

## Construction Noise and Vibration Monthly Report – March 2024

**Birmingham City Council**

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# Non-Technical Summary

This Noise and Vibration Monitoring Report fulfils HS2 Limited's commitment detailed in the Environmental Minimum Requirements (EMRs), Annex 1, Code of Construction Practice, to present the results of noise and vibration monitoring carried out within Birmingham City Council during the month of March 2024.

Within this period monitoring was undertaken at the following worksites:

- Noise monitoring was undertaken in the vicinity of the Curzon Street Station worksite (ref.: CSS), where piling, haul road and pile mat construction were underway.
- Noise monitoring was undertaken in the vicinity of the Curzon Street worksite (ref.: CS), where material deliveries, storage and movement of materials, wheel wash operation and maintenance, deck construction works, scaffold installation, welding works, excavation, concrete casting, steel fixing and formwork, haul road use, stockpiling and bridge construction were underway.
- Noise monitoring was undertaken in the vicinity of the Lawley Middleway worksite (ref.: LMW), where pier construction, stockpiling, material deliveries, storage and movement of materials, bearing installation and casting, excavation and backfilling, were underway.
- Noise monitoring was undertaken in the vicinity of the Saltley Viaduct Satellite worksite (ref.: SVS), where abutments finishing works, installation of utility ducts, waterproofing, railway diversion, excavation, pile cropping, formwork and steel fixing, piling, bentonite plant operation, asbestos remediation and installation of working platform were underway.
- Noise and vibration monitoring was undertaken in the vicinity of the Washwood Heath Depot worksite (ref.: WWHD), where haul road operations and material and plant deliveries were underway.
- Noise and vibration monitoring was undertaken in the vicinity of the Twisted Oak Stables worksite (ref.: TOS), where steel fixing and formwork, and installation of steel cages, sidekicks, door box and frame, rock anchors, shutters and vibrators were underway.

The HS2 threshold levels for significant noise impacts, which are defined in Information Paper E23 (<https://www.gov.uk/government/publications/hs2-information-papers-environment>), were not exceeded during the reporting period.

There were no exceedances of trigger levels as defined in Section 61 consents during the reporting period at any monitoring position.

Three (3) complaints were received during the monitoring period. A description of the complaints, the results of investigations and any actions taken are detailed in Table 7 of this report.

# Abbreviations and Descriptions

The abbreviations, descriptions and project terminology used within this report can be found in Table 1.

Table 1: Table of Abbreviations

Acronym/Term	Definition
$L_{Aeq,T}$	See equivalent continuous sound pressure level
Ambient sound	A description of the all-encompassing sound at a given location and time which will include sound from many sources near and far. Ambient sound can be quantified in terms of the equivalent continuous sound pressure level, $L_{pAeq,T}$
Decibel(s), or dB	Between the quietest audible sound and the loudest tolerable sound there is a million to one ratio in sound pressure (measured in Pascal (Pa)). Because of this wide range, a level scale called the decibel (dB) scale, based on a logarithmic ratio, is used in sound measurement. Audibility of sound covers a range of approximately 0-140dB.
Decibel(s) A-weighted, or dB(A)	The human ear system does not respond uniformly to sound across the detectable frequency range and consequently instrumentation used to measure sound is weighted to represent the performance of the ear. This is known as the 'A weighting' and is written as 'dB(A)'.
Equivalent continuous sound pressure level, or $L_{Aeq,T}$	An index used internationally for the assessment of environmental sound impacts. It is defined as the notional unchanging level that would, over a given period of time (T), deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating sound levels can be described in terms of an equivalent single figure value, typically expressed as a decibel level.
Exclusion of data	Measurement of noise levels can be affected by weather conditions such as prolonged periods of rain, winds speeds higher than 5m/s and snow/ice ground cover. Noise levels measured during these periods are considered not representative of normal noise conditions at the site and, for the purposes of this report, are excluded from the assessment of exceedances and calculation of typical noise levels and are also greyed out in charts. Identifiable incongruous noise and vibration events not attributable to HS2 construction noise are also excluded.
Façade	A facade noise level is the noise level 1m in front of a large reflecting surface. The effect of reflection, is to produce a slightly higher (typically +3 dB) sound level than it would be if the reflecting surface was not there.
Free-field	A free-field noise level is the noise level measured at a location where no reflective surfaces, other than the ground, lies within 3.5 metres of the microphone position.
LOAEL	Lowest Observed Adverse Effect Level - the level above which adverse effects on health and quality of life can be detected.
Peak particle velocity, or PPV	Instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position. The PPV is a simple indicator of perceptibility and risk of damage to structures due to vibration. It is usually measured in mm/s.
SOAEL	Significant Observed Adverse Effect Level - the level above which significant adverse effects on health and quality of life occur.
Sound pressure level	The parameter by which sound levels are measured in air. It is measured in decibels. The threshold of hearing has been set at 0dB, while the threshold of pain is approximately 120dB. Normal speech is approximately 60dB at a distance of 1 metre and a change of 3dB in a time varying sound signal is commonly regarded as being just detectable. A change of 10dB is subjectively twice, or half, as loud.
Vibration dose value, or VDV	An index used to evaluate human exposure to vibration in buildings. While the PPV provides information regarding the magnitude of single vibration events, the VDV provides a measure of the total vibration experienced over a specified period of time (typically 16h daytime and 8h night-time). It takes into account the magnitude, the number and the duration of vibration events and can be used to quantify exposure to continuous, impulsive, occasional and intermittent vibration. The vibration dose value is measured in $m/s^{1.75}$ .

