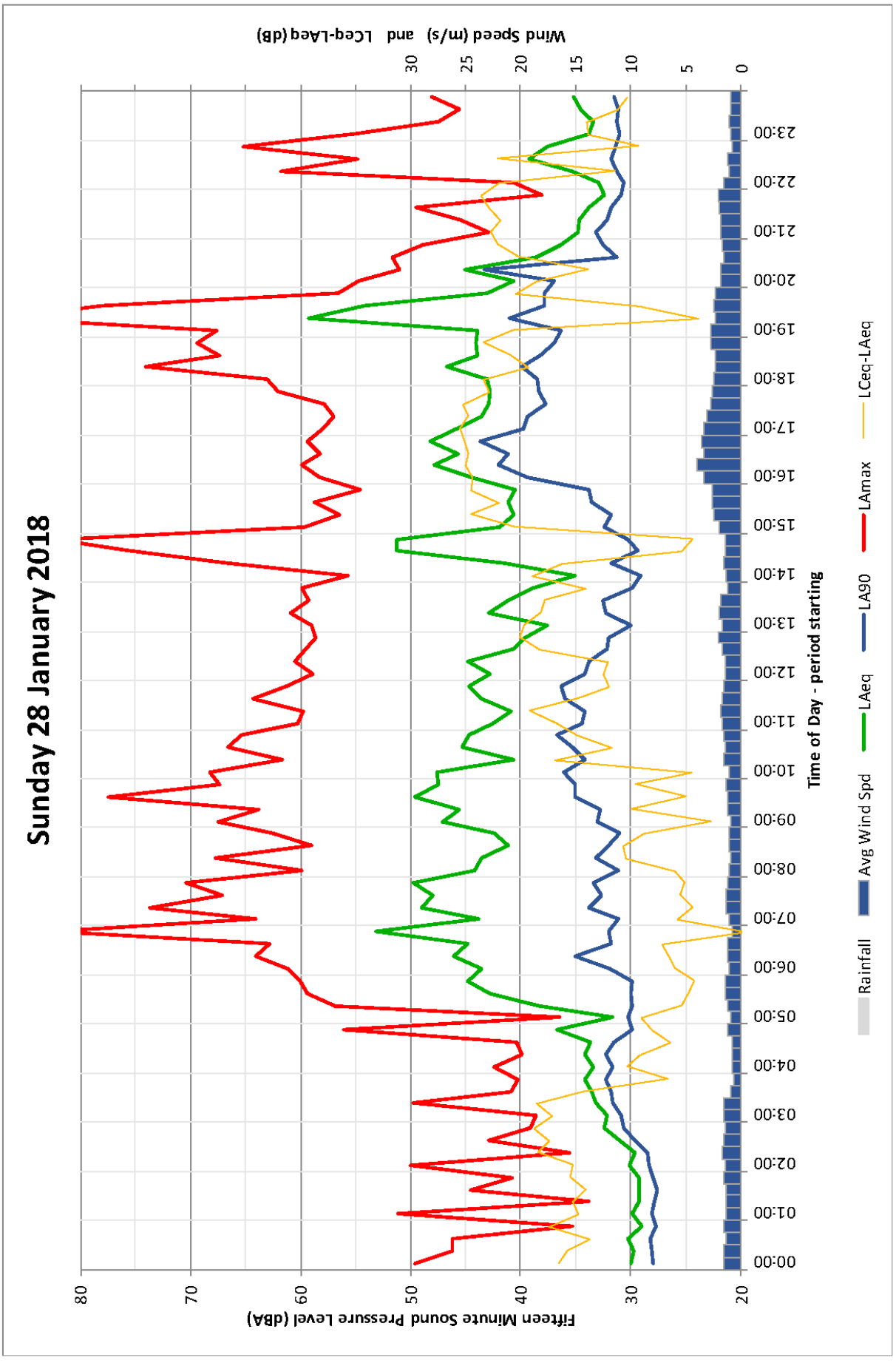

Tuesday 23 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall

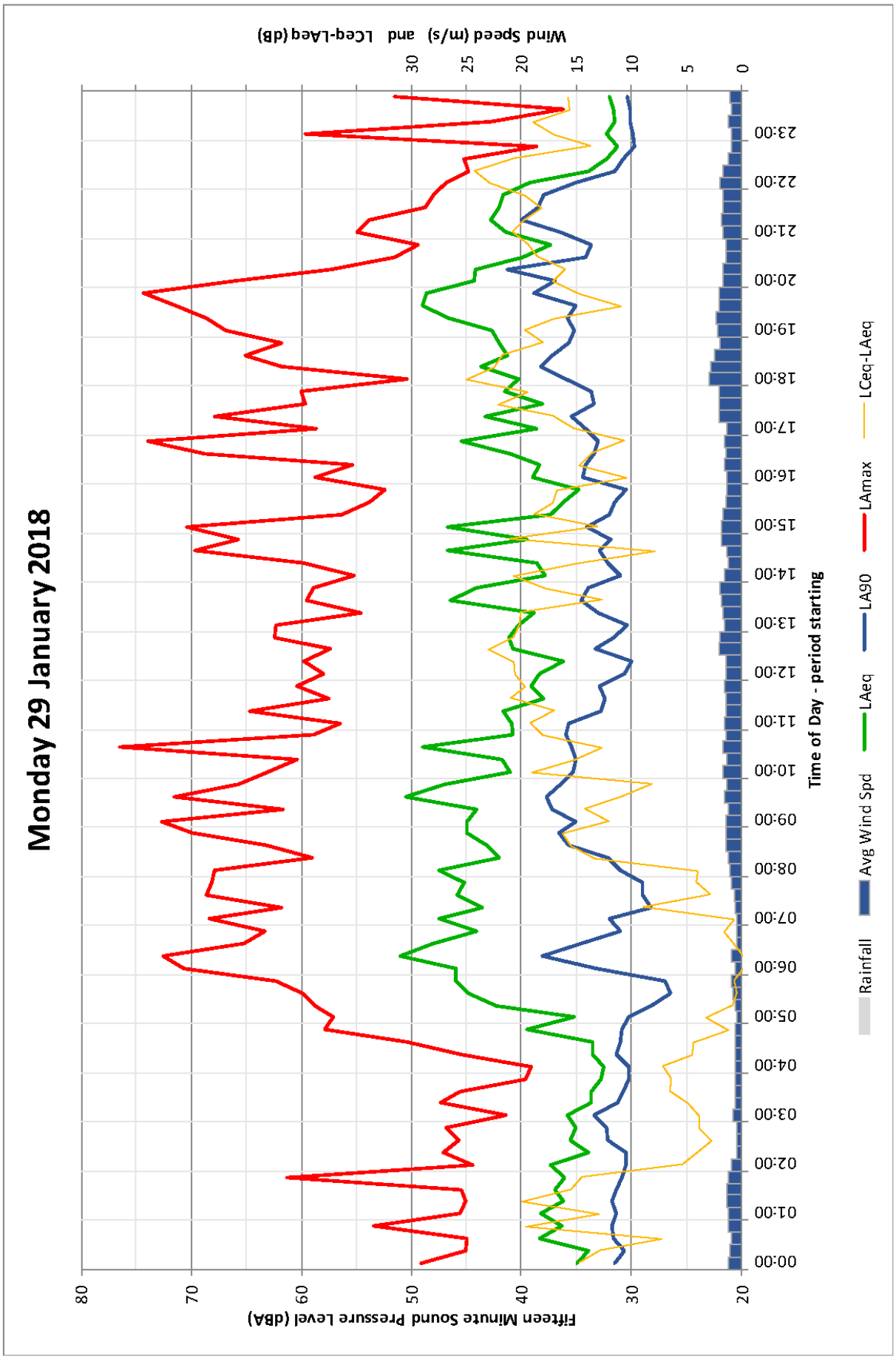

Wednesday 24 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

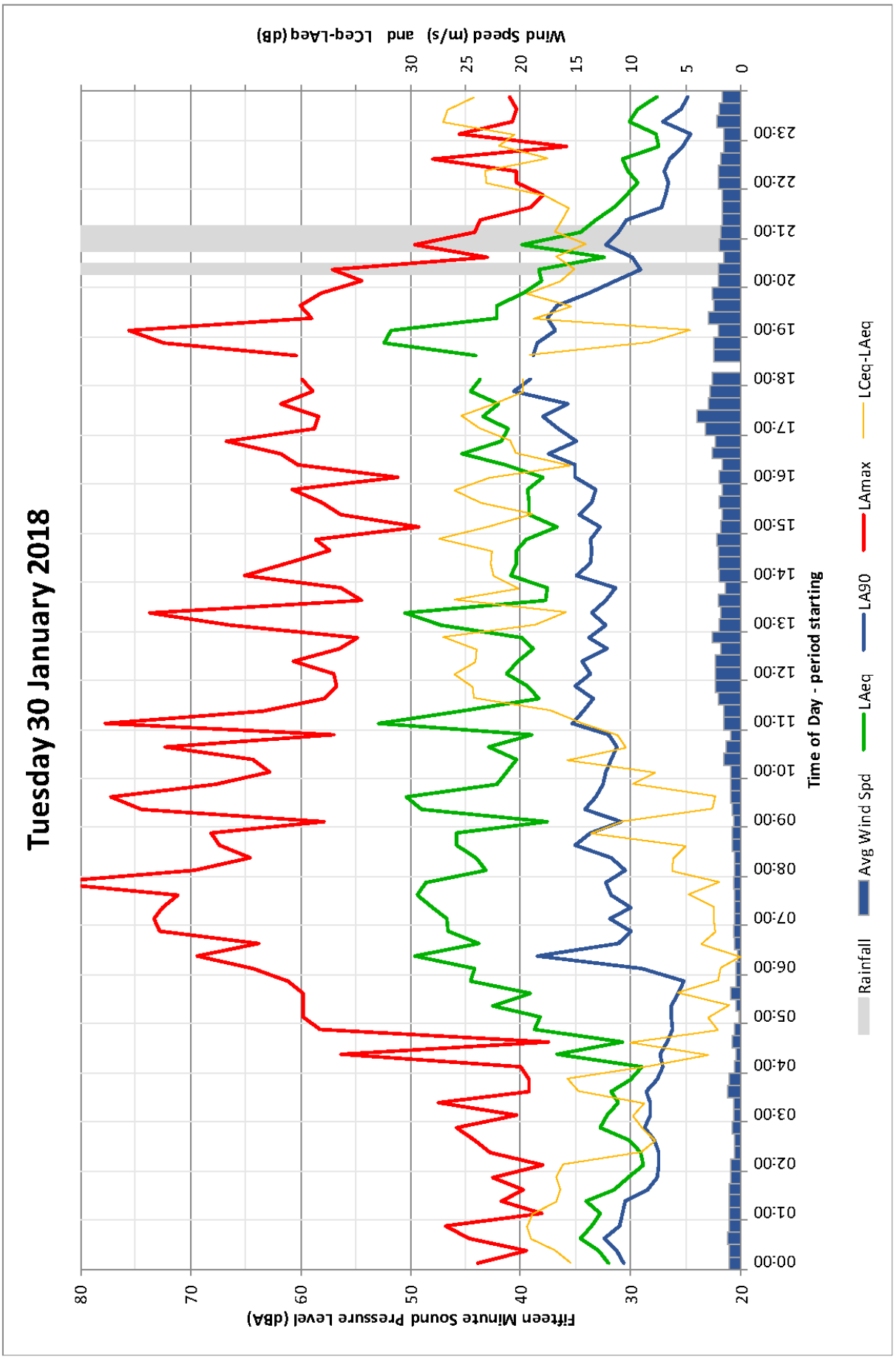

Thursday 25 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

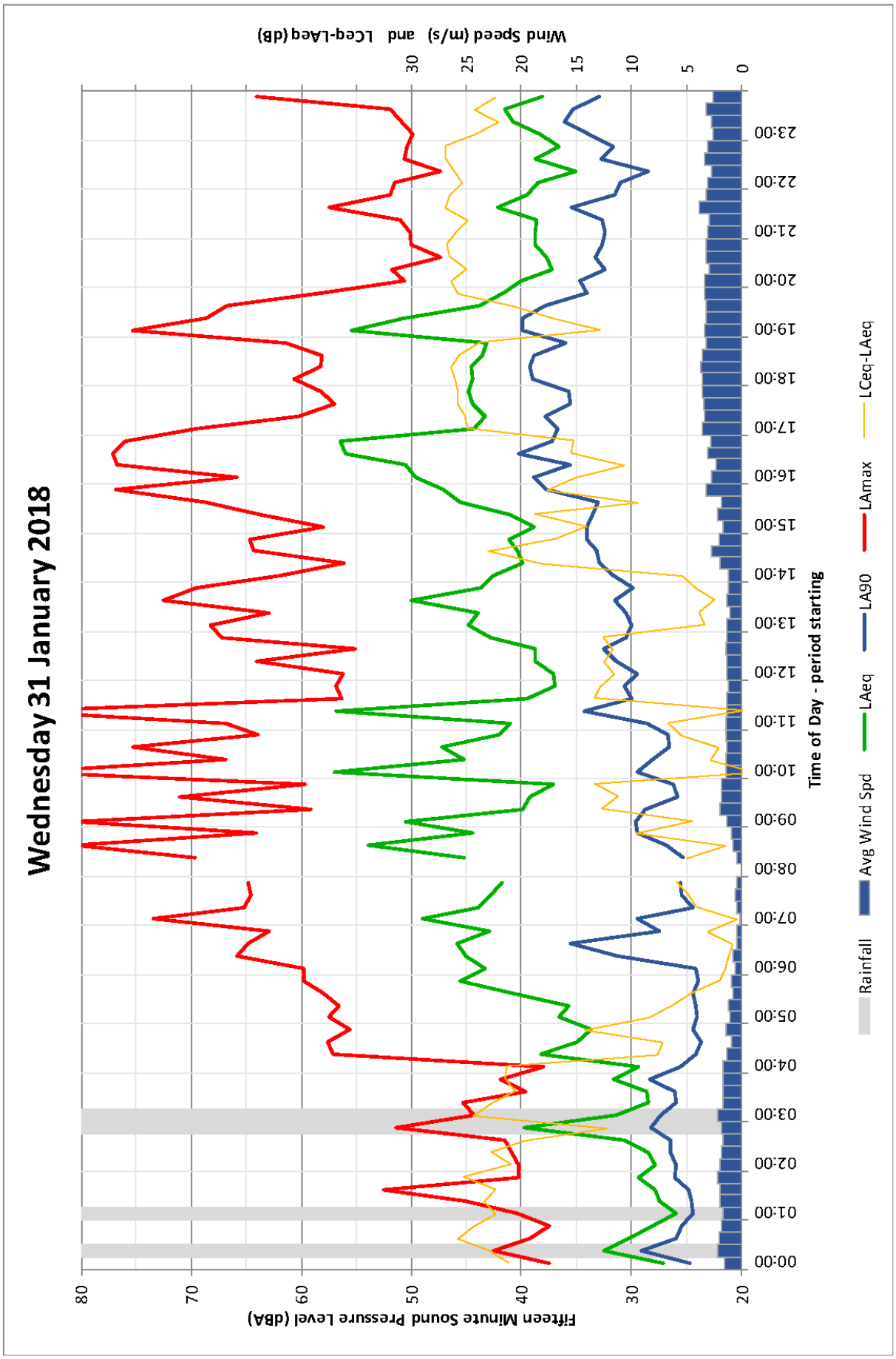

Friday 26 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

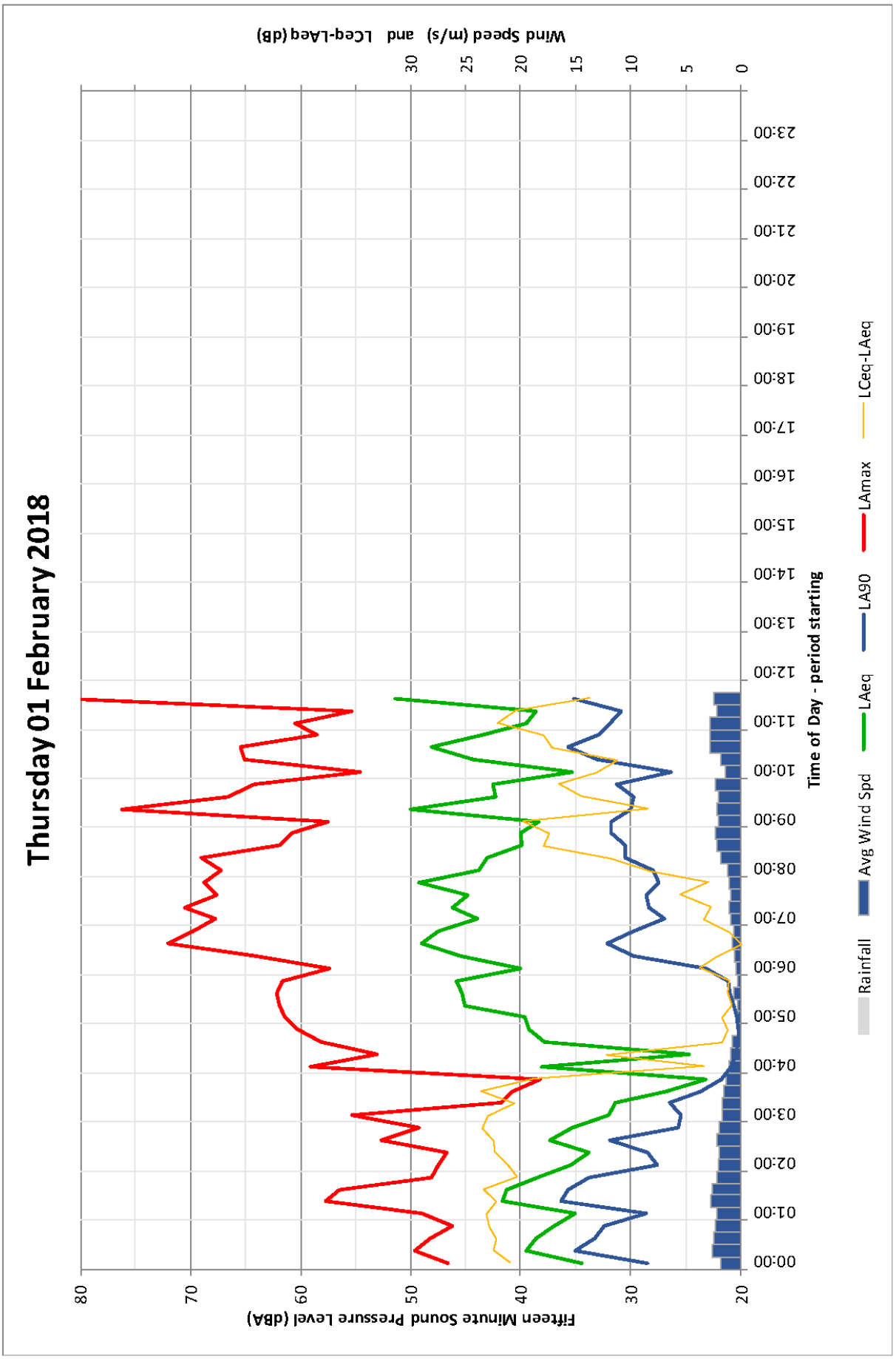

Saturday 27 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LAeq
LA90
LAmax
LCeq-LAeq
Avg Wind Spd
Rainfall


Sunday 28 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall


Monday 29 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LCeq-LAeq
LAmax
LA90
LAeq
Avg Wind Spd
Rainfall


Tuesday 30 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq


Wednesday 31 January 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
LAmax
LCeq-LAeq
LAeq
LA90
Avg Wind Spd
Rainfall


Thursday 01 February 2018
Fifteen Minute Sound Pressure Level (dBA)
Wind Speed (m/s) and LCeq-LAeq (dB)
Time of Day - period starting
Rainfall
Avg Wind Spd
LAeq
LA90
LAmax
LCeq-LAeq

ATTACHMENT B

UNATTENDED NOISE MONITORING RESULTS DISCUSSION

A key aspect of determining the contributed noise level from operations at the premises for comparison with licence limits is removing non-premises (extraneous) noise from the noise levels measured by the logger. Examples of extraneous noise sources audible at the monitoring location include (but are not limited to):

- Vehicle traffic on nearby local public roads;
- Aircraft flying overhead;
- Fauna (e.g. birds, insects, frogs, livestock);
- Vegetation (e.g. wind in trees); and
- Weather events and after-effects (e.g. rainfall, thunder, dripping and running water after rain).

Noise contributions from one or more extraneous sources were present within most of the 15-minute periods during the monitoring period. The two primary methods used to remove these extraneous contributions were:

- Frequency-based filtering; and
- Time-based filtering.

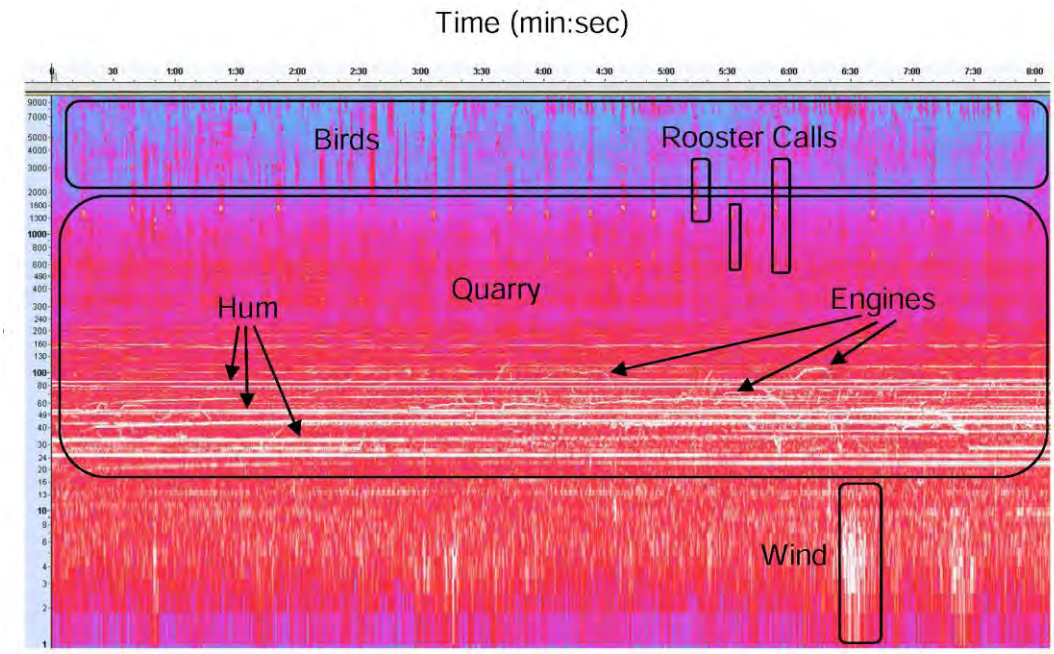
Frequency-based filtering is particularly suited to sources that only emit noise in part of the audio spectrum. Most frogs, birds and insects, for example, emit higher-frequency noise above about 2kHz and applying a low pass filter approach at this frequency band largely discounted their contribution. Similarly, noise contributions from wind were generally removed by screening out frequencies below the 31.5Hz 1/3-octave frequency band.

