

Royal Prince Alfred Hospital Redevelopment (RPAH
Redevelopment)

Construction Noise and Vibration Monitoring Report 4

Client Doc. No. RPA-ACO-ACL-RPT-MW-000007 - Rev A

Project ID	20230239.17
Document Title	Construction Noise and Vibration Monitoring
Attention To	CPB Contractors Pty Limited

Revision	Date	Document Reference	Prepared By	Checked By	Approved By
0	14/02/2024	20230239.17/1402A/R0/LA	LA		AW

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1 INTRODUCTION

This report presents the results of the noise and vibration monitoring conducted by Acoustic Logic during the site establishment works for the RPA Hospital redevelopment, located at 50 Missenden Road, Camperdown. Details presented in this report include monitoring locations, relevant noise and vibration objectives, measured noise and vibration levels over the presented monitoring period and a discussion of results where applicable.

This report covers the fourth fortnight since the beginning of construction monitoring, being between Monday 22nd January, 2024 and Sunday 04th February, 2024.

Unattended noise and vibration monitoring has been undertaken to satisfy the requirements of Condition B26 of SSD-47662959's Development Consent, in conjunction with the noise and vibration management levels established within the *Early Works Construction Noise and Vibration Management Plan*, prepared by this office, and as they are so updated throughout the construction process where necessitated (Ref: 20230239.9/0610A/R1/LA). Condition B26 of SSD-47662959's Development Consent is provided below for reference:

"Environmental Management Plan Requirements

B26. *Management plans required under this consent must be prepared having regard to the relevant guidelines, including but not limited to the Environmental Management Plan Guideline: Guideline for Infrastructure Projects (DPIE April 2020).*

Notes:

The Environmental Management Plan Guideline is available on the Planning Portal at: <https://www.planningportal.nsw.gov.au/major-projects/assessment/post-approval>.

The Planning Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans."

2 SITE DESCRIPTION

The site is maintained on Lot 1000 DP 1159799, and is bound by the existing operational RPA Hospital to the west, the Centenary Institute to the north, and University of Sydney’s Bruce William Pavilion and Susan Wakil Health Building to the east and south respectively. The site is surrounded by various residential, commercial, hospital, university, research and active recreation sensitive receivers generally.

The works maintained within Early Works and Site Establishment pertain specifically to works along Lambie Dew Drive and John Hopkins Drive.

The surrounding affected sensitive receivers that are investigated within the contents of this monitoring assessment are as presented below:

Table 1 – Surrounding Sensitive Receivers

ID No.	Receiver Description	Receiver Category
Re1	Centenary Institute	Research Facilities
E1	CreateSpace and Susan Wakil Health Building	Education
E2	Charles Perkins Centre	

See an aerial photo in Figure 1 below for detailed receiver locations.

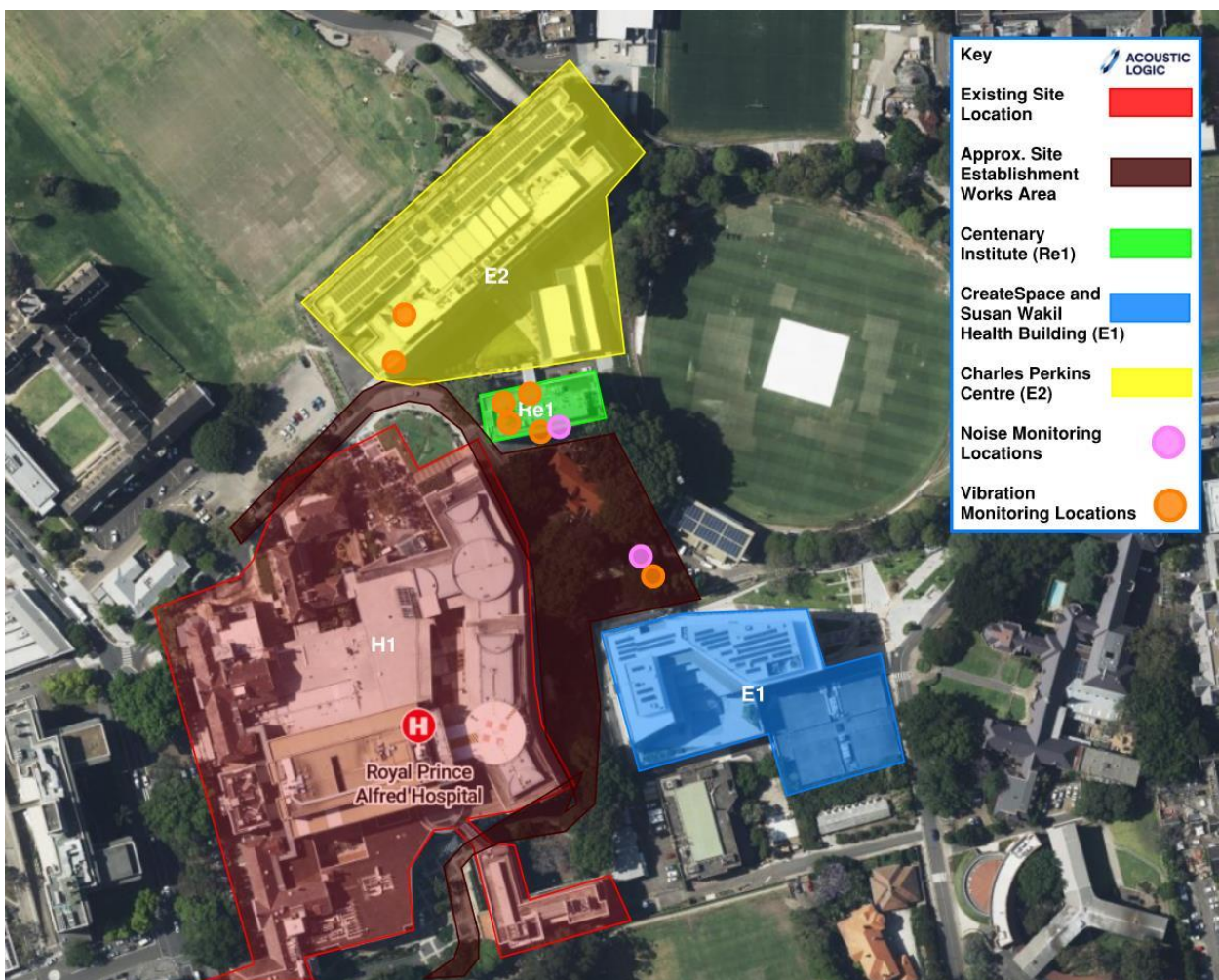


Figure 1: Aerial Site Map with Nearest Sensitive Receivers (Sourced from Sixmaps)

3 NOISE AND VIBRATION MANAGEMENT LEVELS

The following section details the relevant construction noise and vibration requirements assessed throughout the monitoring period.

3.1 NOISE MANAGEMENT LEVELS

Noise Management levels relevant to the contents of this report are summarised in the table below, as provided within the *Early Works Construction Noise and Vibration Management Plan*, prepared for the project by this office (Ref: 20230239.9/0610A/R1/LA):

Table 2 – Noise Management Levels

Receiver	Room Usage	Noise Management Level dB(A) $L_{eq}(15min)$
E1 and E2	All	45 (Internally)
R1	Laser Scanning Microscope	58 (Internally)
	Animal Housing / Breeding / Observation Rooms	64 (Internally)
	Rat Operating Room	46 (Internally)

3.2 PROJECT VIBRATION CRITERIA

Relevant project vibration criteria to the contents of this report are provided within the table below. Vibration criteria presented for spaces within Re1 and E2 have been updated based upon the conclusion of the "Baseline Monitoring Results," report, as well as the "Construction Noise and Vibration Monitoring Report 1," both of which were prepared by this office for the project (Ref: 20230239.17/0412A/R1/LA and 20230239.17/2301A/R0/LA):

Table 3 – Summarised Proposed Project Vibration Limits

Receiver	Location	Vibration Criteria (μms^{-1})
Re1 Centenary Institute	L1 Laser Room	VC-B (ASHRAE Handbook) (25 μms^{-1}) RMS Velocity
	L3 Fish Tank Room	400 μms^{-1} Peak Particle Velocity
	L4 – Animal Behaviour / Holding / Breeding Rooms	VC-A (ASHRAE Handbook) (50 μms^{-1}) RMS Velocity
E1 Createspace and Susan Wakil Health Building	All spaces	DIN 4150-3 Type 1 Criteria (20,000 μms^{-1} / 20 mms^{-1}) Peak Particle Velocity
E2 Charles Perkins Centre	Imaging Equipment (Southern Wing Corridor)	VC-B (ASHRAE Handbook) (25 μms^{-1}) RMS Velocity
	Animal Behaviour / Holding / Breeding Rooms	200 μms^{-1} Peak Particle Velocity

4 MONITORING EQUIPMENT AND LOCATIONS

4.1 NOISE MONITORING EQUIPMENT AND LOCATIONS

Unattended noise monitoring was conducted using Acoustic Research Laboratories Pty Ltd noise loggers. The loggers were programmed to store 15-minute statistical noise levels throughout the monitoring period. The equipment was calibrated at the beginning and the end of each measurement using a Rion NC-73 calibrator; no significant drift was detected. All measurements were taken on A-weighted fast response mode.

Two individual noise monitors have been installed surrounding the site at the following locations:

- Centenary Institute Level 4 Surgery (Southern Façade).
- Outside Susan Wakil Health Building, on grade.

Please refer to Figure 1 for detailed monitoring locations. Appendix C provides photos of the monitors installed at the project site.

4.2 VIBRATION MONITORING EQUIPMENT AND LOCATIONS

Vibration monitoring was conducted using either Texcel ETM vibration monitors with external Tri-axial Geophones, or Bruel and Kjaer Type 4450 vibration monitors.

Three Texcel ETM monitors have been placed surrounding the site at the following locations:

- Centenary Institute Level 3, Fish Tanks.
- Charles Perkins Centre Level B1, Southern Wing Observation Room E.
- Outside Susan Wakil Health Building, on grade.

Additionally, four Bruel and Kjaer Type 4450 Vibration monitors have been installed surrounding the site at the following locations:

- Centenary Institute:
 - Level 1 Laser Imaging Room.
 - Level 4 Surgery (Southern Façade).
 - Level 4 Change Rooms (Northern Façade)
- Charles Perkins Centre Level B1, Southern Wing Corridor.

Please refer to Figure 1 for detailed monitoring locations. Appendix C provides photos of the monitors installed at the project site.

5 RESULTS

Appendix A presents the results of the noise monitoring, whilst Appendix B presents the results of the vibration monitoring where exceedances occurred during the monitoring period as presented within the contents of this report.

A discussion pertaining the findings of the noise and vibration monitoring undertaken during this monitoring period is provided within the proceeding sections.

5.1 NOISE MONITORING RESULTS DISCUSSION

Noise monitoring conducted throughout the monitoring period shows general adherence to the noise management levels provided within Section 3 of this letter.

With regards to the noise monitor in place within the L4 Surgery Room of Centenary Institute, we note the following:

- Due to a technical issue with the control software for the monitoring station, there has been no data collated at this monitoring station during part of this monitoring period.
- Data being collated at this monitoring location was recommenced on Wednesday 31st January 2024 and continued for the remainder of this monitoring period.
- Equipment has been updated and replaced on site.
- With respect to the collated data, we note the following:
 - Measured noise levels were above noise management levels on 31/01/2024 between 1:45pm and 3:30pm. The measured noise levels are not indicative of construction noise as the measured noise levels are too high to be representative of the construction activity that was conducted on the date externally to the building, and are more so representative of operational activity within the room with the monitor.
 - Measured noise levels were above noise management levels on 01/02/2024 at 9:00am. The measured noise levels were returned to being below management levels after an individual 15-min period.
 - Measured noise levels are maintained below the noise management levels for the remainder of the available data within the monitoring period.

With regards to the noise monitor in place for the Susan Wakil Health Building, we note the following:

- The monitor located outside of the Susan Wakil Health Building is within the demolition site boundary and approximately 15m closer to the area of the works than the façade of the Susan Wakil Health Building.
- Noting this increased distance attenuation, in conjunction with the transmission loss experienced through the inoperable façade of the Susan Wakil Health Building when comparing internal and external noise levels, Acoustic Logic expect that, at minimum, there is a 30dB reduction between the measured noise levels by the monitor, when compared with the resultant internal noise levels within the receiver.
- Based on this reduction, measured noise levels were observed to be above the noise management levels on the following dates:
 - 23/01/2024.
 - 24/01/2024.

- 29/01/2024.
- 01/02/2024
- Generally, noise levels were observed to be above noise management levels for short periods (≤ 45 min) before reducing to be in line with internal noise objectives.
- Noise levels impacting Susan Wakil will be continued to be monitored throughout the early works construction to assess the impact of this receiver.
- Hence, the noise levels generated by construction works, measured by this monitoring station are shown to adhere to the noise management levels provided within Section 3 of this letter.

5.2 VIBRATION MONITORING RESULTS DISCUSSION

With regards to the vibration measured vibration levels during the monitoring period, we note the following:

- Note that the graphs presented within the Appendix of this document show the maximum recorded velocity for each individual frequency within a given day's monitoring period.
- Data has only been provided for days in which exceedances attributed to vibration works have been experienced at the monitoring station.
- Centenary Institute:
 - Level 1 – Laser Imaging Room:
 - Exceedances of L1 VC-B criteria attributed to construction activity were observed at the monitoring station on the following dates:
 - 22/01/2024 – Approx. 1:00pm, 3:00pm and 4:00pm.
 - 24/01/2024 – Approx. 9:15am.
 - 29/01/2024 – Approx. 7:30am, 9:45am and 1:30pm.
 - 30/01/2024 – Approx. 1:30pm and 2:30pm.
 - 31/01/2024 – Approx. 11am, 2:30pm and 3:30pm.
 - 02/02/2024 – Approx. 12pm.
 - Exceedances due to construction activity are generally observed to result at up to a maximum of 200% of the VC-B criteria at a given frequency (Approximately measured at $75\mu\text{ms}^{-1}$). The maximum level measured during the monitoring period was $110\mu\text{ms}^{-1}$ at 20Hz on 22/01/2024.
 - Exceedances are generally observed at 20Hz, which is likely to be the natural frequency of the Centenary Institute suspended slab. Exceedances at frequencies exclusive of 20Hz are rarely observed.
 - Currently, investigation into the vibration impacts of tracking of the demolition excavator atop the pathology suspended slab is being undertaken, with separate work methodologies being discussed in order to limit the vibration impacts on the laser room.
 - With regards to the vibration impacts on this area, we note the following:
 - Precision imaging equipment such as the laser scanning apparatus investigated by this monitoring station are impacted by vibration through output results, noting that the calibration of the equipment would be lost when experiencing high levels of external vibration.

- This would hence be observed by operators of the equipment, whereby the system would not be operating correctly/results of the system would be impacted.
 - To the knowledge of this office, no impacts on the results output of the equipment have been reported by Centenary Institute throughout the early works construction period.
 - Further, and based upon onsite inspections and testing, AL note that the Laser room is subject to various sources of ambient vibration from the operation of the facility which contribute to the levels measured during construction, inclusive of refrigerant plant maintained within the basement of the facility.
 - Where any changes to the operation / results of the laser scanning apparatus are observed by the operators of the equipment, this is to be relayed to this office for investigation and alignment with construction activity to appropriately assess and mitigate impacts.
- Level 3 – Fish Tanks:
 - No exceedances of criteria were observed within the monitoring period.
 - Level 4 – Surgery Room (Southern Façade):
 - No exceedances of VC-A criteria were observed within the monitoring period.
 - Level 4 – Bathroom (Northern Façade):
 - Two individual exceedance events were observed on 22/01/2024, at approximately 1:00pm and 3:00pm.
 - Exceedances of criteria were marginal, with a maximum measured RMS of $61\mu\text{ms}^{-1}$ at 20Hz.
 - These exceedance events align with events measured by the L1 monitoring station and are hence attributed to sources external of the Centenary facility.
 - We note that exceedances were not observed at the monitor adjacent to the Southern façade where works were being conducted at the time.
 - Based upon site investigation, it was noted to this office that works on site were limited to sawcutting within the hospital loading area and tracking of the excavator around pathology.
 - It is not expected that sawcutting in the location where it was being undertaken at the time would result in an exceedance at this monitoring station.
 - Assessment of the impacts with respect to the excavator movement are currently being undertaken.
 - Notwithstanding, it would be expected that exceedances are observed at the southern monitor if caused by excavator tracking, noting that this monitor was closer to the works than the northern monitor.
 - Various extraneous sources of vibration may have caused the exceedances, such as heavy vehicle movements along Lambie Dew Drive, works within the park to the north of the labour ward, or construction activity at the Charles Perkins Centre separate to the scope of this monitoring.

- Charles Perkins Centre:
 - Southern Corridor (Imaging):
 - Exceedances of B1 VC-B criteria attributed to construction activity were observed at the monitoring station on the following dates:
 - 22/01/2024 – Approx. 1:00pm and 3:00pm.
 - 24/01/2024 – Approx. 10:15am.
 - 25/01/2024 – Approx. 9:45am.
 - 29/01/2024 – Approx. 7:30am, 9:45am, 12:30pm, 2:00pm and 3:45pm.
 - 30/01/2024 – Approx. 12:00pm, 1:15pm and 2:30pm.
 - 02/02/2024 – Approx. 6.30am and 1:30pm.
 - Exceedances due to construction activity are generally observed to result at up to a maximum of 200% of the VC-B criteria at a given frequency (Approximately measured at $75\mu\text{ms}^{-1}$). The maximum level measured during the monitoring period was $110\mu\text{ms}^{-1}$ at 12.5Hz on 24/01/2024.
 - Exceedances are generally observed at 12.5Hz, likely to be the natural frequency of the CPC suspended slab. Exceedances at frequencies exclusive of 12.5Hz and 20Hz are rarely observed.
 - Measured exceedances due to extraneous vibration sources experienced at monitors within both CPC and Centenary occur throughout the monitoring period, however, we note the following:
 - For many of the observed exceedances throughout the monitoring period, measured levels within the CPC basement southern wing exceed those measured by the monitors within Centenary Institute.
 - Throughout the monitoring period, works have been generally restricted to two main areas:
 - Demolition within the pathology demolition area, and
 - Detailed excavation undertaken within the park to the north of the labour ward at the existing hospital.
 - It is expected that any works undertaken within the pathology demolition area would be measured to be higher at monitors installed within Centenary Institute than at CPC, noting that these works are being undertaken close to the Centenary boundary.
 - Whilst works maintained within the park north of the labour ward are closer to CPC (Approx. 25m away) than Centenary L1 (Approx. 40m away,) Detailed excavation is generally not considered to be high vibration generating work, and due to the distance between the works and receiver, as well as the construction methodologies employed on site, are not expected to result in repeated exceedances.
 - However, and due to the suspended basement slab of B1 of CPC, it is possible that significant amplification of the vibration impacts from these works is occurring and resulting in exceedances at the monitoring location.
 - Also, it is prudent to note that CPC is undergoing a façade refurbishment exclusive to the scope of the construction activity assessed within this

report, and this may also be the cause of some of the exceedances observed throughout the period.

- Also, there are some occurrences where exceedances due to external vibration are only experienced within the CPC monitoring data.
- These events are generally not indicative of works for the RPA Hospital redevelopment, as due to the location of the works as discussed above, it would be expected that events are observed at other surrounding vibration monitors.
- Observation Room E:
 - No exceedances of the relevant vibration criteria were observed during the monitoring period.
- Susan Wakil Health Building:
 - No exceedances of the relevant imposed vibration criteria were observed during the monitoring period.

6 CONCLUSION

Noise and vibration monitoring has been conducted by Acoustic Logic for the Early Works being undertaken for SSD-47662959, the RPA Hospital Redevelopment, located at 50 Missenden Road, Camperdown.

This letter presents the results of the monitoring between the period of Monday 22nd January, 2024 and Sunday 04th February, 2024.

Monitoring results have been provided with reference to the Noise and Vibration Management Levels established within the *Early Works Construction Noise and Vibration Management Plan*, prepared by this office, or as they have been updated throughout the construction process, specifically pertaining to the recommendations of the *Baseline Monitoring Results* and *Construction Noise and Vibration Monitoring Report 1*, both also prepared by this office (Ref: 20230239.9/0610A/R1/LA, 20230239.17/0412A/R1/LA and 20230239.17/2301A/R0/LA).

Noise monitoring results have been provided within Appendix A, whilst vibration monitoring results have been provided throughout Appendix B of this letter.

We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,



Acoustic Logic Pty Ltd
Lachlan Abood

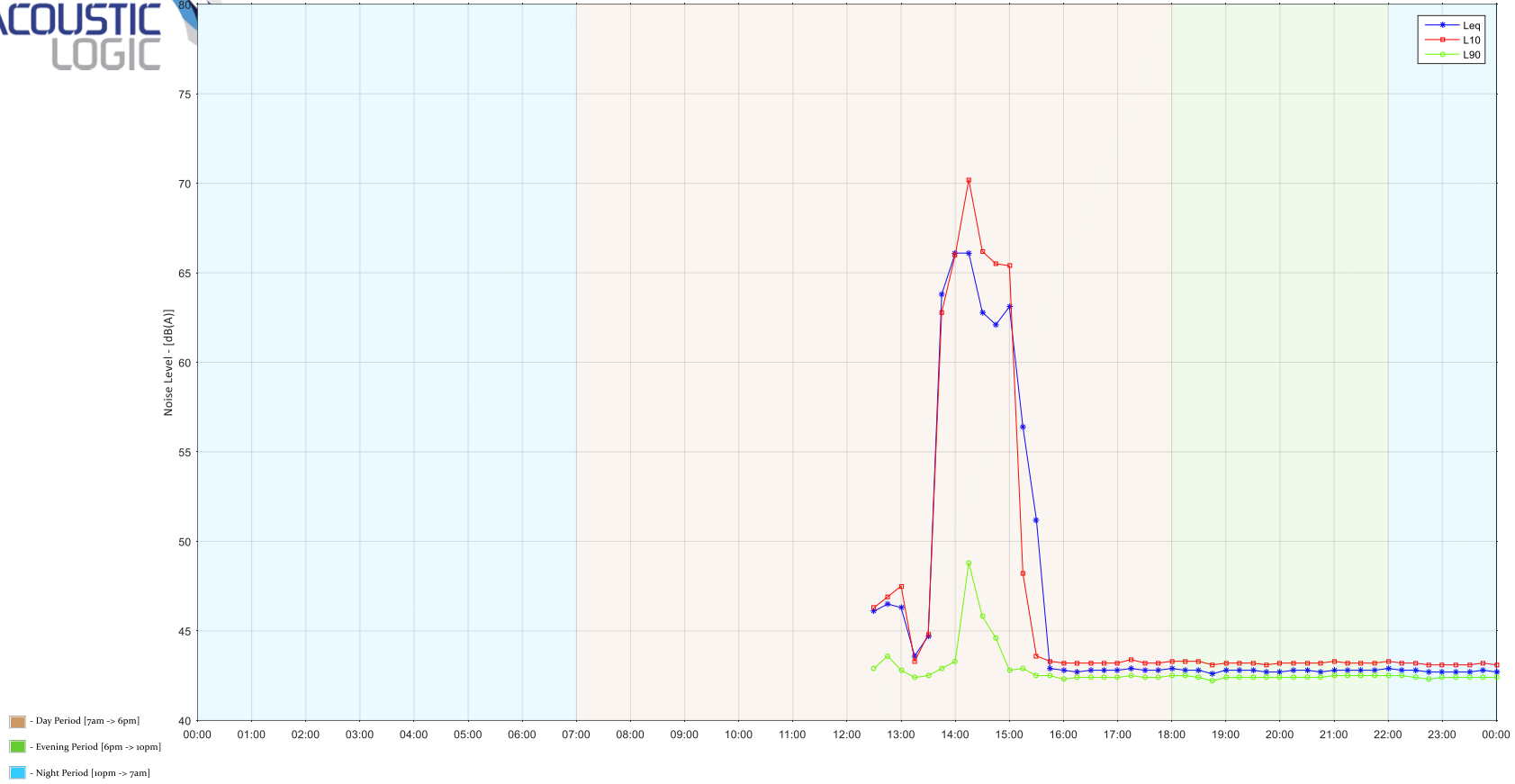
APPENDIX A – NOISE MONITORING RESULTS

CENTENARY INSTITUTE – LEVEL 4 SURGERY ROOM (SOUTHERN FAÇADE)

Due to a technical issue with the control software for the monitoring station, data has only been collated at this monitoring location between Wednesday 31st January 2024 and Sunday 04th February, 2024.