# 1 Introduction

1.1.1 HS2 is required to undertake noise (and vibration) monitoring as necessary to comply with the requirements of the High Speed Rail (London-West Midlands) Environmental Minimum Requirements, including specifically Annex 1: Code of Construction Practice, in addition to any monitoring requirements arising from conditions imposed through consents under Section 61 of the Control of Pollution Act, 1974 or through Undertakings & Assurances given to third parties. Such monitoring may be undertaken for the following purposes:

- monitoring the impact of construction works;
- investigating complaints, incidents and exceedance of trigger levels; or
- monitoring the effectiveness of noise and vibration control measures.

1.1.2 Monitoring data and interpretive reports are to be provided to each relevant local authority on a monthly basis and shall include a summary of the construction activities occurring, the data recorded over the monitoring period, any complaints received, any periods in exceedance of agreed trigger levels, the results of any investigations and any actions taken or mitigation measures implemented. This report provides vibration data, and interpretation thereof, for monitoring carried out by HS2 within Birmingham City Council for the period 1<sup>st</sup> to 31<sup>st</sup> March 2024.

1.1.3 Active construction sites in the local authority area where monitoring was undertaken during this period include:

- Curzon Street Station worksite ref.: CSS (see plan 1 in Appendix A) where work activities included:
  - Haul road construction.
  - Construction of pile mat.
- Curzon Street worksite ref.: CS (see plan 1 in Appendix A) where work activities included:
  - Material deliveries, movement and storage.
  - Wheel wash operation and maintenance.
  - Deck construction including formwork erection, steel fixing and concrete casting.
  - Scaffold installation.
  - Welding works.
  - Excavation.
  - Concrete casting.

- Steel fixing and formwork.
- Haul road use.
- Stockpiling.
- Bridge construction including installing girders, welding works and scaffold erection.
- Lawley Middleway worksite, ref.: LMW (see plan 1 in Appendix A) where work activities included:
  - Pier construction works, including striking and formwork removal.
  - Stockpiling, including removal of arising stockpiles off-site and stockpiling of aggregate deliveries.
  - Material deliveries, storage and movement.
  - Bearings installation and casting.
  - Excavation.
  - Backfilling.
- Saltley Viaduct Satellite worksite, ref.: SVS (see plan 2 in Appendix A) where work activities included:
  - Abutments finishing works.
  - Installation of utility ducts.
  - Waterproofing.
  - Railway diversion works.
  - Excavation.
  - Pile cropping.
  - Steel fixing.
  - Piling.
  - Bentonite plant operation.
  - Asbestos remediation.
  - Installation of working platform.
- Washwood Heath Depot worksite, ref.: WWHD (see plan 3 in Appendix A) where work activities included:
  - Haul road operations, including maintenance, excavation, articulated dump truck movements and compaction works.
  - Material and plant deliveries including loading and unloading.

