MARSHALL DAY Acoustics

WHENUAPAI ENGINE TESTING NOISE LOGGING AND ANALYSIS

Rp 001 R03 20171025 | 14 April 2021

84 Symonds Street
PO Box 5811
Victoria Street West
Auckland 1142 New Zealand
T: +64 9 379 7822 F: +64 9 309 3540
www.marshallday.com

Project: **WHENUAPAI ENGINE TESTING**

Prepared for: **The Neil Group**
PO Box 8751
Symonds Street
Auckland 1150

Attention: **Trevor Canty**

Report No.: **Rp 001 R03 20171025**

Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
Client Draft			11 Mar 2021	L Smith	
Client Draft	R01		15 Mar 2021	L Smith	
Issued	R02		9 April 2021	L Smith	M Hamilton
Issued	R03	Additional graphs	14 April 2021	L Smith	M Hamilton

TABLE OF CONTENTS

1.0 INTRODUCTION

This report sets out the results of noise monitoring carried out at two sites adjacent to Whenuapai Airbase (Airbase) over a period of approximately 10 months in 2020. The Airbase is operated by the New Zealand Defence Force (NZDF). The main purpose of the monitoring was to establish actual noise levels from aircraft engine testing activities at the Airbase received on two neighbouring sites (Kauri Rd and Totara Rd) owned by Neil Group and proposed for subdivision.

The future zoning of the two sites is yet to be determined and one factor influencing this decision is the extent of engine testing noise emissions from the Airbase and the potential adverse effects on future residential and other noise sensitive activities.

Due to the variability and poor record keeping of engine testing activities at the Airbase, acoustic experts have found it difficult to quantify the levels of engine testing noise received in surrounding areas. The data presented in this report represents the most extensive monitoring results of engine testing noise from the Airbase available to date and therefore provides the most reliable information regarding the actual engine testing noise levels currently received at the two sites.

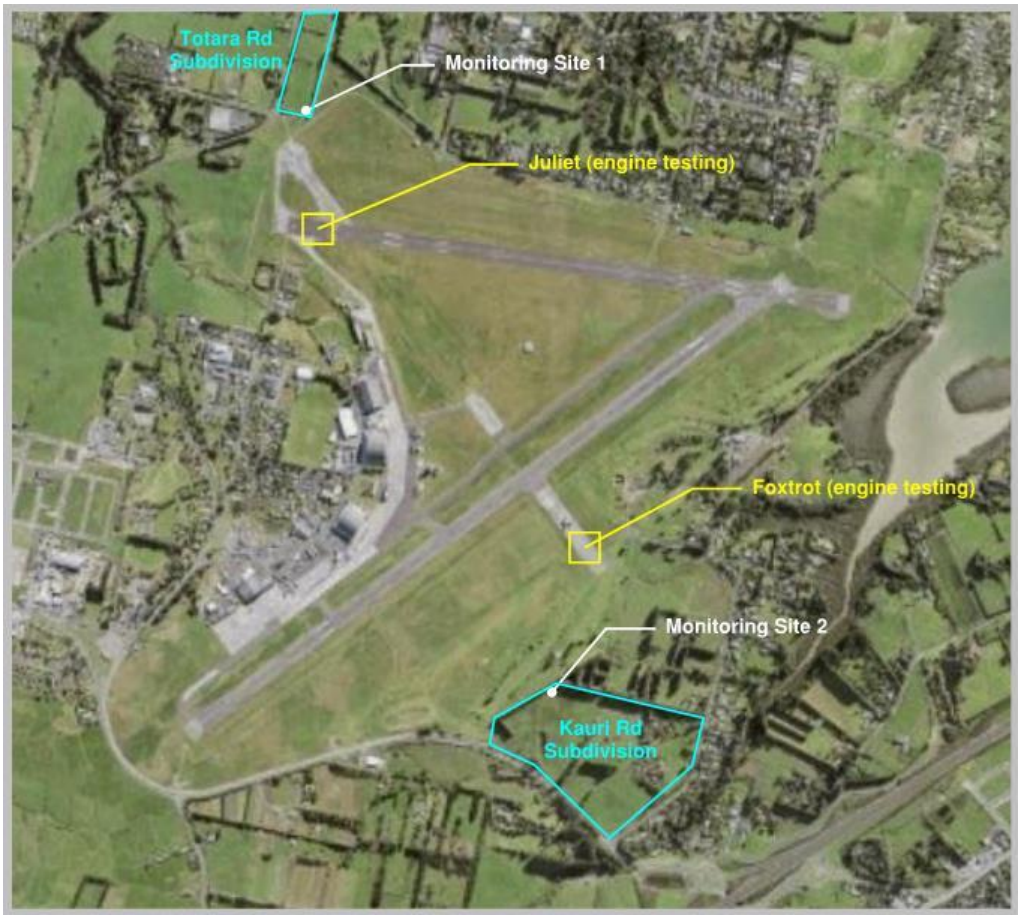
We have considered the monitoring results in the context of proposed Auckland Unitary Plan (AUP) - Plan Change 5 which affects the zoning on the Kauri Road site owned by Neil Group. The monitoring generally supports engine testing noise contours prepared for NZDF by Tonkin and Taylor (dated 27 February 2020, 13 March 2020) and the more recent and more conservative update by Tonkin and Taylor dated March 2021.

2.0 PROPOSED SUBDIVISION AND MONITORING LOCATIONS

Neil Group owns two areas of land that share a boundary with Whenuapai Airbase shown in Figure 1 (Kauri Rd and Totara Rd). The land is zoned Future Urban in the Auckland Unitary Plan (AUP) and Neil Group plans to subdivide and develop the sites. The Kauri Rd site is subject to AUP Plan Change 5 which will determine the zoning and development controls for this and other surrounding sites.

Noise monitoring was undertaken at both sites to establish the actual noise levels in the area with a particular focus on quantifying noise from engine testing at the Airbase. The locations of the monitoring stations and the closest engine testing locations are shown in Figure 1.

Figure 1: Site and Monitoring Plan



3.0 NOISE MONITORING

3.1 Monitoring Setup

Noise loggers were installed by Jepson Acoustics and Electronics Ltd at the two subdivision sites. Monitoring Site 1 (Site1) at the Totara Road and Monitoring Site 2 (Site2) at the Kauri Road site.

The Jepson noise monitors recorded noise levels every second from mid-February 2020 until mid-January 2021 (24 hours a day, 7 days a week). The monitoring stations also photographed the engine testing sites and took audio recordings whenever noise levels reached a predefined threshold. During analysis of the data, we utilised the images and audio recordings to help identify engine testing events.

3.2 Data Analysis

We analysed the noise data from 16 February 2020 to 31 December 2020[1]. From the data, we calculated the following information:

- The individual occurrence and duration of engine testing events. These were identified based on a review of time trace noise data. Events were identified based on their graphic pattern (classically, a sharp increase and decrease in sound level with a consistent raised level in between, as depicted in Appendix B) and cross referenced with audio recordings. Engine testing events that were not confirmed with audio recordings were described as

[1] The January 2021 data is not considered reliable as earthworks had commenced at the Kauri Road site.

'possible events'. All confirmed and possible events were included in the analysis described in the following bullet points.

- The daily L_{dn} noise level due to engine testing events only.
- The seven-day rolling average L_{dn} due to engine testing events only.
- The daily duration of engine testing and the 7-day average duration.
- The duration of engine testing at night and the 7-day average duration at night.
- The seven-day rolling average L_{dn} for all sound.

Appendix C contains graphs showing the results of the above analysis.

Appendix D includes graphs of the measured 6 hourly L_{Aeq} at Site 2 from all noise sources. This provides a further graphical representation of the noise environment at this location over time.

3.3 Summary of Results

Results of the analysis are summarised in Table 1, graphed in Appendix C and discussed below.

Table 1: Summary Statistics from the Monitoring Period (16 Feb – 31 Dec 2020)

	Site 1 Totara Rd	Site 2 Kauri Rd
# Days with Engine Testing (ET)	169 (53%)	243 (76%)
# Days with no ET	149 (47%)	75 (24%)
% Saturdays with no ET	78%	67%
% Sundays with no ET	74%	65%
# Nights with ET	72 (23%)	85 (27%)
Average duration of ET on days it occurred (minutes)	65	102
Average duration of ET on nights it occurred (minutes)	30	34
Average total sound (L_{dn} 318 days[2])	57	61
Average total sound on days with no ET (L_{dn})	50	48
Average ET noise (L_{dn} 318 days[1])	54	60
Maximum Daily L_{dn} from ET	72	76
Maximum 7-day L_{dn} from ET	63	68

The graphs in Appendix C illustrate how the engine testing noise exposure varied over the monitoring period. Engine testing noise is highly variable at both sites. Where the 7-day average noise level

[2] This value is equivalent to the average 7-day L_{dn}

(from engine testing) is high, this tends to be controlled by a single busy day of engine testing. While there are days when the noise exposure is high, there are also many days with low noise levels or no noise from engine testing. To understand this further, the pie charts in Figure 2 and Figure 3 compare the prevalence of the noisy days with quieter days over the monitoring period.

Figure 2: Summary of Site 1 (Totara Rd) Engine Testing Noise Exposure by Daily L_{dn}

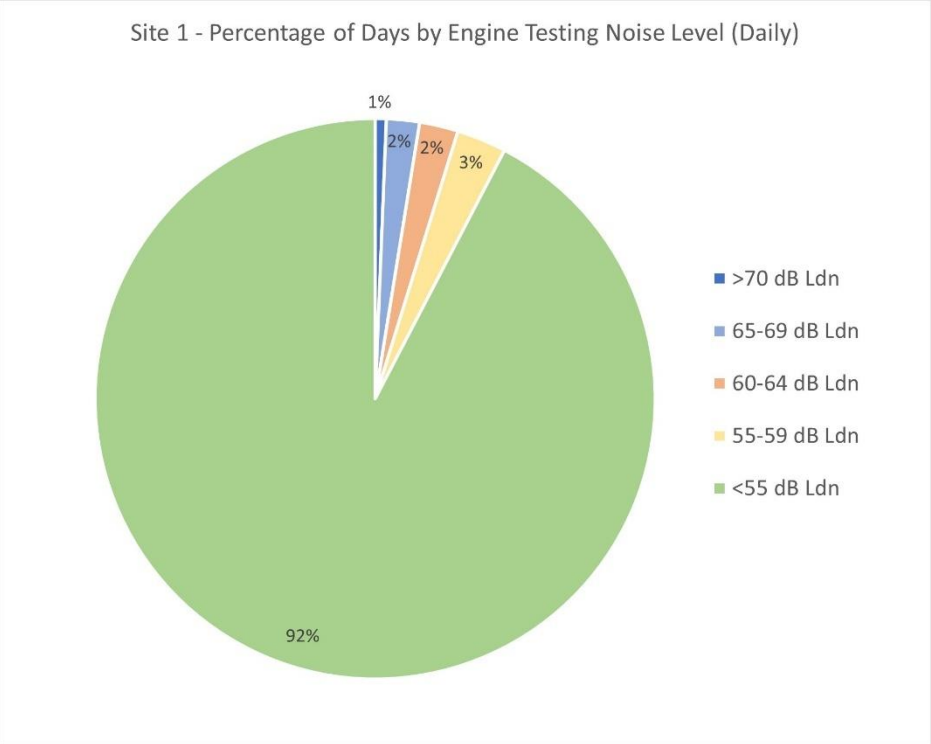
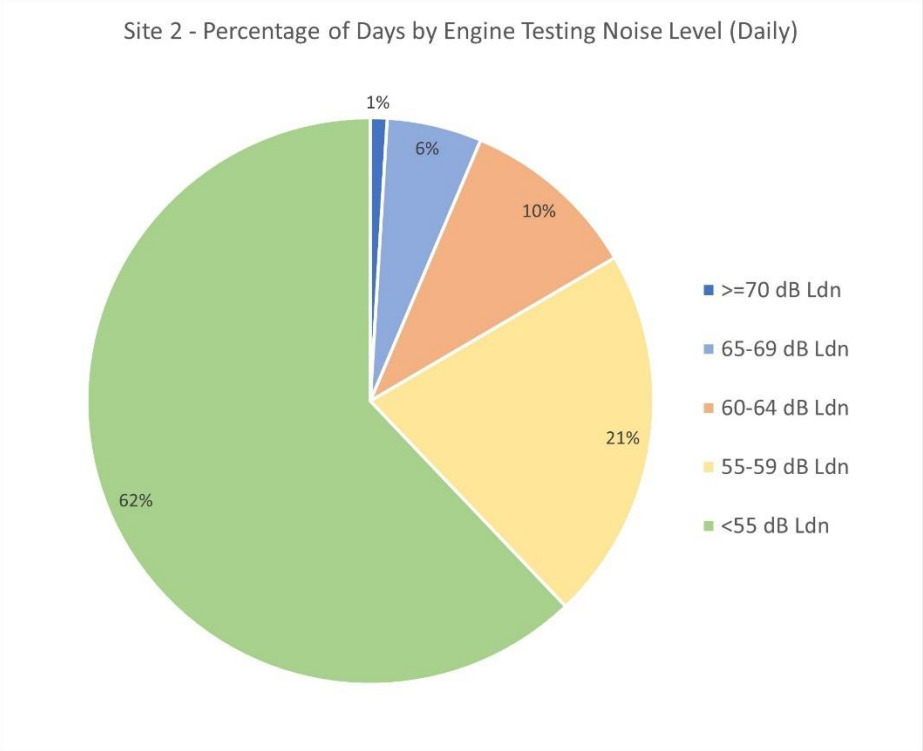


Figure 3: Summary of Site 2 (Kauri Rd) Engine Testing Noise Exposure by Daily Ldn



The charts show that the daily L_{dn} from engine testing exceeds 65 dB on only 3% of days at Site 1 and 7% of days at Site 2. Days with moderately high noise levels of 55 – 65 dB L_{dn} are more prevalent (31% of days) at Site 2 than Site 1 where the level is below 55 dB L_{dn} on 92% of days.