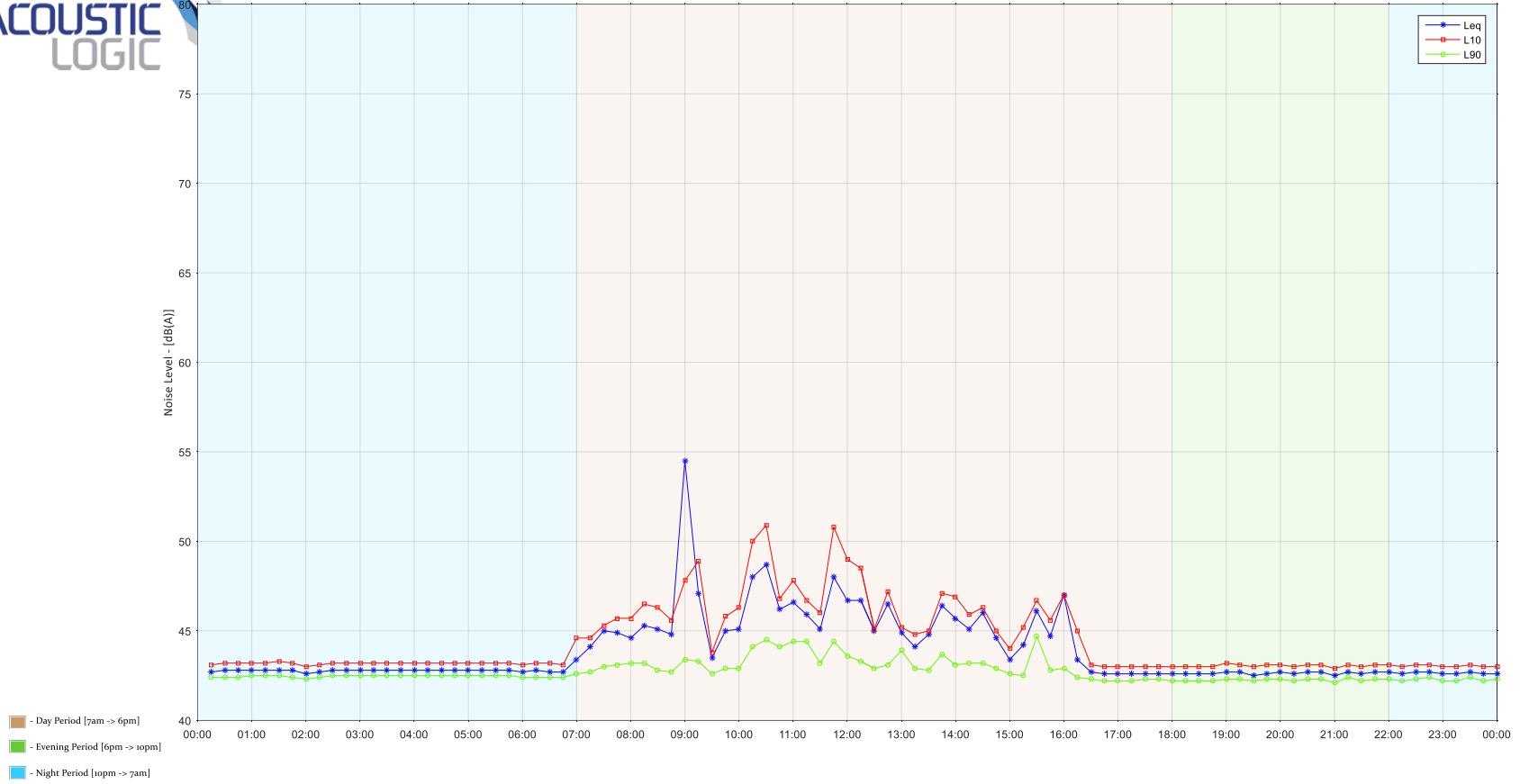


Centenary Institute - L4 Surgery Room: Wednesday 31 January, 2024



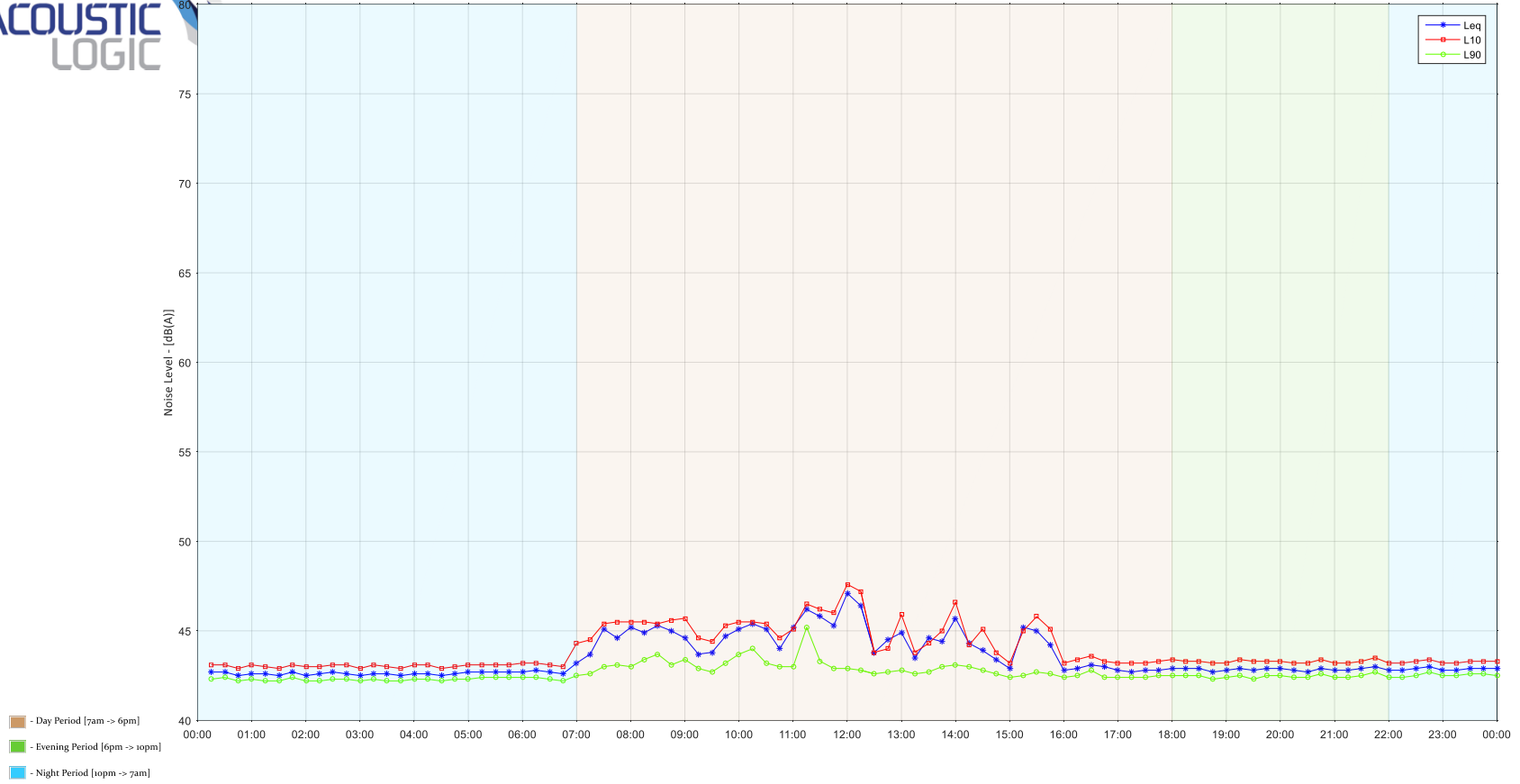


Centenary Institute - L4 Surgery Room: Thursday 01 February, 2024



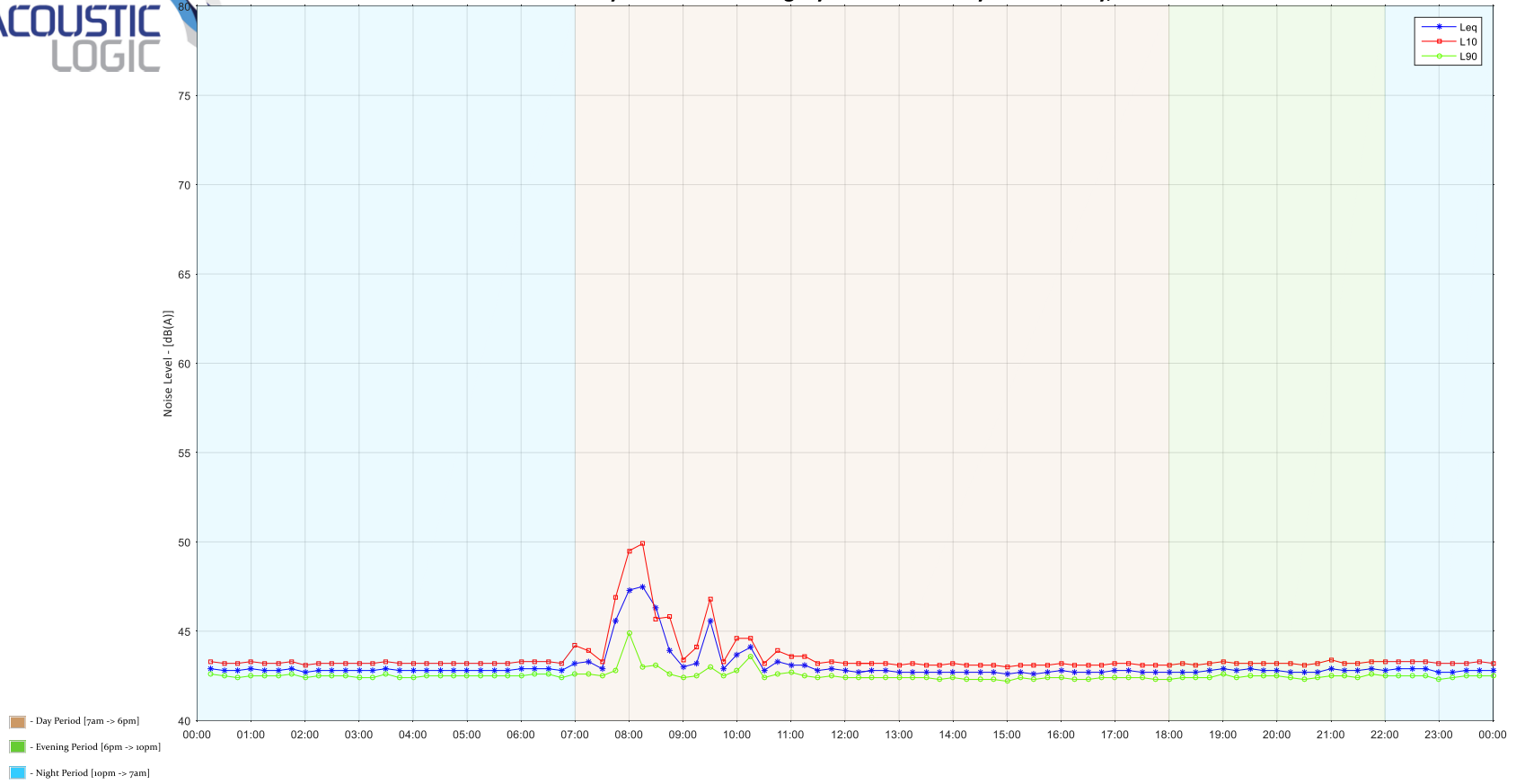


Centenary Institute - L4 Surgery Room: Friday 02 February, 2024





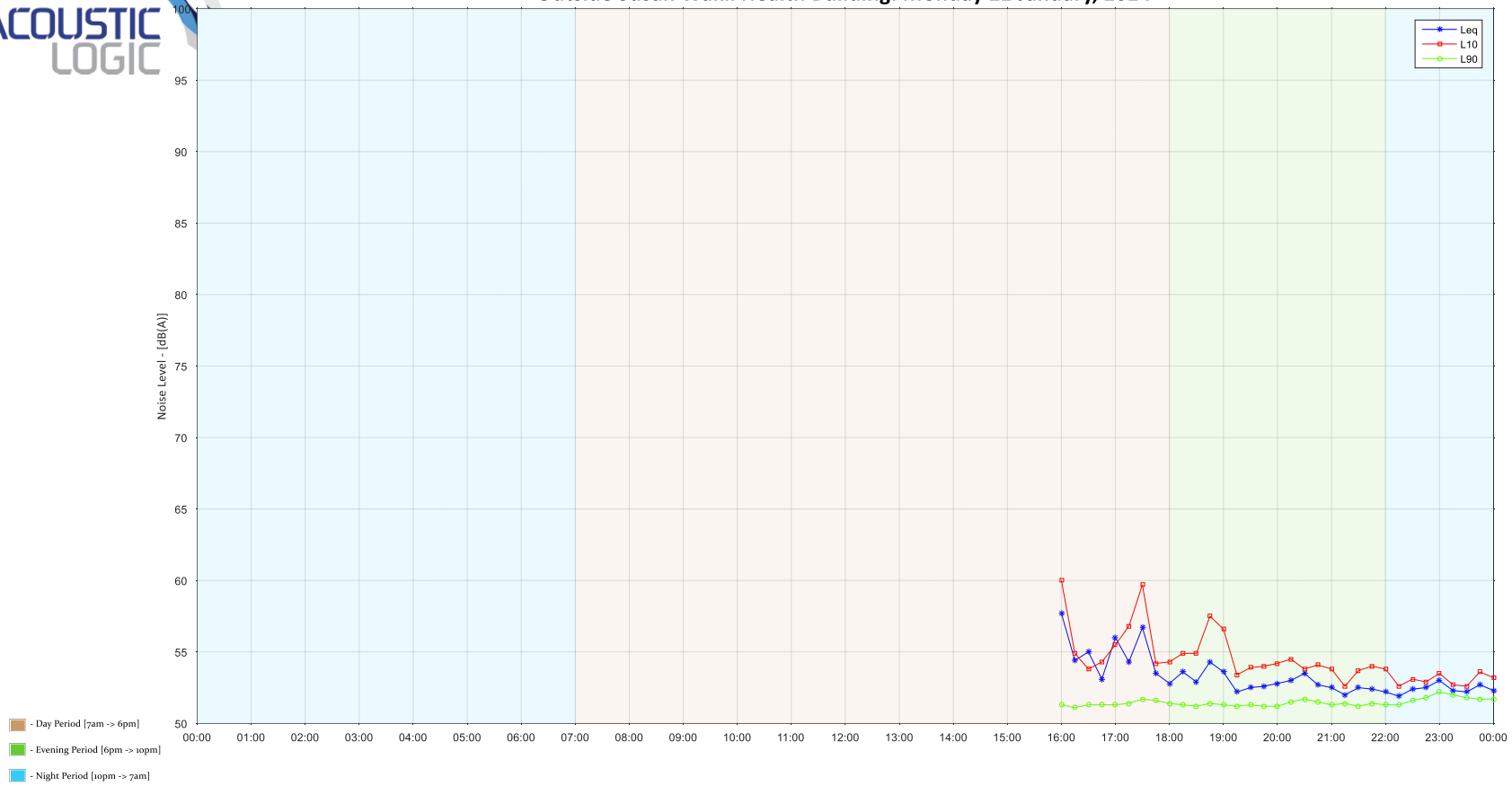
Centenary Institute - L4 Surgery Room: Saturday 03 February, 2024