Time-based filtering is better suited to non-continuous sources of noise such as fauna noise, vehicular traffic, aircraft and weather-induced noise such as wind in trees. It was not possible to find a 'clean' 15-minute period that did not contain at least one of the above events, hence the one-minute noise logging period results were used. Using one-minute data periods increased the probability of finding relatively 'clean' measurement samples, not overly tainted by extraneous noise events.

An additional layer of time-based filtering used on this project involved selecting the $L_{A90(1\ minute)}$ descriptor to represent the essentially constant noise contribution from operations at the premises. Many intermittent extraneous noises, such as rooster calls, only occur for a short time within any one-minute period and hence do not affect the L_{A90} (background) noise level.

The above approaches can be seen in Figure 1 below. The figure shows a noise spectrogram produced by freely available 'Audacity' software. In the figure, the horizontal axis represents time and the vertical axis represents frequency, with the varying colour of the chart representing level.

Figure 1. Spectrogram of premises and extraneous noise captured during audio recording (7 December 2017, 7:00am to 7:08am).



The analysis results are thus based on one-minute frequency-filtered data periods. While this does not provide strict comparison with the licence limits, which are 15 minute values, it does provide:

- An indication of the premises' noise emissions in relation to the licence limits; and
- An indication of any variation in the premises' noise emissions according to the time of day.

The above results in turn can assist in guiding any feasible and reasonable noise mitigation efforts, if required, to provide most benefit in reducing impacts.

The complainants compiled notes during the monitoring campaign describing the times and character of noise they believed to be associated with the premises.

The process of analysing the data involved a number of steps:

1. The complainant's notes described a number of occasions where noise attributed to the quarry was clearly audible, for example on 7, 8, 13, 14 December and 8, 22 January. The EPA listened to the audio recordings captured on these occasions and selected one occasion (the morning of 7 December) which contained clear, largely 'clean' samples of noise which sounded like quarrying.

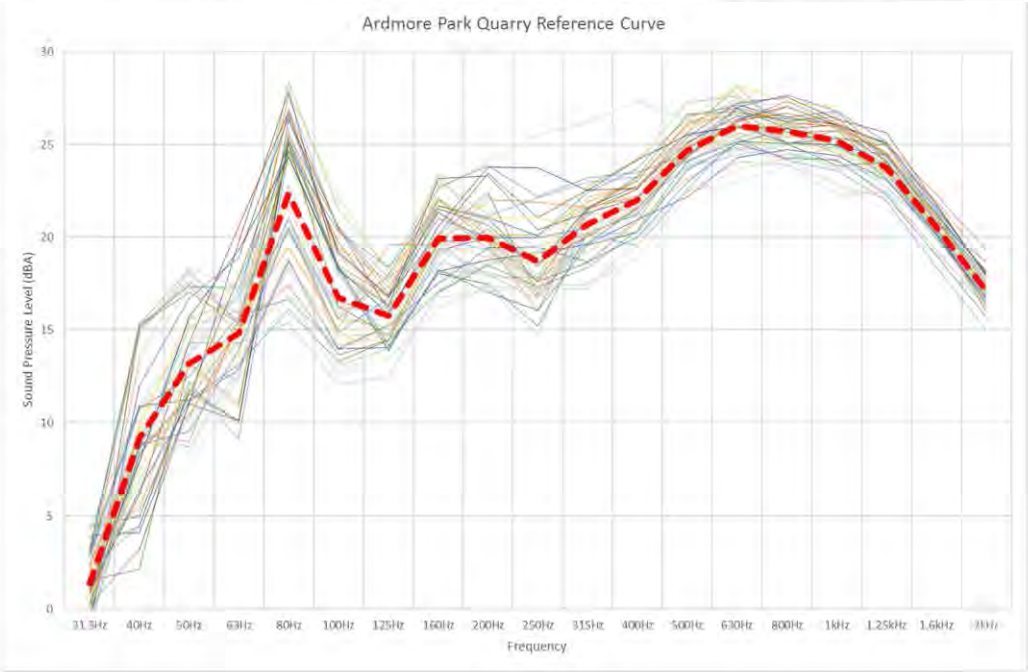
2. The EPA examined the $L_{A90(1\ minute)}$ spectra from 31.5Hz to 2kHz for the 'clean' audio samples, in this case between 6:55am and 7:48am. The EPA aggregated this data to develop a 'reference curve' considered representative of operations at the premises. The reference curve was developed by calculating the

logarithmic average of each one minute 'input' spectrum, for each frequency band.

The 'reference curve', shown as a heavy red dotted line, and the 'input' spectra from which it was derived, are shown graphically in Figure 2. It should be noted that the actual noise levels of this reference curve are not important, it is the 'shape' of the curve that will be used in subsequent steps.

A series of statistical measures were calculated on the data set in Figure 2 which described how well each one of the input spectra correlated with the reference curve, and the amount of variance in each curve/spectrum.