Figure 4 and Figure 5 show the percentage of weeks during the monitoring period where the 7-day average L_{dn} from engine testing was in each noise level band.

Figure 4: Summary of Site 1 (Totara Rd) Engine Testing Noise Exposure by 7 Day L_{dn}

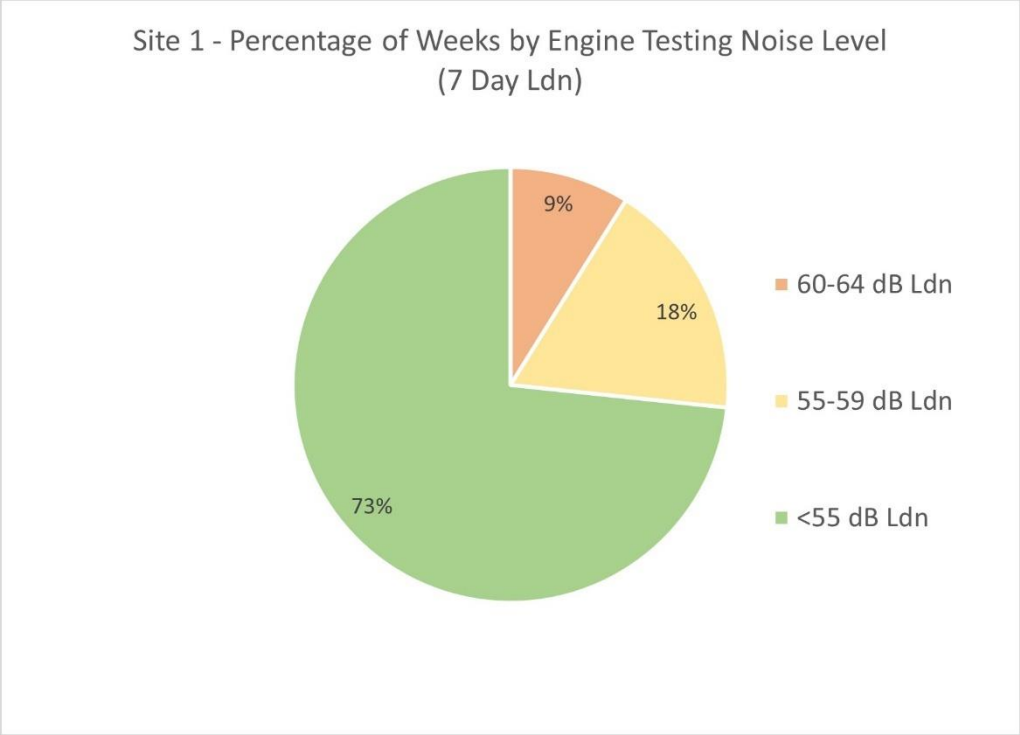
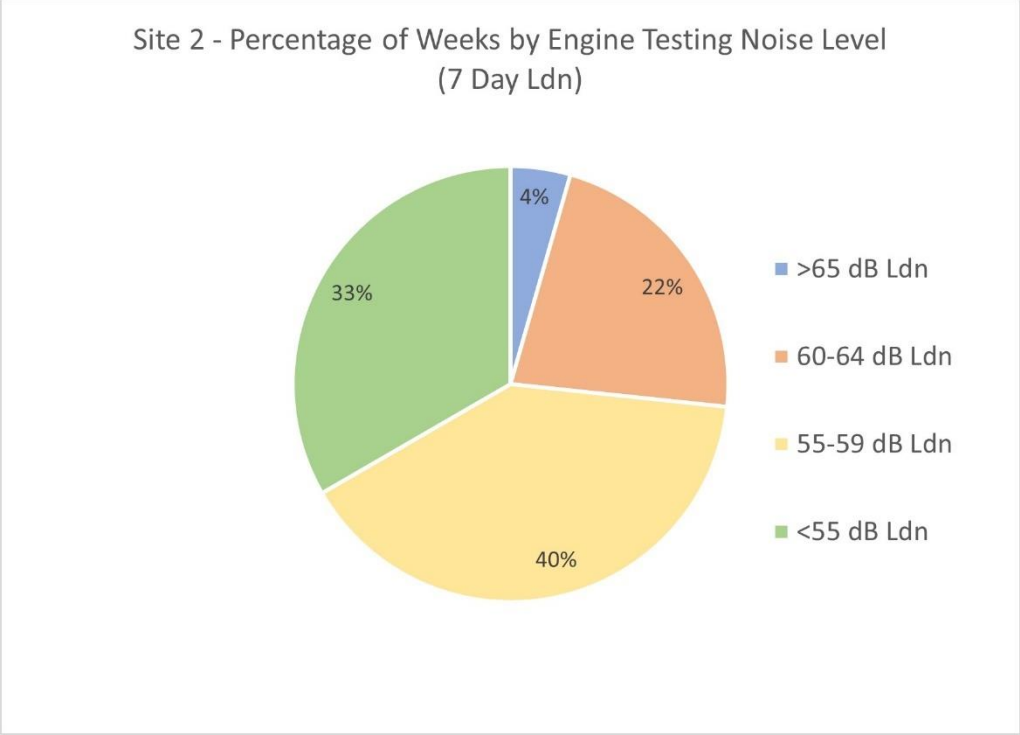


Figure 5: Summary of Site 2 (Kauri Rd) Engine Testing Noise Exposure by 7 Day L_{dn}



At Site 1, the 7-day L_{dn} did not exceed 65 dB and was below 60 dB for 91% of weeks.

At Site 2, there were two weeks (4% of weeks) during the monitoring period when the 7-day average exceeded 65 dB. For 96% of weeks, the 7-day average level was below 65 dB L_{dn} and for 73% of weeks, the 7-day average was below 60 dB L_{dn}.

In addition to considering the average durations and noise levels from engine testing, it is important to quantify the actual sound level during an engine test to determine what the short-term effects would be on receivers whenever an engine test is carried out. During some engine testing events, noise levels recorded at Sites 1 and 2 exceeded 75 dB L_{Aeq} for extended periods (up to several hours), as depicted in Appendix B. The levels reached low 80 dB L_{Aeq} figures but did not breech the 85 dB L_{Aeq} threshold that triggers the need for hearing protection in an occupational setting.

4.0 APPLICATION OF THE MONITORING RESULTS TO PLAN CHANGE 5

The future zoning of the Kauri Road site is to be determined by Plan Change 5 (PC5) to the AUP. One factor influencing the zoning and land use rules is the extent of engine testing noise emissions from the Airbase.

Due to the variability and poor record keeping of engine testing activities at the Airbase, acoustic experts have found it difficult to quantify the levels of engine testing noise received in surrounding areas. Also, due to the high variability of the activity, it is difficult to determine what is an appropriate basis for assessing and managing the effects of engine testing.

Several noise contour maps have been provided by NZDF to describe the extent of engine testing noise emissions and define areas where noise sensitive activities should be prohibited or insulated. The proposed land use for PC5 is for Residential – Single House zoning with acoustic insulation between the 57 and 65 dB L_{dn} contours. Inside the 65 dB L_{dn} contour, Business - Light Industry zoning is proposed.

4.1 Engine Testing Noise Contours

4.1.1 Modelling Issues

Acoustic consultants have had difficulty arriving at an appropriate set of engine testing noise contours for a number of reasons.

- The original PC5 modelling by Malcolm Hunt Associates was based on a sample of engine testing records that was too small to represent the actual variability of the activity, plus night-time engine testing was not included.
- Details of engine testing events have been poorly recorded and are inherently inaccurate.
- Engine testing take place at multiple locations which adds to the variability of the activity. Also, there are options to move testing away from the Airbase boundaries to reduce noise emissions.
- Planned fleet changes at the Airbase will reduce the amount of required engine testing within the next five years. Specifically, the P-3 aircraft, which is a significant contributor to engine testing noise, will be decommissioned by 2023 and its replacement will be based elsewhere.
- It has generally been agreed by the acousticians involved that an assessment period of 7 days is appropriate for engine testing at the Airbase, however the activity is so variable it is difficult to select a representative amount of engine testing over 7 days for assessment. The options include the historical worst case (from a limited sample), the hypothetical worst case, or some other more frequently occurring level of activity (e.g. occurs more than 5% of the time).

4.1.2 Tonkin and Taylor Contours 2020

In 2020 Tonkin and Taylor prepared two sets of noise contours (dated 27 February and 13 March 2020) for consultation purposes as follows:

1. Scenario 1: All Aircraft Noisy Week Scenario[3]
2. Scenario 2: B757 and C130 Aircraft Noisy Week Scenario[4]

Both sets of contours represent the actual engine testing activity during the "noisy week" from the available sample of engine testing records in 2017. The first scenario is the noisy week for all three aircraft whereas the second scenario is the noisy week for the C130 and B757 with any P-3 engine testing excluded. Therefore Scenario 2 represents the noisy week in the near future when the P-3 is decommissioned.

It is important to remember that the contours do not represent the typical noise environment. Instead, they represent a very small portion of weeks in a year. This was confirmed by the noise monitoring reported in this document and is demonstrated by the blue wedge in the pie chart in Figure 5.

For Scenario 1: All Aircraft Noisy Week, the 65 dB L_{dn} contour lies partially inside the Kauri Road site very near to the Site 2 monitoring location. The monitoring results show the noisiest 7-day period was 68 dB L_{dn} and this occurred twice over the 10-month monitoring period. For all other weeks, the level was below 65 dB L_{dn}. Comparing the modelling and monitoring, we consider that the modelled contours for Scenario 1 are a reasonable representation of the current worst-case week.

For Scenario 2: B757 and C130 Aircraft Noisy Week (no P-3 aircraft), the 65 dB L_{dn} contour does not extend into the Kauri Road site. The P-3 is a significant contributor to engine testing noise as confirmed by the monitoring results where photographs identified P-3 testing at the Foxtrot taxiway location. We agree that when the P-3 is decommissioned in the near future, engine testing noise emissions will decrease and that the Scenario 2 contours are likely to be a reasonable representation of the expected future condition.

4.1.3 Tonkin and Taylor Contours 2021

More recently NZDF has provided a revised report by Tonkin and Taylor '*Whenuapai Airbase – Engine Testing Noise Contours*' dated March 2021. The modelling inputs and assumptions have been refined further following two weeks of in-field testing undertaken by Tonkin and Taylor in November 2019. The contours are generally based on the Scenario 1: All Aircraft Noisy Week Scenario discussed above but with the addition of 20% more testing. The Tonkin and Taylor contours are included in Appendix E.

The latest Tonkin and Taylor contours are just slightly larger than the previous Scenario 1 contours (dated 27 February 2020). As there is only a small difference, we can apply the same conclusion as above that the latest modelled contours are a reasonable representation of the current worst-case week. The results of long-term monitoring presented in this report demonstrate that this level of noise exposure is not experienced every week. Also, as discussed above, once the P-3 is decommissioned, we expect the engine testing noise exposure would decrease appreciably.

[3] Based on records from week commencing 9 October 2017

[4] Based on records from week commencing 28 August 2017

4.2 Land Use Controls

The proposed land use for PC5 is for Residential – Single House zoning with acoustic insulation between the 57 and 65 dB L_{dn} engine testing contours.

The main noise effects of engine testing at the Airbase on residential activity would be:

- outdoor amenity - annoyance and communication interference
- night-time sleep disturbance
- indoor amenity - annoyance and communication interference.

The effect of engine testing noise on outdoor amenity is difficult to mitigate through design. In this case, it is important to recognise that while engine testing events are loud and can last for a long time, there are many periods of respite, particularly during weekends and public holidays, which is beneficial for residential amenity.

The night-time and indoor noise effects can be mitigated by acoustically insulating buildings. While engine testing would still be audible indoors, residents would be able to achieve reasonable indoor levels by closing doors and windows. Provision of ventilation and cooling/heating would mean a reasonable air quality and thermal comfort could also be achieved.

With respect to the appropriate type of residential development within the engine testing noise contours, we consider the following factors should be considered.

- The difference in residents' expectations and lifestyle (particularly outdoor living) in standalone house developments compared with terrace house developments.
- A high level of acoustic insulation can be achieved more efficiently for terrace houses than for standalone houses as there are fewer external façades to treat.

5.0 CONCLUSION

The long term in-field monitoring data presented in this report represents the most extensive monitoring results of engine testing noise from the Whenuapai Airbase available to date. The data provides a true record of actual noise emissions, testing times and durations for a ten-month period and therefore provides the most reliable information regarding the actual engine testing noise levels currently received at the two monitoring sites.

Site 1 on Totara Road is affected by high noise levels from engine testing on taxiway Juliet from time to time but overall, the noise exposure levels are generally suitable for residential activity.