- Twisted Oak Stables worksite, ref.: TOS (see plan 4 in Appendix A) where work activities included:
  - Installation works including, steel cages, sidekicks, door box and frame, rock anchors, shutters and vibrators.
  - Steel fixing and formwork.

1.1.4 The applicable standards, guidance, and monitoring methodology is outlined in the construction noise and vibration monitoring methodology report which can be found at the following location <https://www.gov.uk/government/collections/monitoring-the-environmental-effects-of-hs2>. Noise and vibration monitoring reports for previous months can also be found at this location.

## 1.2 Measurement Locations

1.2.1 Nine (9) noise and four (4) vibration monitoring installations were active in March in the Birmingham City area. Table 2 summarises the position of noise and vibration monitoring installations within the Birmingham City area in March 2024.

1.2.2 Maps showing the position of noise and vibration monitoring installations are presented in Appendix B.

Table 2: Monitoring Locations

Worksite Reference	Measurement Reference	Address
CSS	CSS-N1	Eastside City Park, Birmingham
	CSS-N2	Moor Street Queensway, Birmingham
CS	CS-N1	Curzon Street, Birmingham
LMW	LMW-N1	Lawford Close, Digbeth, Birmingham
SVS	SVS-N1	Duddeston Mill Road, Saltley Business Park Area, Birmingham
WWHD	WWHD-N1	114 Drews Lane, Birmingham
	WWHD-V1	Drews Lane, Birmingham
	WWHD-N2	93 Common Lane, Birmingham
	WWHD-V2	93 Common Lane, Birmingham
	WWHD-N3	154 Warren Road, Washwood Heath, Birmingham
	WWHD-V3	154 Warren Road, Washwood Heath, Birmingham
TOS	TOS-N1	B4118-Birmingham Road, Water Orton, Birmingham
	TOS-V1	B4118-Birmingham Road, Water Orton, Birmingham



## 2 Summary of Results

### 2.1 Summary of Measured Noise and Vibration Levels

2.1.1 Table 3 presents a summary of the measured noise levels at each monitoring location over the reporting period. The  $L_{Aeq,T}$  is presented for each of the relevant time periods averaged over the calendar month, along with the highest single period  $L_{Aeq,T}$  that was found to occur within the month.