Figure 2. Ardmore Park Quarry 'Reference Curve' and 'input' spectra.



3. Every $L_{A90(1\ minute)}$ spectrum in the overall monitoring period data set for the quarry's hours of operation, including an additional hour in the early morning (i.e. 6:00am to 6:00pm), was compared against this reference curve to identify individual minutes where noise with a similar shape of spectral content to that of the 'clean' audio samples in Step 1 was present.

   The search algorithm does not look for particular overall noise levels, only the relative differences between frequency bands within each spectrum (i.e. the 'shape' of the spectrum). The 'tolerance' envelope of the matching process is governed by the statistical measures calculated in Step 2.

   For each $L_{A90(1\ minute)}$ spectrum in the overall data set where there is an acceptable match with the reference curve, the band-limited spectrum's total noise level is calculated by summing the 1/3-octave levels in the 31.5Hz to 2kHz bands.

In the above analysis, one-minute periods where the average wind speed was above 5 m/s, or during periods of rain, were excluded.

While this approach to data analysis is considered sensible and appropriate for situations such as this, where noise emissions from a premise are intermittent and confounded by extraneous noises, it has not been validated. It has been checked for good agreement against complainant logs.

It is possible that some matched data points are not associated with activities at the premises, and also that noise emissions from some activities at the premises with a spectrum outside the data matching 'envelope' will not be captured in the analysis.

The results of this analysis are shown in Figures 3 to 7 below.

Figure 3. Noise Level Distribution – Ardmore Park Quarry Matched Contribution.

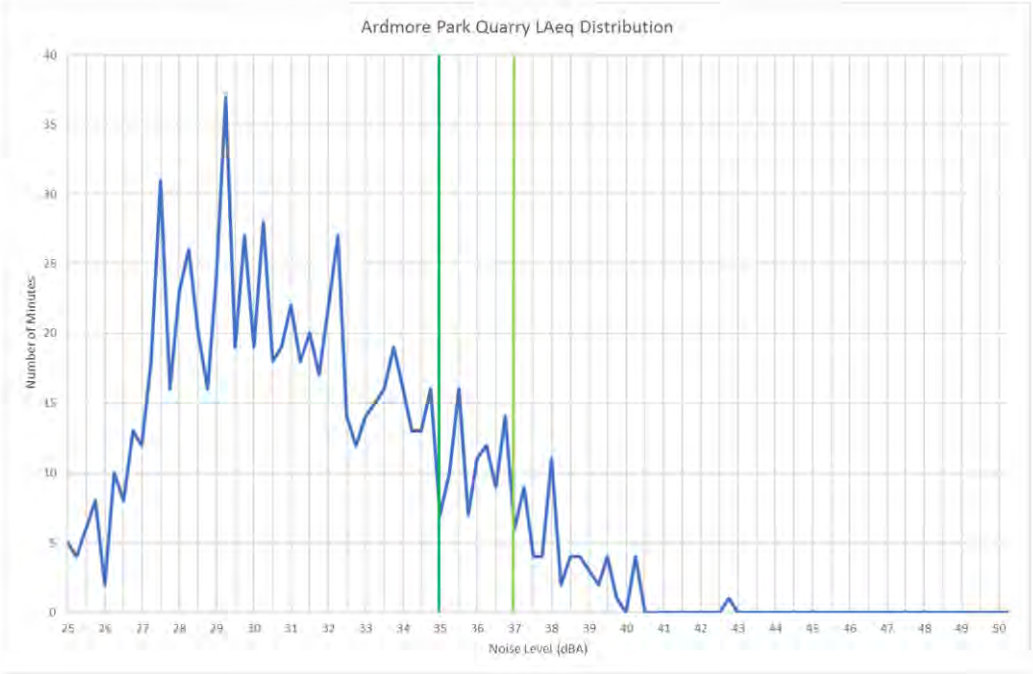


Figure 4. Noise Level Cumulative Distribution – Ardmore Park Quarry Matched Contribution.

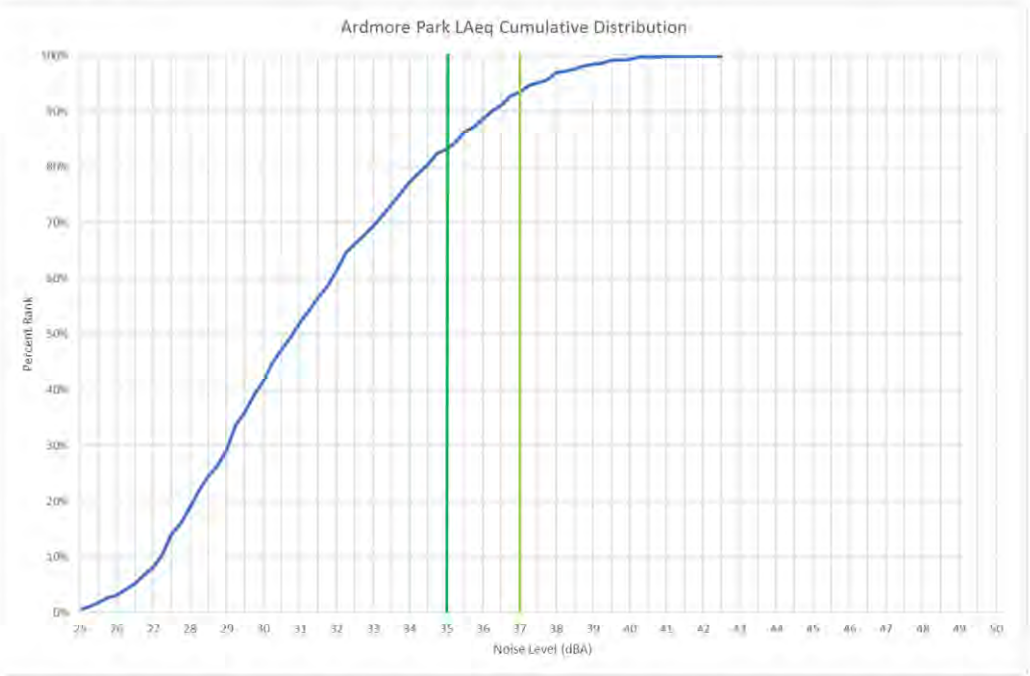


Figure 3 shows the distribution of overall levels of the band-limited one-minute spectra that matched the reference curve for the premises. This indicates that the background noise during each of those minutes sounded similar to that of operations at the premises.