Site 2 on Kauri Road experiences higher average noise exposure levels than Site 1 as taxiway Foxtrot is used more extensively than taxiway Juliet for engine testing. The proposed Plan Change 5 provisions of the Auckland Unitary Plan would enable residential development for noise levels below 65 dB L_{dn}. The monitoring results show that currently the daily noise exposure at the property boundary closest to Taxiway Foxtrot is below 65 dB L_{dn} on 93% of days and the 7-day noise exposure is below 65 dB L_{dn} on 96% of weeks.

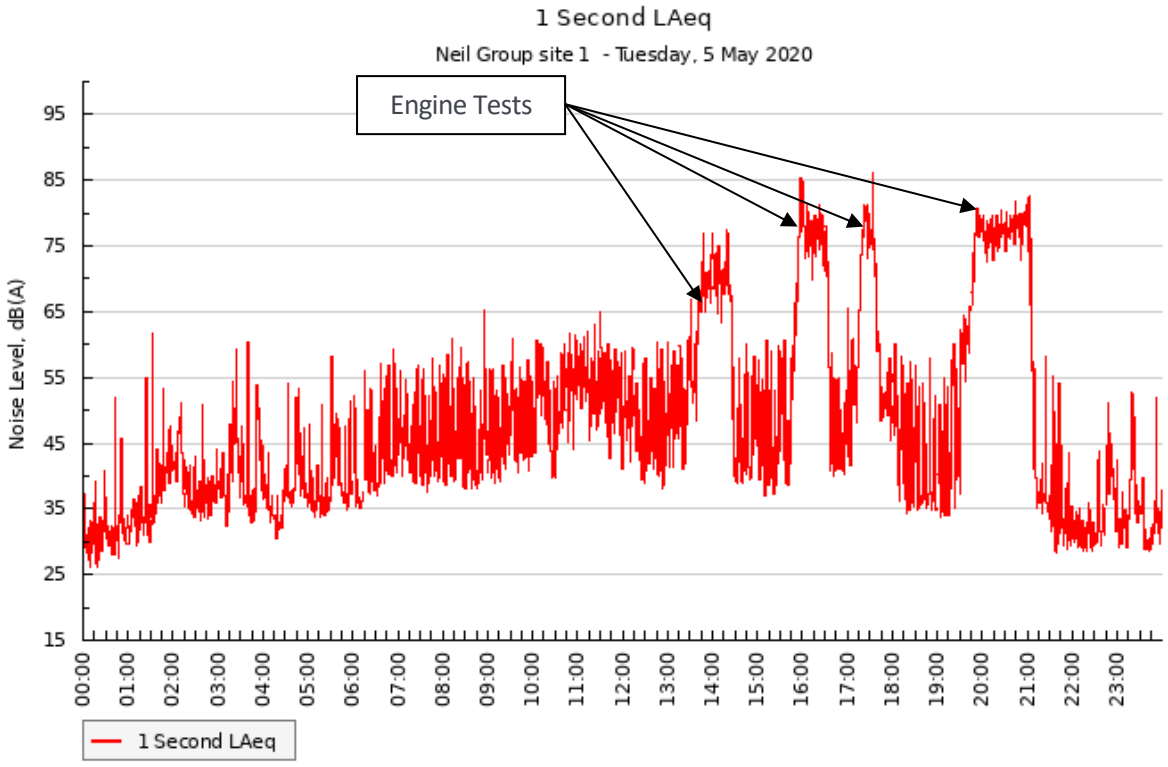
We consider that the Tonkin and Taylor noise contours dated March 2021 are a reasonable representation of the current worst-case week of engine testing noise. When the P-3 aircraft is decommissioned, the worst case 7-day noise exposure is predicted to decrease. We consider that the Tonkin and Taylor noise contours for the B757 and C130 Noisy Week Scenario (dated 13 March 2020) are a reasonable representation of this future situation.

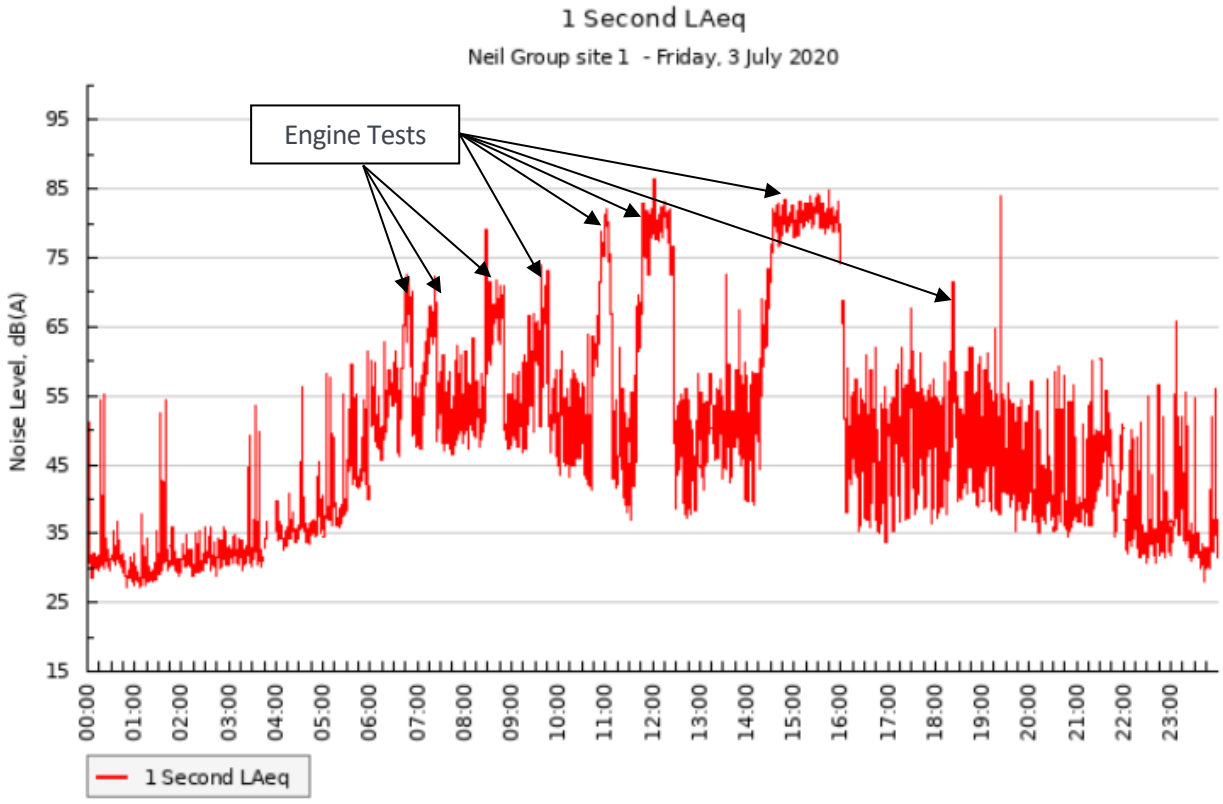
APPENDIX A GLOSSARY OF TERMINOLOGY

Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
dB	Decibel The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
L_{dn}	The day night noise level which is calculated from the 24 hour L_{Aeq} with a 10 dB penalty applied to the night-time (2200-0700 hours) L_{Aeq}.
$L_{Aeq\,(t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
Noise	A sound that is unwanted by, or distracting to, the receiver.