OUTSIDE SUSAN WAKIL HEALTH BUILDING

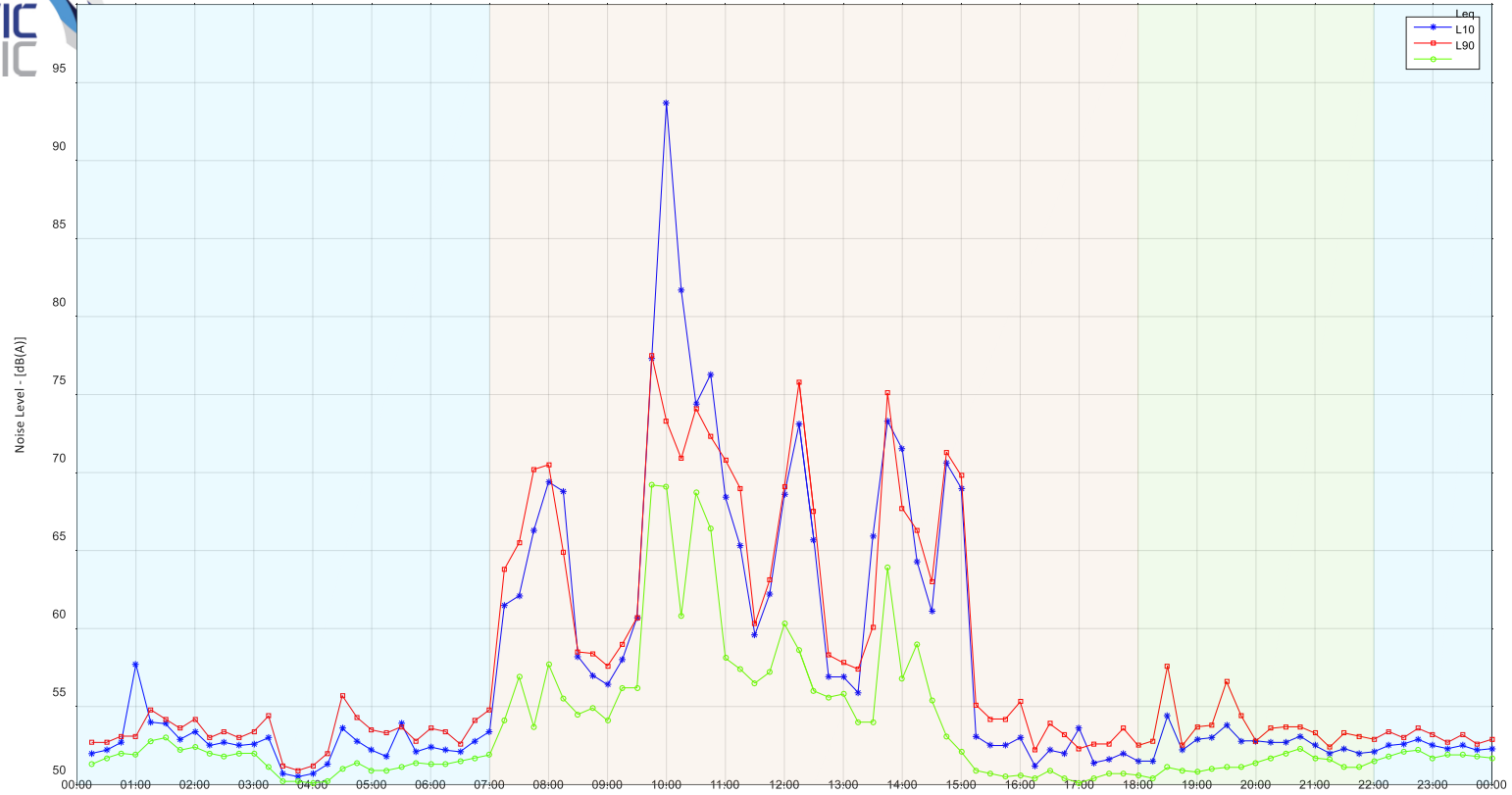


Outside Susan Wakil Health Building: Monday 22 January, 2024



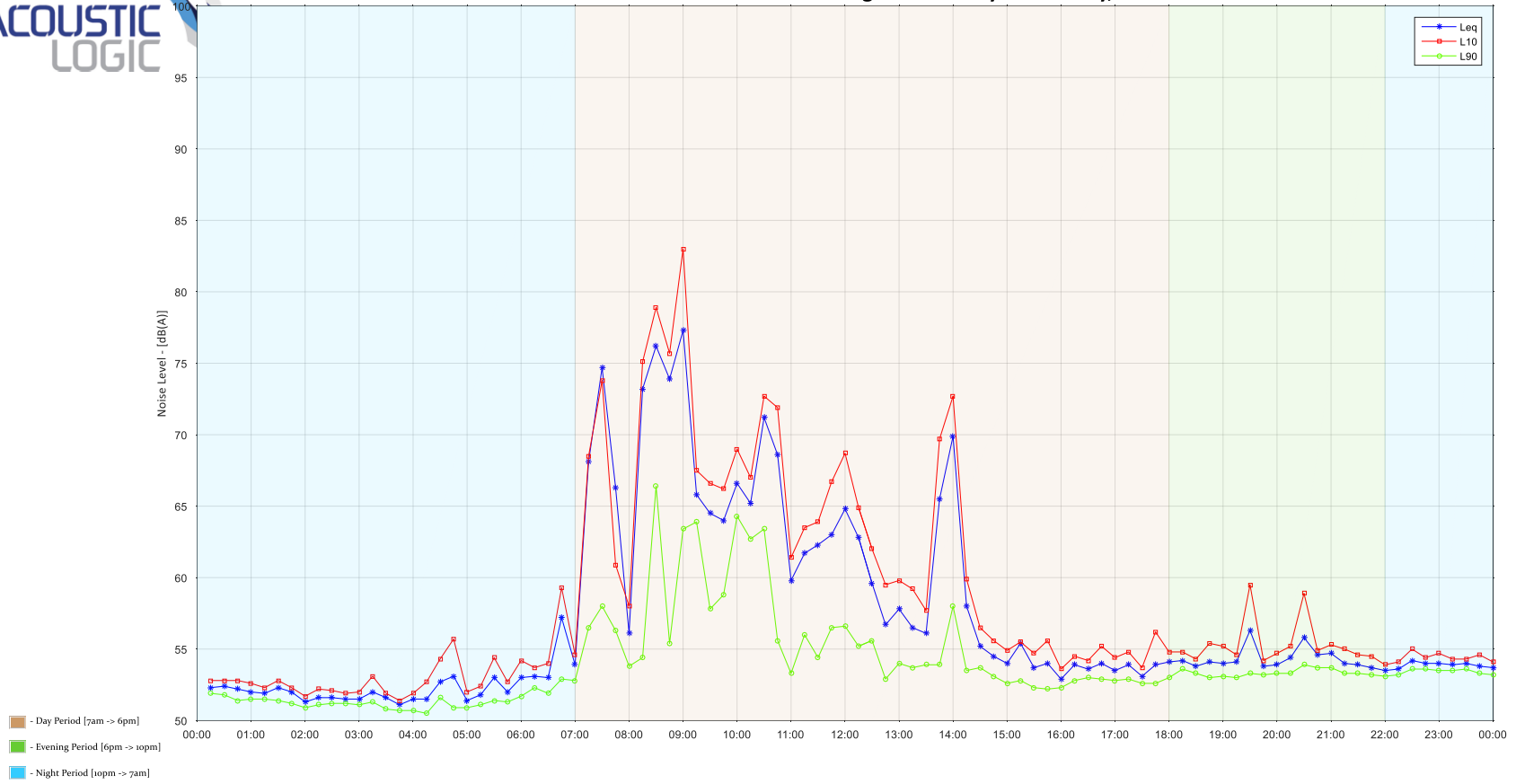


Outside Susan Wakil Health Building: Tuesday 23 January, 2024



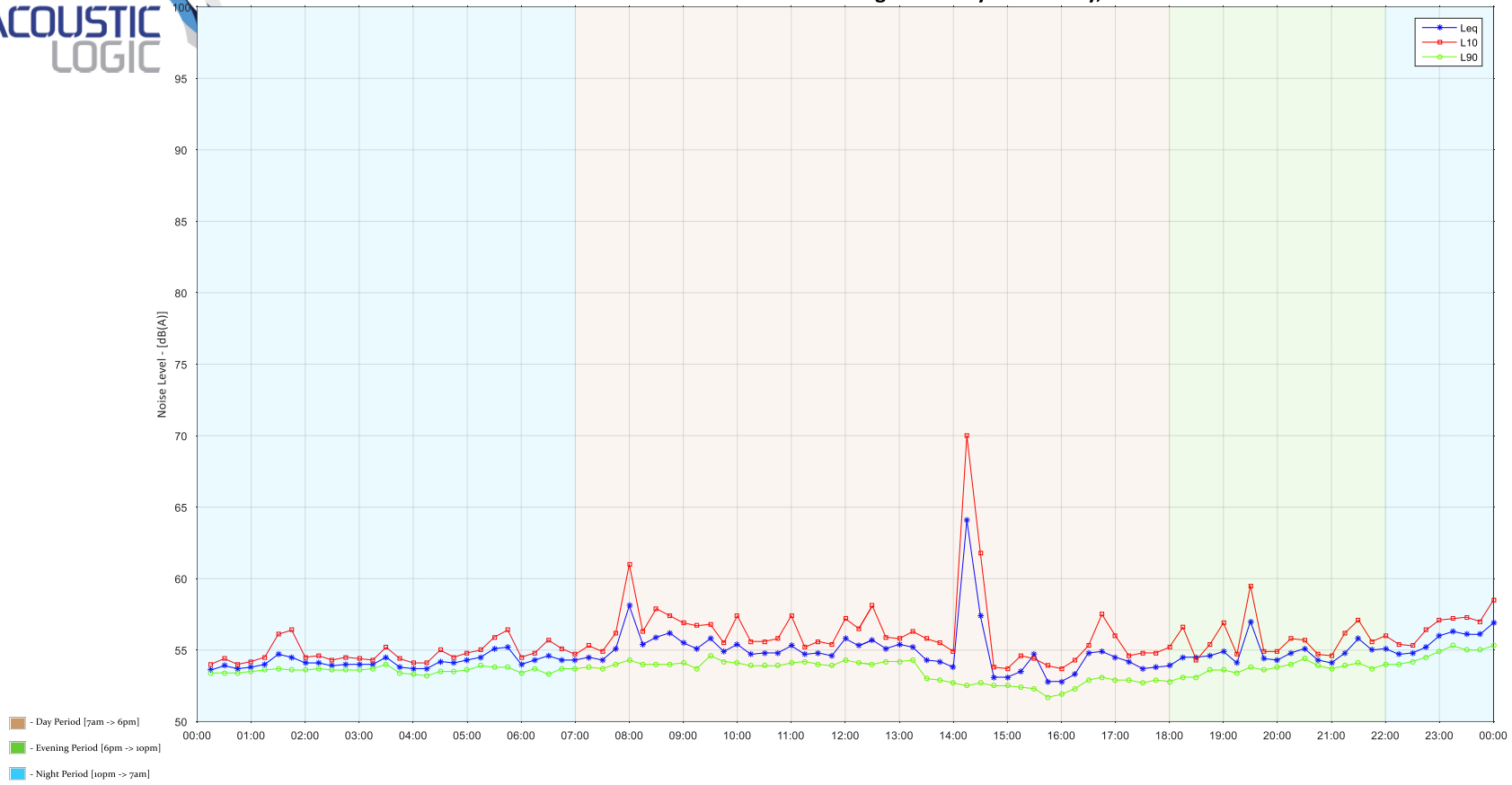


Outside Susan Wakil Health Building: Wednesday 24 January, 2024



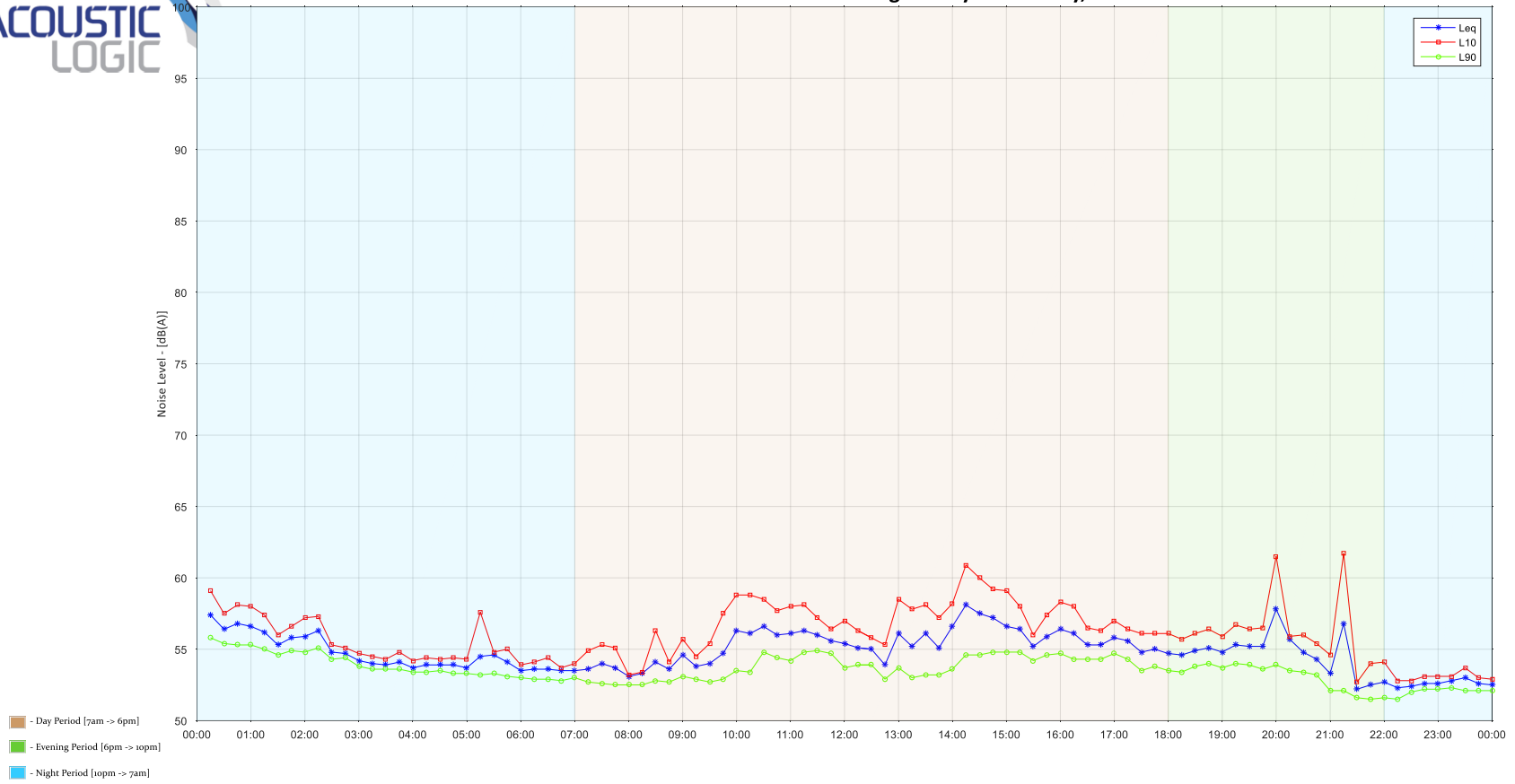


Outside Susan Wakil Health Building: Thursday 25 January, 2024



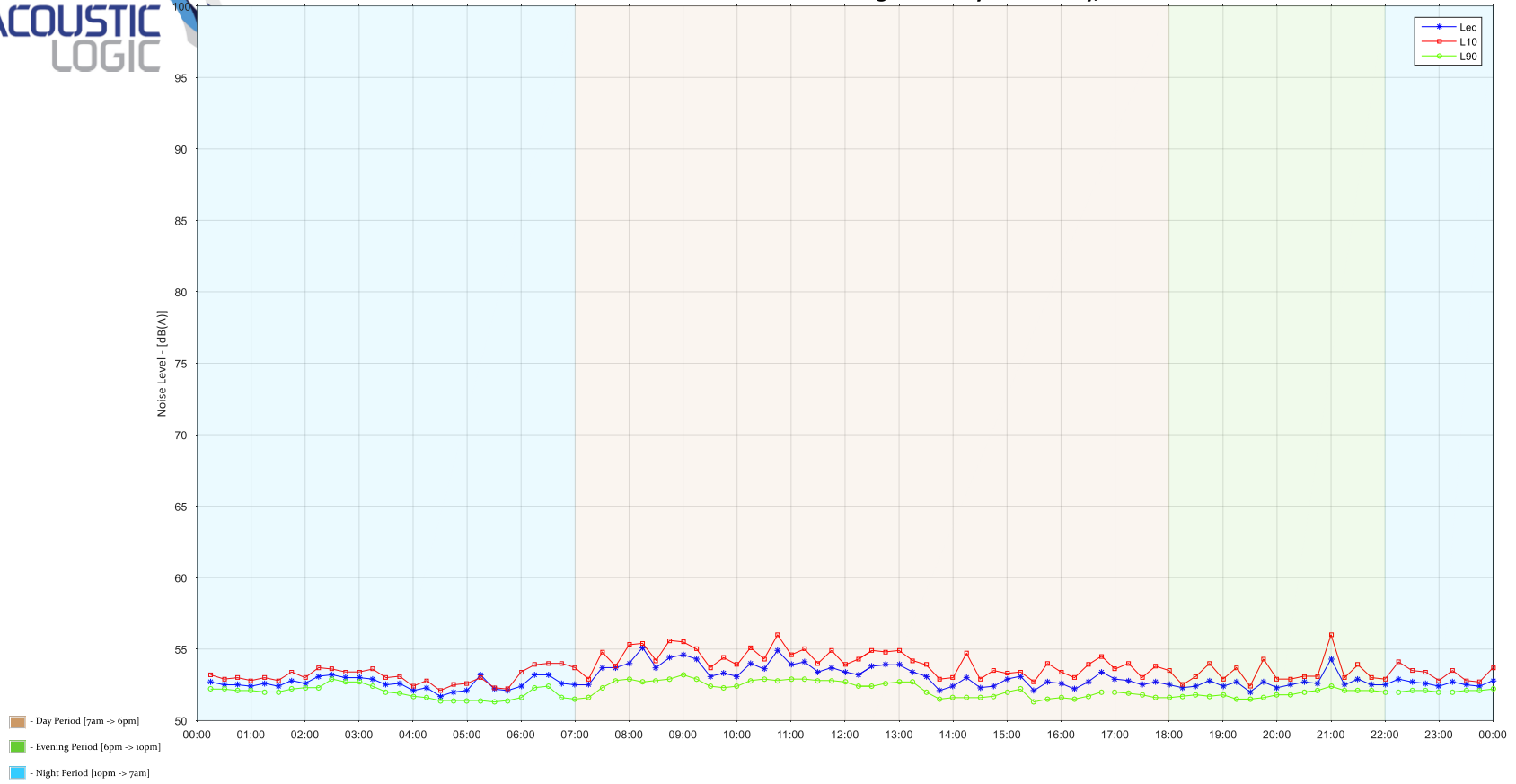


Outside Susan Wakil Health Building: Friday 26 January, 2024



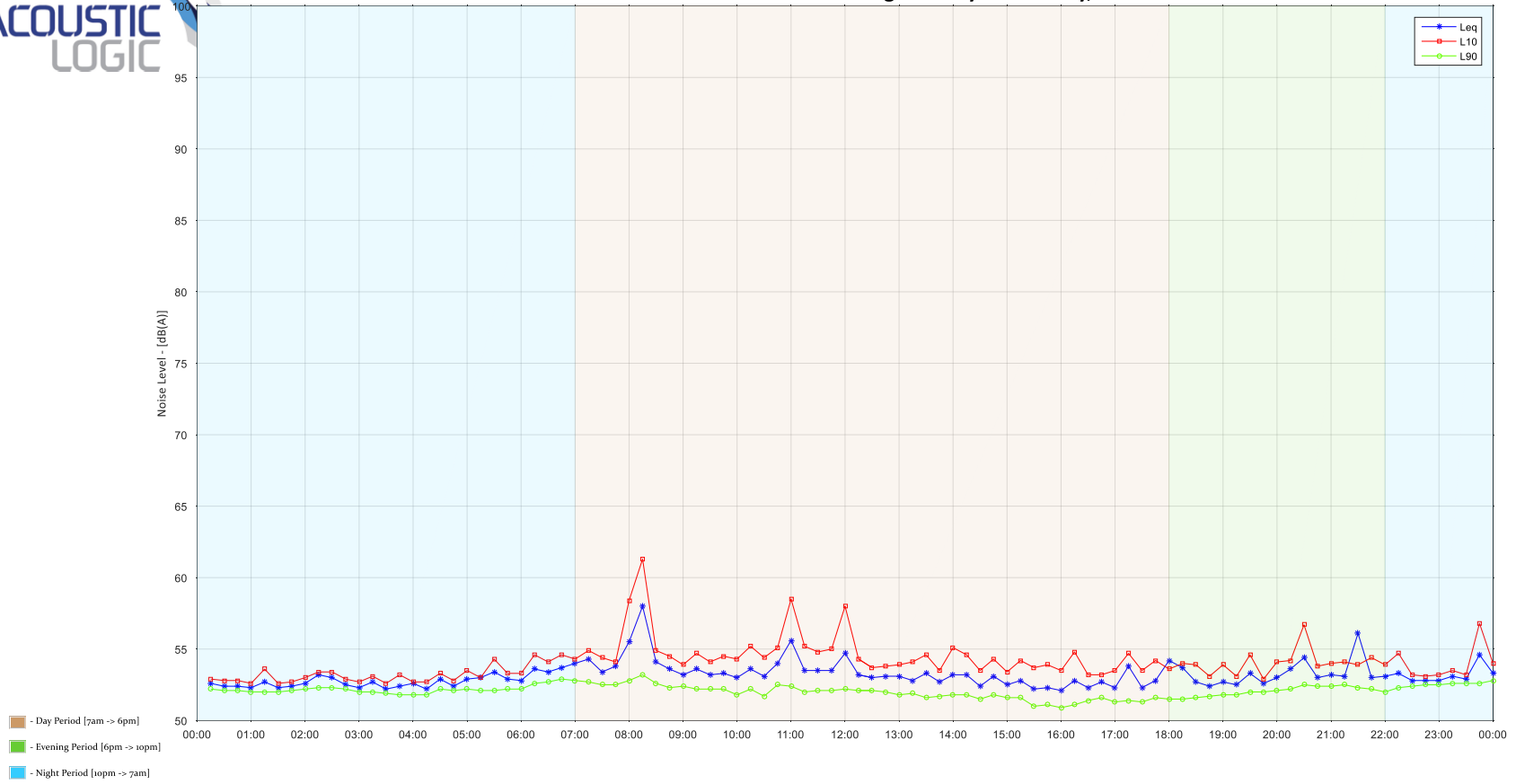


Outside Susan Wakil Health Building: Saturday 27 January, 2024



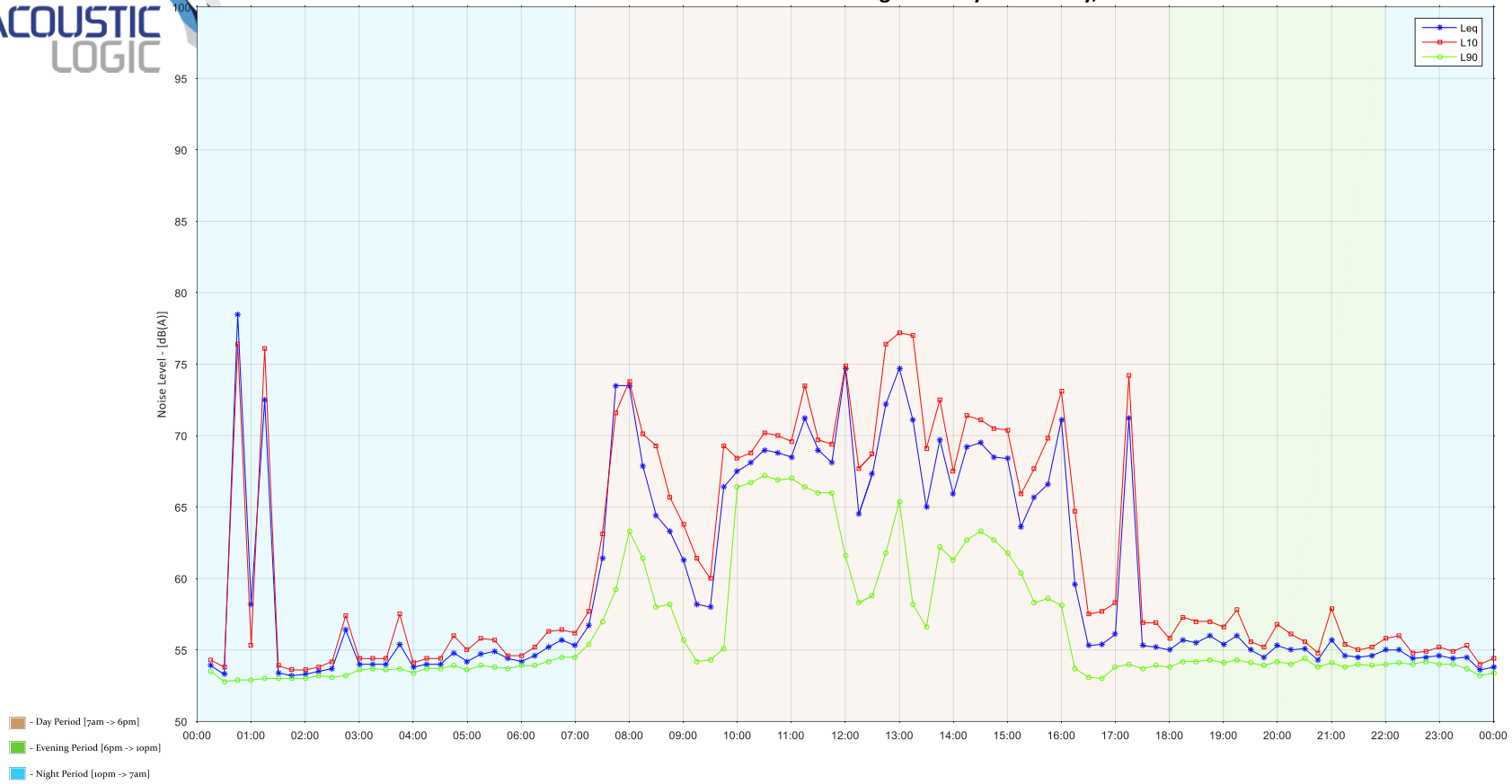


Outside Susan Wakil Health Building: Sunday 28 January, 2024



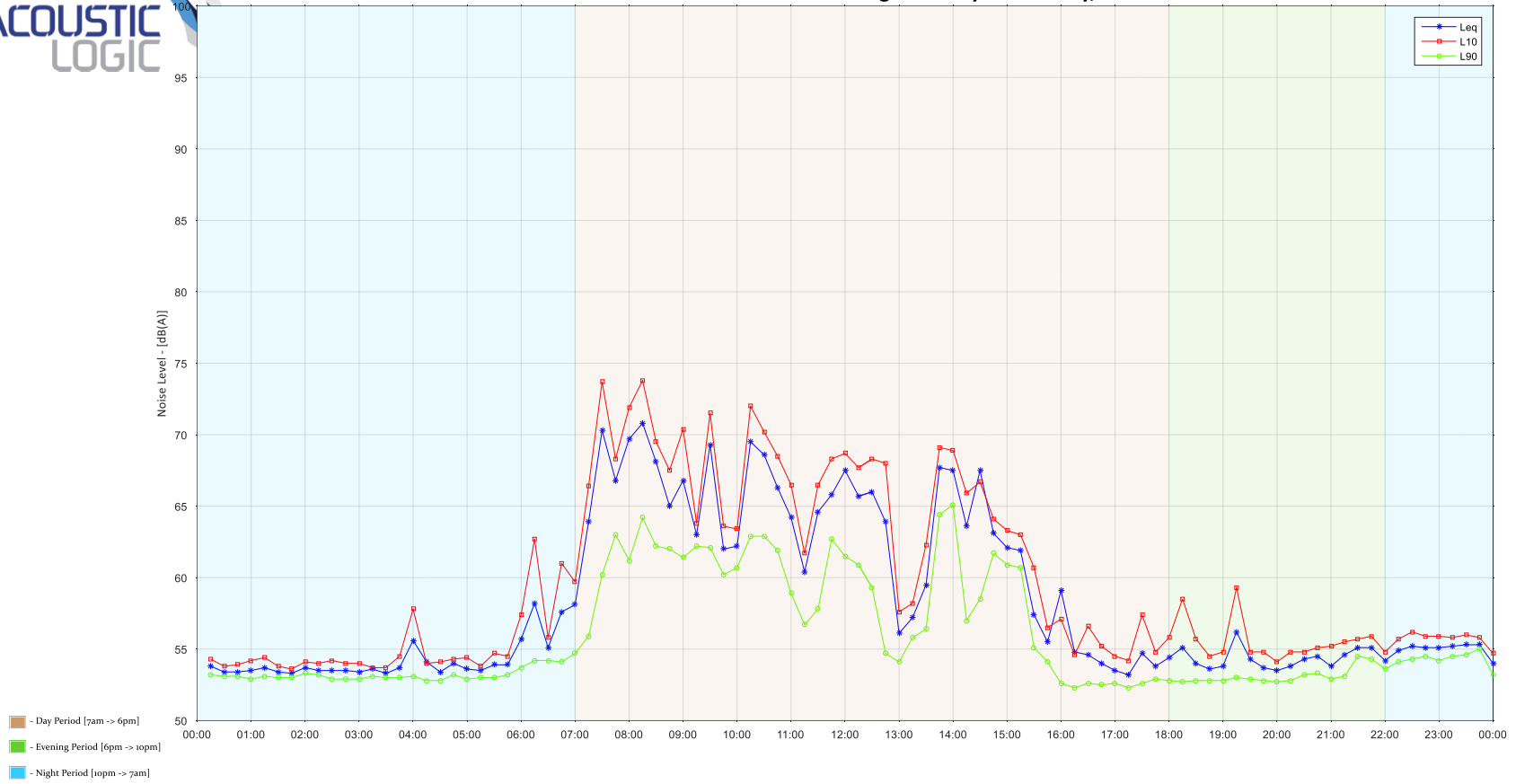


Outside Susan Wakil Health Building: Monday 29 January, 2024



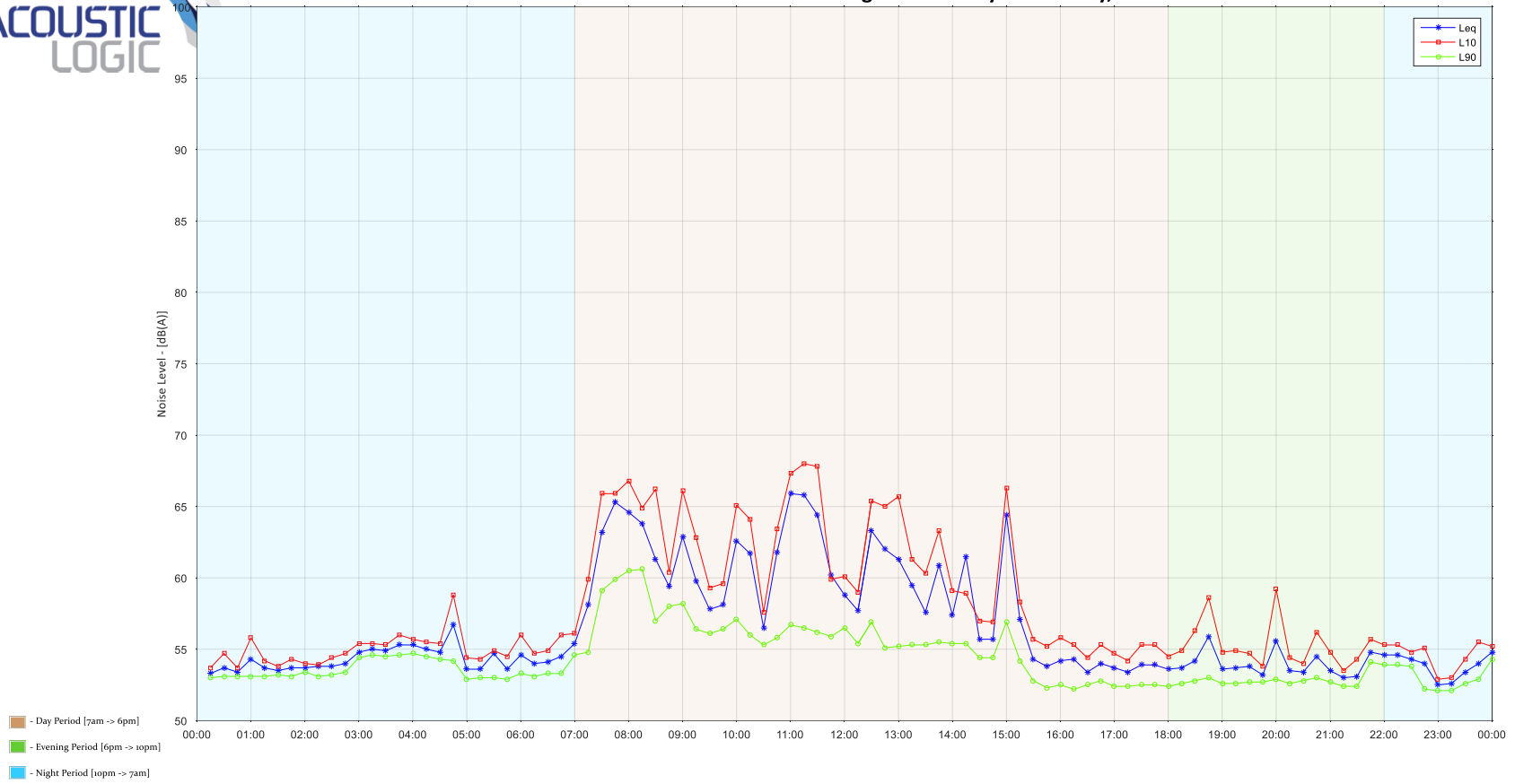


Outside Susan Wakil Health Building: Tuesday 30 January, 2024



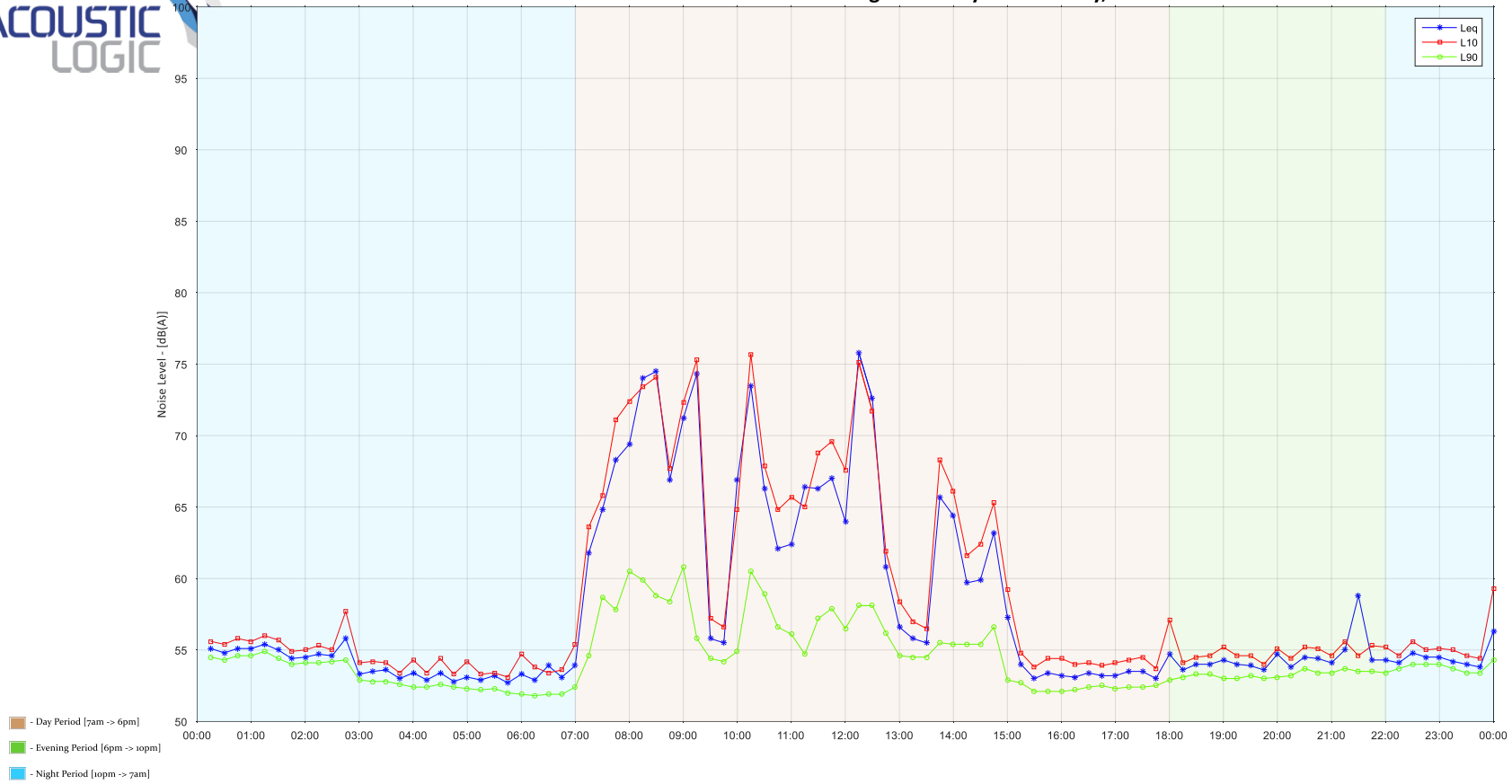


Outside Susan Wakil Health Building: Wednesday 31 January, 2024



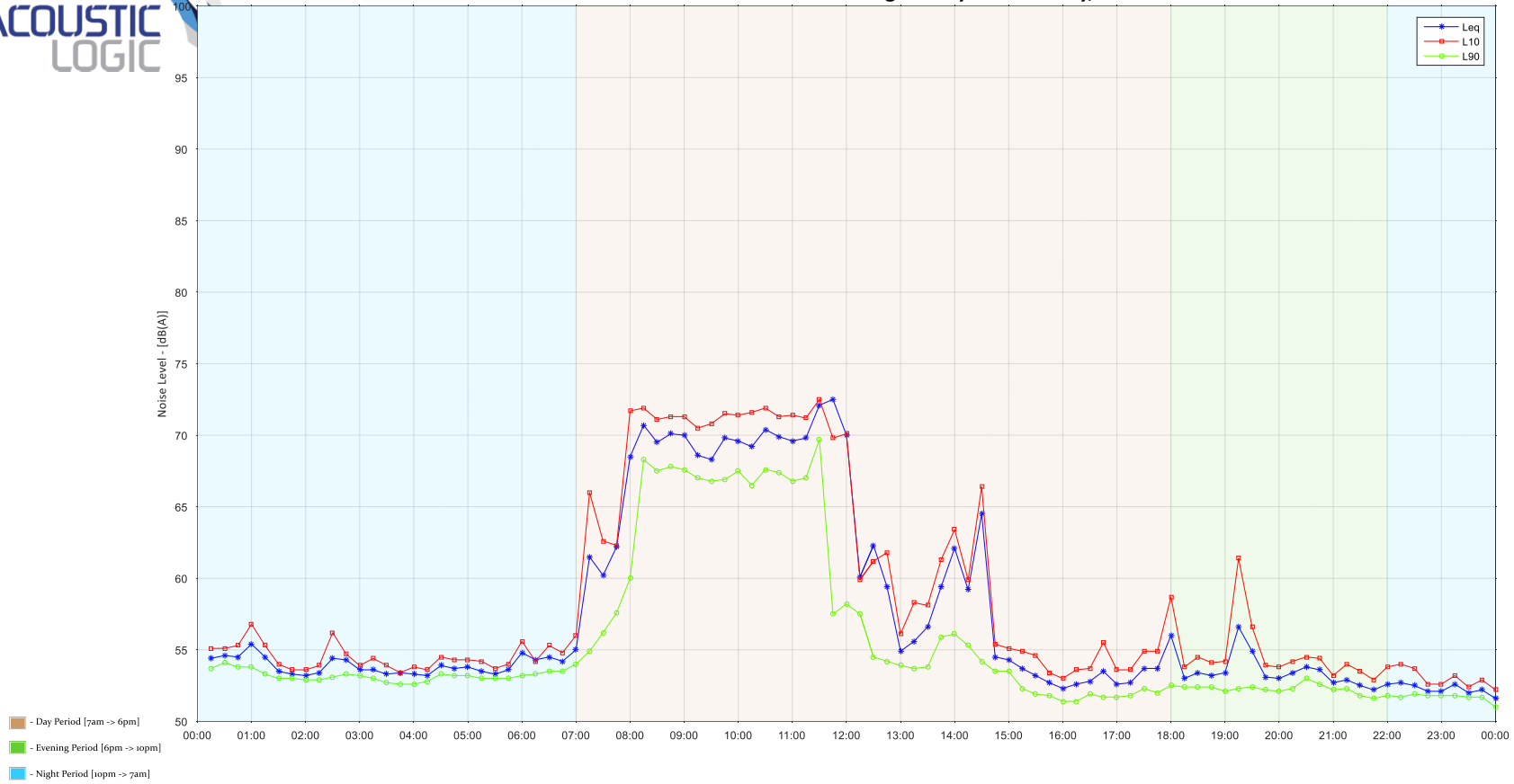