Table 3: Summary of Measured dB LAeq Data over the Monitoring Period

Worksite Reference	Measurement Reference	Site Address	Free-field or Façade measurement	Weekday Average LAeq,T (Highest Day LAeq,T)					Saturday Average LAeq,T (Highest Day LAeq,T)					Sunday / Public Holiday Average LAeq,T (Highest Day LAeq,T)	
				0700 - 0800	0800 - 1800	1800 - 1900	1900 - 2200	2200 - 0700	0700 - 0800	0800 - 1300	1300 - 1400	1400 - 2200	2200 - 0700	0700 - 2200	2200 - 0700
CSS	CSS-N1	Eastside City Park	Façade	54.6 (57.0)	64.0 (74.2)	57.9 (63.7)	55.2 (60.4)	51.6 (56.7)	52.8 (54.3)	55.0 (56.3)	55.5 (56.0)	55.7 (57.9)	52.7 (56.2)	53.7 (57.2)	51.5 (55.8)
	CSS-N2	Moor Street Queensway	Façade	56.1 (58.2)	60.3 (63.4)	57.9 (60.0)	56.6 (60.2)	53.3 (57.7)	54.7 (55.8)	56.5 (58.0)	56.7 (57.8)	57.5 (59.7)	54.9 (58.3)	56.2 (64.4)	53.3 (55.7)
CS	CS-N1	Curzon Street	Free-field	66.0 (67.4)	67.6 (69.1)	65.4 (67.1)	64.3 (66.7)	62.6 (70.1)	62.4 (63.5)	64.2 (66.2)	64.9 (66.7)	65.0 (68.1)	63.6 (67.1)	63.5 (67.2)	63.3 (67.9)
LMW	LMW-N1	Lawford Close, Digbeth	Free-field	65.9 (67.5)	67.4 (70.9)	65.1 (68.4)	64.7 (67.3)	62.9 (67.0)	63.5 (64.1)	66.1 (70.8)	65.3 (67.3)	64.6 (66.6)	63.4 (66.0)	63.9 (65.6)	62.9 (66.9)
SVS	SVS-N1	Duddeston Mill Road	Free-field	59.0 (68.4)	62.6 (70.0)	53.2 (56.4)	52.5 (55.3)	51.9 (62.4)	53.7 (54.7)	53.9 (59.9)	53.2 (59.5)	53.2 (65.0)	51.4 (59.0)	51.7 (66.8)	50.0 (57.0)
WWHD	WWHD-N1	114 Drews Lane	Free-field	60.8 (63.5)	63.4 (67.9)	55.3 (60.5)	55.0 (59.8)	52.2 (59.0)	56.1 (60.1)	60.6 (67.4)	61.3 (70.6)	56.6 (63.8)	53.2 (58.1)	55.4 (59.6)	53.3 (60.5)
	WWHD-N2	93 Common Lane	Free-field	54.2 (57.9)	58.8 (62.1)	52.5 (57.1)	52.2 (59.7)	51.0 (58.5)	51.8 (56.4)	53.4 (57.1)	52.4 (57.0)	53.1 (62.4)	52.4 (55.9)	53.8 (57.5)	52.9 (59.8)
	WWHD-N3	154 Warren Road	Free-field	56.3 (61.0)	59.9 (61.9)	52.3 (59.6)	51.2 (59.5)	49.8 (58.1)	52.1 (56.0)	53.9 (58.9)	53.1 (57.7)	51.1 (56.8)	50.7 (55.6)	53.2 (57.3)	52.2 (59.3)

Worksite Reference	Measurement Reference	Site Address	Free-field or Façade measurement	Weekday Average $L_{Aeq,T}$ (Highest Day $L_{Aeq,T}$ )					Saturday Average $L_{Aeq,T}$ (Highest Day $L_{Aeq,T}$ )					Sunday / Public Holiday Average $L_{Aeq,T}$ (Highest Day $L_{Aeq,T}$ )	
				0700 - 0800	0800 - 1800	1800 - 1900	1900 - 2200	2200 - 0700	0700 - 0800	0800 - 1300	1300 - 1400	1400 - 2200	2200 - 0700	0700 - 2200	2200 - 0700
TOS	TOS-N1	B4118-Birmingham Road	Free-field	67.8 (69.5)	69.0 (71.8)	66.6 (68.5)	66.4 (71.2)	65.4 (68.8)	64.8 (66.8)	66.5 (68.0)	66.9 (68.1)	65.5 (68.5)	64.2 (68.2)	65.7 (69.3)	63.7 (68.0)

2.1.2 Table 4 presents a summary of the measured vibration levels at each monitoring location over the reporting period. The highest component PPV measured during periods of works along any axis is presented in the table.

Table 4: Summary of Measured Component PPV Data over the Monitoring Period

Worksite Reference	Measurement Reference	Monitor Address	Highest PPV measured in any axis, mm/s
WWHD	WWHD-V1	Drews Lane, Birmingham	2.55 (Z-axis)
	WWHD-V2	93 Common Lane, Birmingham	2.70 (X-axis)
	WWHD-V3	154 Warren Road	0.94 (Y-axis)
TOS	TOS-V1	B4118-Birmingham Road, Water Orton, Birmingham	1.50 (Y-axis)

2.1.3 Appendix C presents graphs of the noise and vibration monitoring data over the month for each of the measurement locations. Noise data presented consists of the hourly  $L_{Aeq}$  values and, where relevant, the  $L_{Aeq,T}$  values (where the time period T has been taken to be the averaging period as specified in Table 1 of HS2 Information Paper E23). Vibration data presented consist of hourly PPV values. The full data set for the monitoring equipment can be found at the following location:

<https://data.gov.uk/dataset/24542ae7-dd44-444f-b259-871c4cc43b5e/environmental-monitoring-data>.