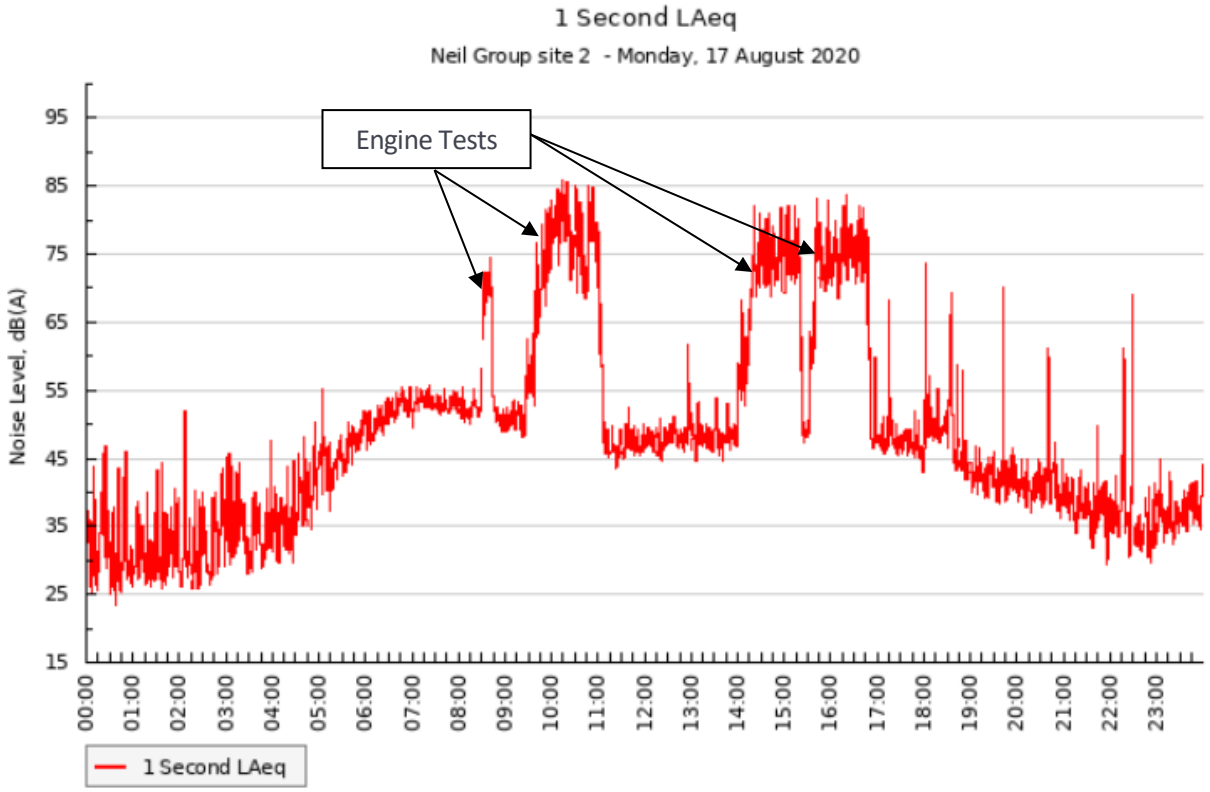
APPENDIX B SAMPLE GRAPHS OF ENGINE TESTING EVENTS

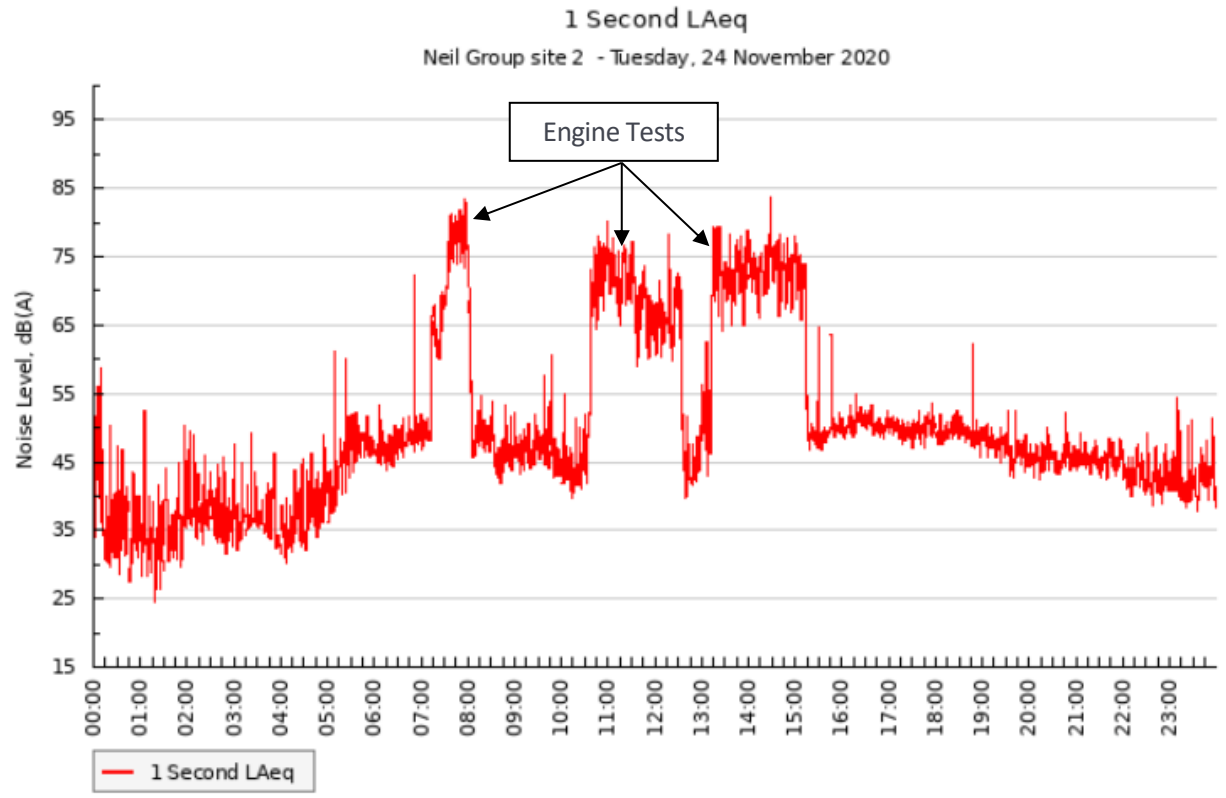
Totara Road



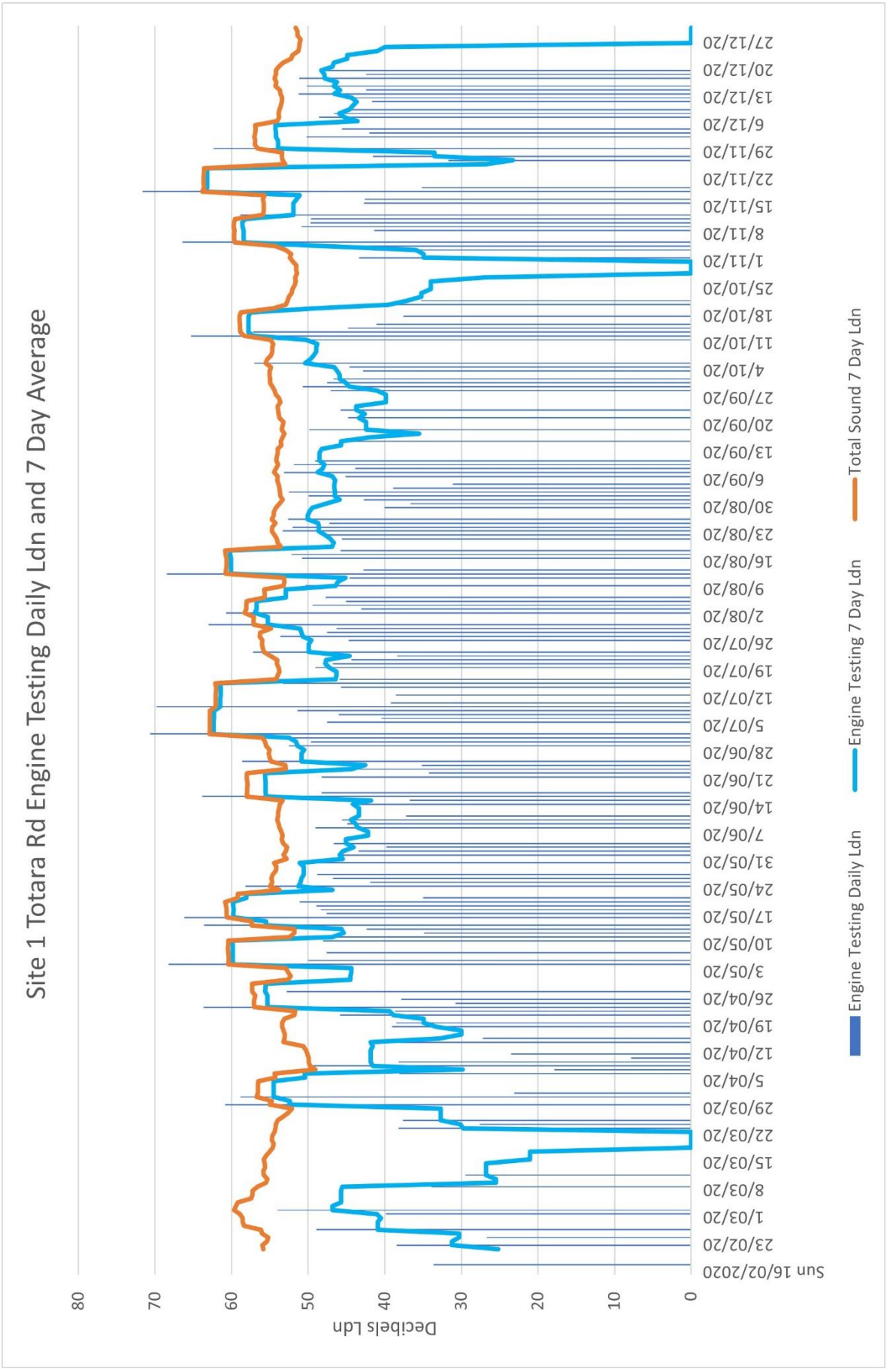


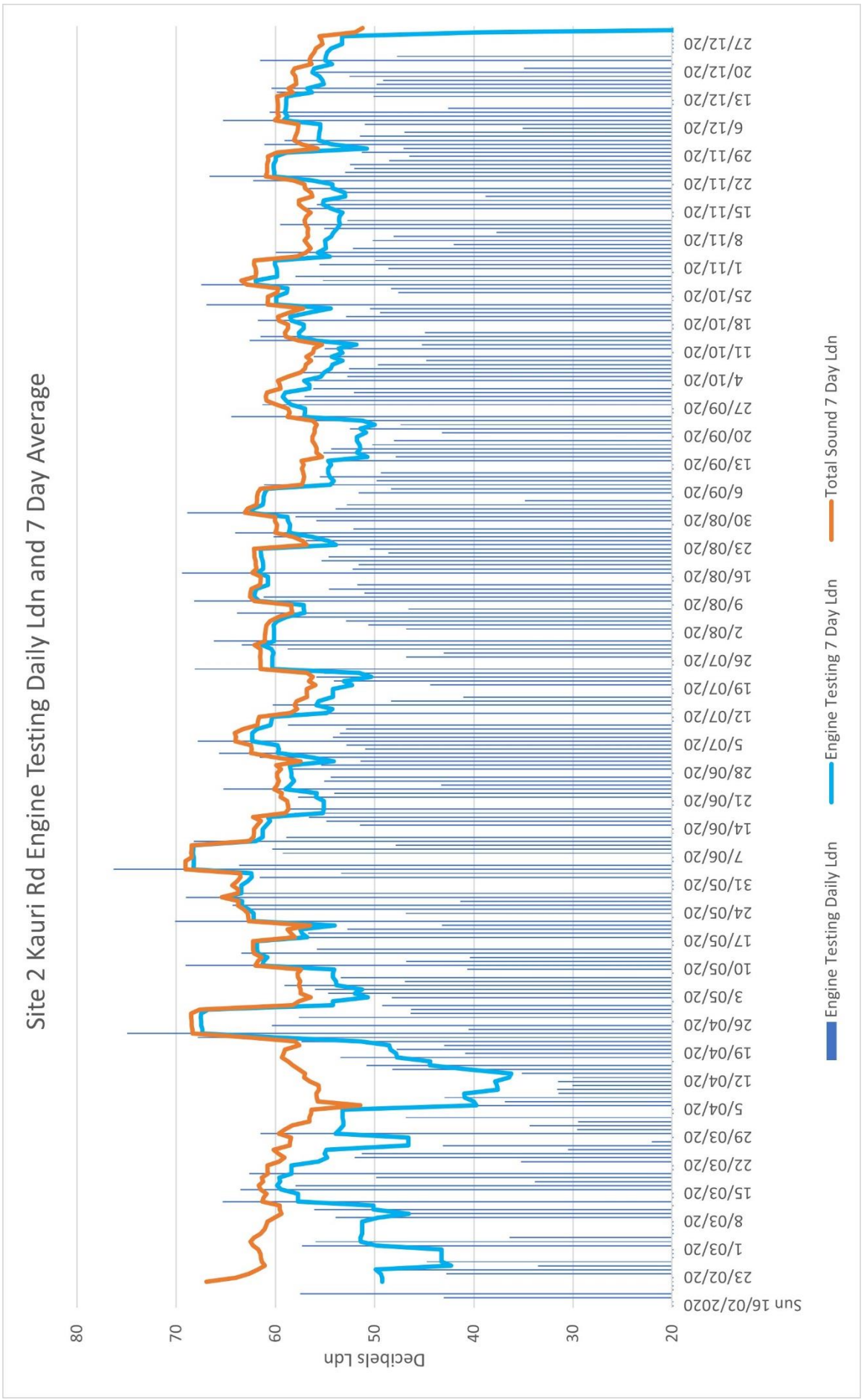
Kauri Road

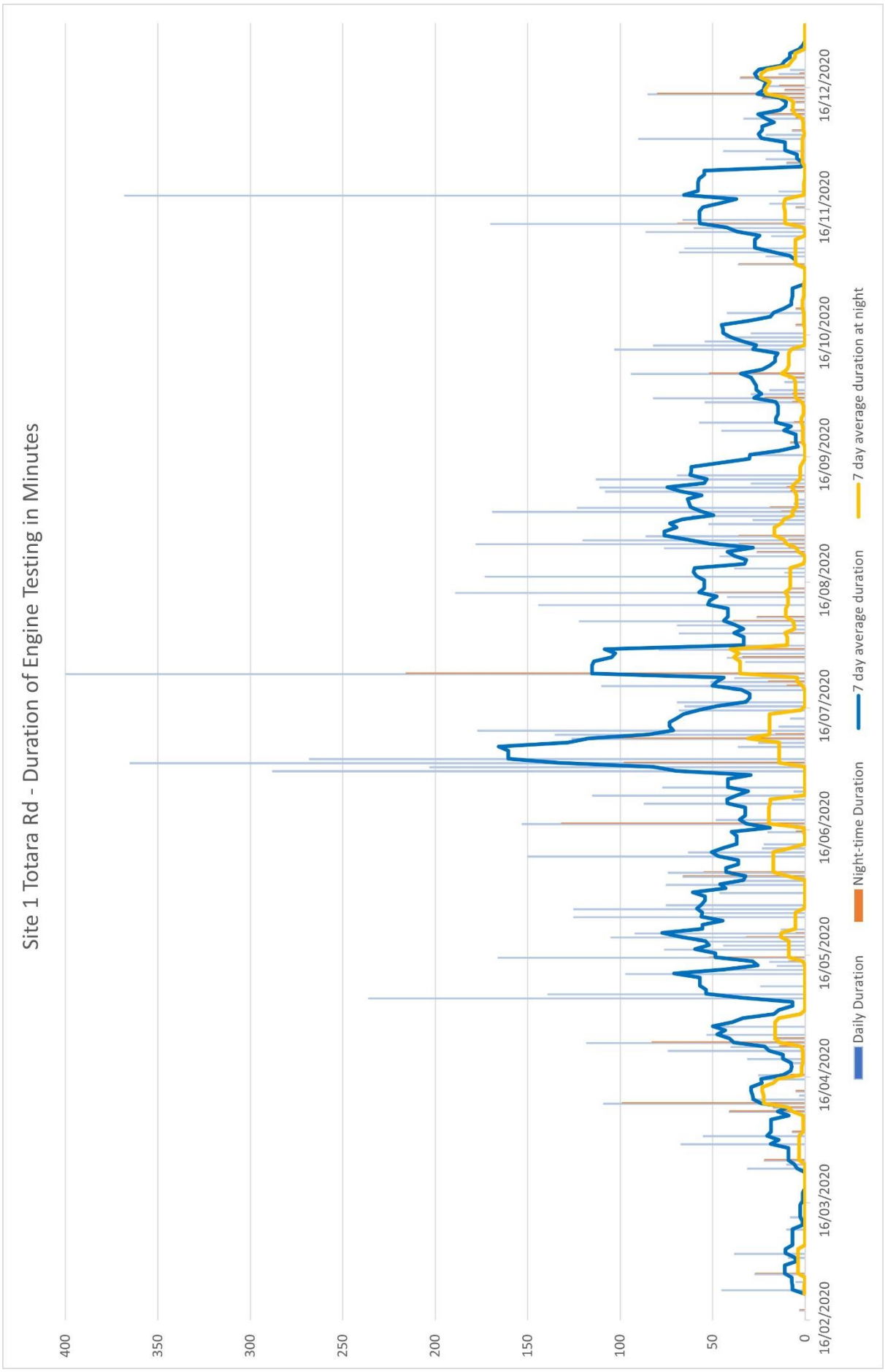


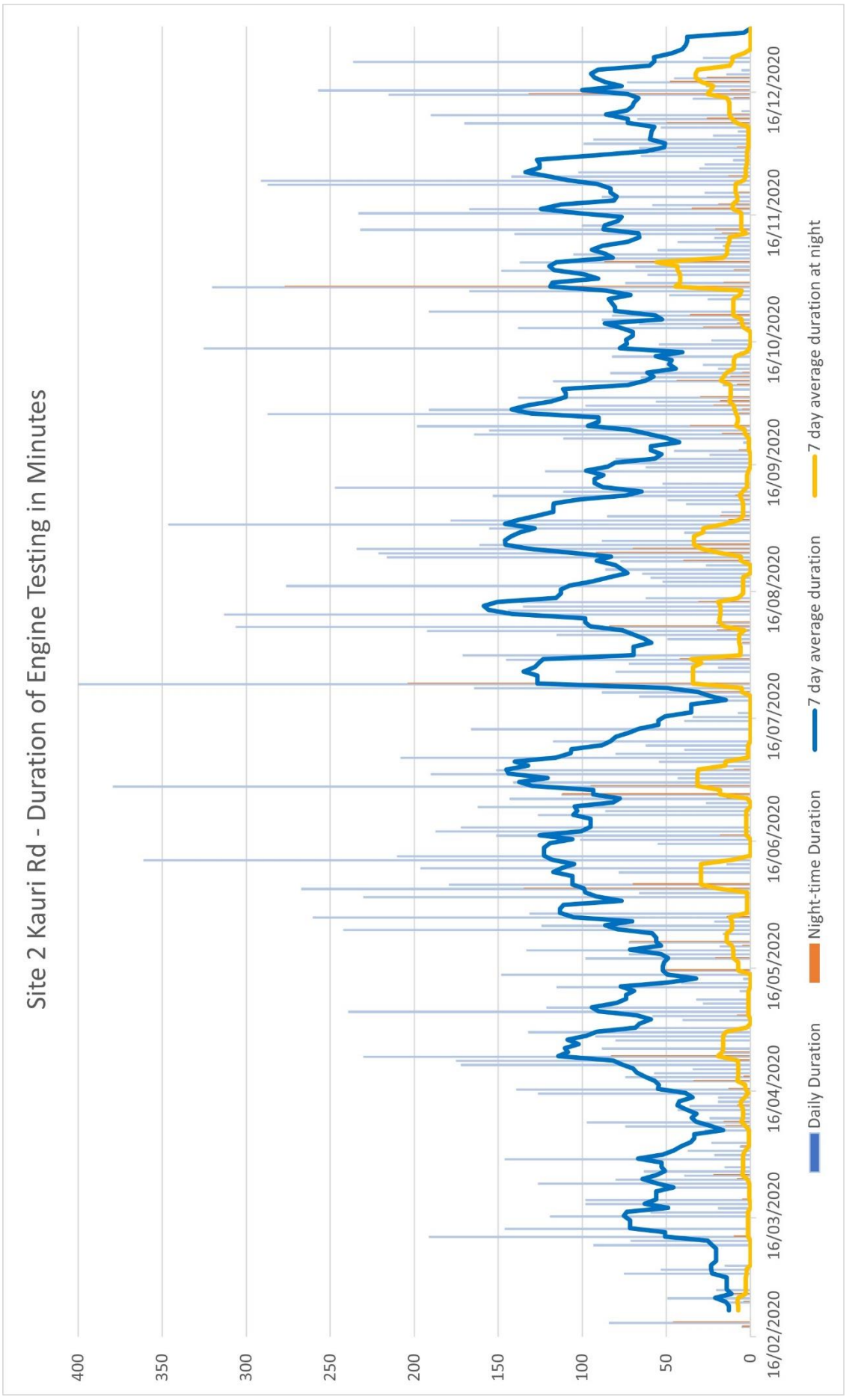