Outside Susan Wakil Health Building: Thursday 01 February, 2024



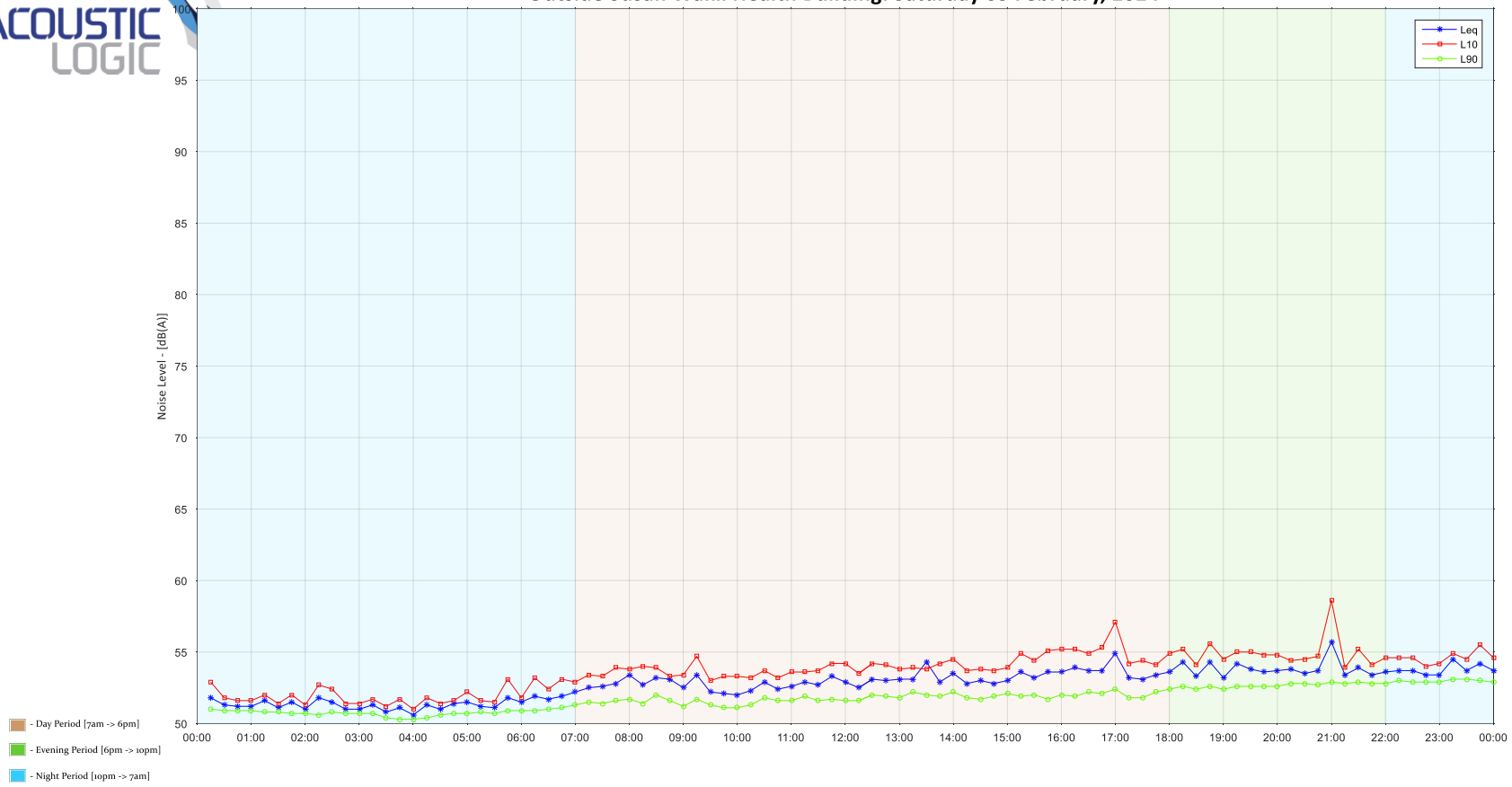


Outside Susan Wakil Health Building: Friday 02 February, 2024



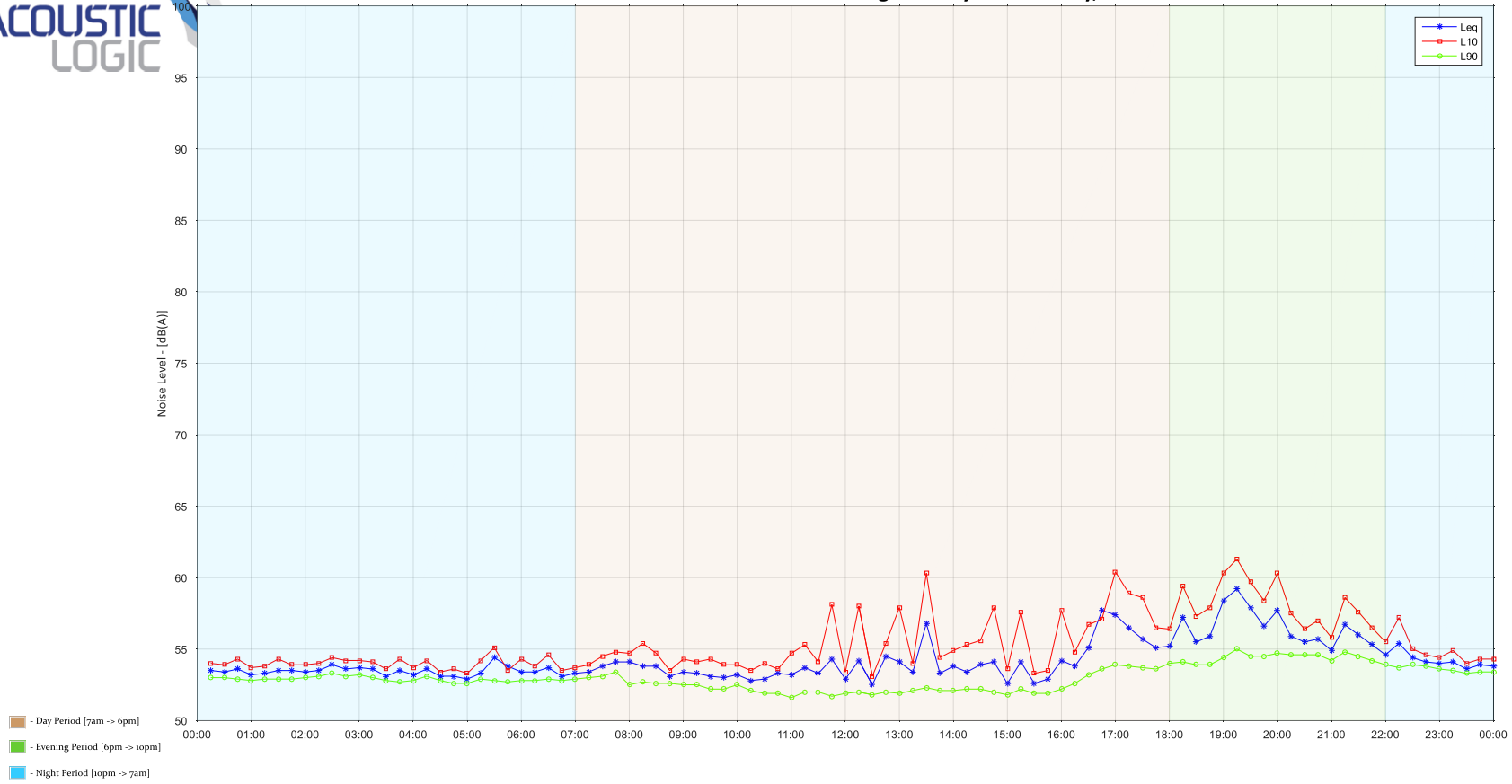


Outside Susan Wakil Health Building: Saturday 03 February, 2024





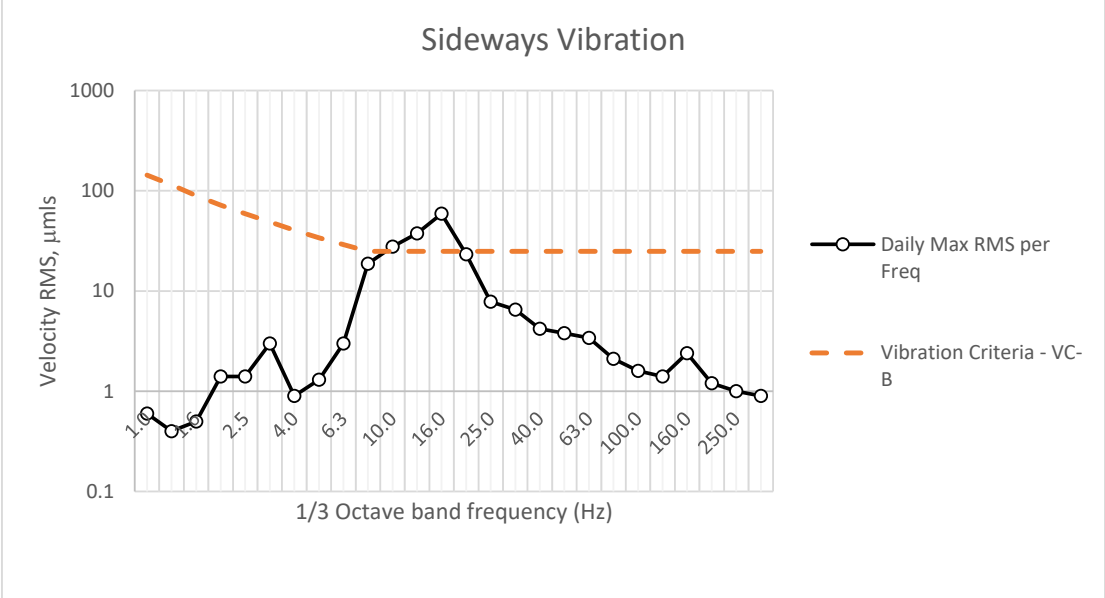
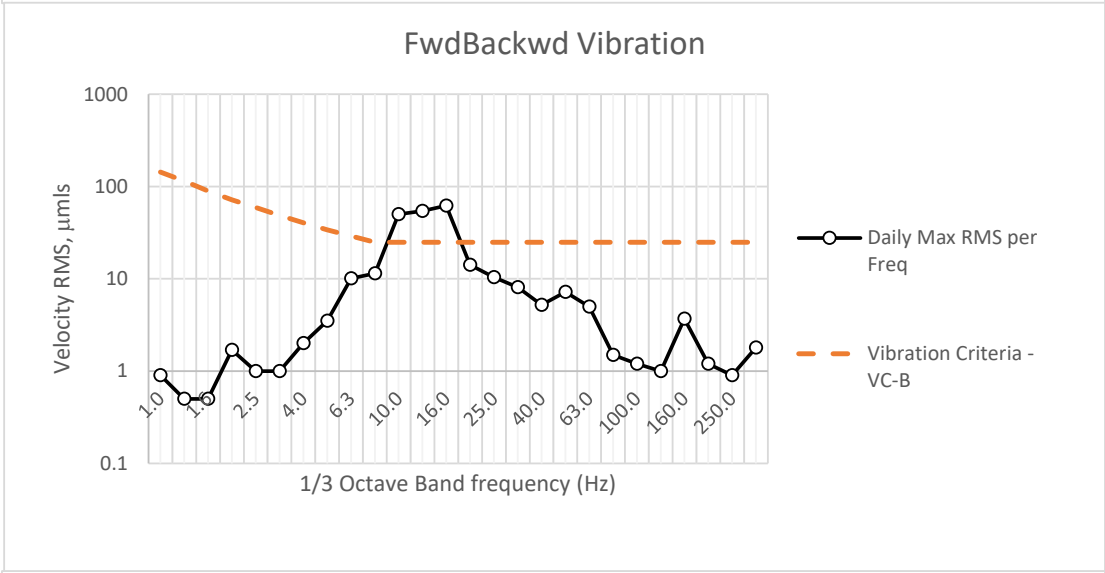
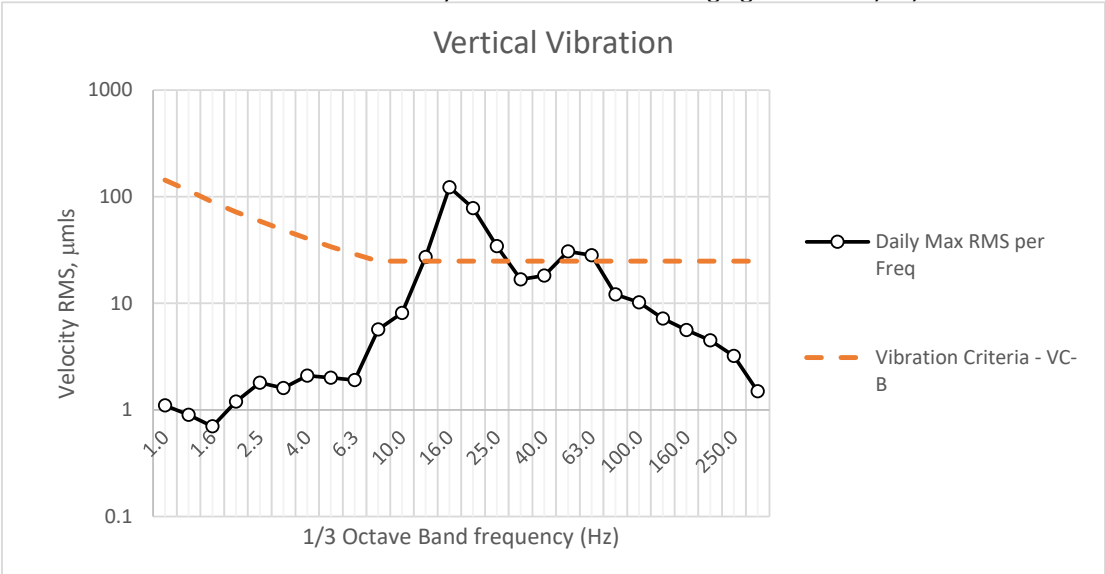
Outside Susan Wakil Health Building: Sunday 04 February, 2024

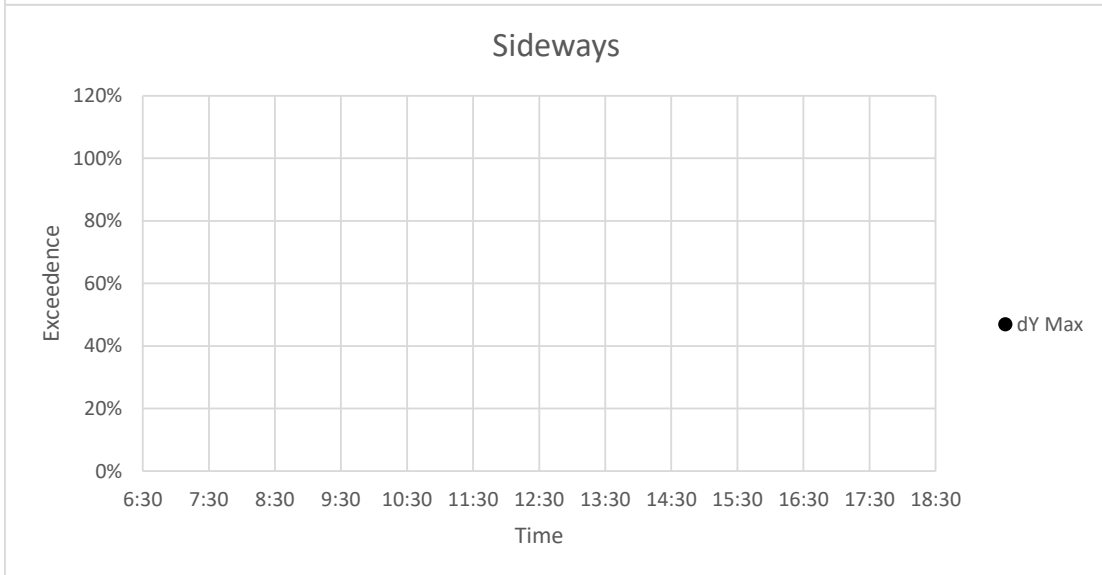
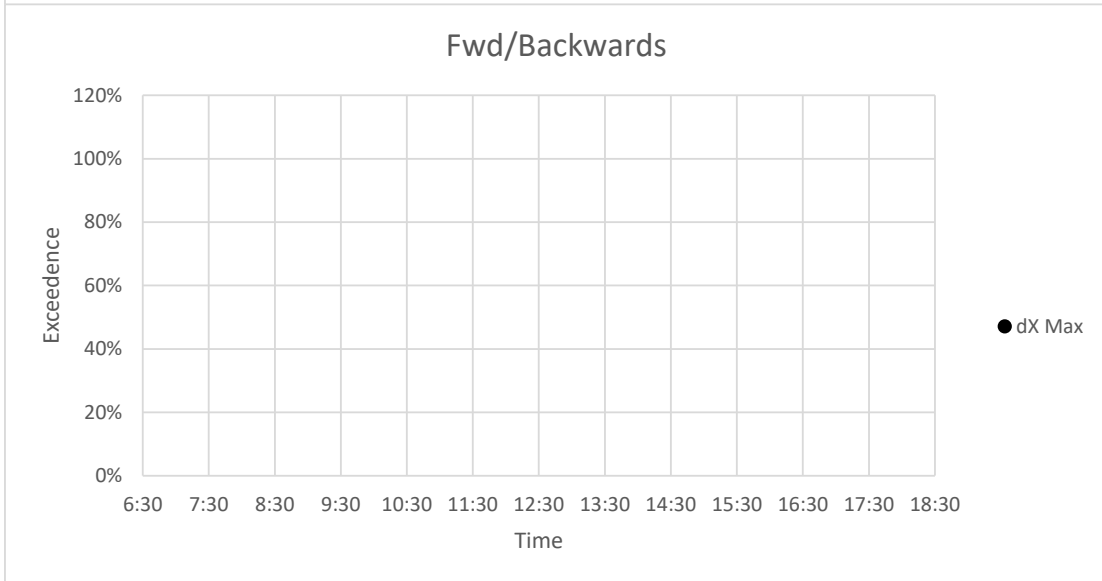
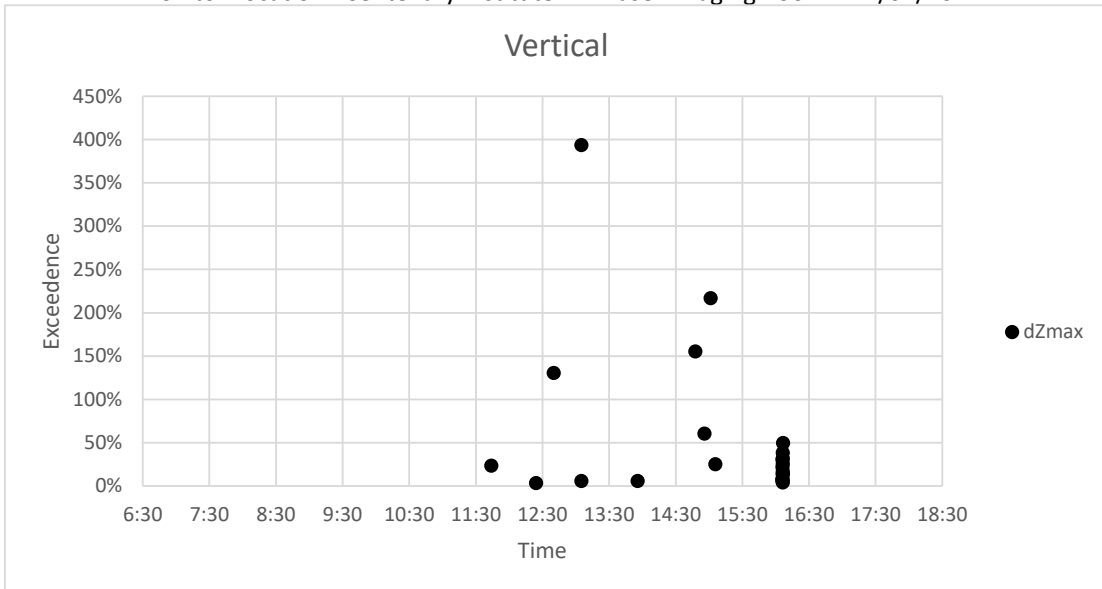


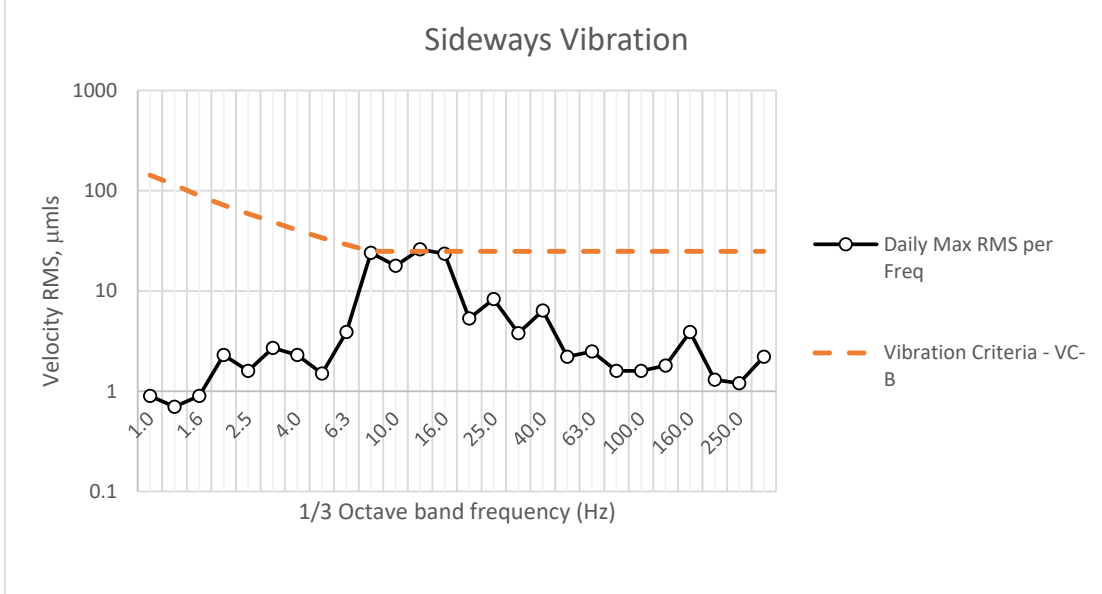
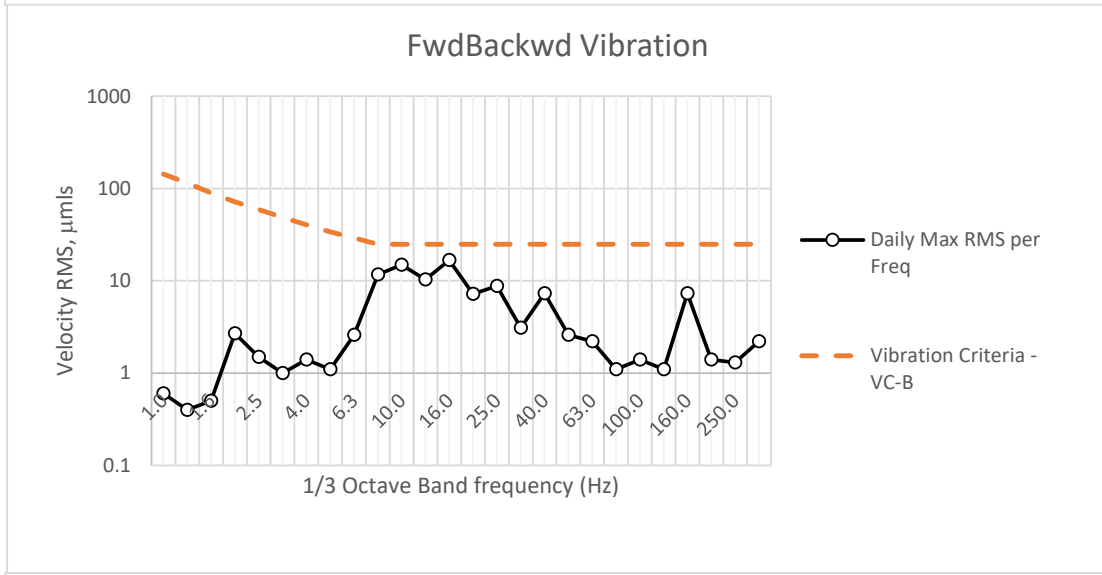
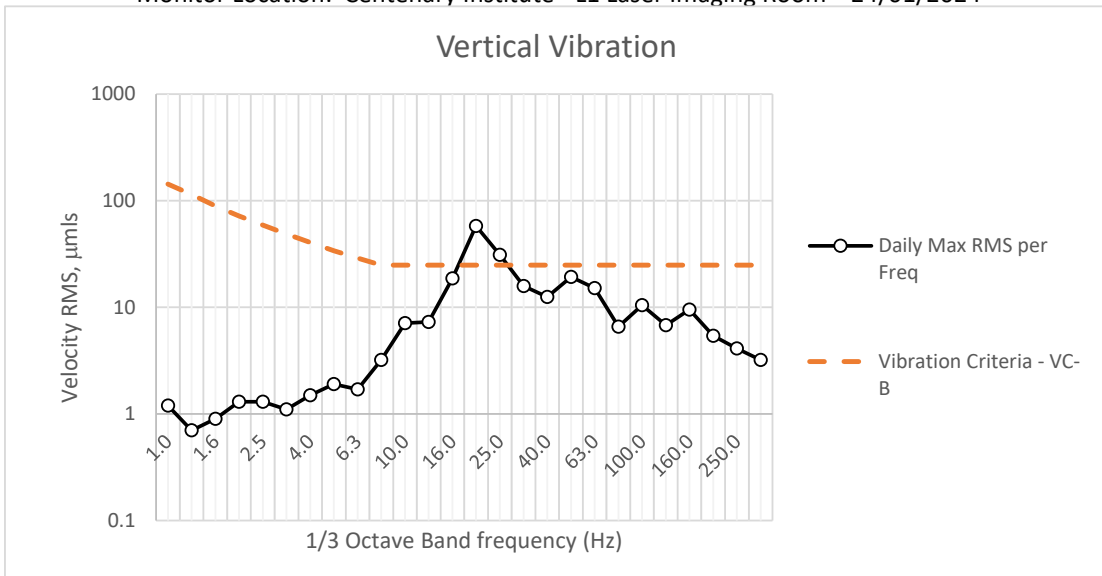
APPENDIX B – VIBRATION MONITORING RESULTS

Note that only dates where exceedances of events were experienced have been provided as per discussion with relevant stakeholders.

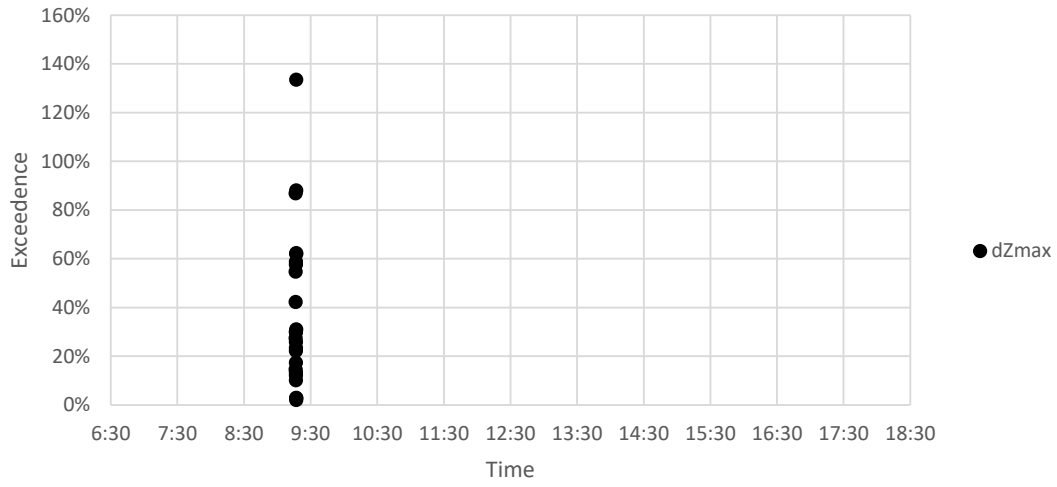
CENTENARY INSTITUTE – LEVEL 1 LASER IMAGING ROOM



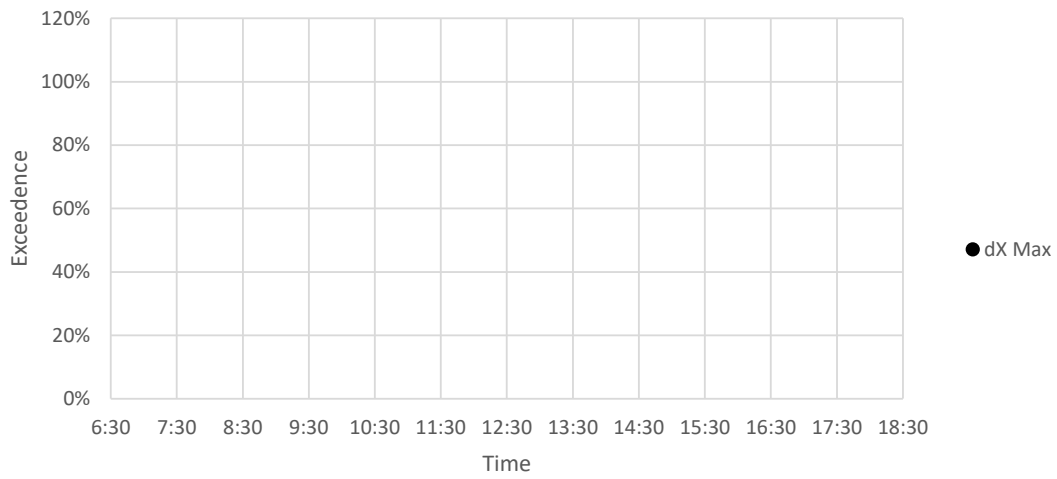




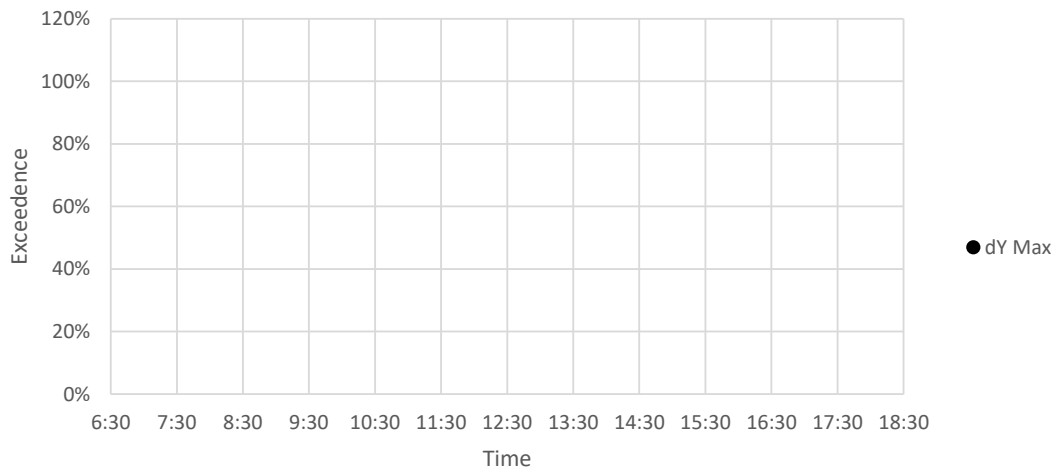
Vertical

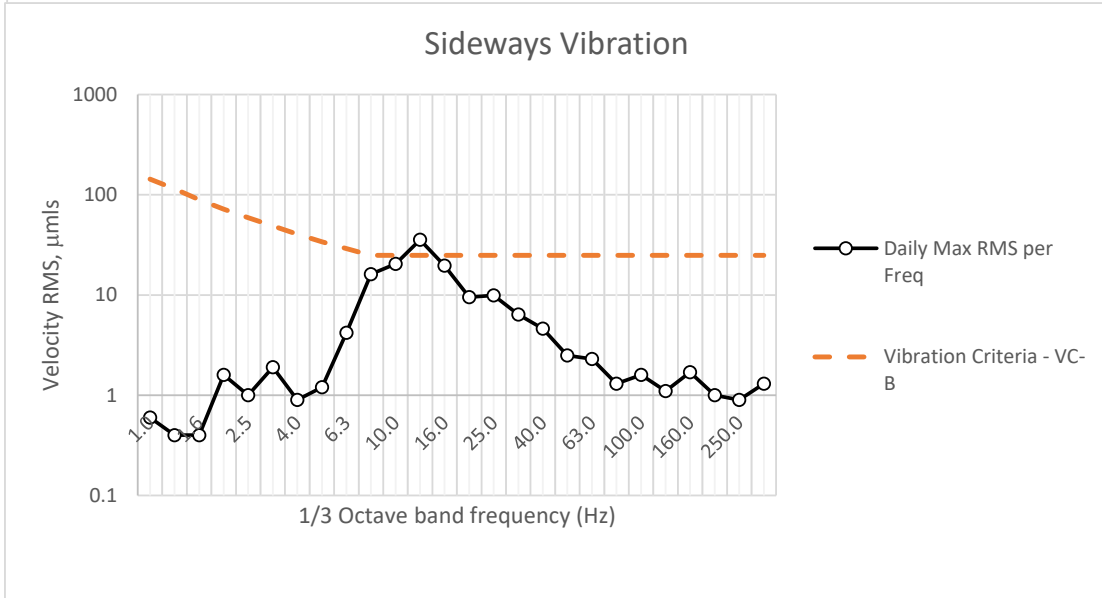
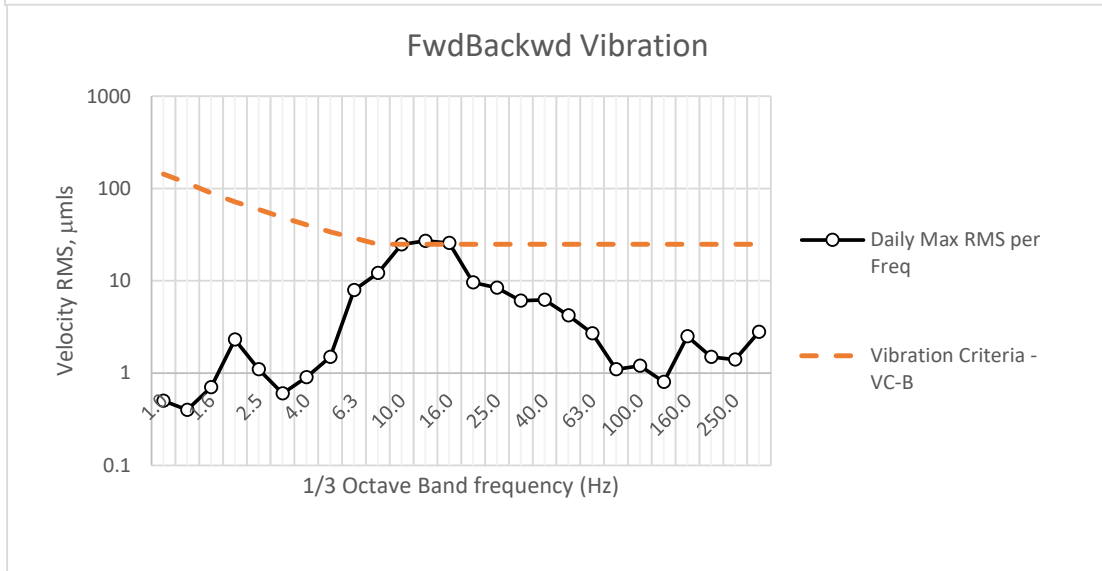
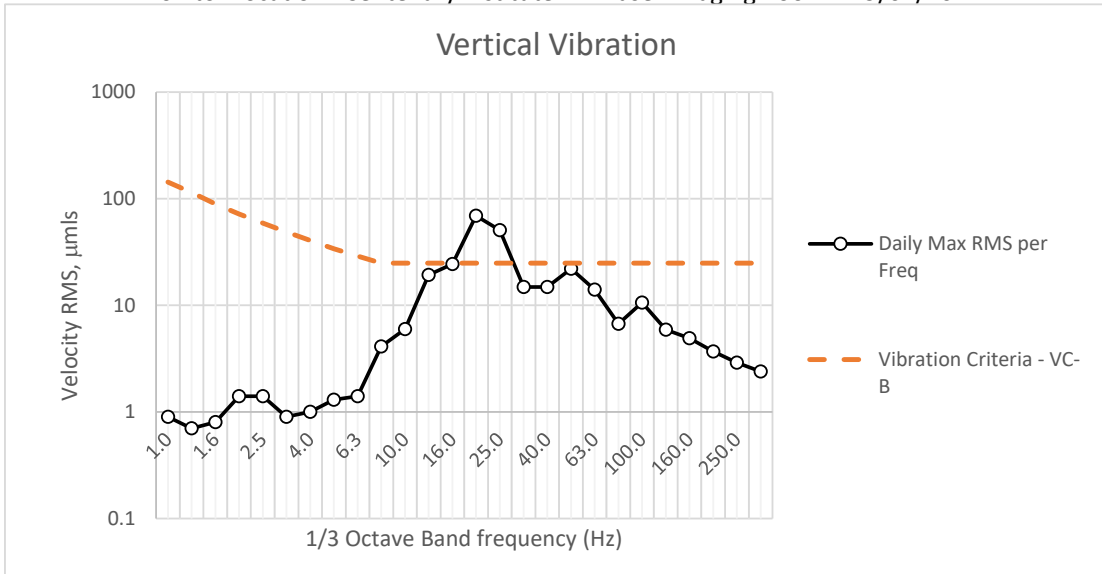