Figure 4 shows an accumulation of this distribution, to show what percentage of the total number of minutes identified is below and above a particular level.

In Figure 3 and Figure 4, there are two vertical green lines. One is at 35 dB(A), which represents the noise limit for this premises. The second green line is at 37 dB(A), which represents the level above which the EPA would usually consider the non-compliance warrants regulatory intervention.

From Figures 3 and 4, the bulk of the matched levels for the premises (approx. 83%) are below the 35 dB(A) noise limit. Approximately 12% of the matched levels for the premises are up to 2 dB(A) above the 35 dB(A) limit, while a smaller portion (approx. 5%) of the matched levels for the premises exceed 37 dB(A). These occur for a total duration of 53 minutes, or 0.1% of the total daytime minutes during the 71 day monitoring period, with the highest repeatable matched level being 40 dB(A), aside from a single occurrence of 43 dB(A).

Figure 5. Noise Level Time Distribution – Ardmore Park Quarry Matched Contribution.

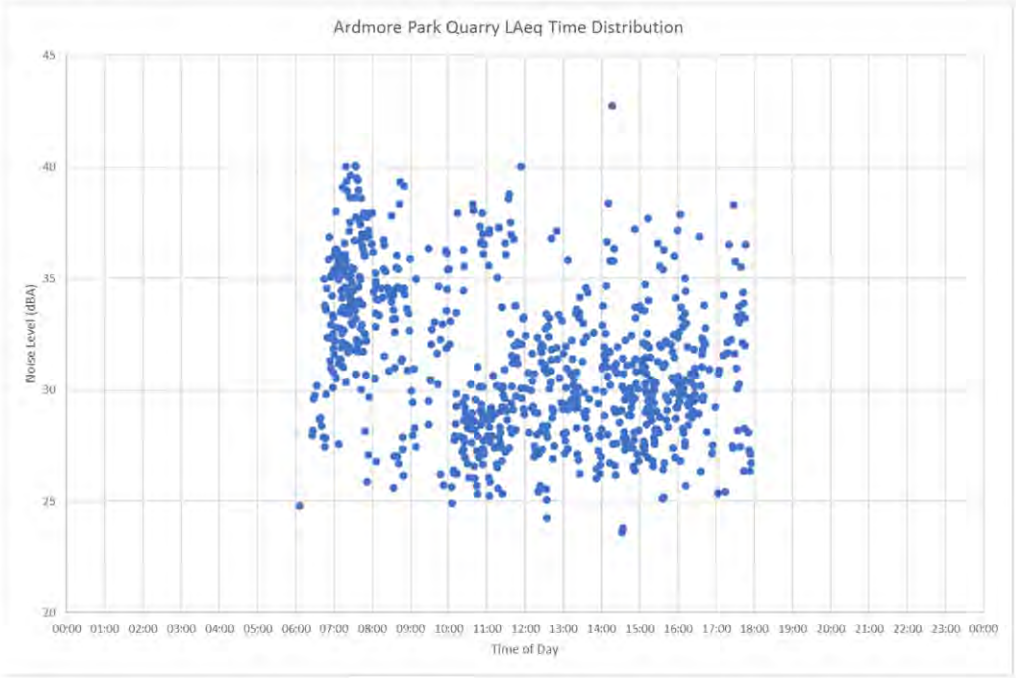


Figure 5 shows the aggregated distribution of these noise levels during the 6:00am to 6:00pm analysis period for the whole monitoring campaign duration. A small number of spurious matches made outside these times were discarded as no audio was available.

From Figure 5, the 7am to 8am period typically coincides with higher noise levels, suggesting that early morning activities are often more intense. A higher proportion of matched levels above 35 dB(A) occur during this time, especially just after 7am. Some matches occur prior to 7am, with some lower noise level matches around 6.30am. A single match at 25 dB(A) just after 6am is possibly spurious and can be ignored.

After 10am, matched noise levels are typically in the lower range below 35 dB(A), indicating steady, less intense activity during the remainder of the day.

Figure 6. Noise Level Date Distribution – Ardmore Park Quarry Matched Contribution.