APPENDIX C MONITORING ANALYSIS RESULTS

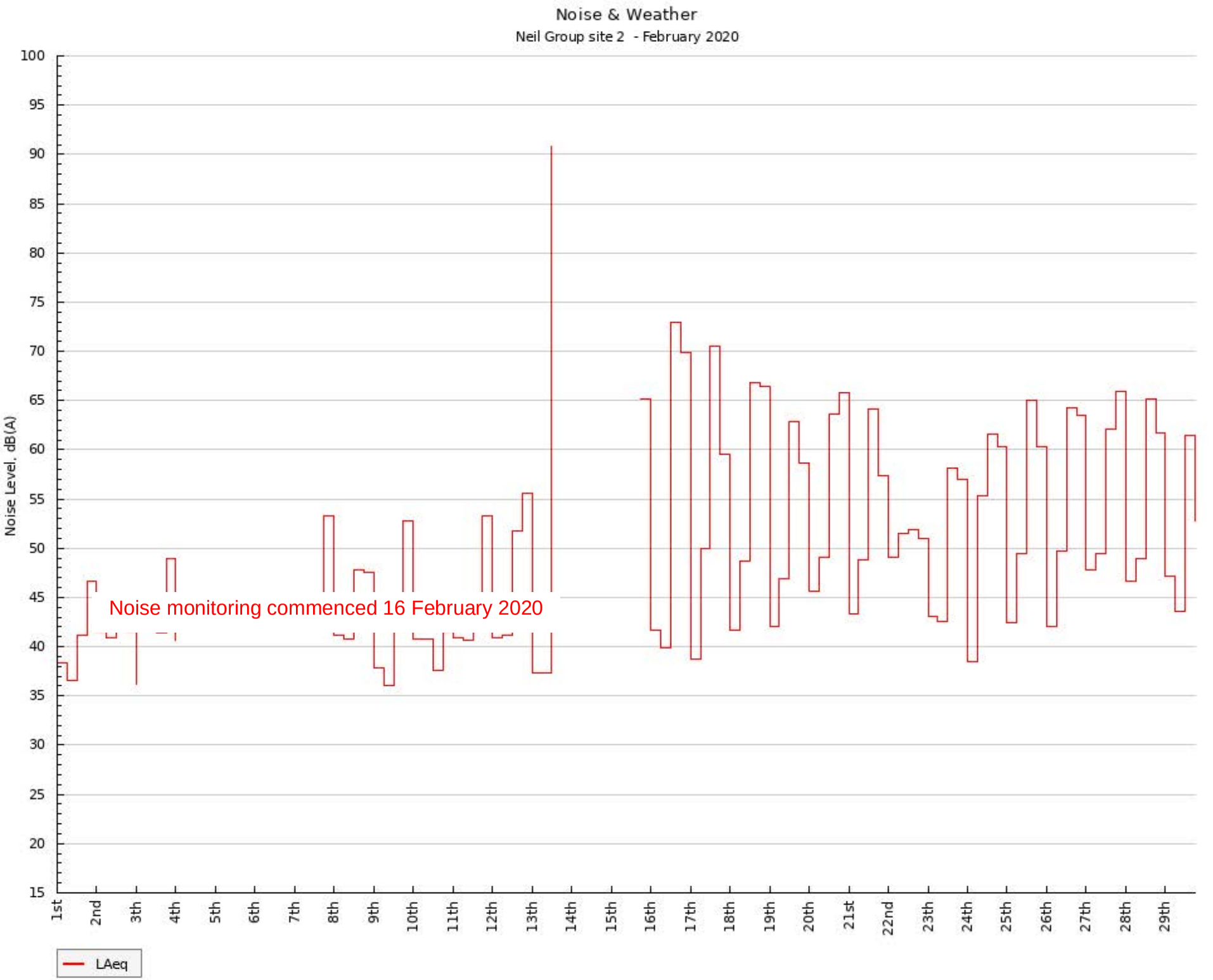


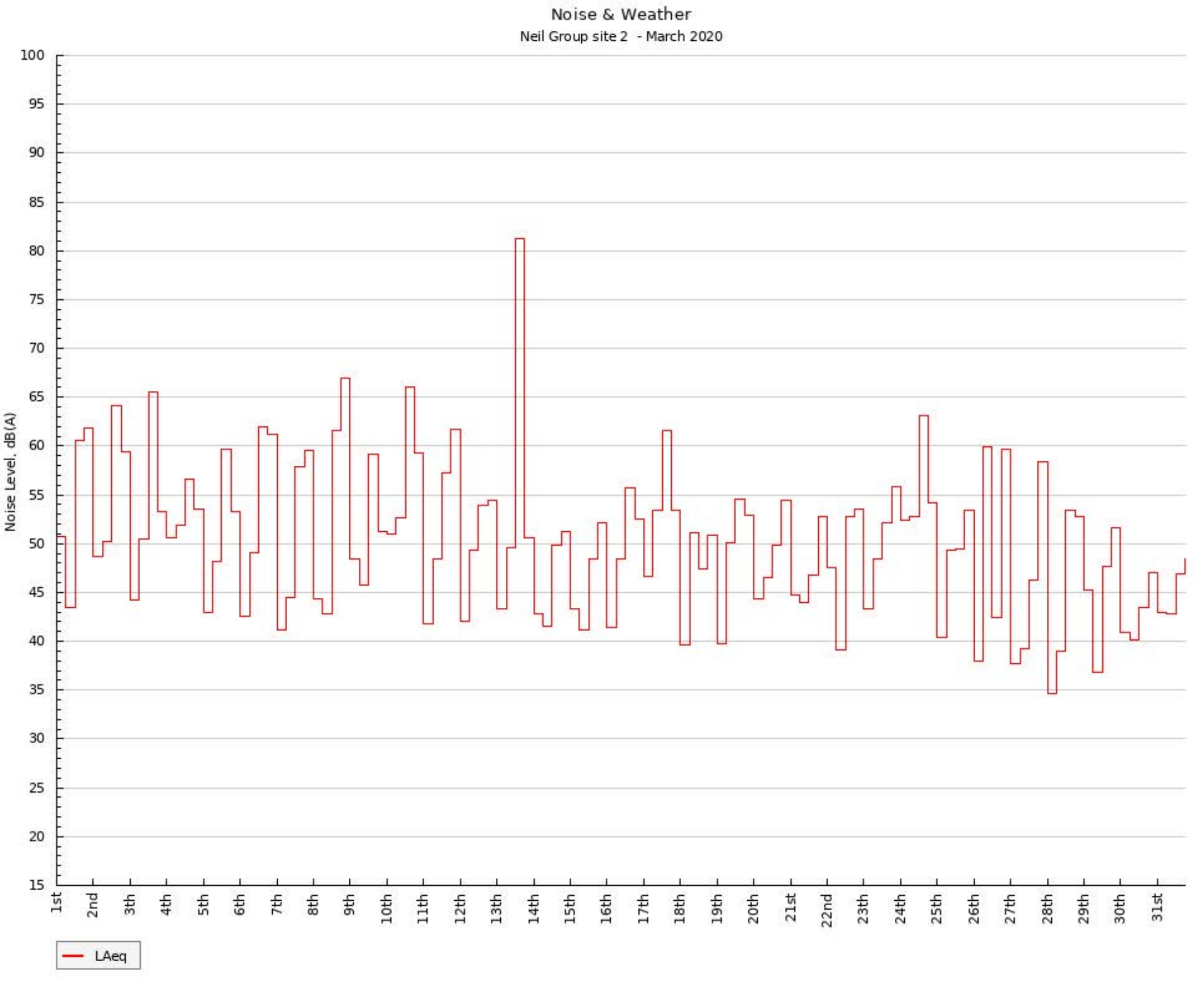


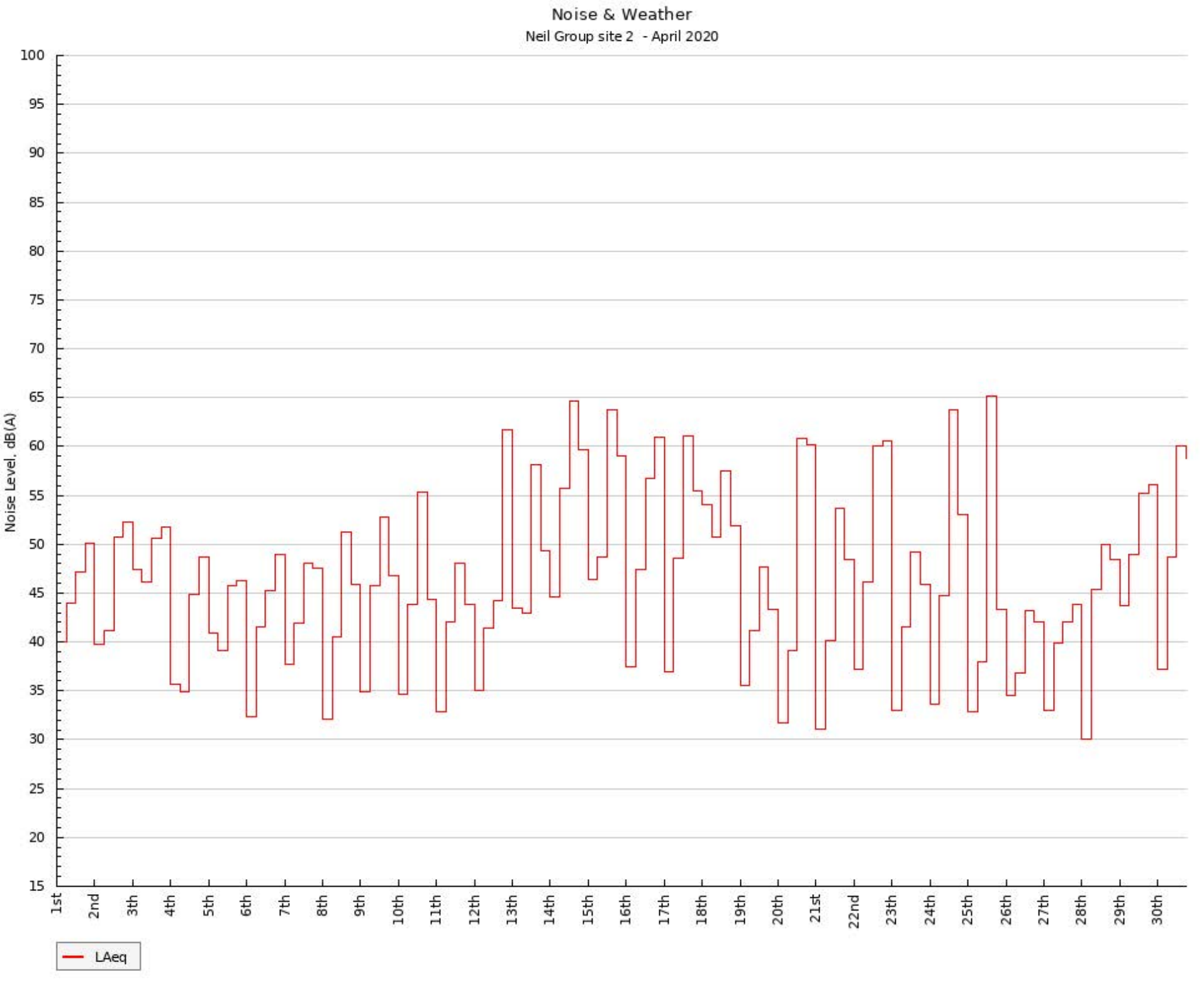


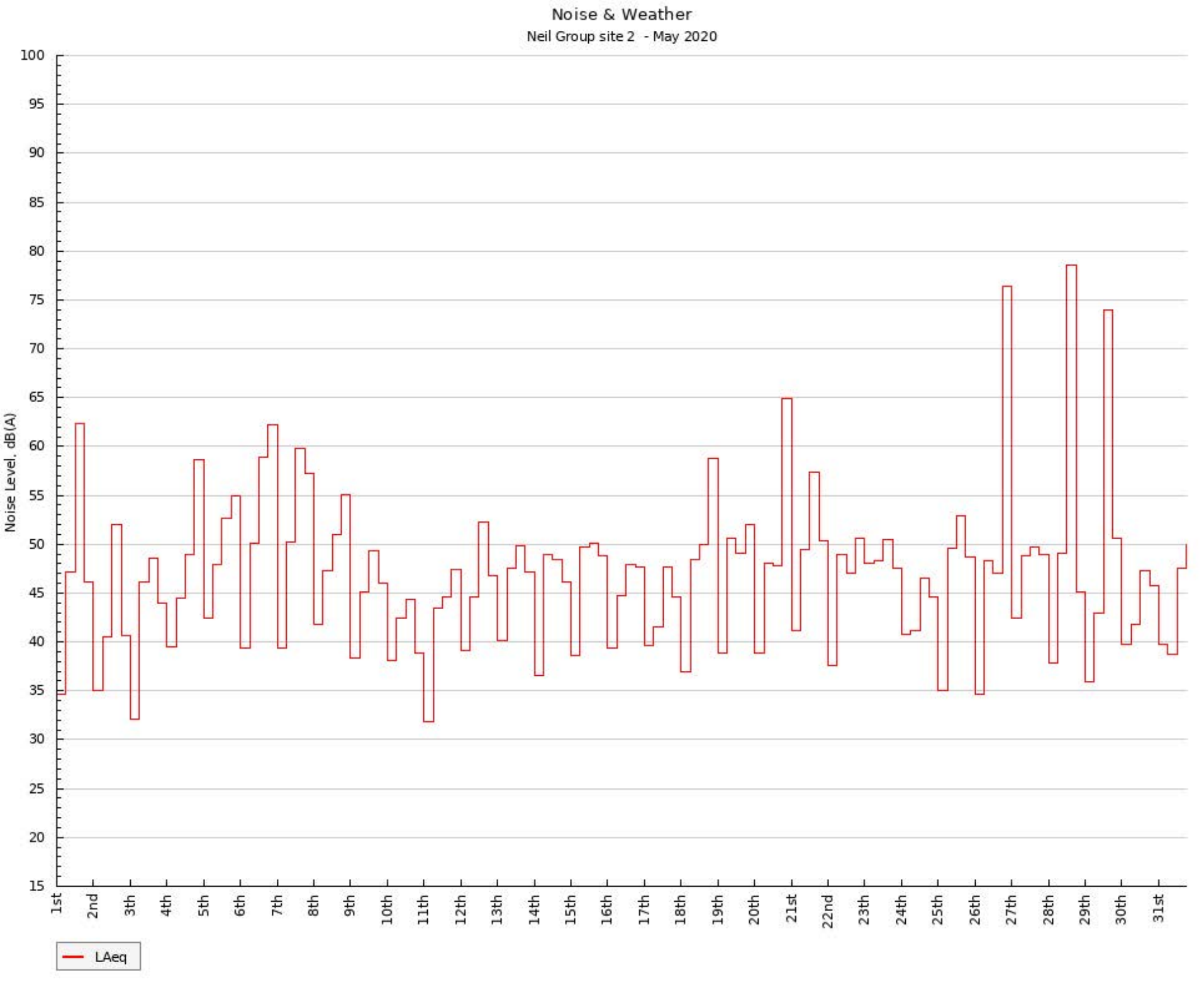


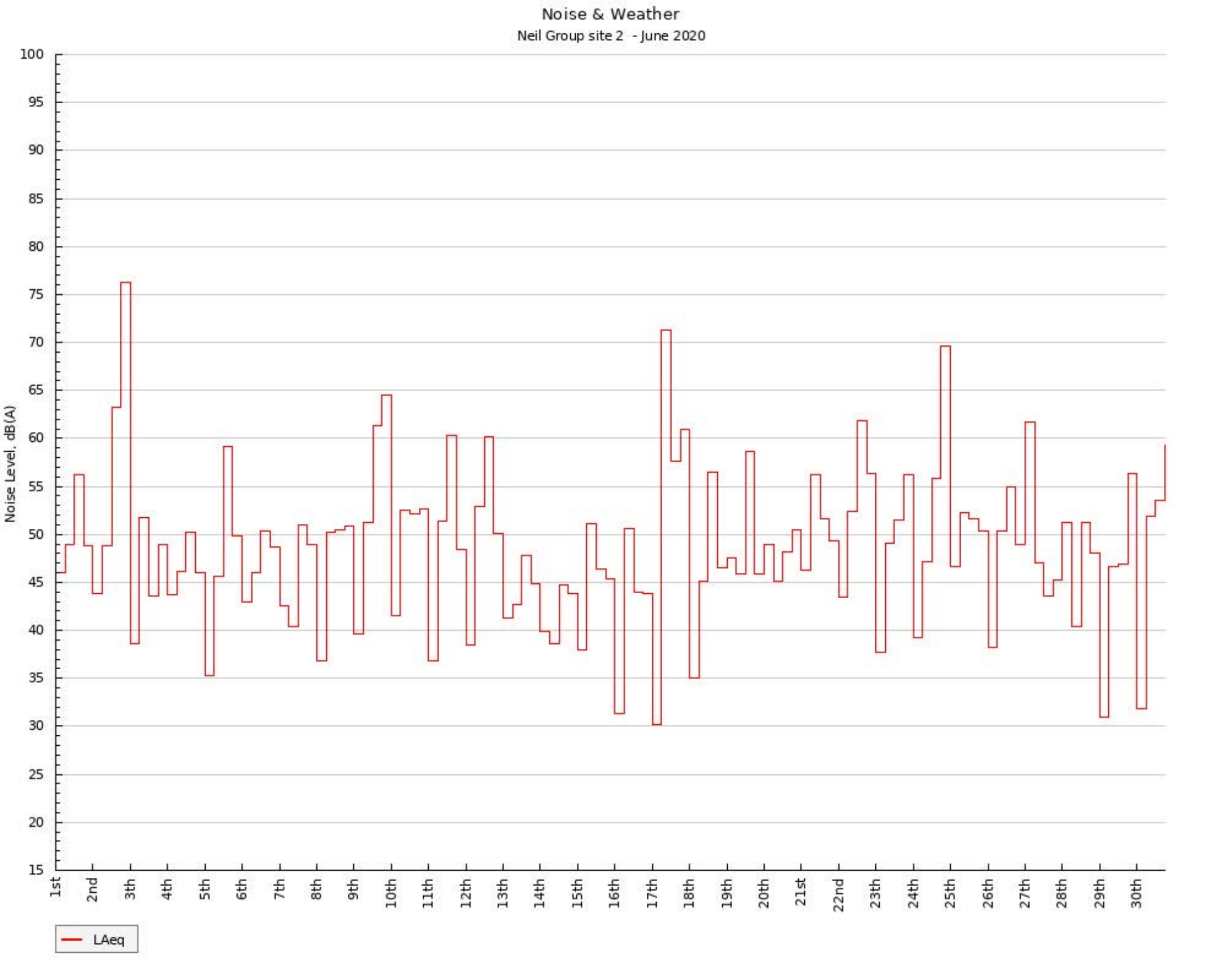
APPENDIX D SITE 2 KAURI ROAD MONITORING RESULTS 6 HOURLY L_{AEQ} FOR ALL NOISE