## 2.2 Exceedances of the LOAEL and SOAEL

2.2.1 The lowest observed adverse effect level (LOAEL) is defined in the Planning Practice Guidance – Noise (PPG) as the level above which "noise starts to cause small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life".

2.2.2 The significant observed adverse effect level (SOAEL) is defined in the 'Planning Practice Guidance – Noise' as the level above which "noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area."

- 2.2.3 HS2 Phase One Information Paper E23: Control of Construction Noise and Vibration sets out the LOAELs and SOAELs for construction noise.
- 2.2.4 Where reported construction noise levels exceed the LOAEL and SOAEL, relevant periods will be identified. Summary statistics to evaluate ongoing qualification for noise insulation and temporary rehousing are also presented where relevant.
- 2.2.5 Table 5 presents a summary of recorded exceedances of the LOAEL and SOAEL at each measurement location over the reporting period, including the number of exceedances during each time period.

Table 5: Summary of Exceedances of LOAEL and SOAEL

Worksite Reference	Measurement Reference	Site Address	Day (Weekday, Saturday, Sunday, Night)	Time period	Number of exceedances of LOAEL	Number of exceedances of SOAEL
CSS	CSS-N1	Eastside City Park, Birmingham	Weekday	0800-1800	3	No exceedance
	CSS-N2	Moor Street Queensway, Birmingham	All days	All periods	No exceedance	No exceedance
CS	CS-N1*	Curzon Street, Birmingham	All days	All periods	Not applicable**	No exceedance
LMW	LMW-N1*	Lawford Close, Digbeth	All days	All periods	Not applicable**	No exceedance
SVS	SVS-N1*	Duddeston Mill Road, Saltley Business Park Area	All days	All periods	No exceedance	No exceedance
WWHD	WWHD-N1*	114 Drews Lane, Birmingham	Saturday	1300-1400	2	No exceedance
			Saturday	1400-2200	4	
	WWHD-N2*	93 Common Lane, Birmingham	All days	All periods	No exceedance	No exceedance
	WWHD-N3	154 Warren Road	All days	All periods	No exceedance	No exceedance
TOS	TOS-N1*	B4118- Birmingham Road, Water Orton	Weekday Saturday Saturday	0800-1800 1300-1400 1400-2200	1 2 4	No exceedance

\* A distance correction has been applied when calculating exceedances of the LOAEL and SOAEL.

\*\* The LOAEL has not been assessed due to high baseline levels.

- 2.2.6 Exceedances of the LOAEL were recorded at three (3) noise monitoring locations during weekday and Saturday periods.
- 2.2.7 No exceedances of the SOAEL were recorded due to HS2 construction works during the reporting period.

## 2.3 Exceedances of Trigger Level

- 2.3.1 Table 6 provides a summary of exceedances of the S61 trigger vibration levels determined to be due to HS2 related construction vibration measured during the reporting period, along with the findings of any investigation.

Table 6: Summary of Exceedances of Trigger Levels

Complaint Reference Number (if applicable)	Worksite Reference	Date and Time Period	Identified Source	Results of Investigation (including noise monitoring results)	Actions Taken
-	-	-	-	-	-

## 2.4 Complaints

- 2.4.1 Table 7 provides a summary of complaint information related to noise and vibration received during the reporting period, along with the findings of any investigation.