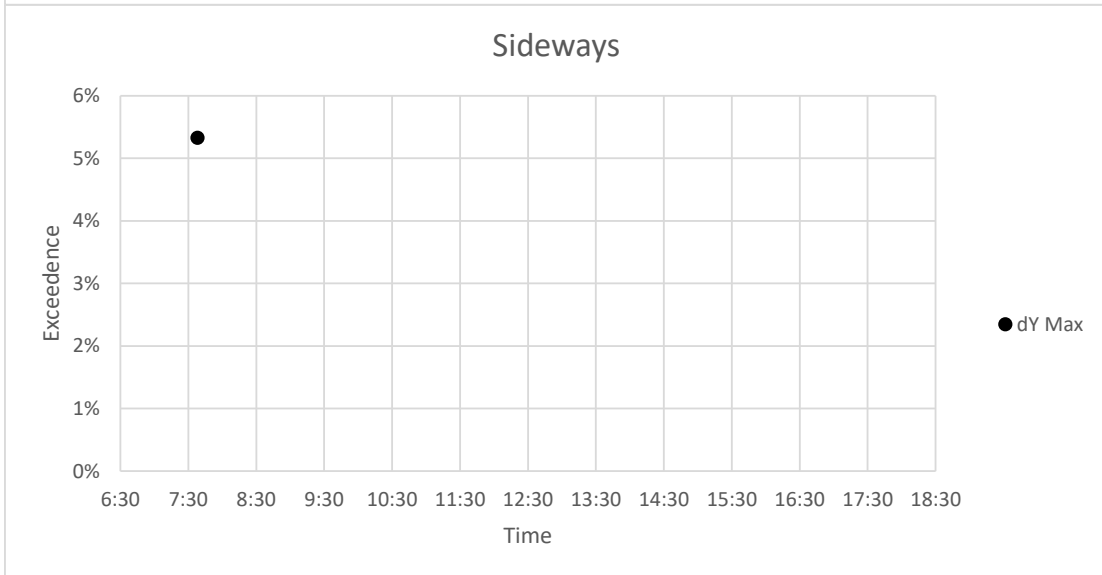
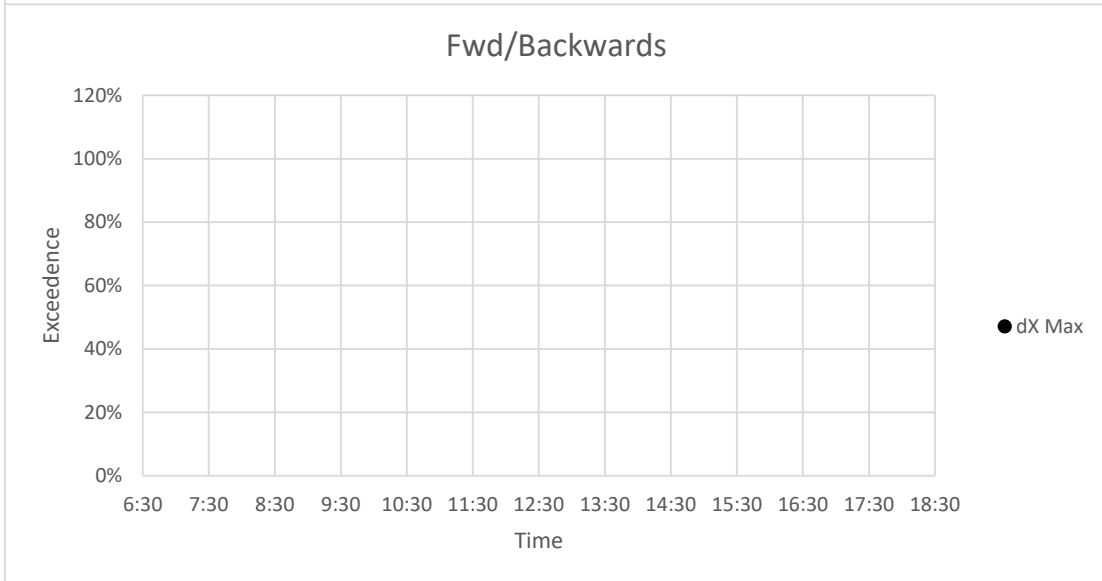
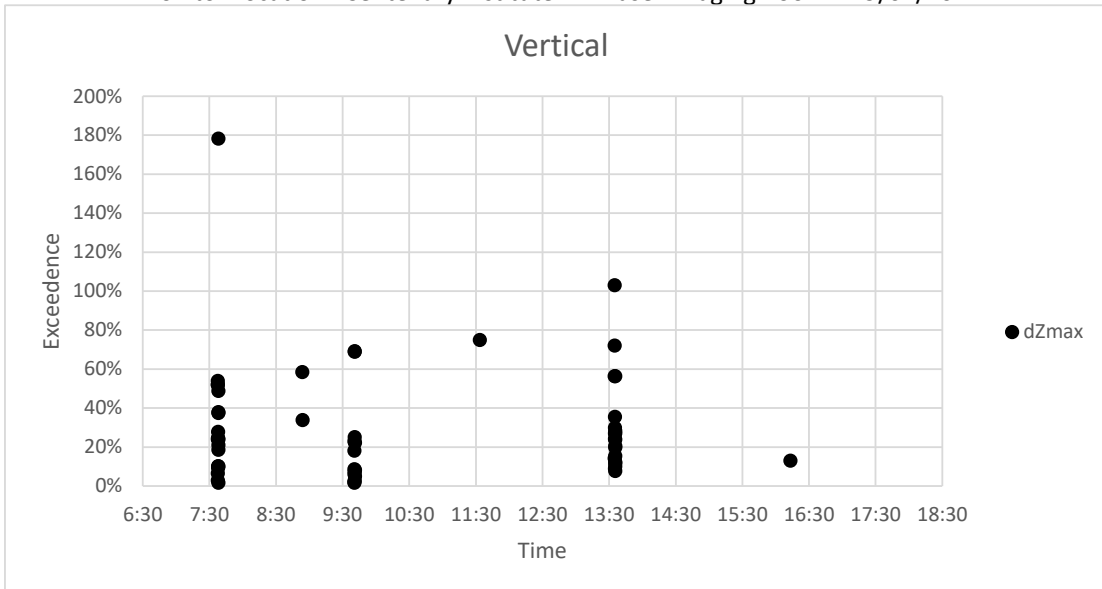
Fwd/Backwards

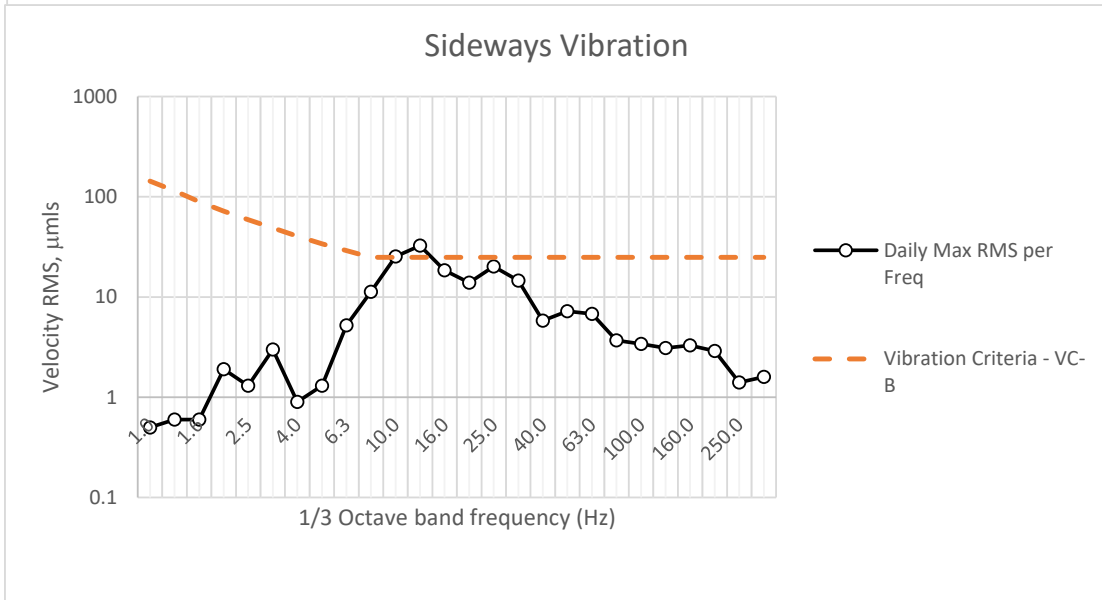
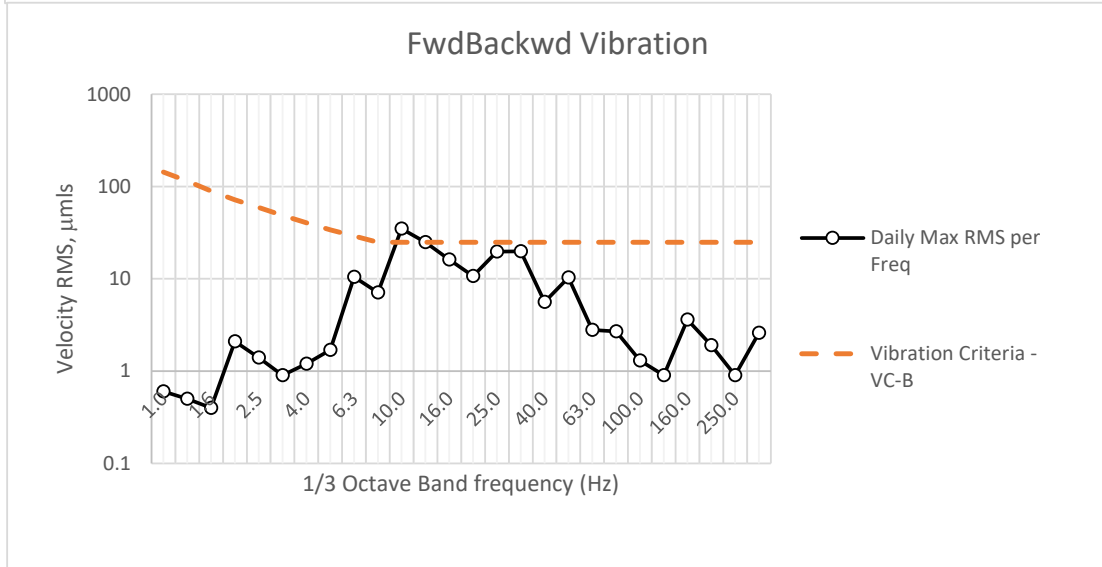
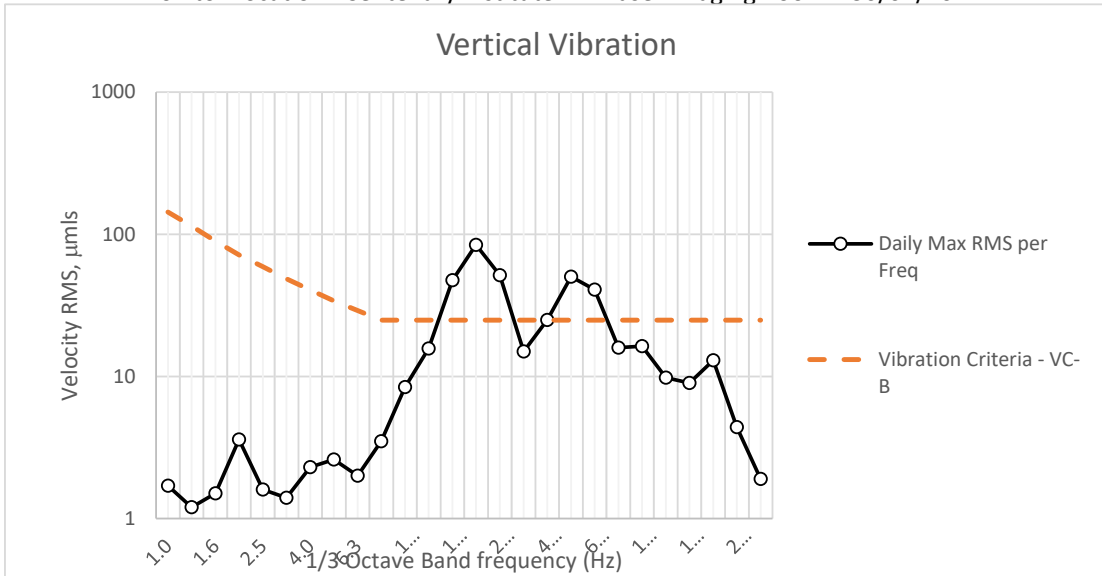


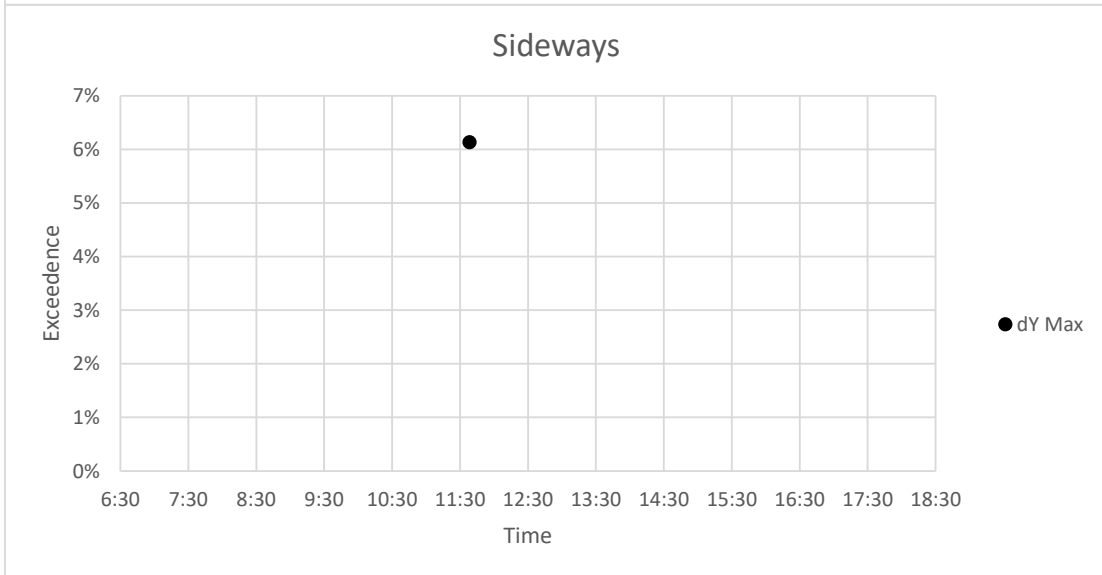
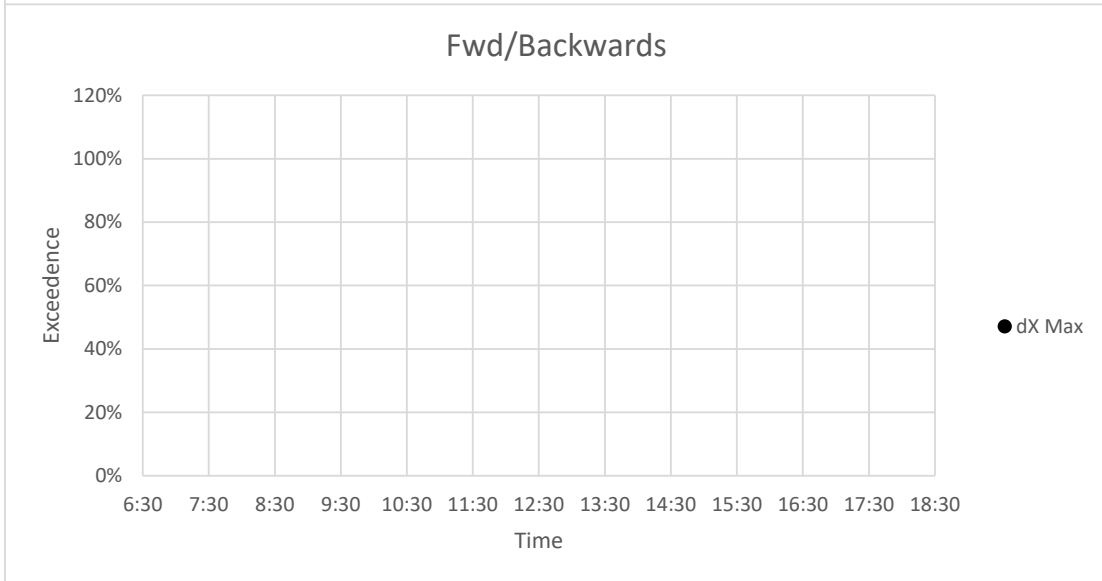
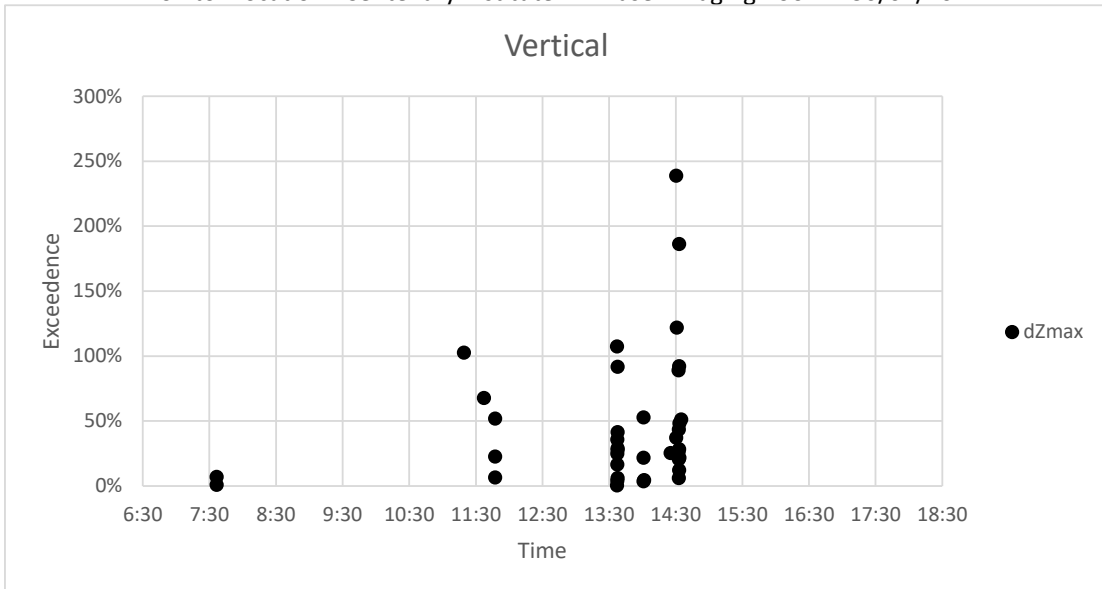
Sideways

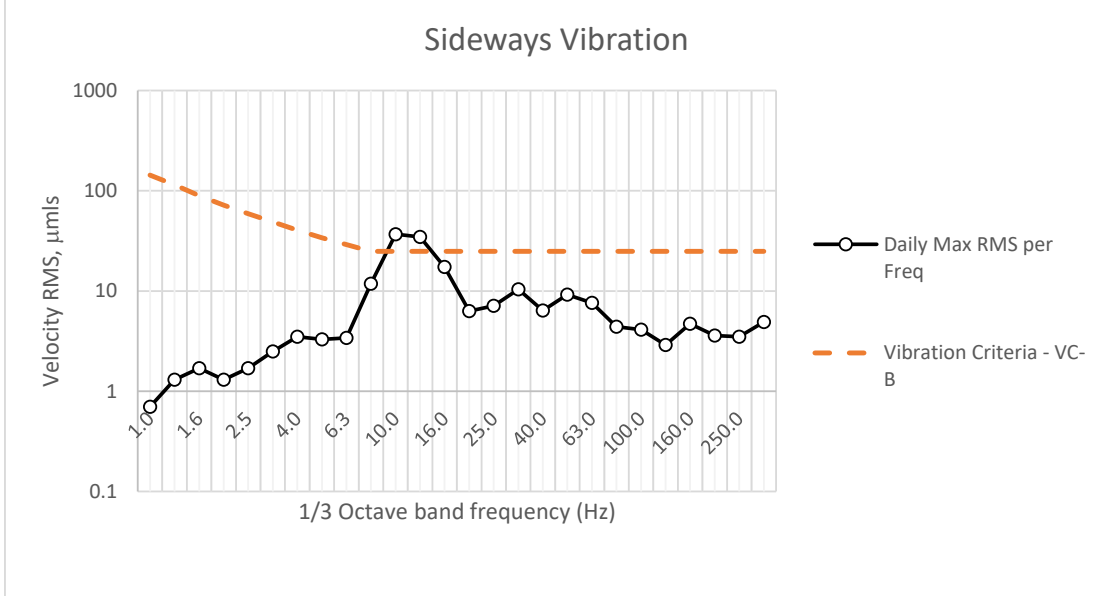
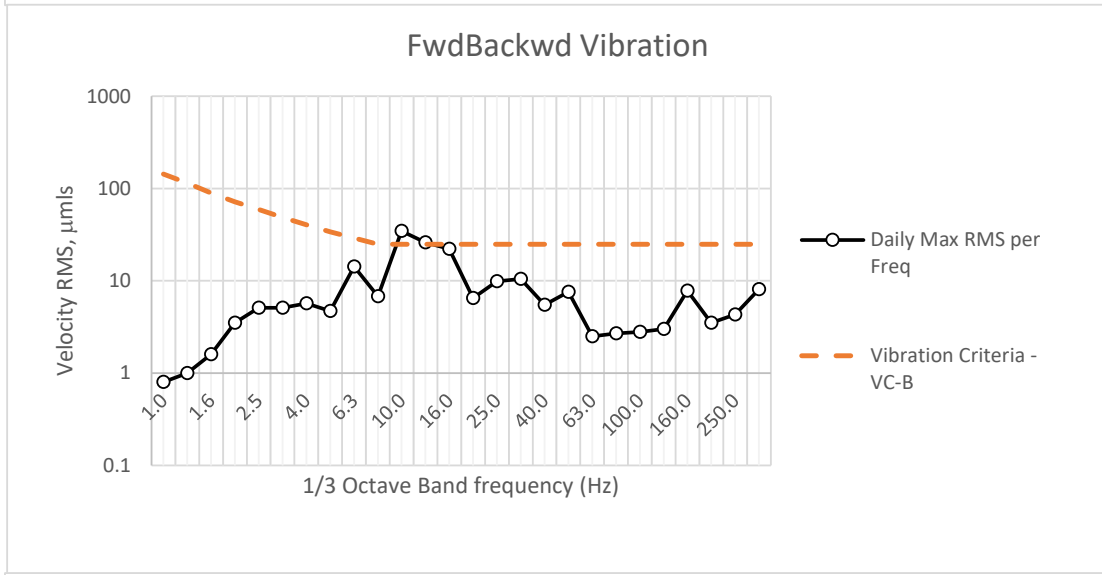
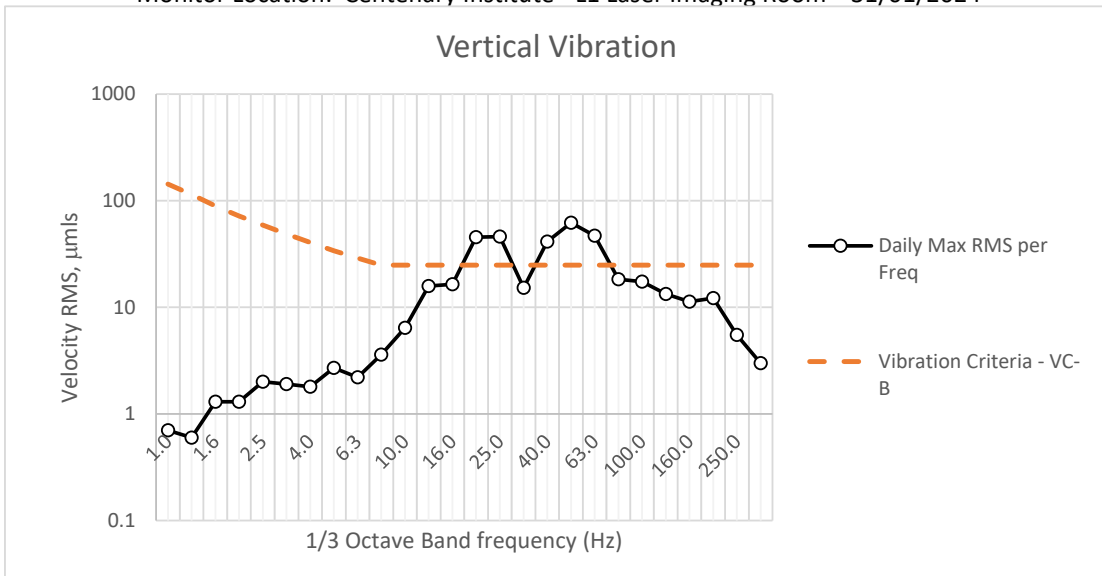


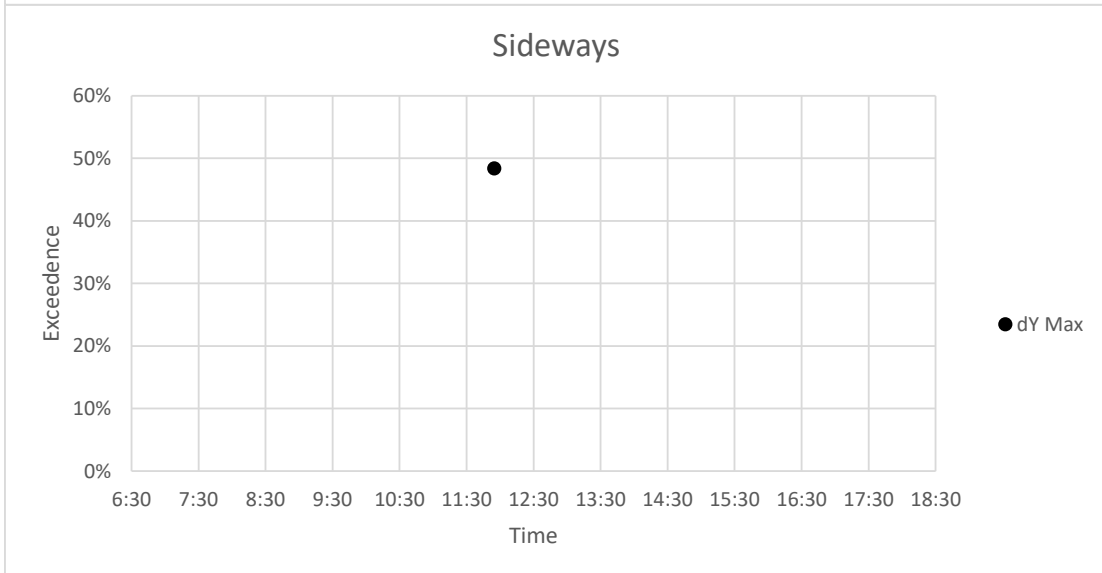
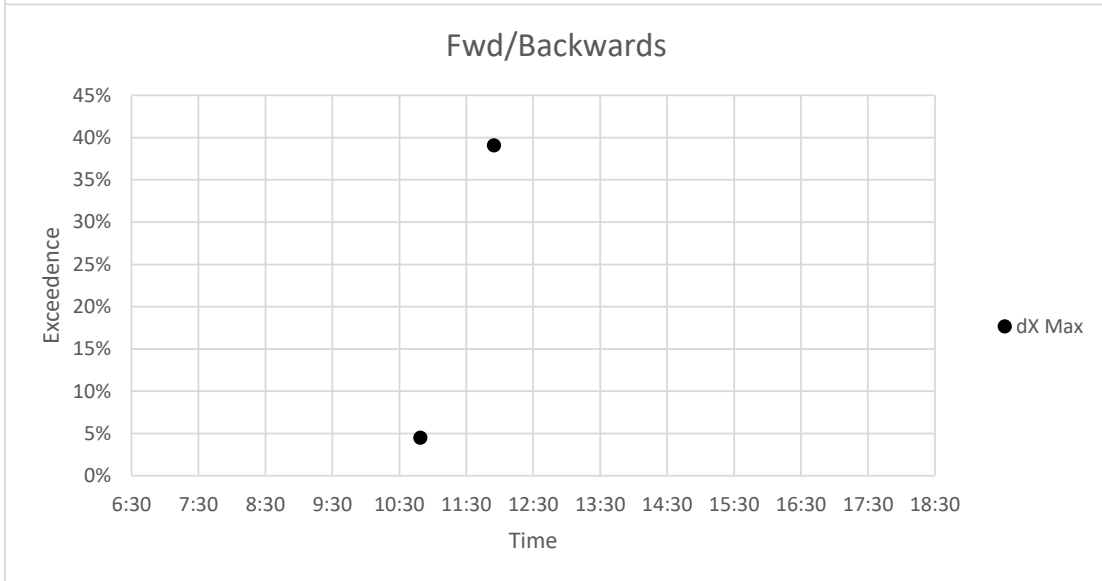
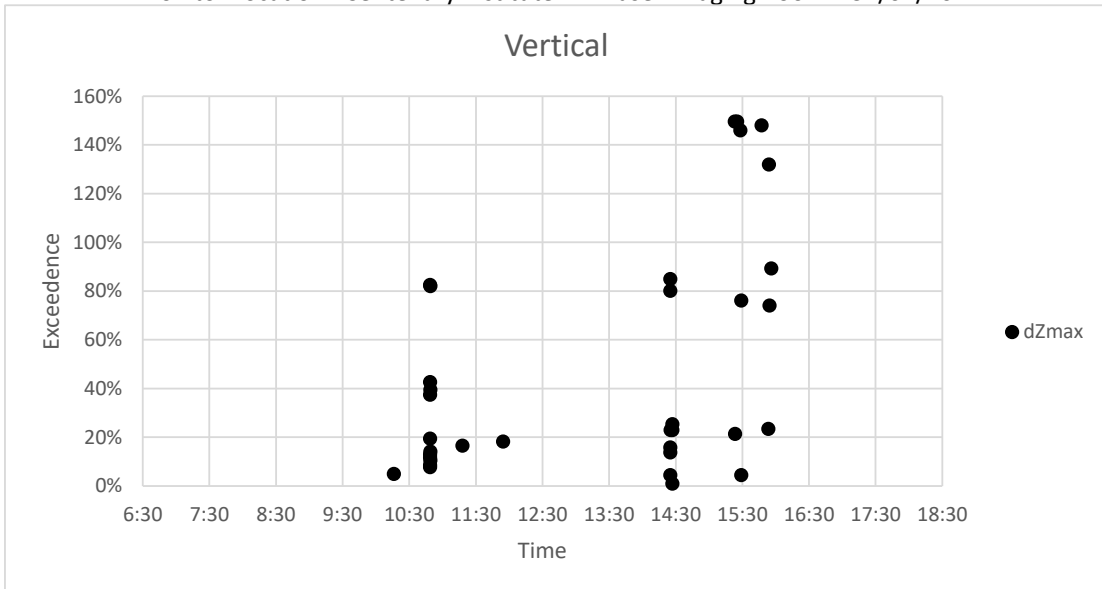