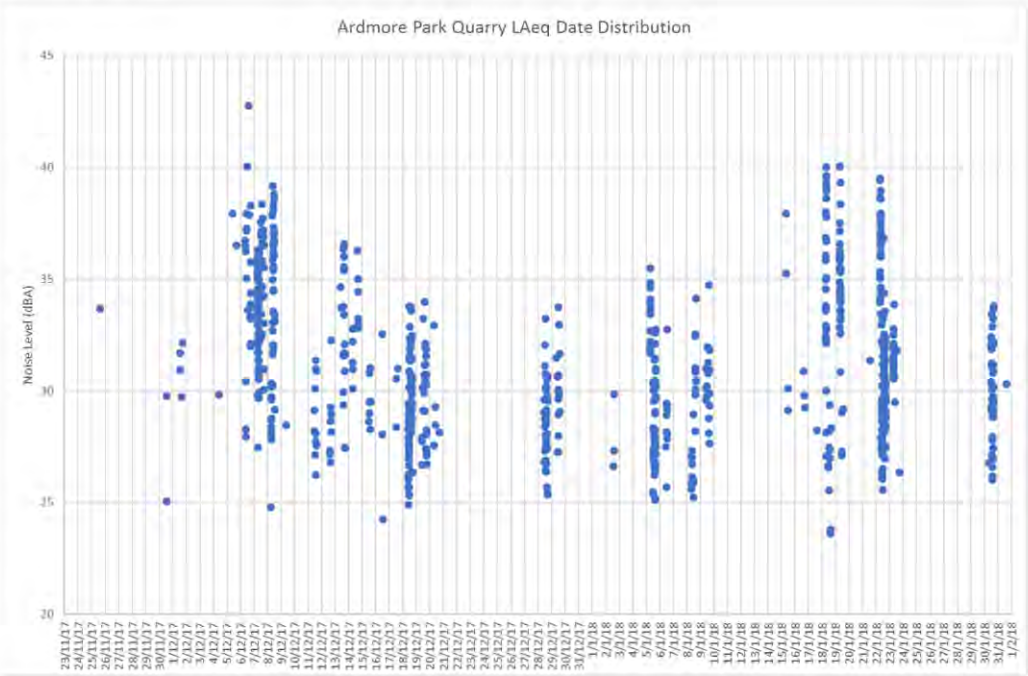


Figure 6 shows the same data as Figure 5, except that it is also separated by date. This provides an indication of days when noise matching operations at the premises was present, and generally agrees with the complainant's log provided to the EPA.

December 6, 7 and 8 indicate generally higher matched noise levels, supported by the log notes for those dates describing quarry noise as being audible. December 11, 12 and 13 also indicate higher matched noise levels, although more sporadic. December 9 & 10 only indicate a single match, supported by the log notes describing "not much going on". December 18 corresponds to a log entry of "still humming/pumping". Matches on 8, 9, 18, 19 and 22 January also correspond to log entries describing quarry noise.

The general agreement between match dates in Figure 6 and the complainant's log entries supports the validity of the 'reference curve' in Figure 2 being representative of contributed noise from operations at the premises.

Figure 7. Wind Direction Distribution.

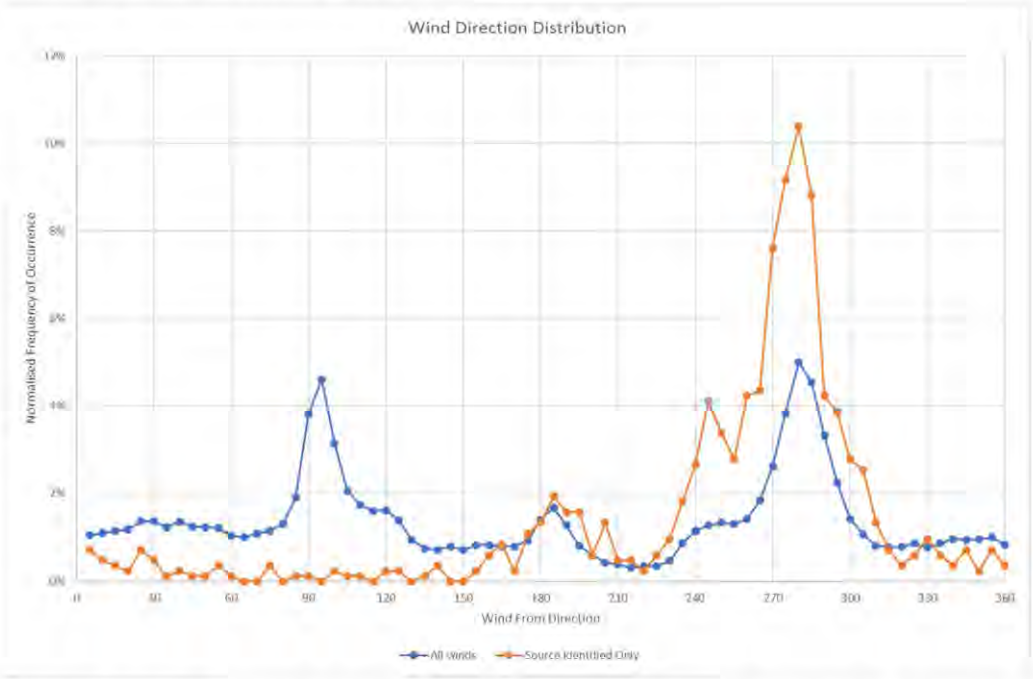


Figure 7 shows a chart of frequency of occurrence of wind direction for each one minute interval:

- During the 6am to 6pm analysis window for the entire monitoring campaign (the blue trace); and
- Where a spectrum matched the reference curve (the orange trace).

The compass bearing that the wind was coming from is shown in the horizontal axis, with 0/360 degrees being due north and 180 degrees being due south. The premises was approximately due west (270 degrees) of the residence.

It should be noted that this data is only for winds below 5 m/s, and directions corresponding to higher wind speeds are not included in this chart.

The blue trace shows that prevailing winds during the analysis window are predominantly from the east (about 90 degrees) and the west (about 270 degrees), with a smaller peak occurrence from the south (about 180 degrees).

The orange trace shows that when spectra matching operations at the premises were identified, the associated wind direction at that time was predominantly from the west (about 280 degrees), and in the direction of the quarry. Conversely, spectra matching operations at the premises were almost never identified when the associated wind direction was opposite, blowing from the east. This trend is significantly beyond the overall distribution of prevailing winds (the blue trace).

Given that noise propagation is enhanced by prevailing winds from source to receiver, and reduced by winds blowing in the opposite direction, this chart further supports the validity of the matched spectra as being representative of contributed noise from operations at the premises.