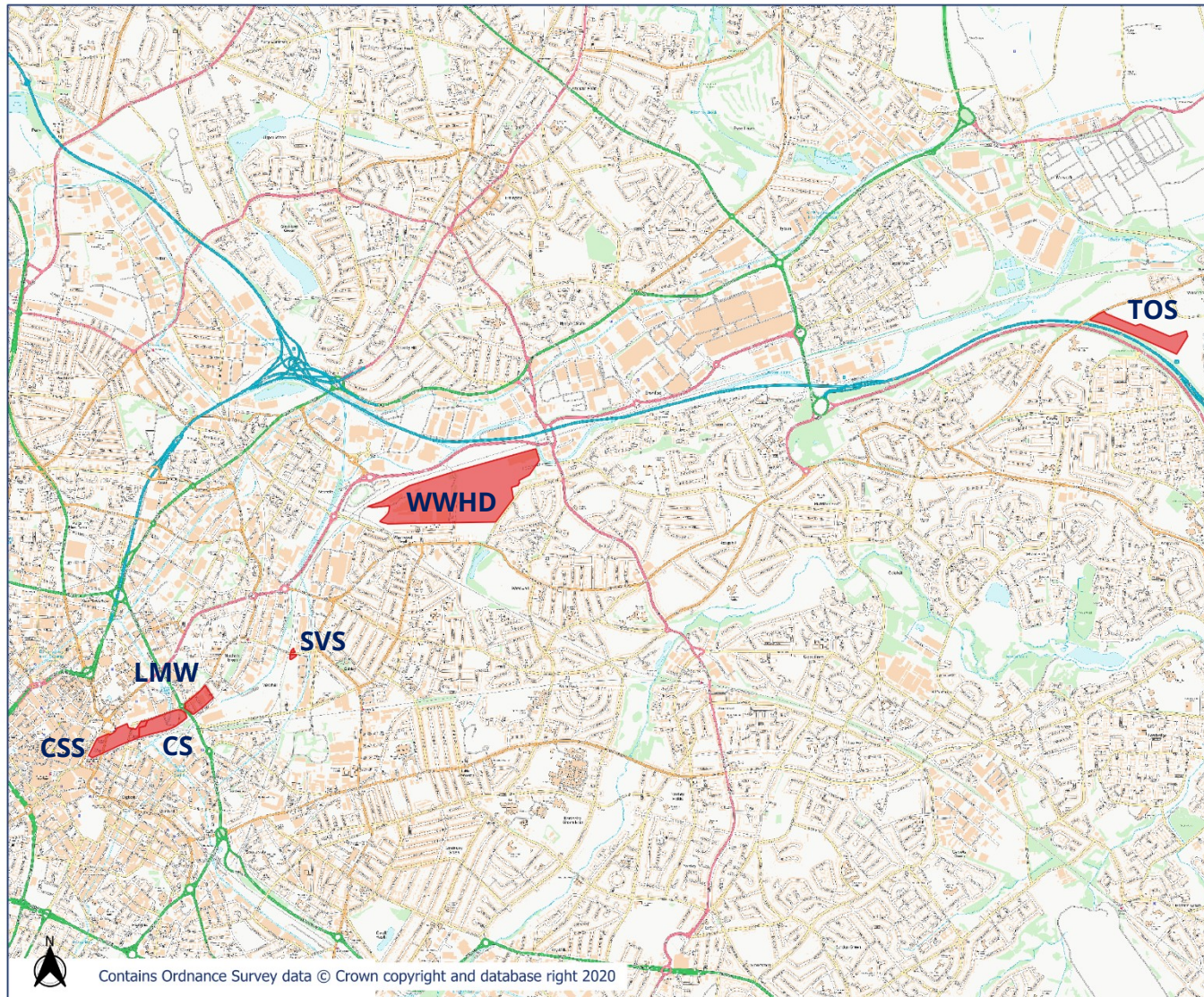
Table 7: Summary of Complaints

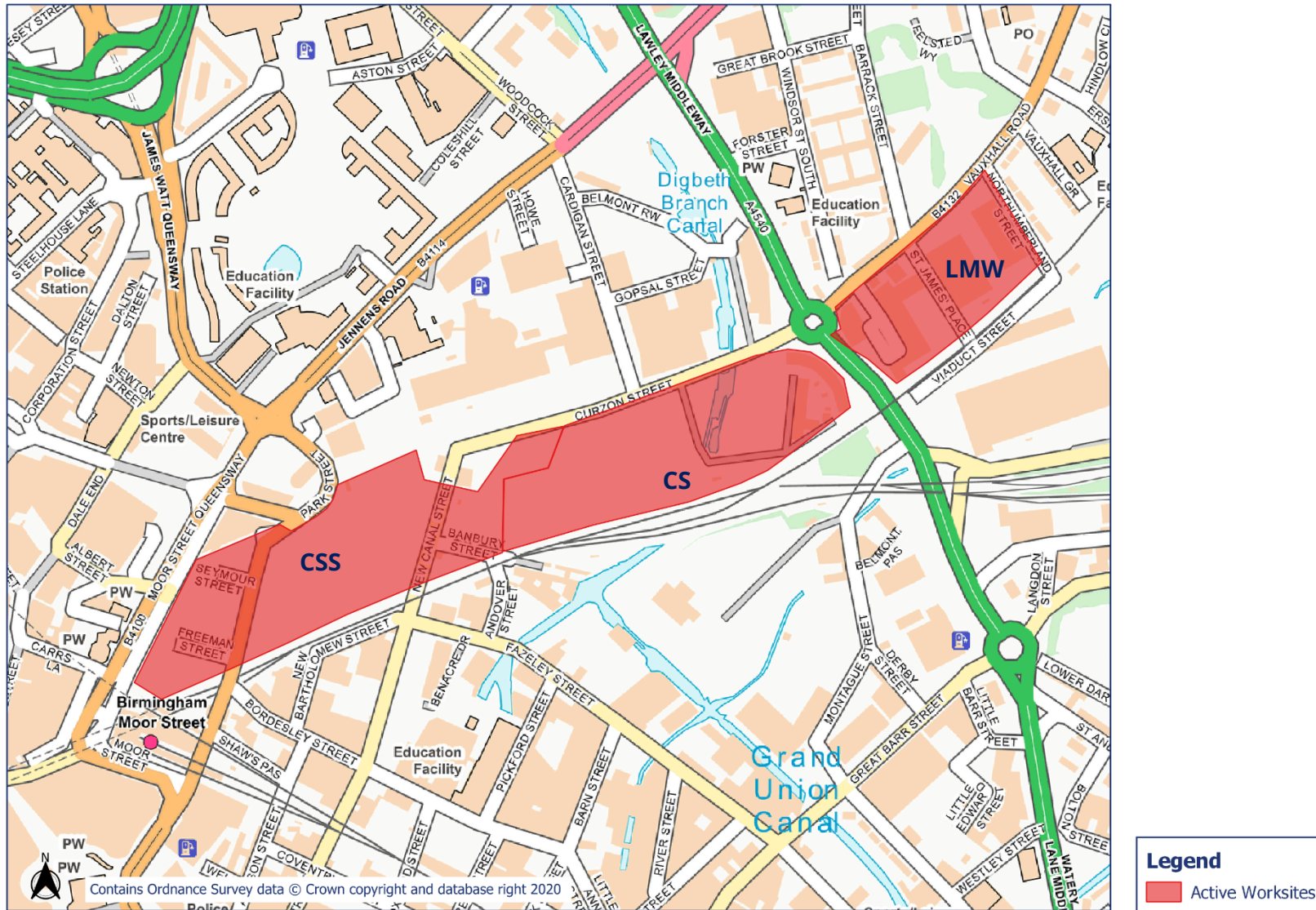
Complaint Reference Number	Worksite Reference	Description of Complaint	Results of Investigation	Actions Taken
HS2-24-106838-E-C	WWHD	Complaint due to vibrations felt at property in close proximity to works.	Vibration at property was due to a new drainage system being installed and movement of plant machinery.	The resident has been informed of the results of the investigation.
HS2-24-45281-C	CSS	Complaint due to construction noise at night.	Investigation found that no HS2 works were taking place during this period.	The resident has been informed of the results of the investigation.

Complaint Reference Number	Worksite Reference	Description of Complaint	Results of Investigation	Actions Taken
HS2-24-45282-C	WWHD	Complaint due to noise disruption from ongoing works.	Monitoring data demonstrates that noise levels were below Section 61 requirements. The resident has previously been offered secondary glazing to mitigate noise	Information was provided to the resident re-confirming the resident's eligibility for secondary glazing.