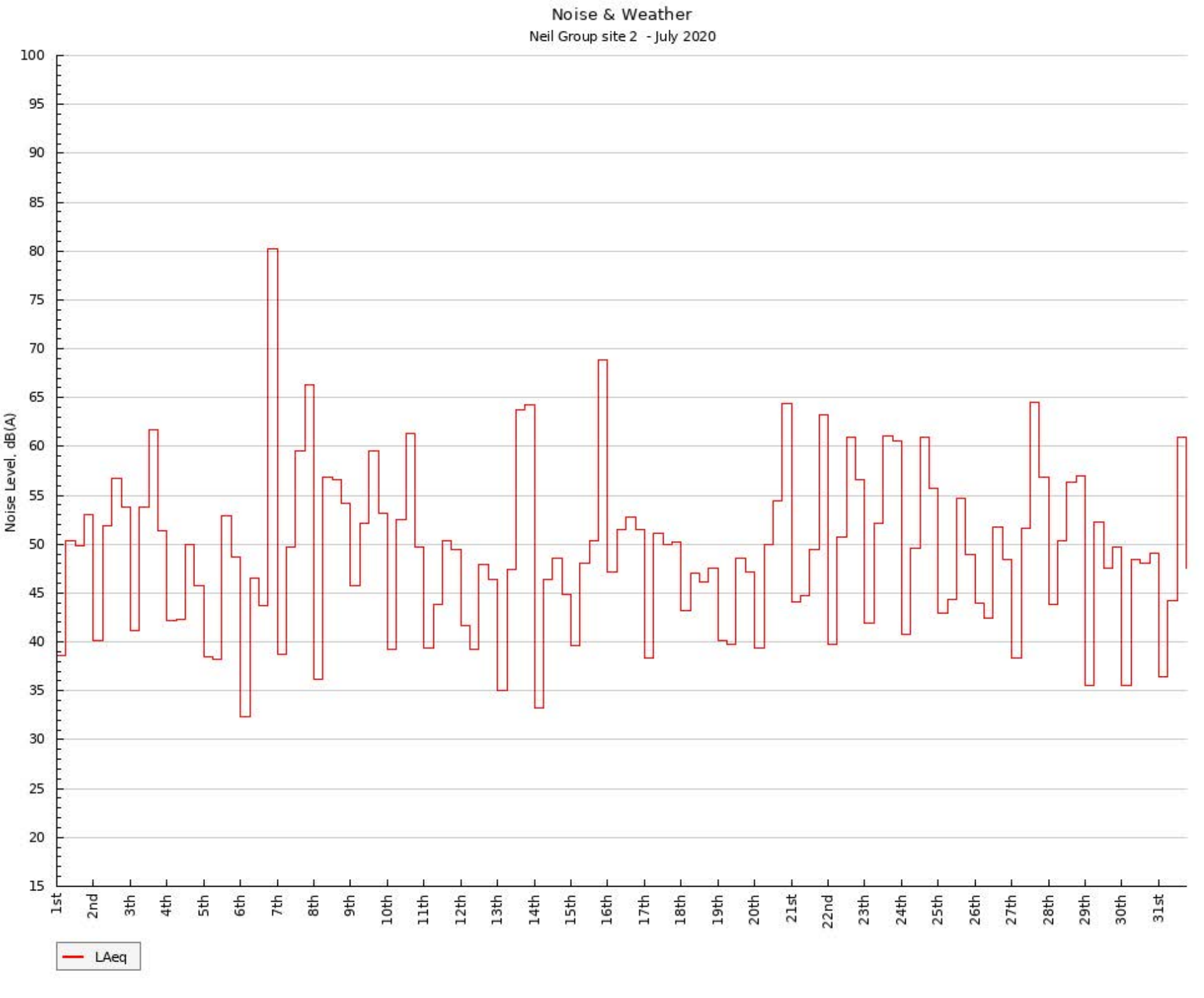

Noise & Weather
Neil Group site 2 - February 2020
Noise Level, dB(A)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
Noise monitoring commenced 16 February 2020
1st
2nd
3th
4th
5th
6th
7th
8th
9th
10th
11th
12th
13th
14th
15th
16th
17th
18th
19th
20th
21st
22nd
23th
24th
25th
26th
27th
28th
29th
LAeq