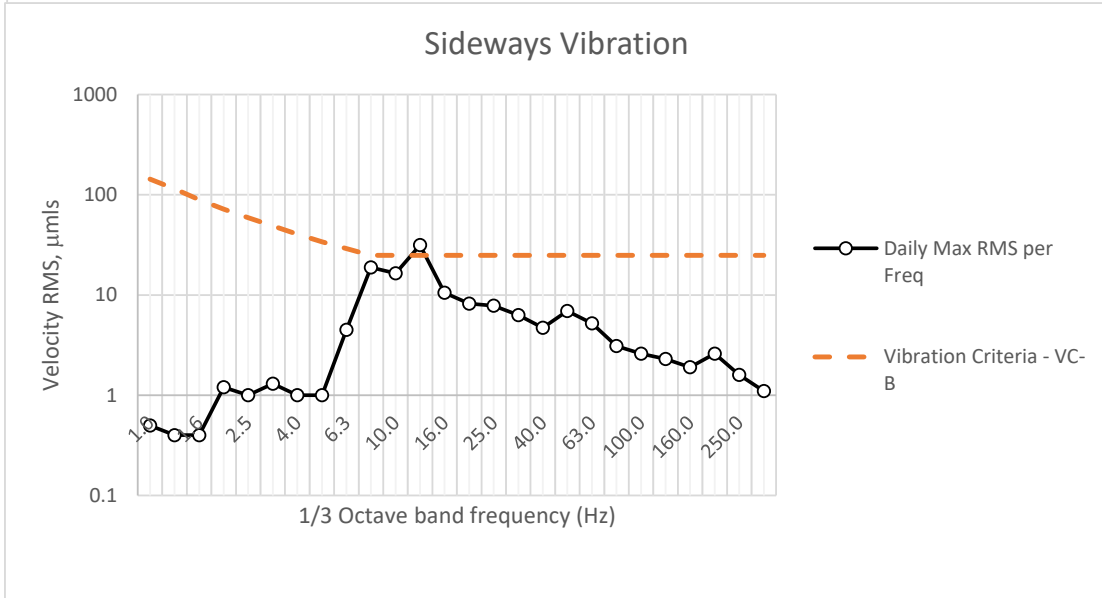
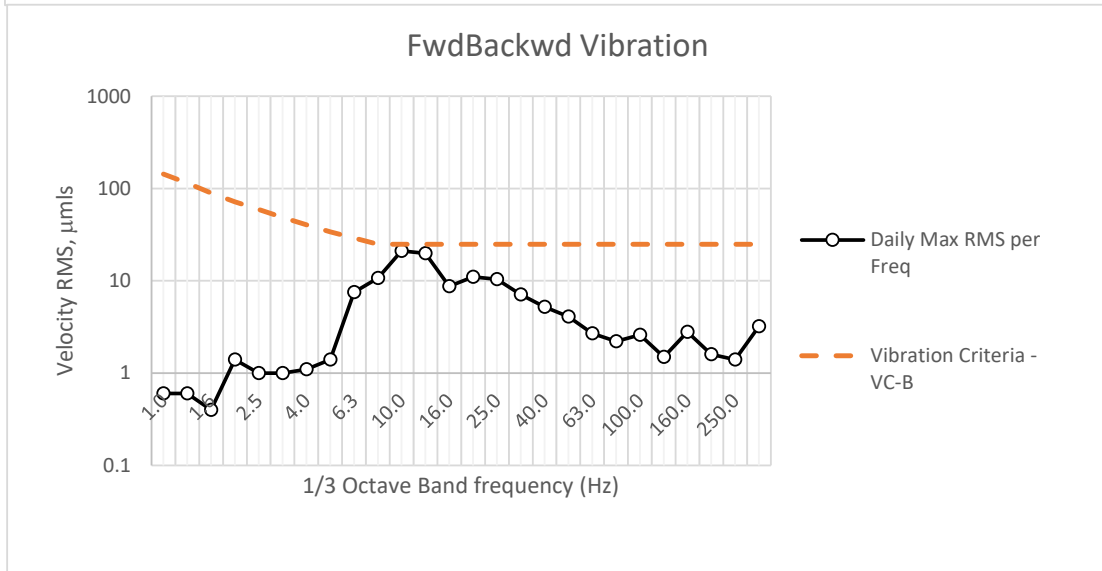
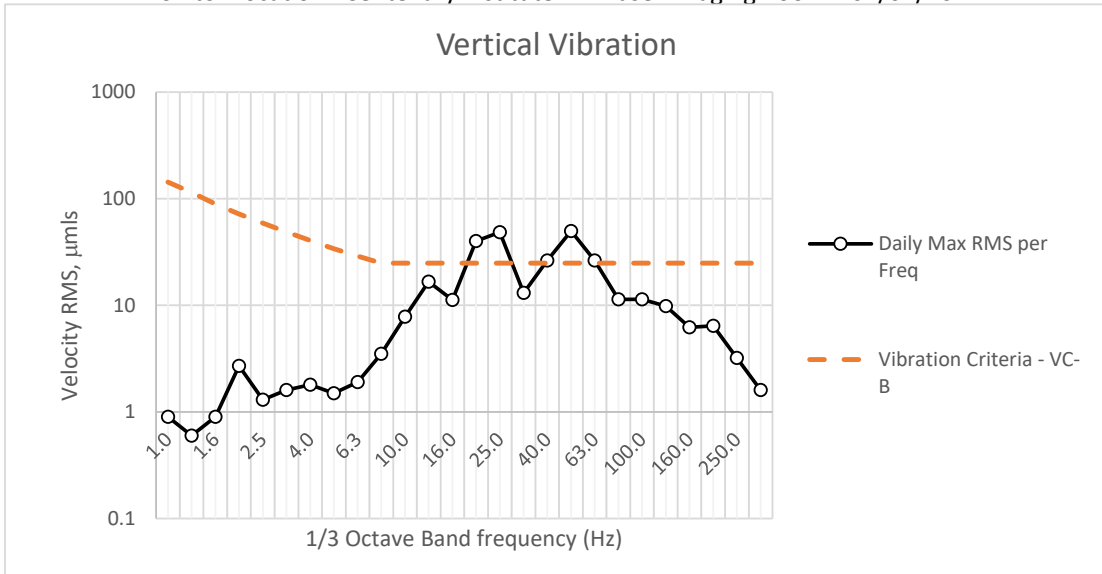


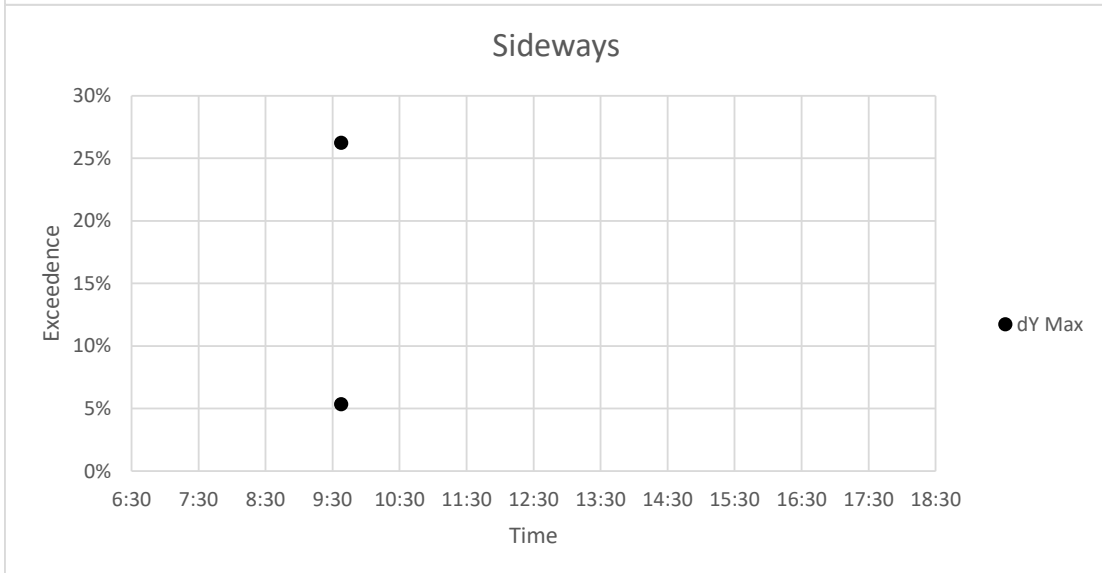
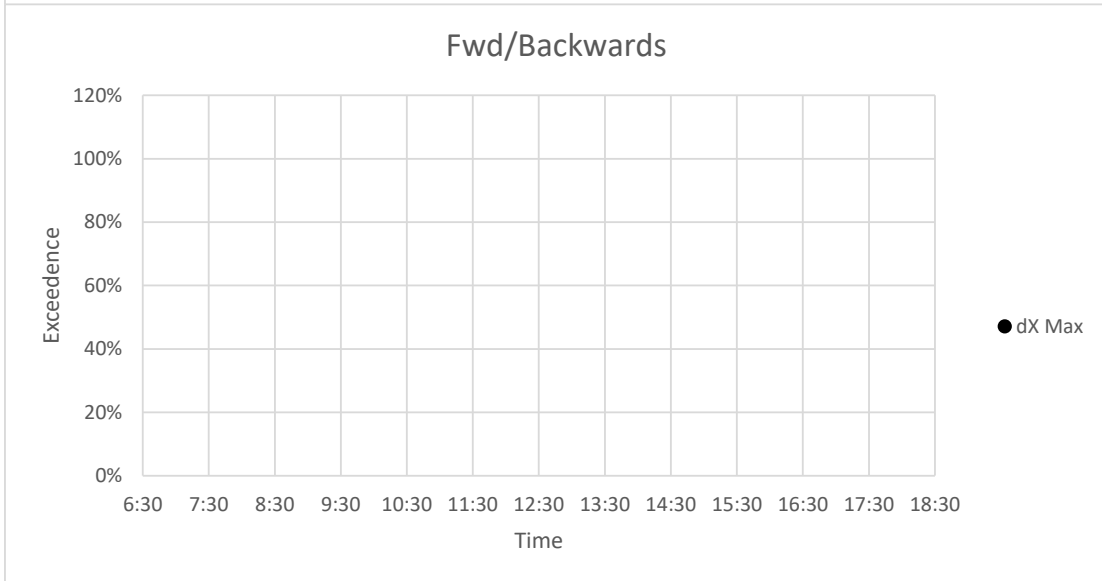
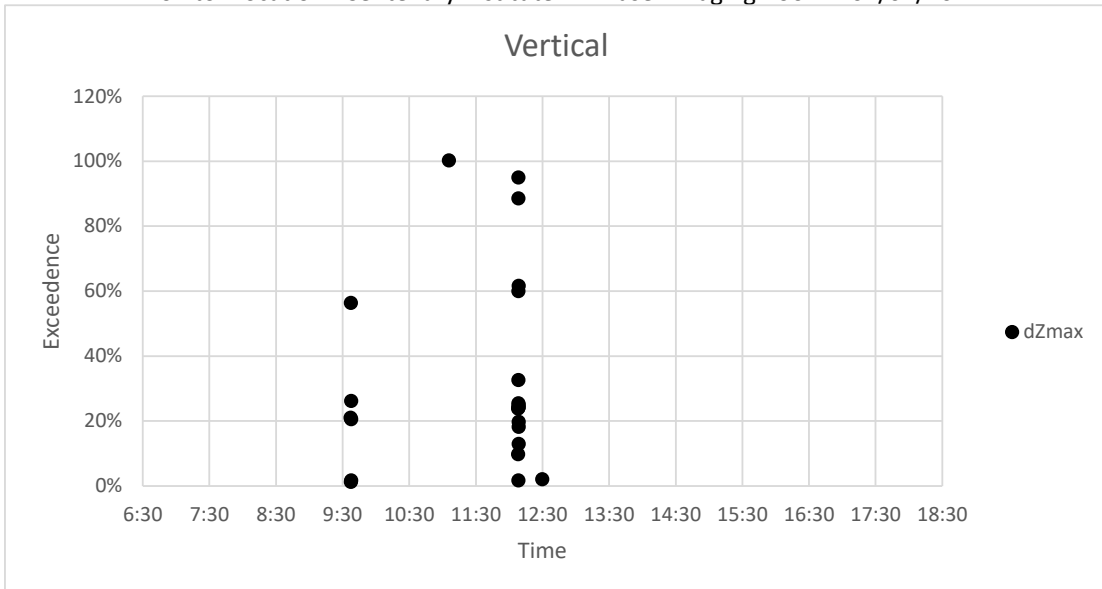












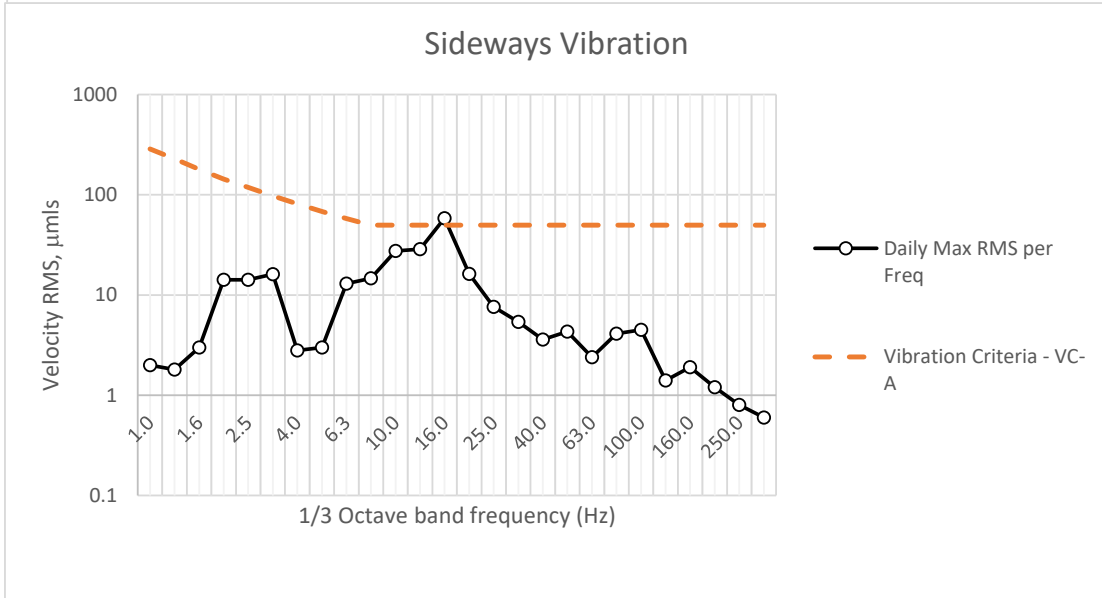
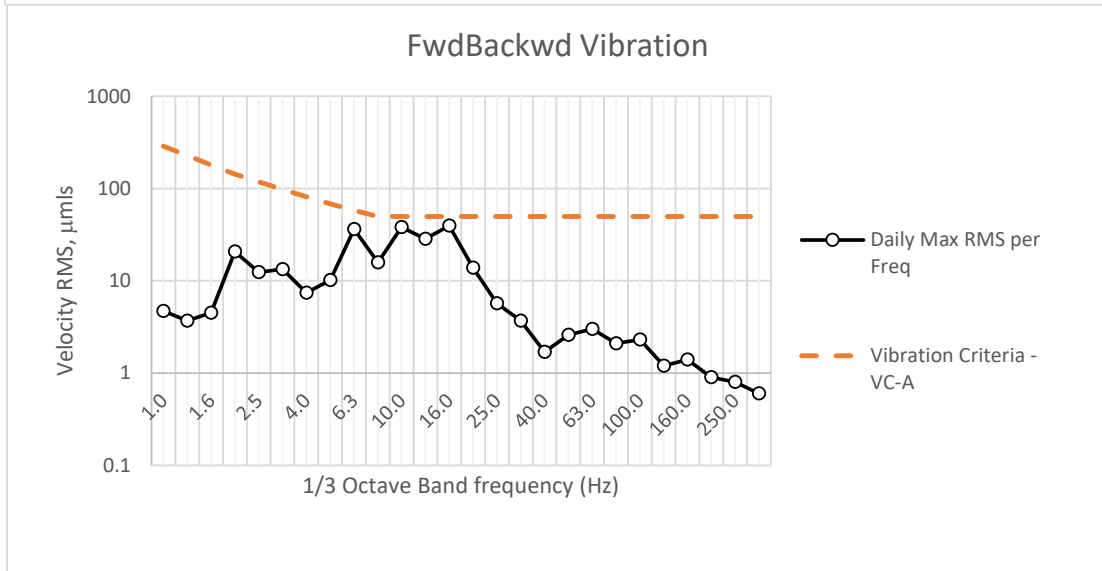
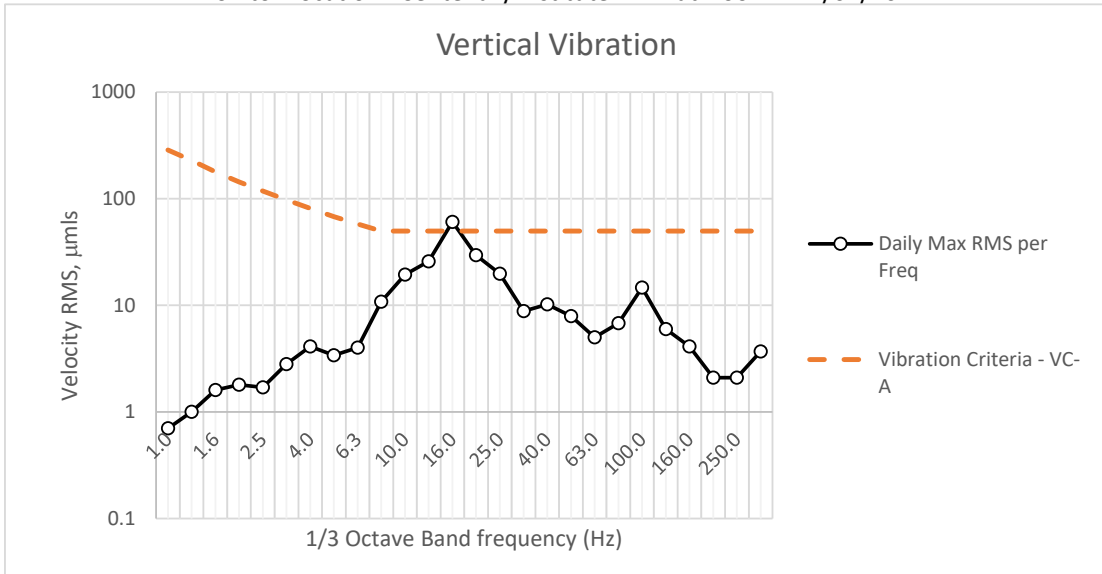
CENTENARY INSTITUTE – LEVEL 3 FISH TANKS

No exceedances occurred during the monitoring period.

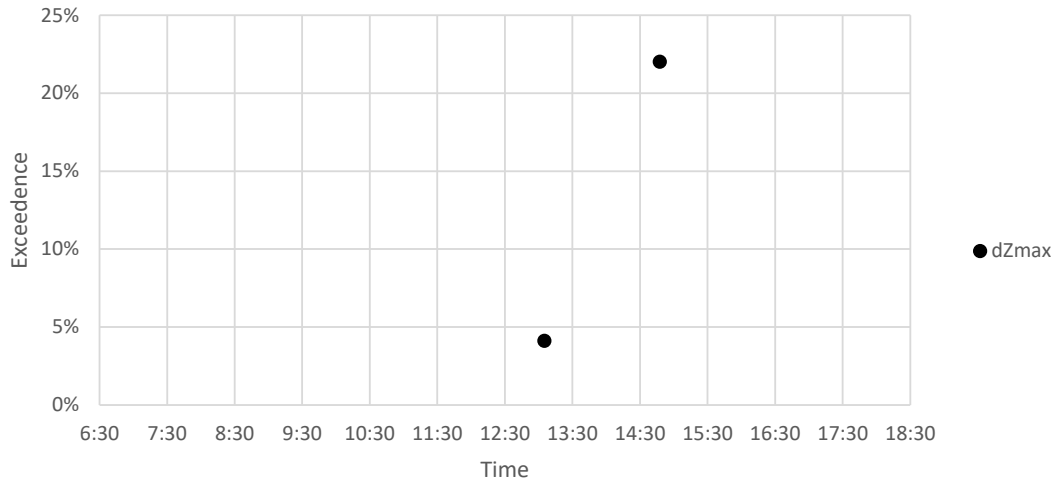
CENTENARY INSTITUTE – LEVEL 4 SURGERY ROOM (SOUTHERN FAÇADE)

No exceedances occurred during the monitoring period.

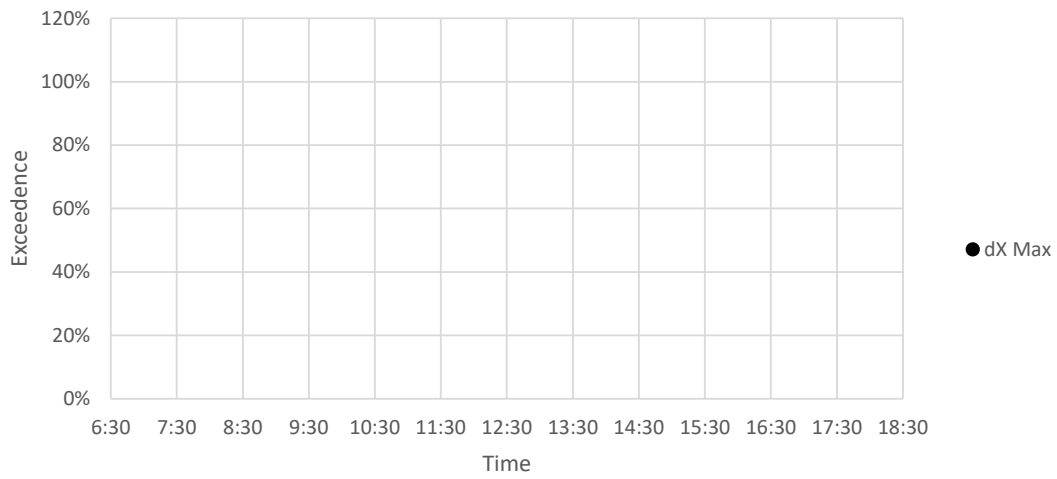
CENTENARY INSTITUTE – LEVEL 4 BATHROOM (NORTHERN FAÇADE)



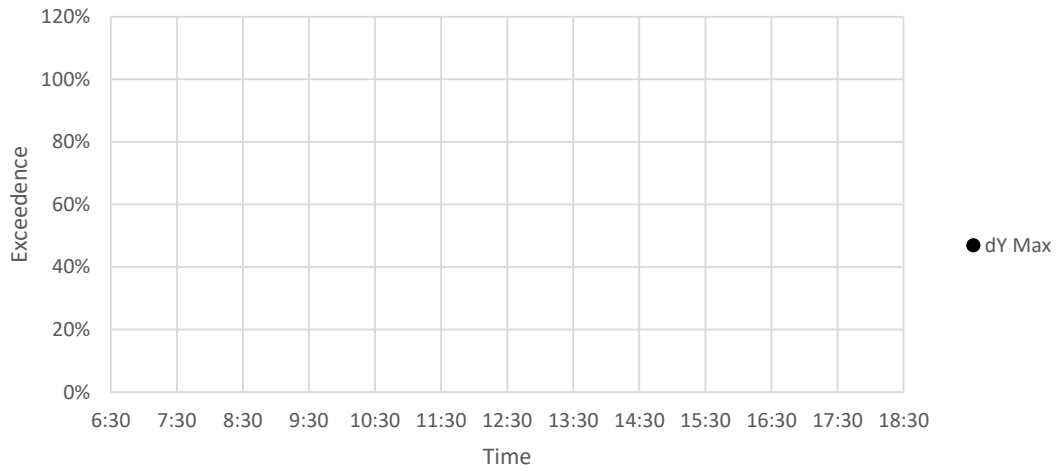
Vertical



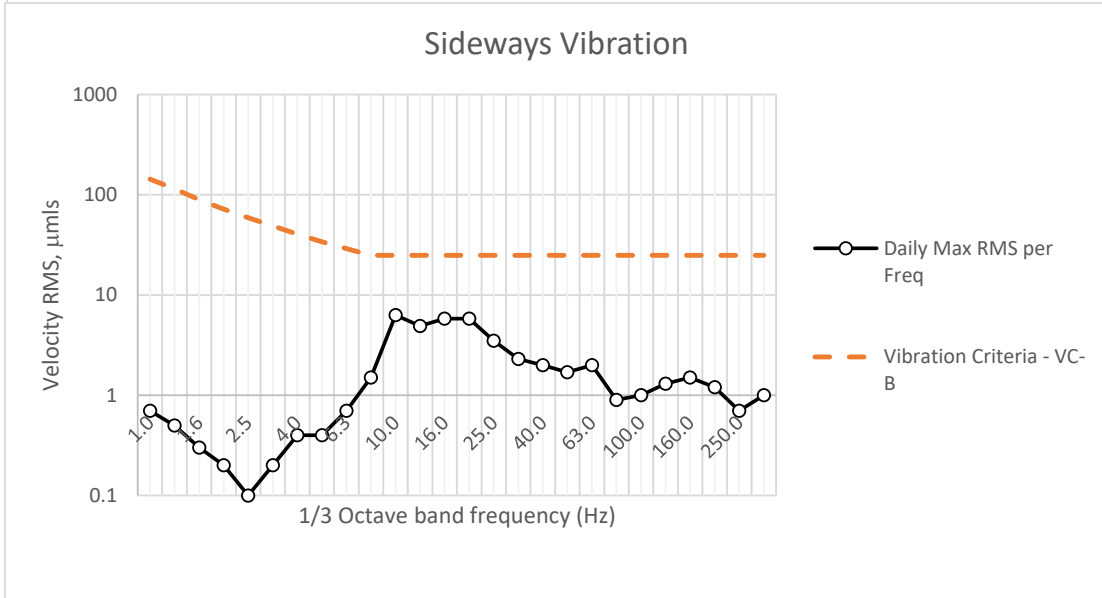
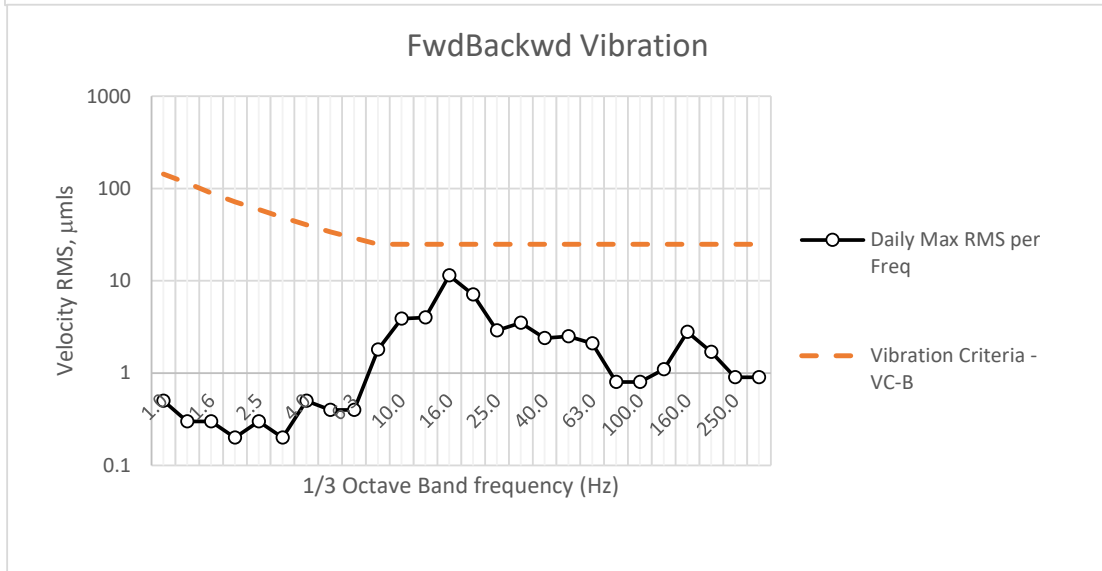
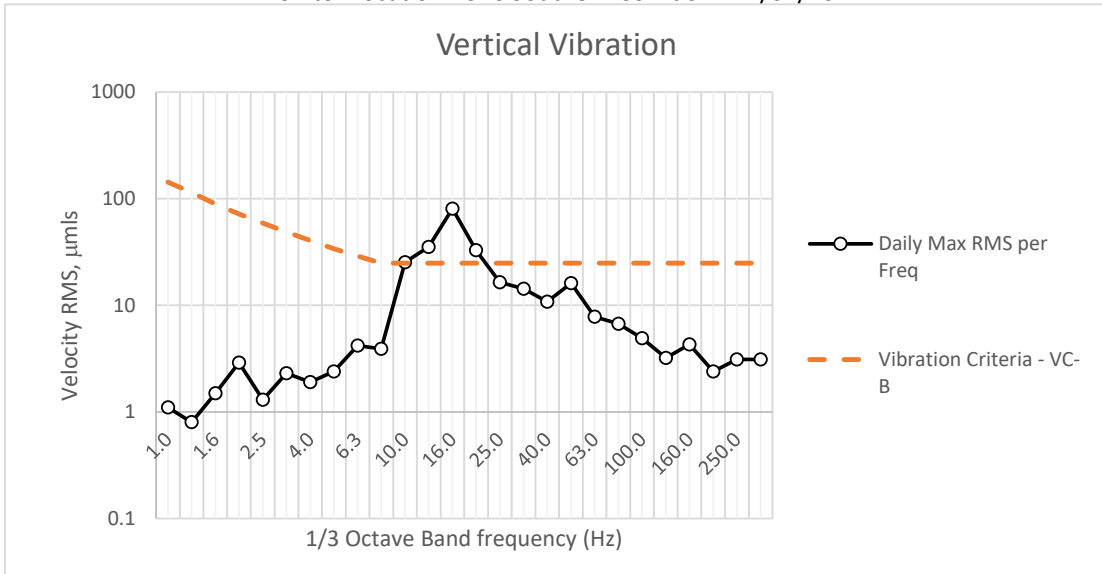
Fwd/Backwards