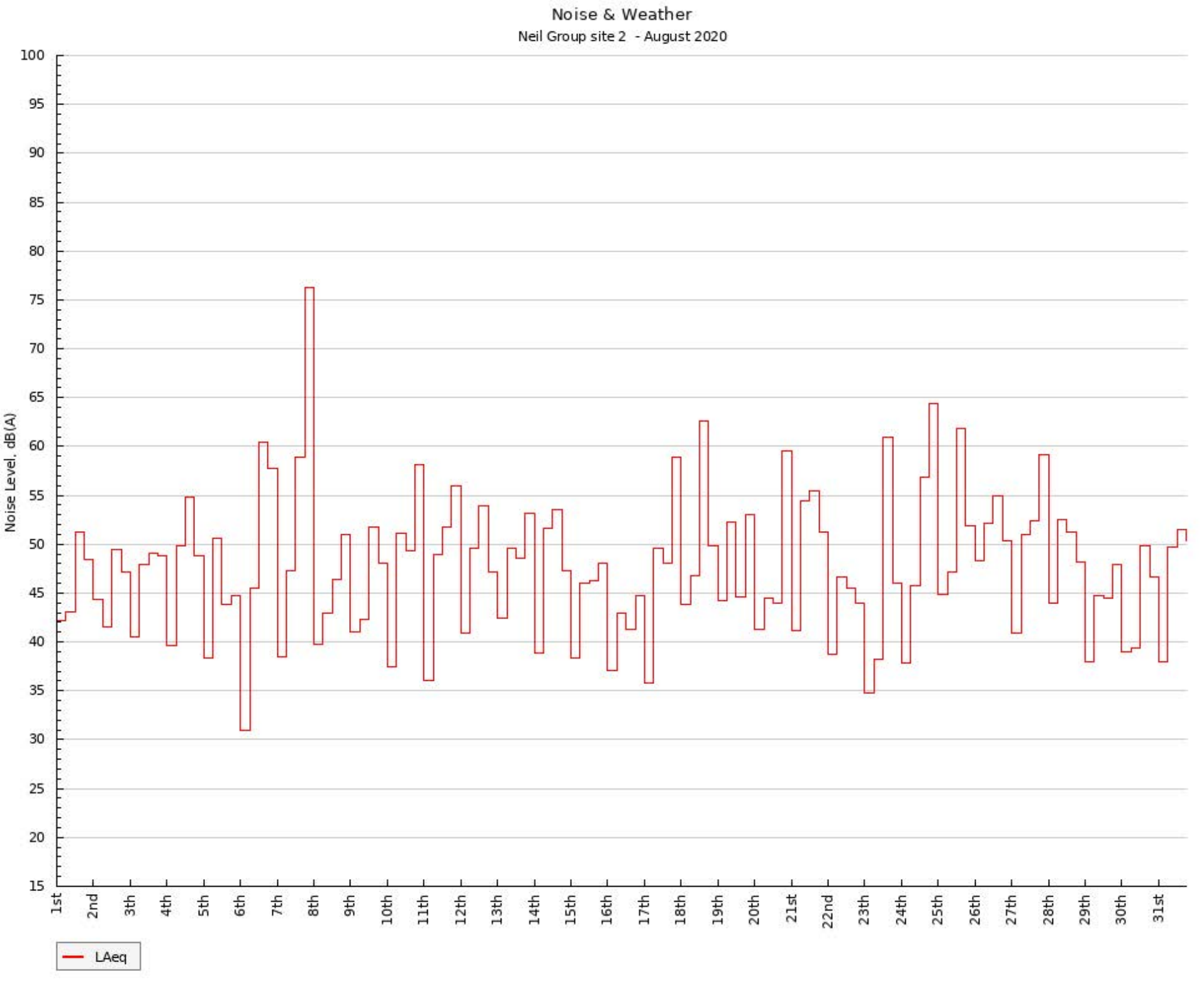

Noise & Weather
Neil Group site 2 - March 2020
Noise Level, dB(A)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
1st
2nd
3th
4th
5th
6th
7th
8th
9th
10th
11th
12th
13th
14th
15th
16th
17th
18th
19th
20th
21st
22nd
23th
24th
25th
26th
27th
28th
29th
30th
31st
LAeq

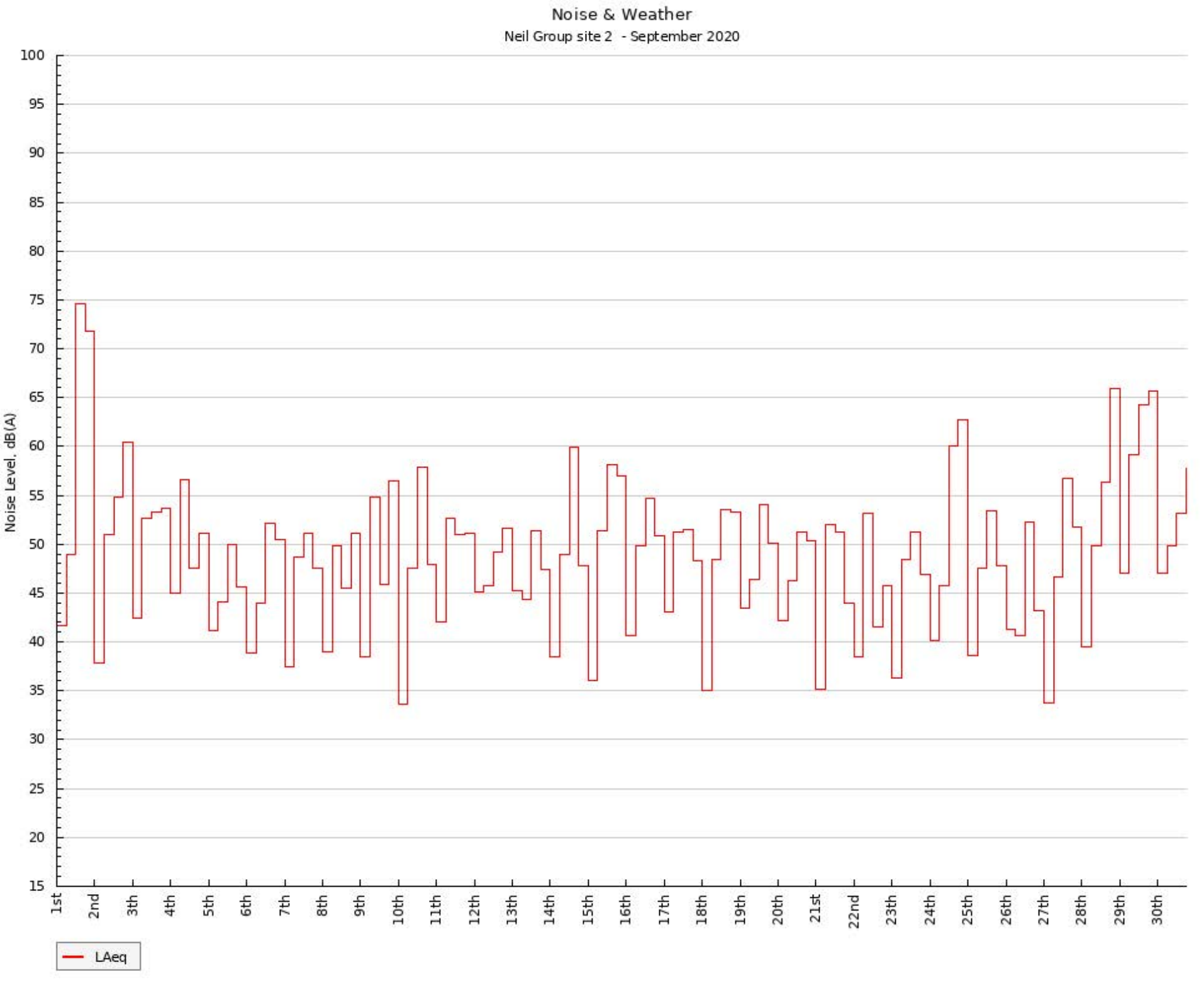

Noise & Weather
Neil Group site 2 - April 2020
Noise Level, dB(A)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
1st
2nd
3th
4th
5th
6th
7th
8th
9th
10th
11th
12th
13th
14th
15th
16th
17th
18th
19th
20th
21st
22nd
23th
24th
25th
26th
27th
28th
29th
30th
LAeq

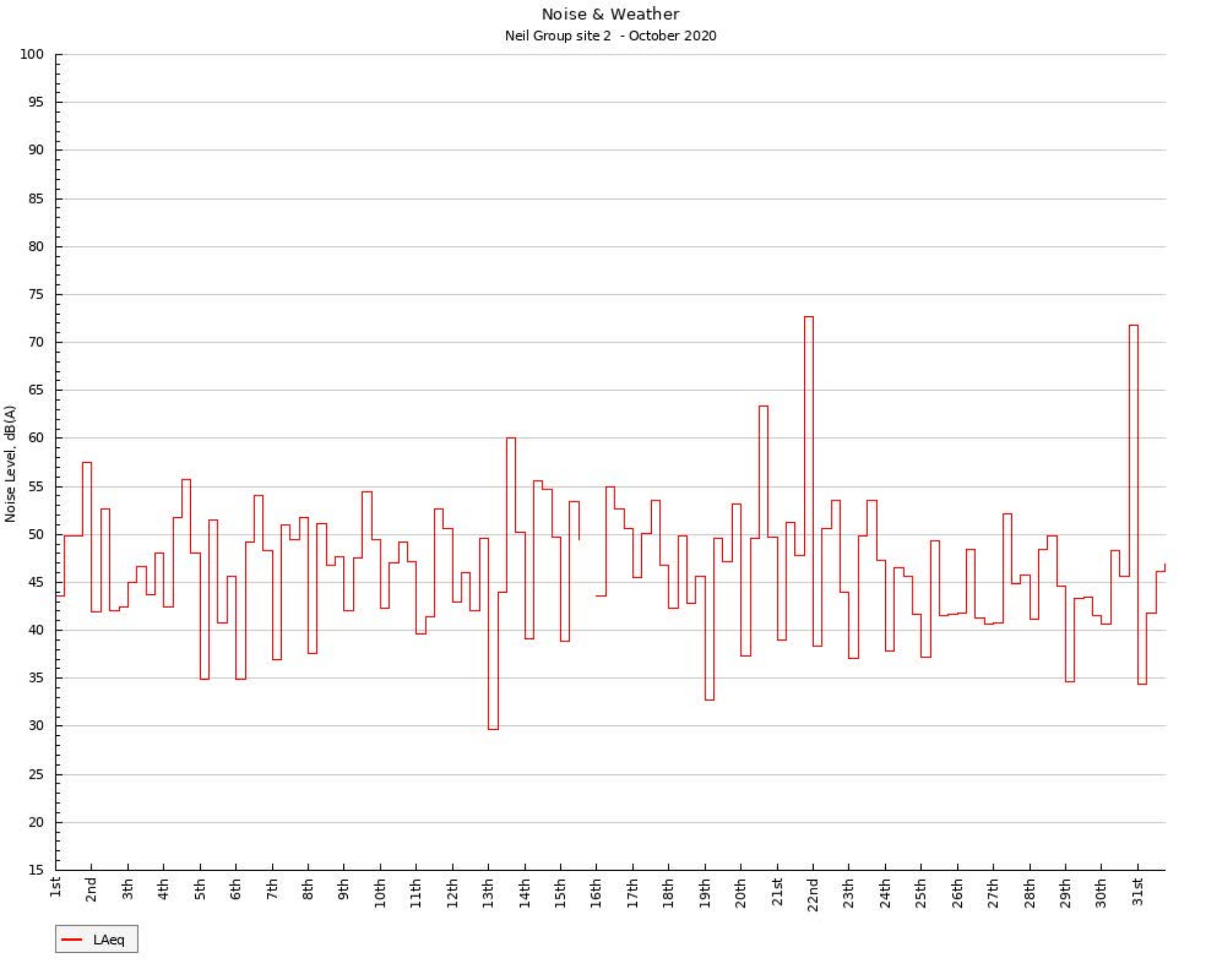

Noise & Weather
Neil Group site 2 - May 2020
Noise Level, dB(A)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
1st
2nd
3rd
4th
5th
6th
7th
8th
9th
10th
11th
12th
13th
14th
15th
16th
17th
18th
19th
20th
21st
22nd
23rd
24th
25th
26th
27th
28th
29th
30th
31st
LAeq