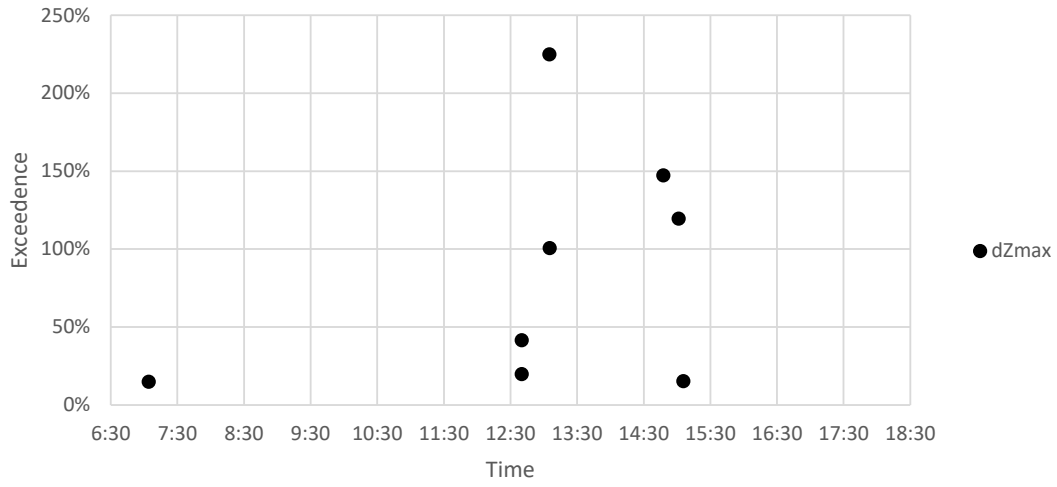
Sideways



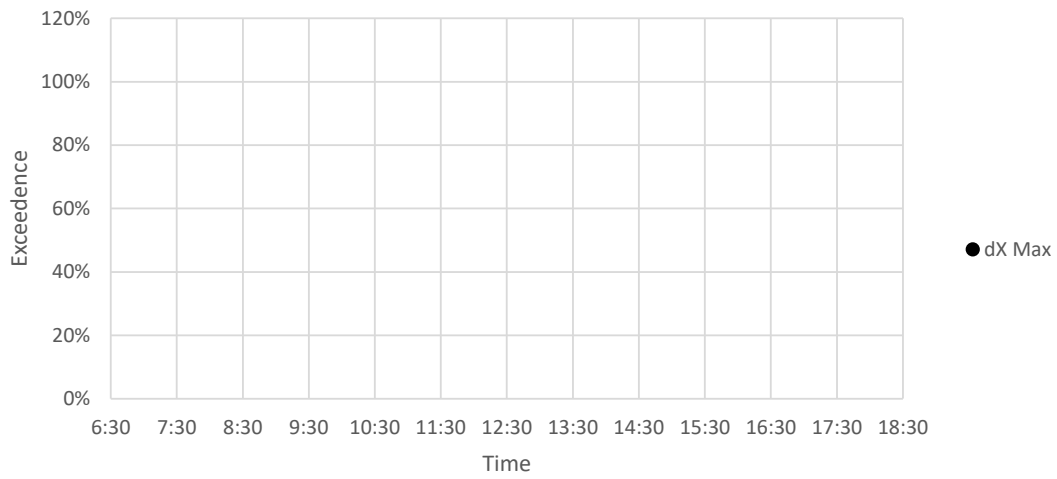
CHARLES PERKINS CENTRE – LEVEL B1 SOUTHERN CORRIDOR



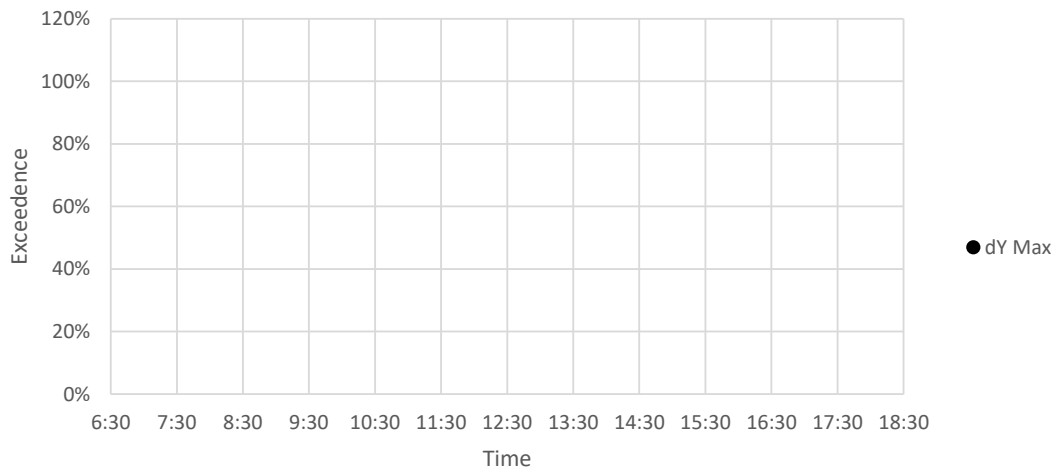
Vertical

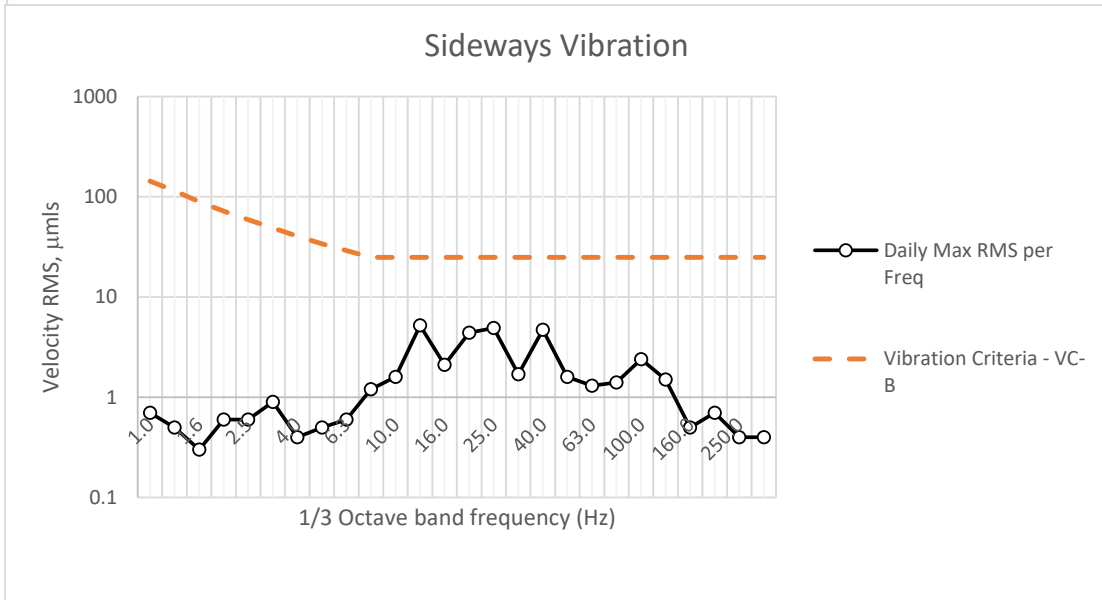
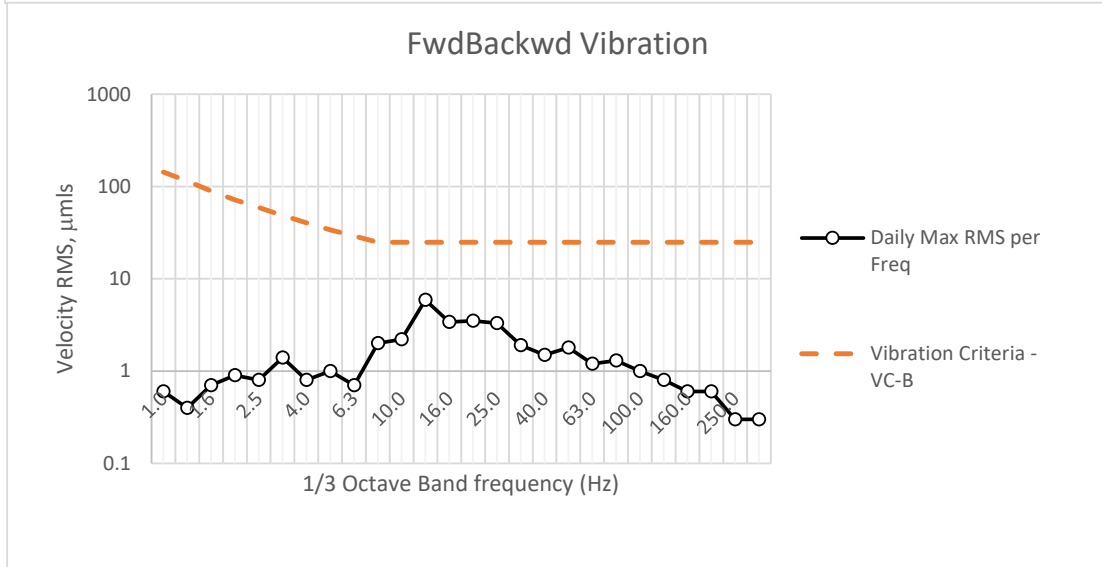
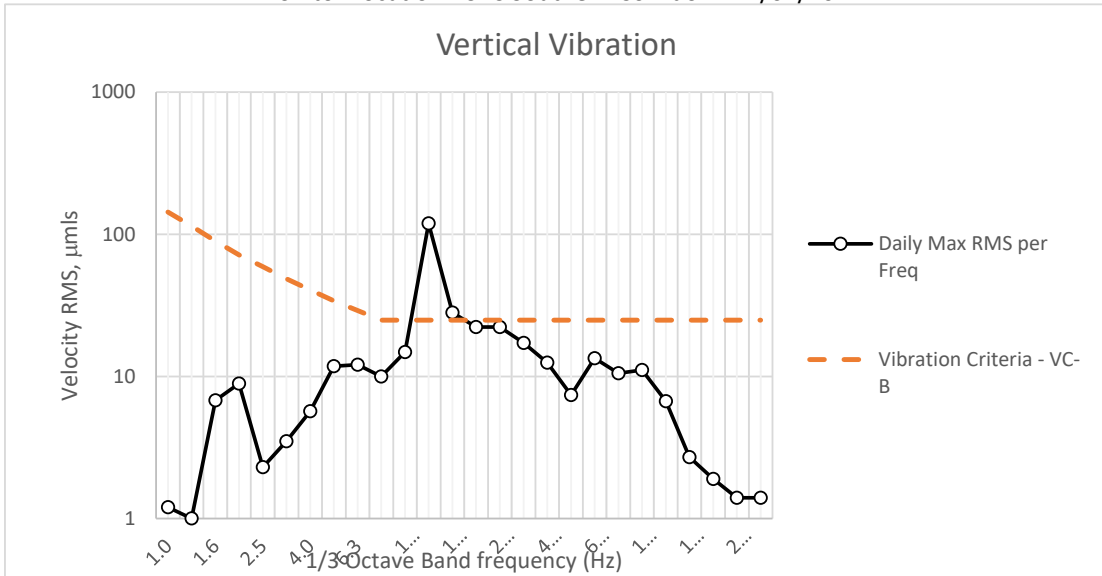


Fwd/Backwards

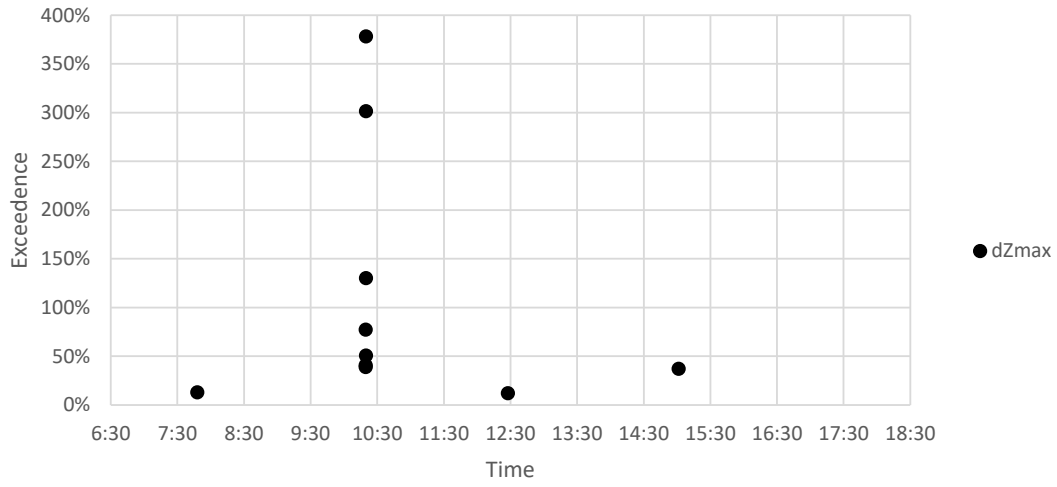


Sideways

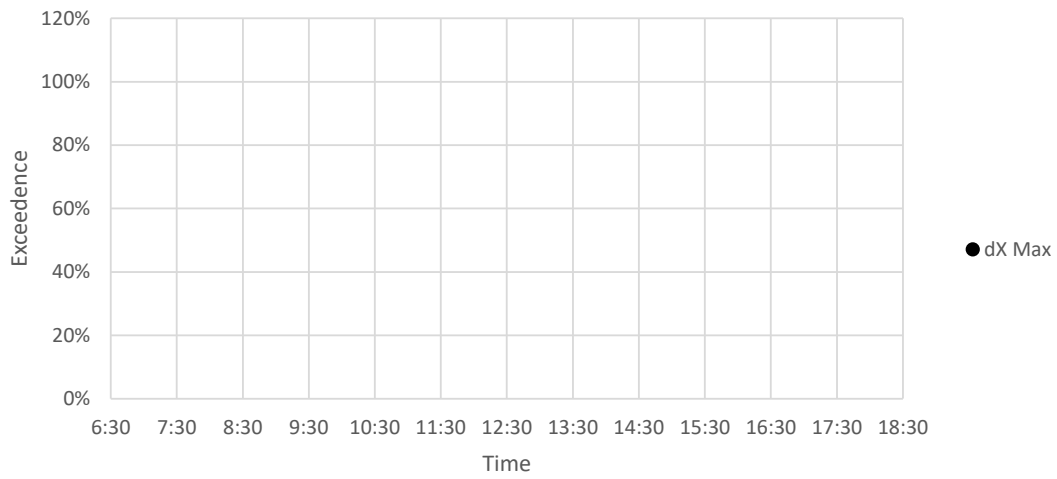




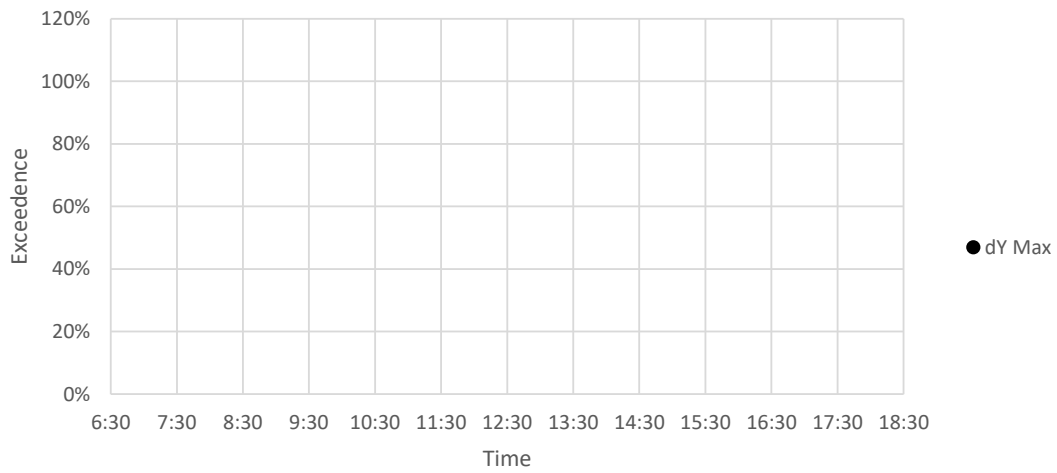
Vertical



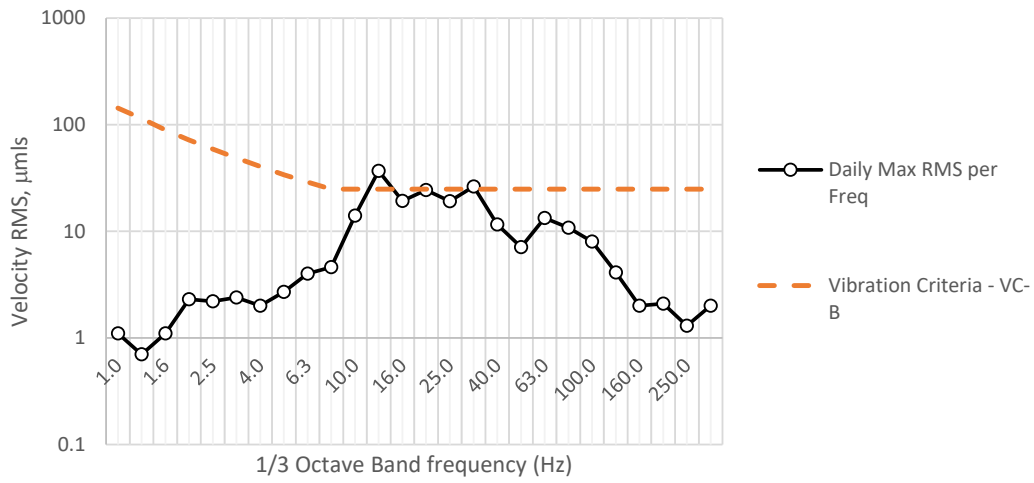
Fwd/Backwards



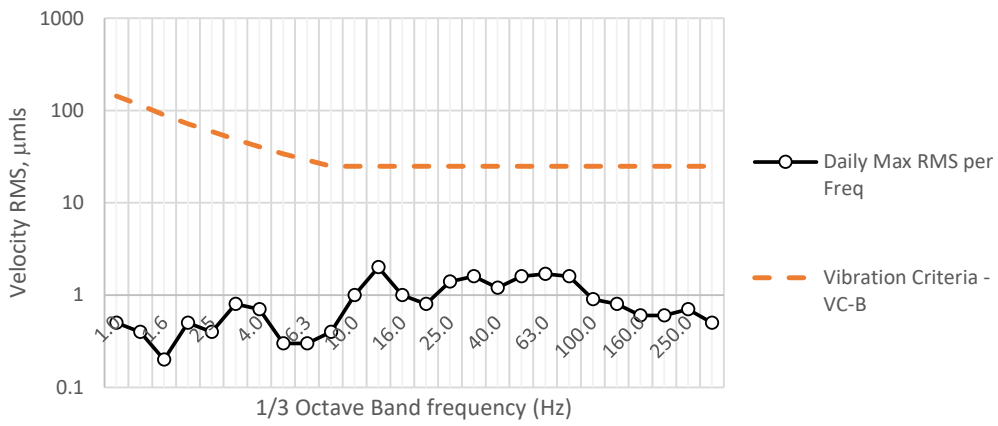
Sideways



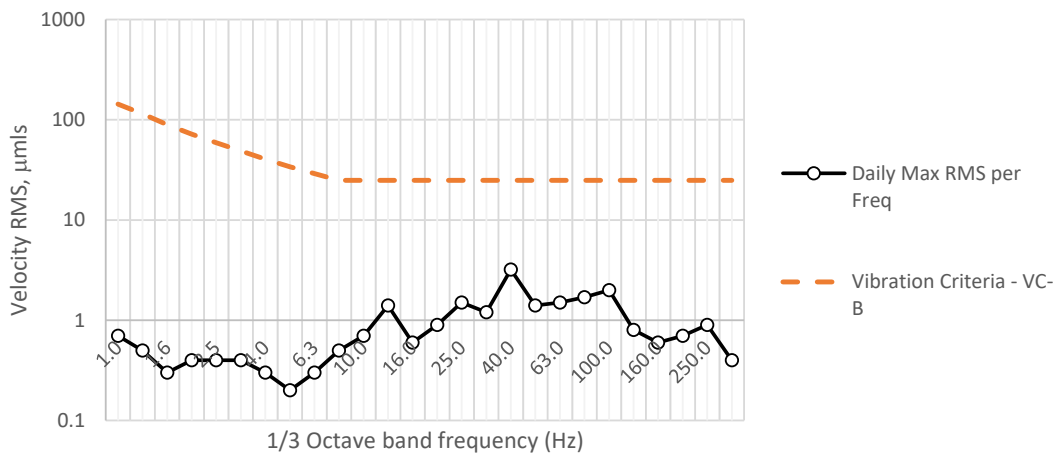
Vertical Vibration



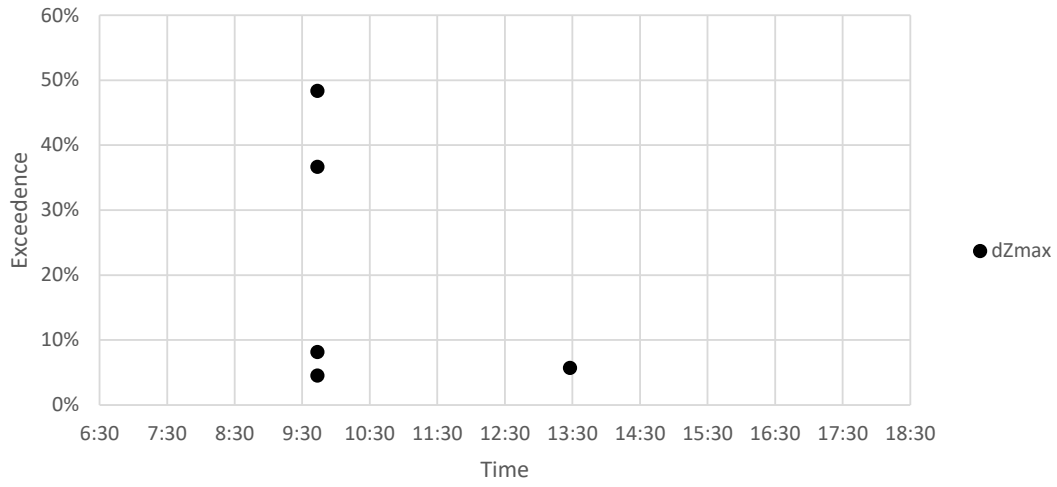
FwdBackwd Vibration



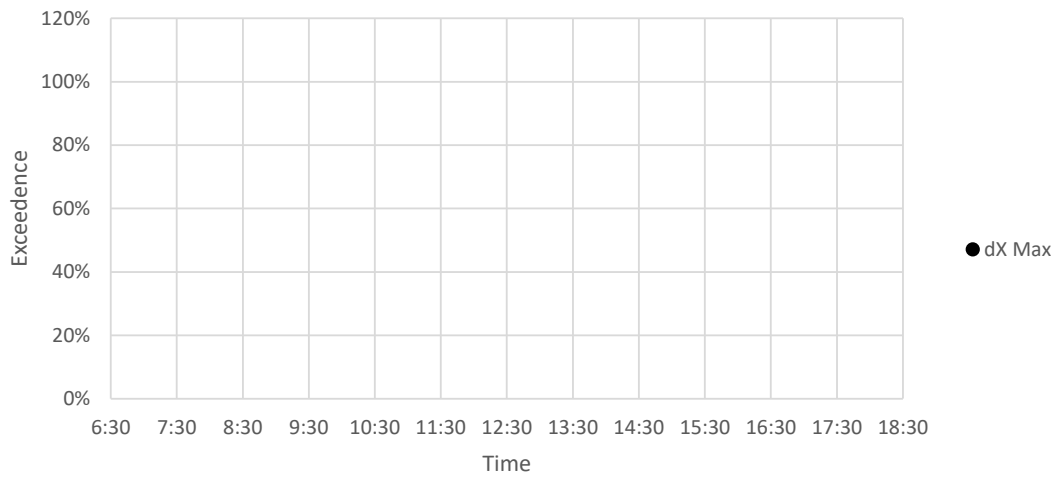
Sideways Vibration



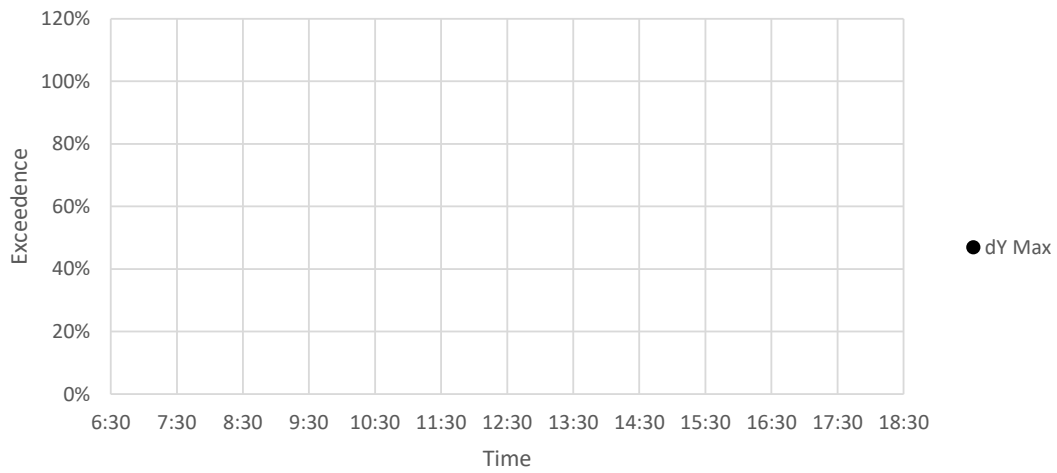
Vertical

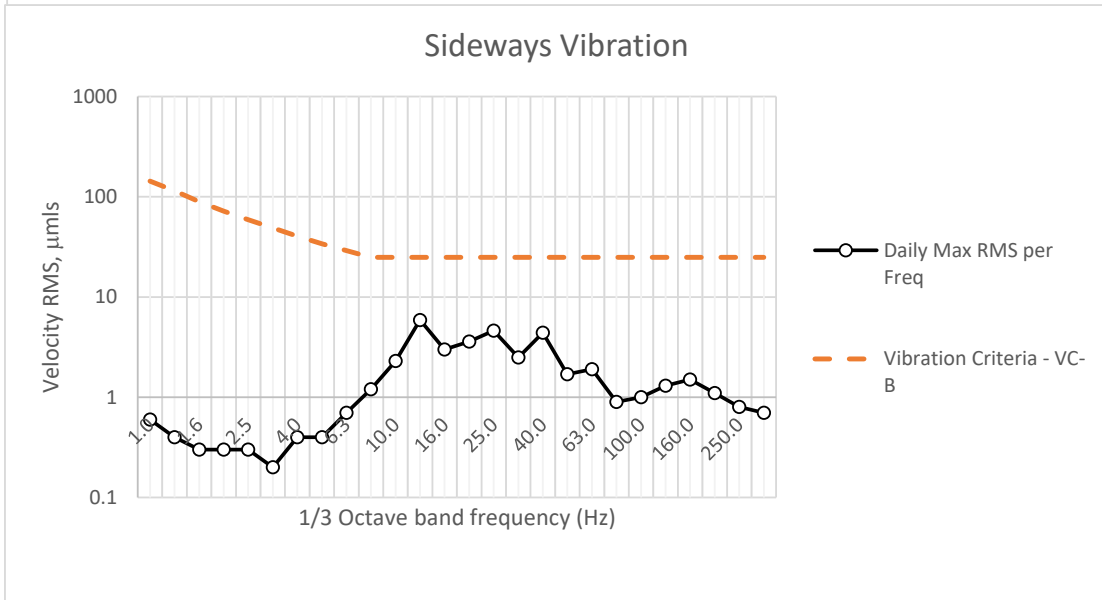
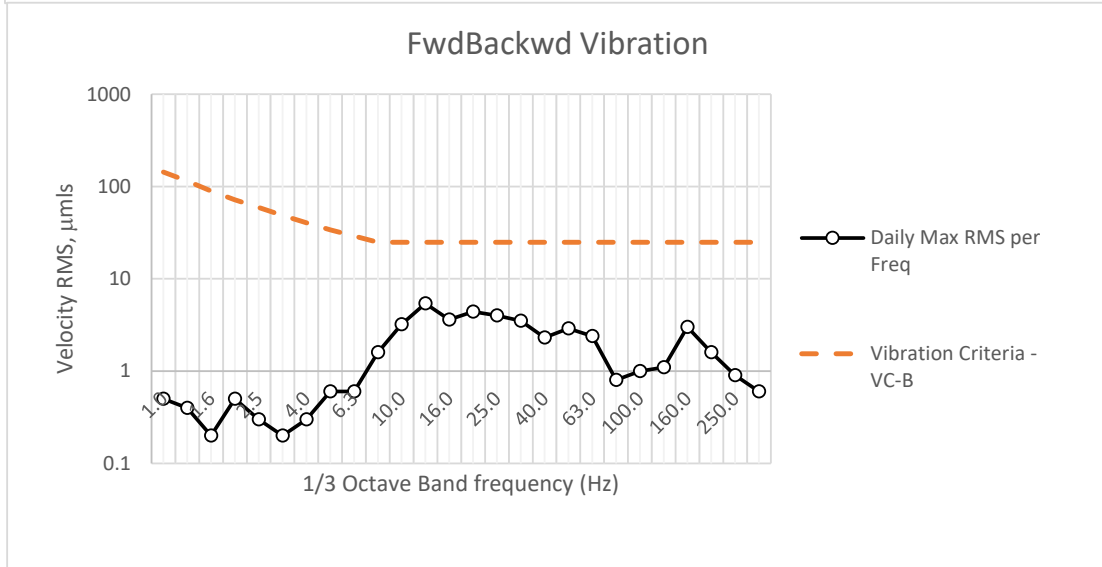
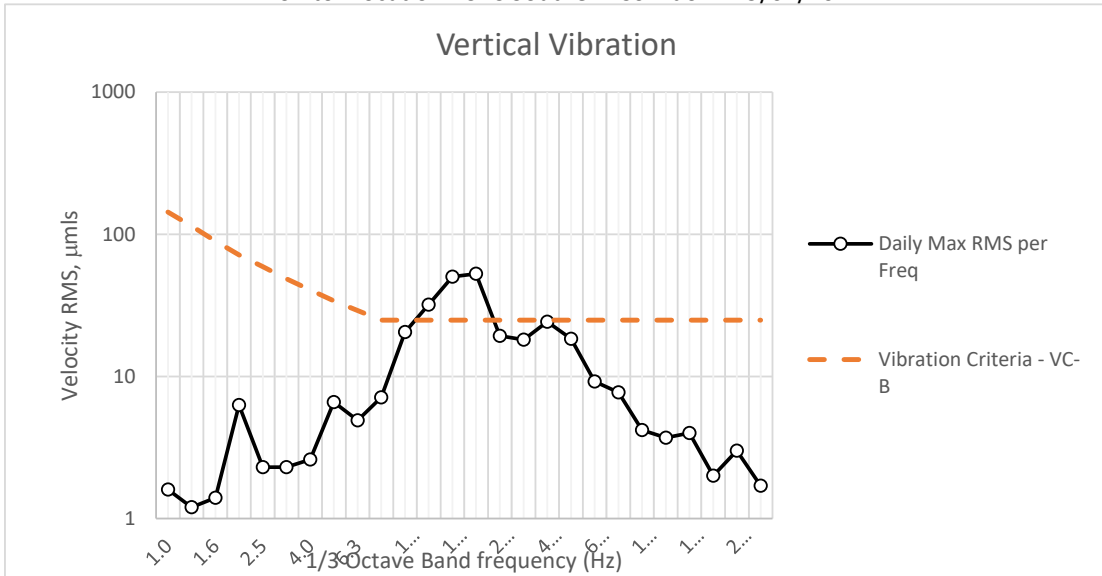


Fwd/Backwards

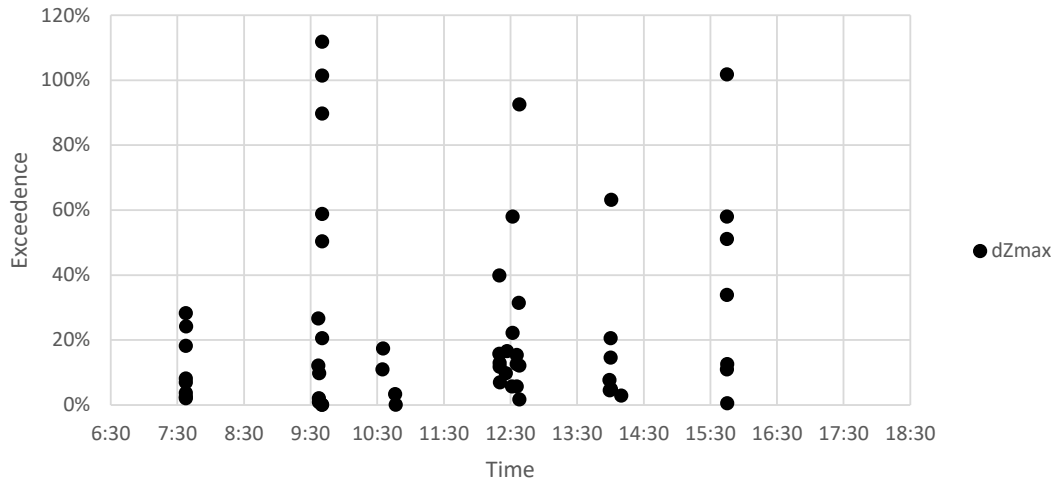


Sideways

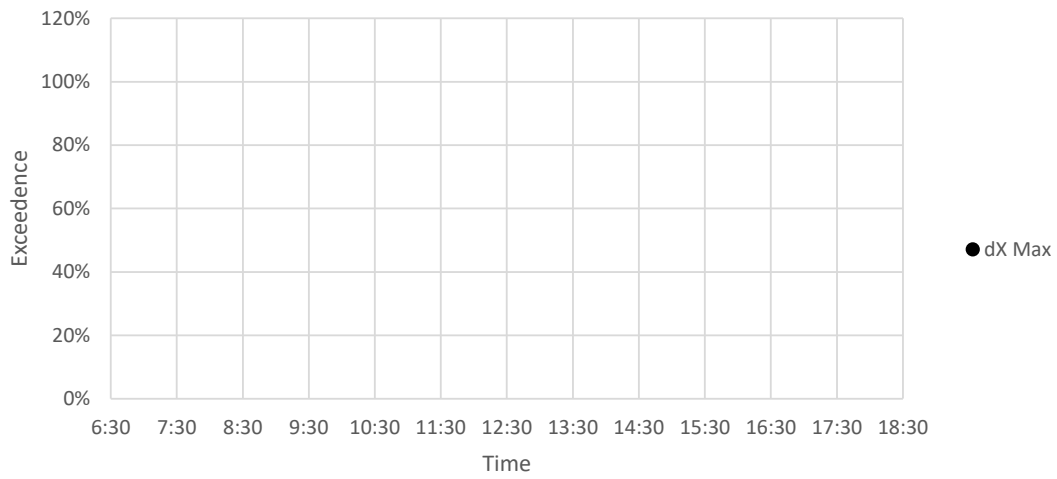




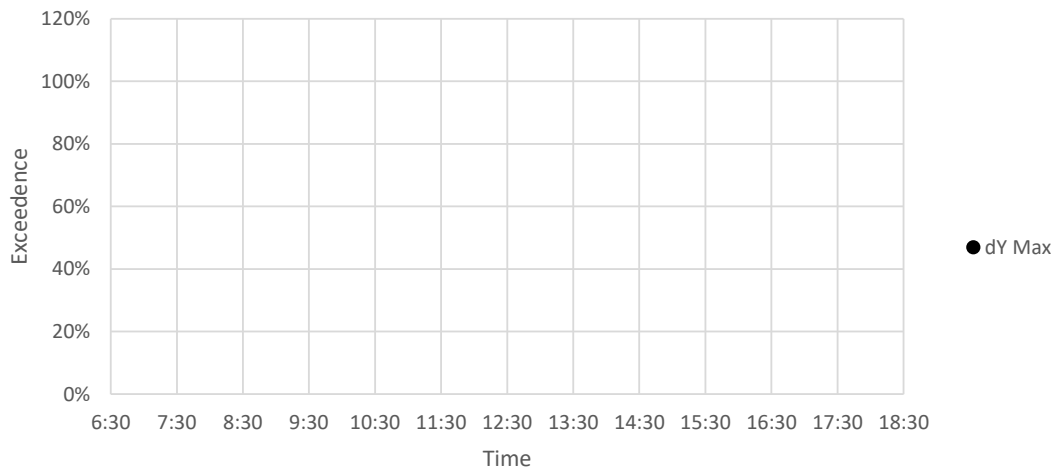
Vertical



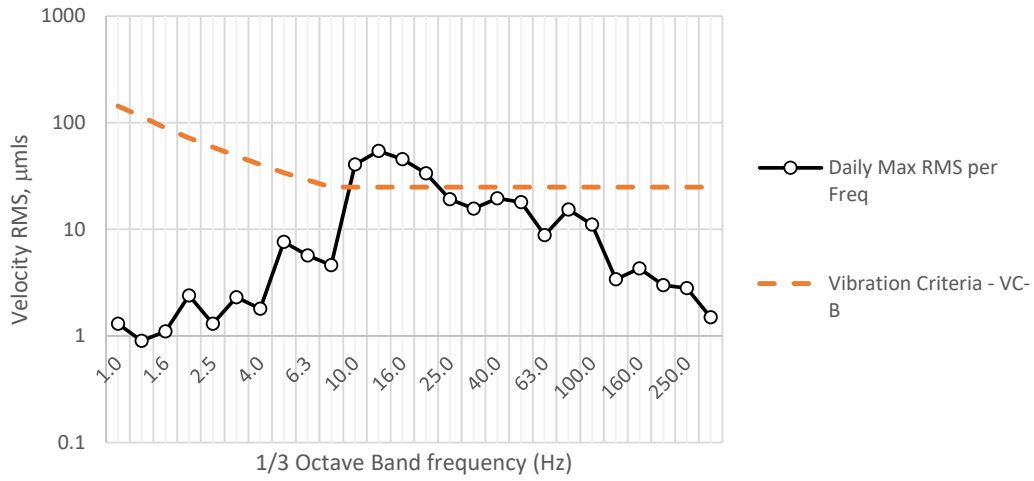
Fwd/Backwards



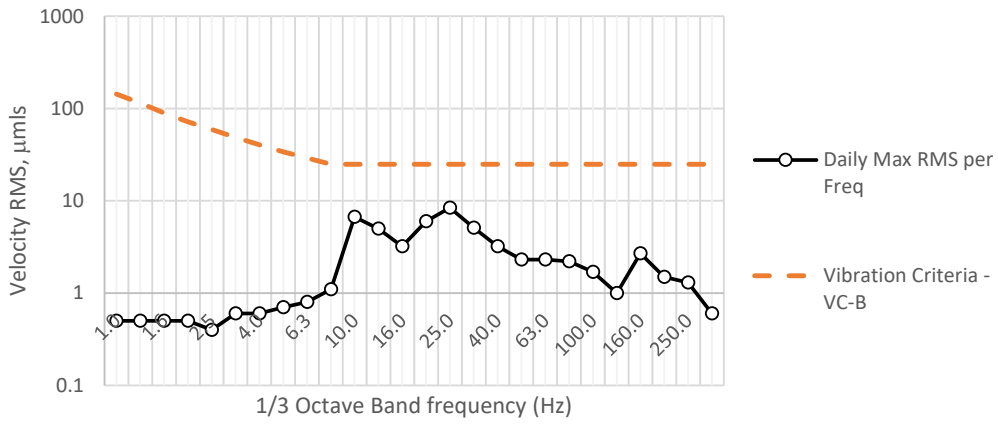
Sideways



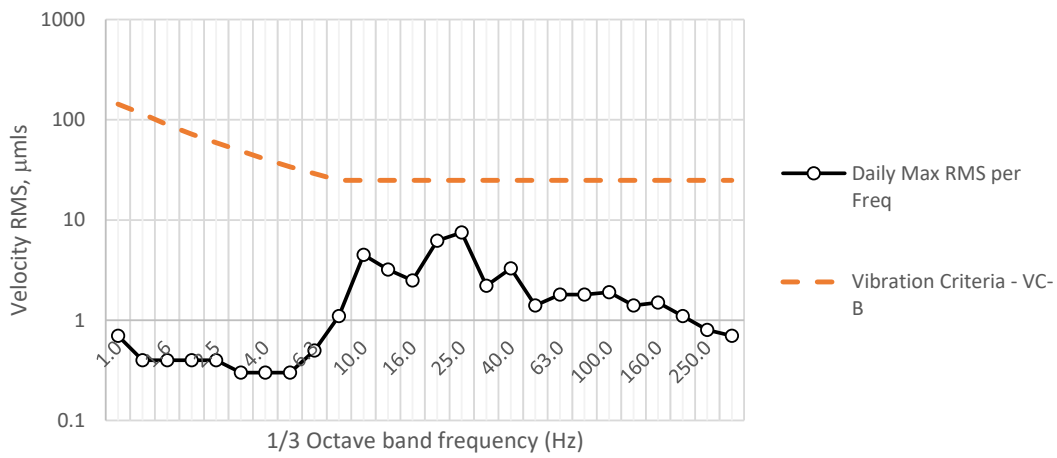
Vertical Vibration

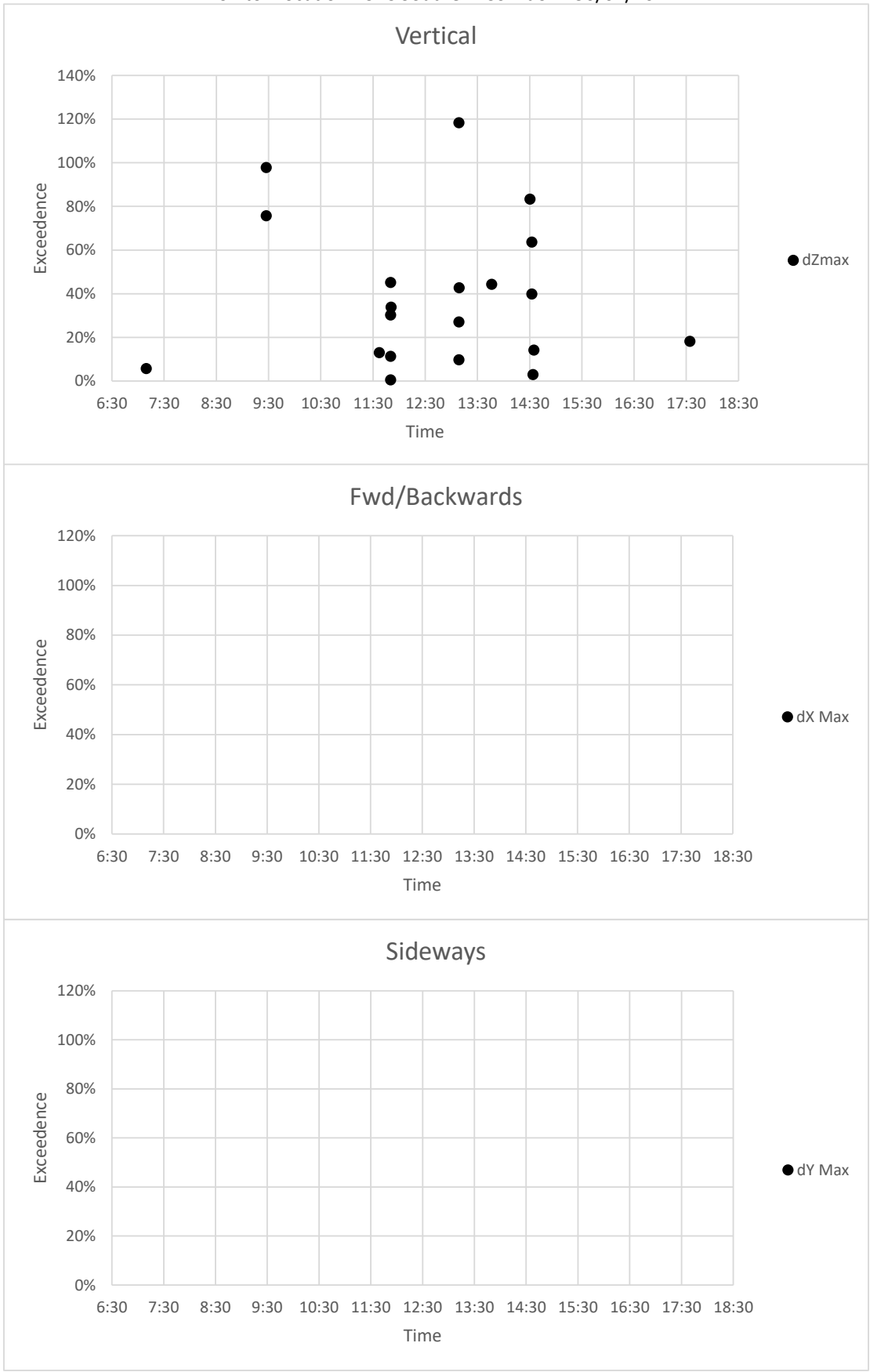


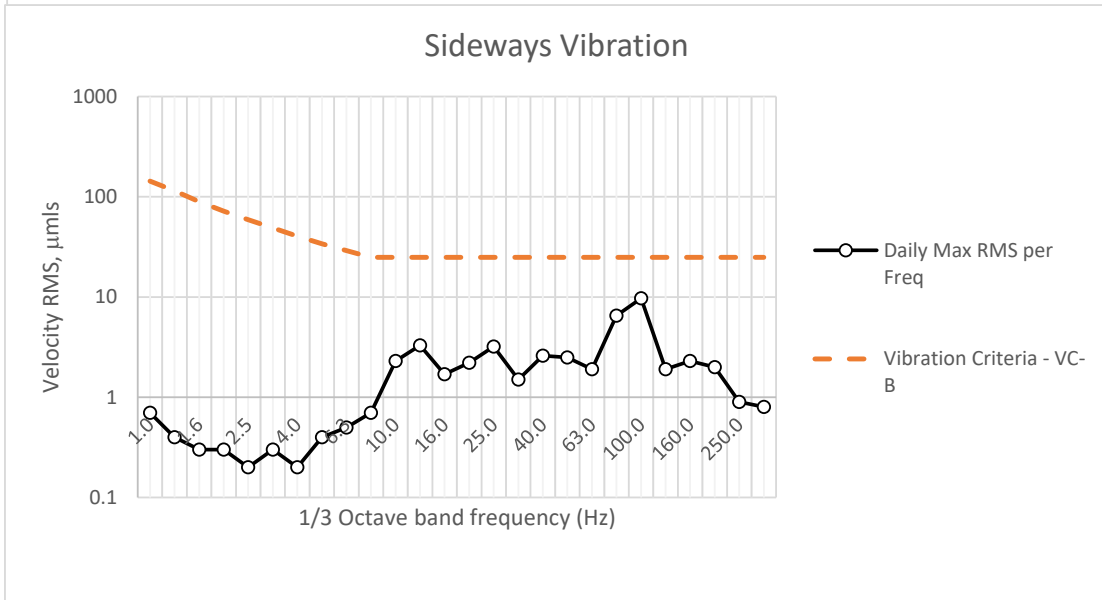
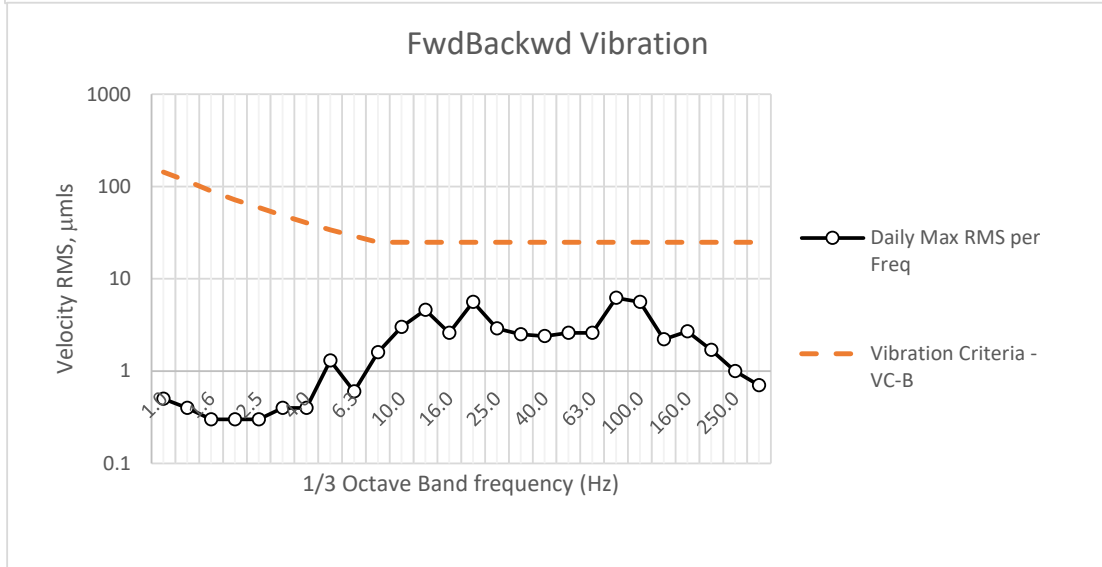
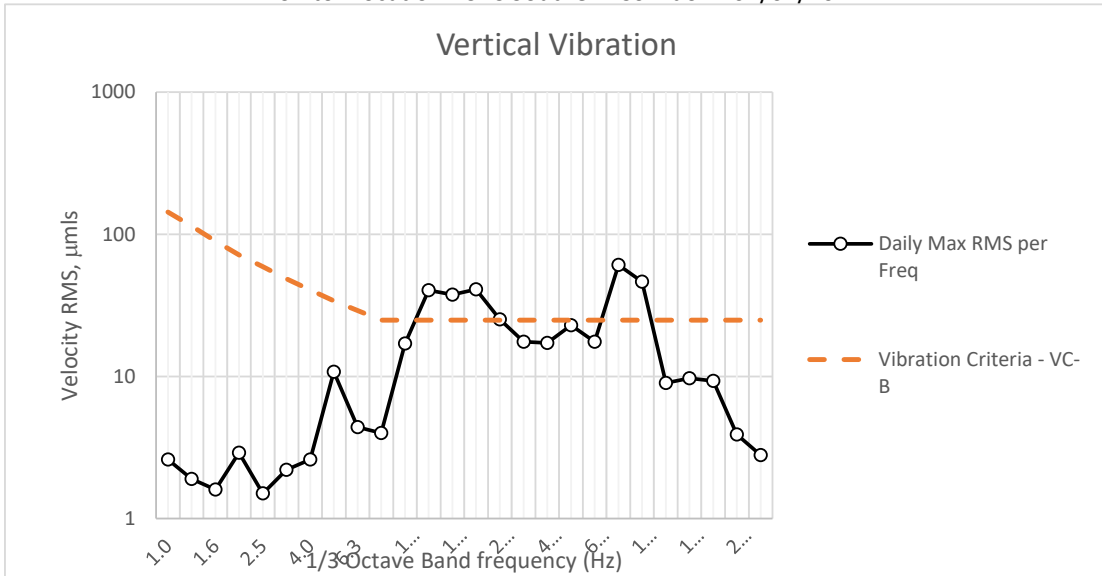
FwdBackwd Vibration



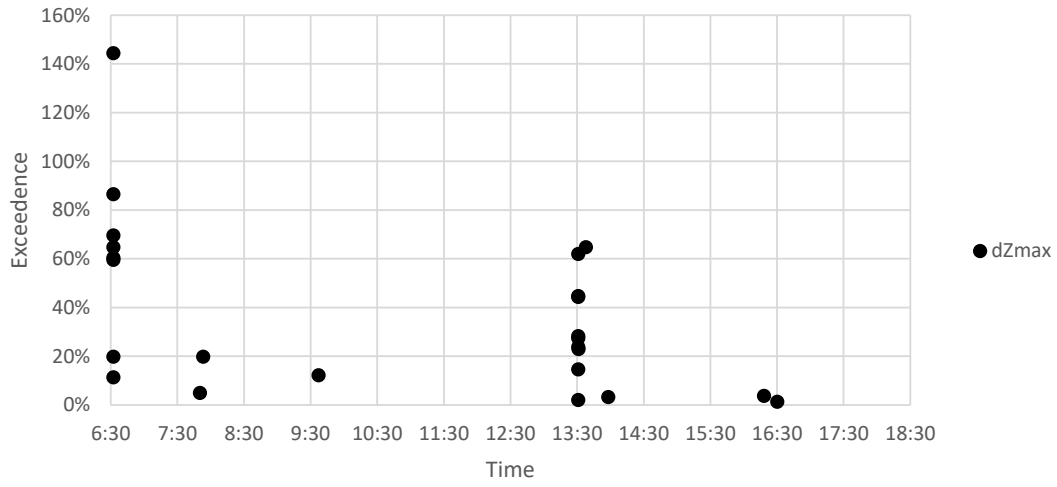
Sideways Vibration



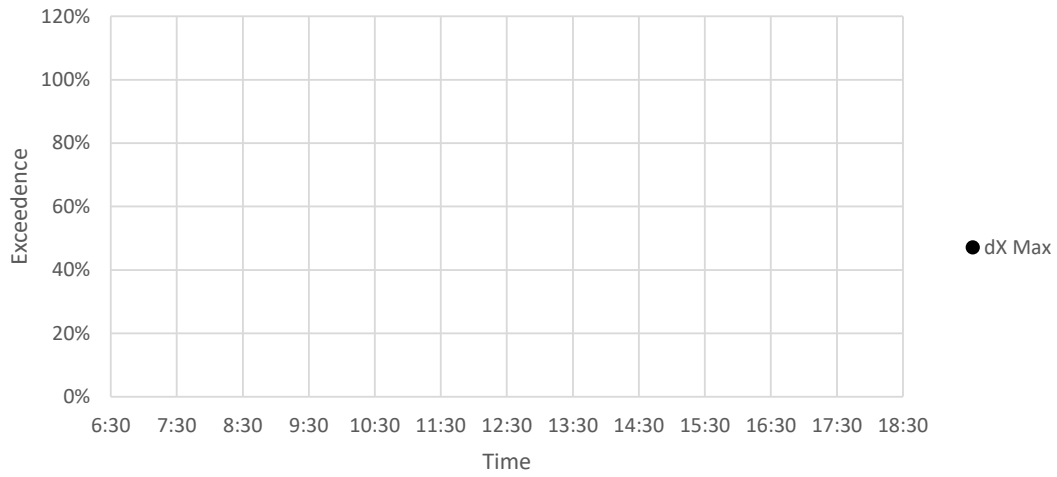




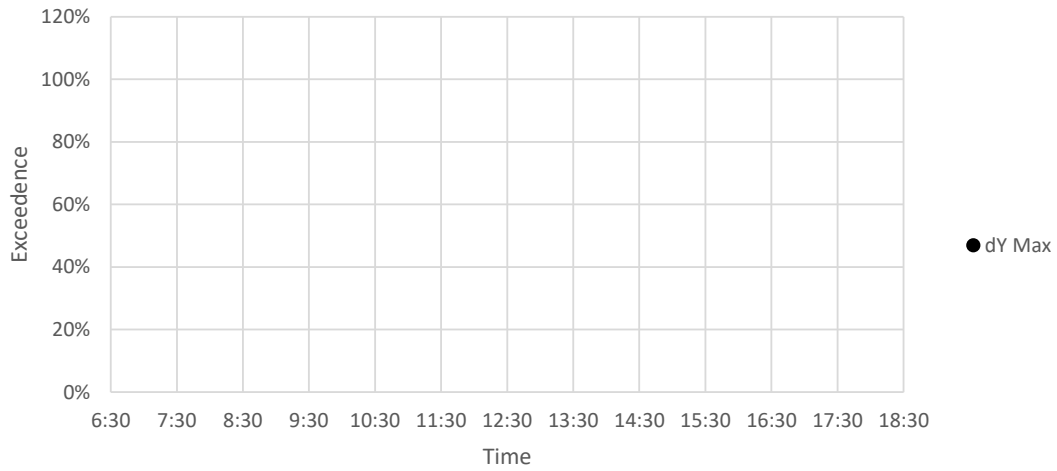
Vertical



Fwd/Backwards



Sideways



CHARLES PERKINS CENTRE – LEVEL B1 SOUTHERN WING OBSERVATION ROOM E

No exceedances occurred during the monitoring period.

OUTSIDE SUSAN WAKIL HEALTH BUILDING

No exceedances occurred during the monitoring period.