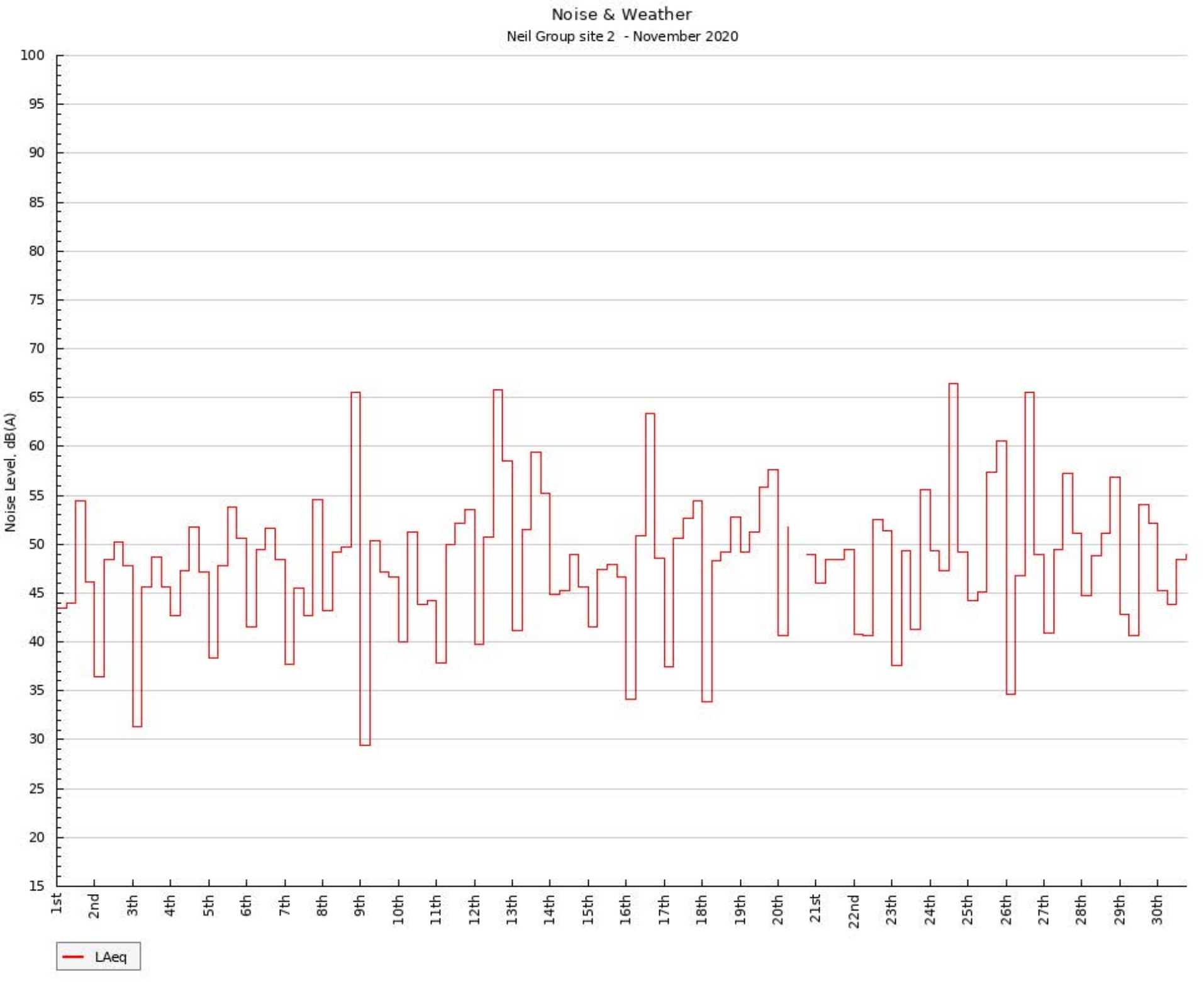

Noise & Weather
Neil Group site 2 - June 2020
Noise Level, dB(A)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
1st
2nd
3rd
4th
5th
6th
7th
8th
9th
10th
11th
12th
13th
14th
15th
16th
17th
18th
19th
20th
21st
22nd
23th
24th
25th
26th
27th
28th
29th
30th
LAeq

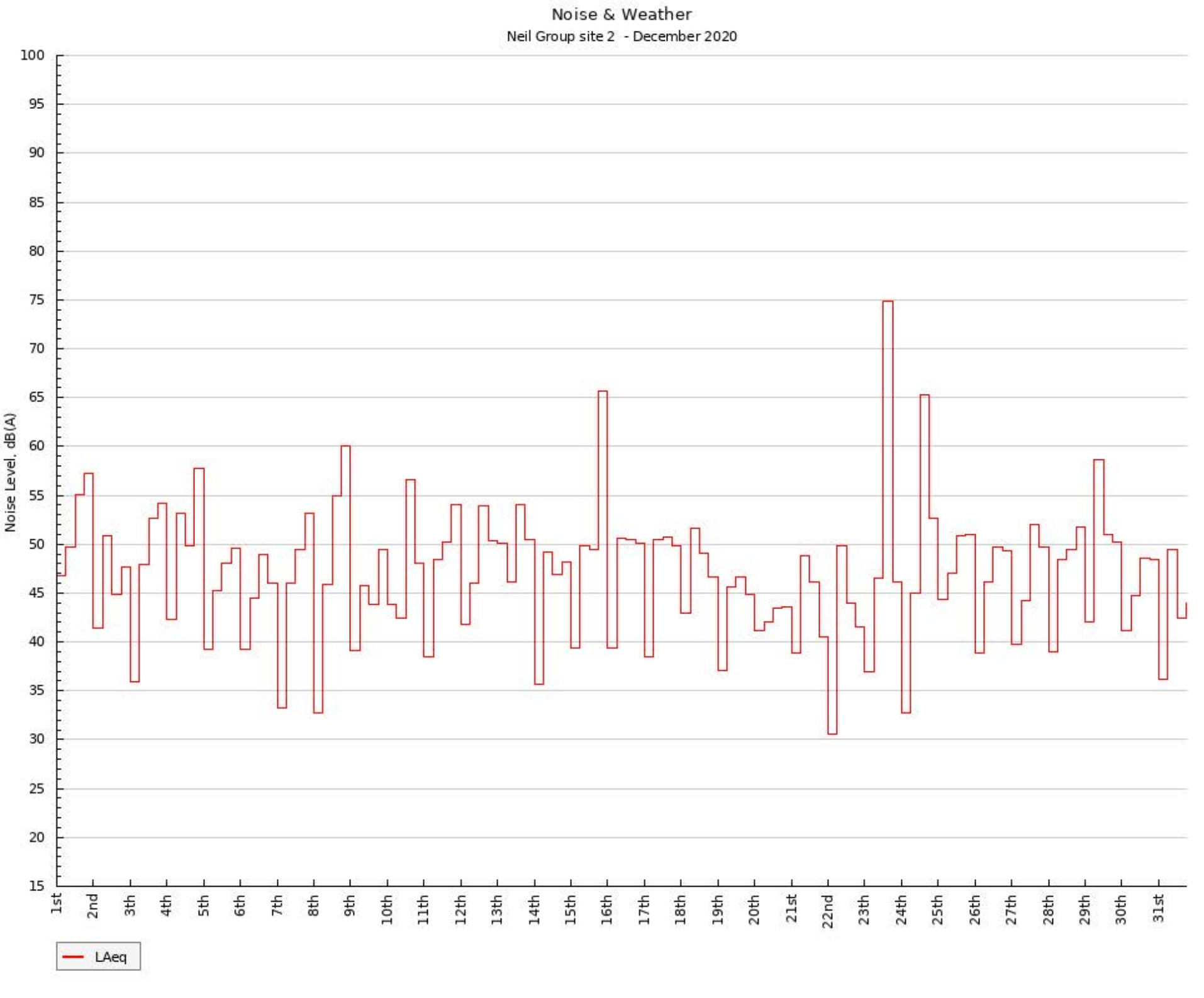

Noise & Weather
Neil Group site 2 - July 2020
Noise Level, dB(A)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
1st
2nd
3th
4th
5th
6th
7th
8th
9th
10th
11th
12th
13th
14th
15th
16th
17th
18th
19th
20th
21st
22nd
23rd
24th
25th
26th
27th
28th
29th
30th
31st
LAeq


Noise & Weather
Neil Group site 2 - August 2020
Noise Level, dB(A)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
1st
2nd
3th
4th
5th
6th
7th
8th
9th
10th
11th
12th
13th
14th
15th
16th
17th
18th
19th
20th
21st
22nd
23th
24th
25th
26th
27th
28th
29th
30th
31st
LAeq


Noise & Weather
Neil Group site 2 - September 2020
Noise Level, dB(A)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
1st
2nd
3th
4th
5th
6th
7th
8th
9th
10th
11th
12th
13th
14th
15th
16th
17th
18th
19th
20th
21st
22nd
23th
24th
25th
26th
27th
28th
29th
30th
LAeq


Noise & Weather
Neil Group site 2 - October 2020
Noise Level, dB(A)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
1st
2nd
3rd
4th
5th
6th
7th
8th
9th
10th
11th
12th
13th
14th
15th
16th
17th
18th
19th
20th
21st
22nd
23rd
24th
25th
26th
27th
28th
29th
30th
31st
LAeq


Noise & Weather
Neil Group site 2 - November 2020
Noise Level, dB(A)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
1st
2nd
3th
4th
5th
6th
7th
8th
9th
10th
11th
12th
13th
14th
15th
16th
17th
18th
19th
20th
21st
22nd
23th
24th
25th
26th
27th
28th
29th
30th
LAeq

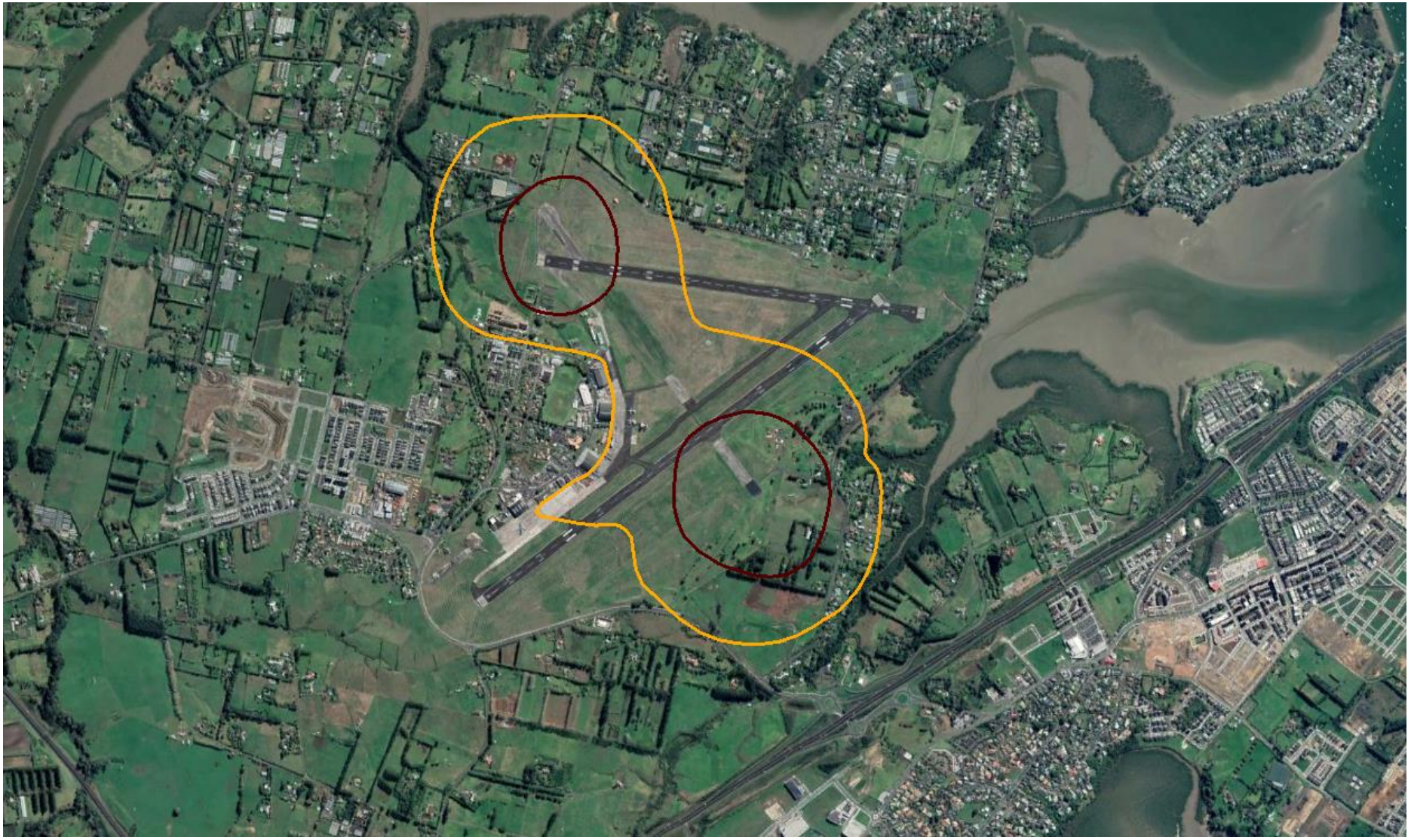

Noise & Weather
Neil Group site 2 - December 2020
Noise Level, dB(A)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
1st
2nd
3th
4th
5th
6th
7th
8th
9th
10th
11th
12th
13th
14th
15th
16th
17th
18th
19th
20th
21st
22nd
23th
24th
25th
26th
27th
28th
29th
30th
31st
LAeq

APPENDIX E NZDF ENGINE TESTING NOISE CONTOURS

Base Auckland Ldn 57 and 65 dB engine testing contours – all aircraft. Based on the "Noisy Week Scenario".

Aircraft engine testing source level data - ground idle power setting, intermediate power setting (70-85%) and high power setting. All power settings above idle located at TWY F, TWY J & RWY THR 08. P3 pre-flight evaluation testing on RWY THR 03/21. Low power testing on aprons.

27 February 2020 – For consultation.



Base Auckland Ldn 57 and 65 dB engine testing contours – B757 and C130 aircraft. Based on the "Noisy Week Scenario".

Aircraft engine testing source level data - ground idle power setting, intermediate power setting (70-85%) and high power setting. All power settings above idle located at TWY F, TWY J & RWY THR 08. Low power testing on aprons.

13 March 2020 – For consultation.

C:\Users\cobe\Documents\whenuapai\Whenuapai\Whenuapai.apx Layout: T+T A3 Landscape Map Template4 2021-Jan-29 16:14 Drawn by COBE

Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

NOTES:
Basemap NZ - Imagery: Sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 4.0 New Zealand licence

REV	DESCRIPTION	GIS	CHK	DATE
0	First version	COBE	DAHU	4/03/21

LOCATION PLAN

PROJECT No.	1009485		
DESIGNED	COBE	MAR.21	
DRAWN	COBE	MAR.21	
CHECKED			
APPROVED	DAHU	4/03/21	

CLIENT **NEW ZEALAND DEFENCE FORCE**
PROJECT **NZAF WHENUAPAI ENGINE TESTING CONTOURS**
TITLE NZDF WHENUAPAI AIRBASE - ENGINE TESTING CONTOURS - PC5
SCALE (A3) 1:25,000 FIG No. FIGURE D. REV 0