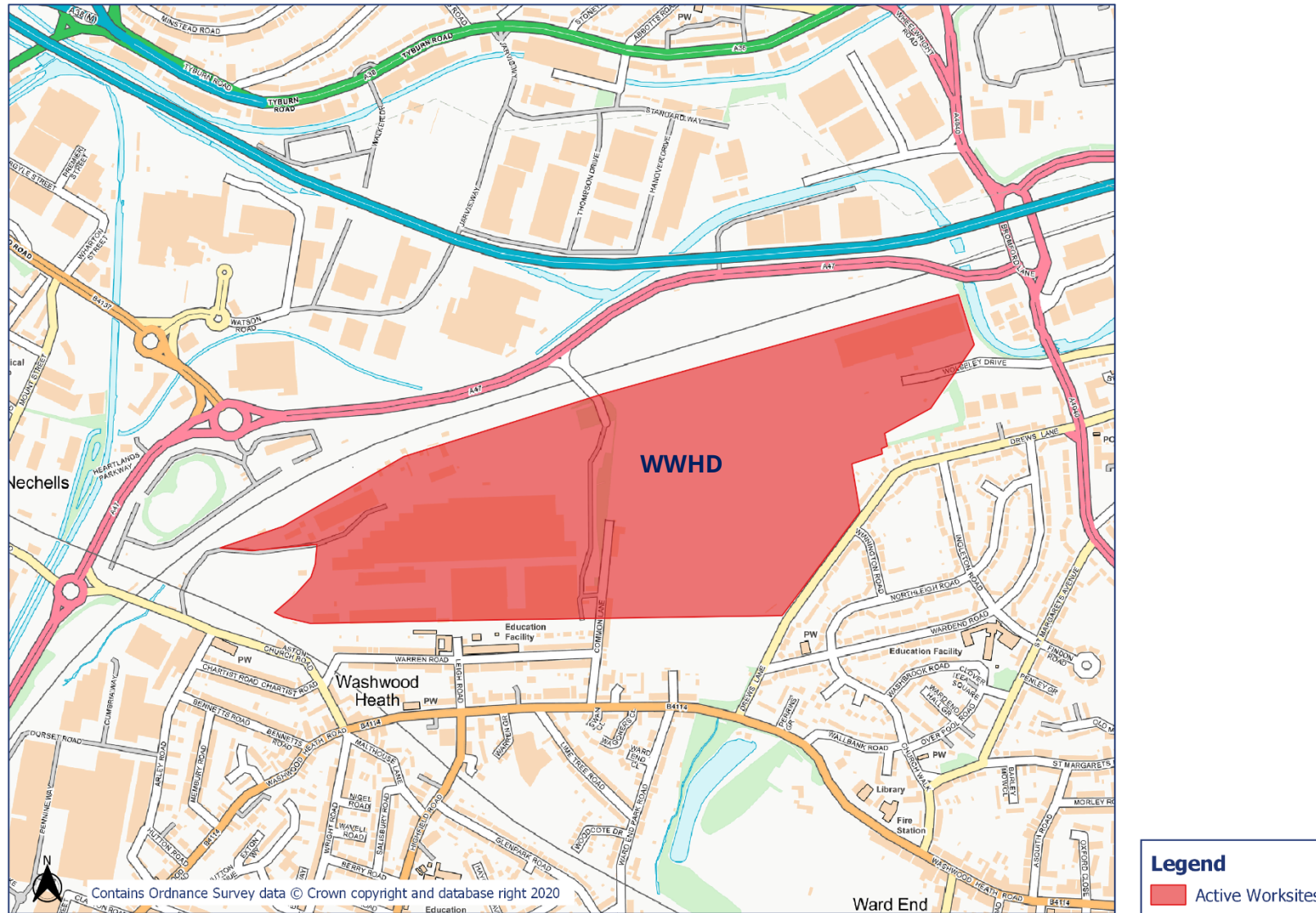
# Appendix A Site Locations

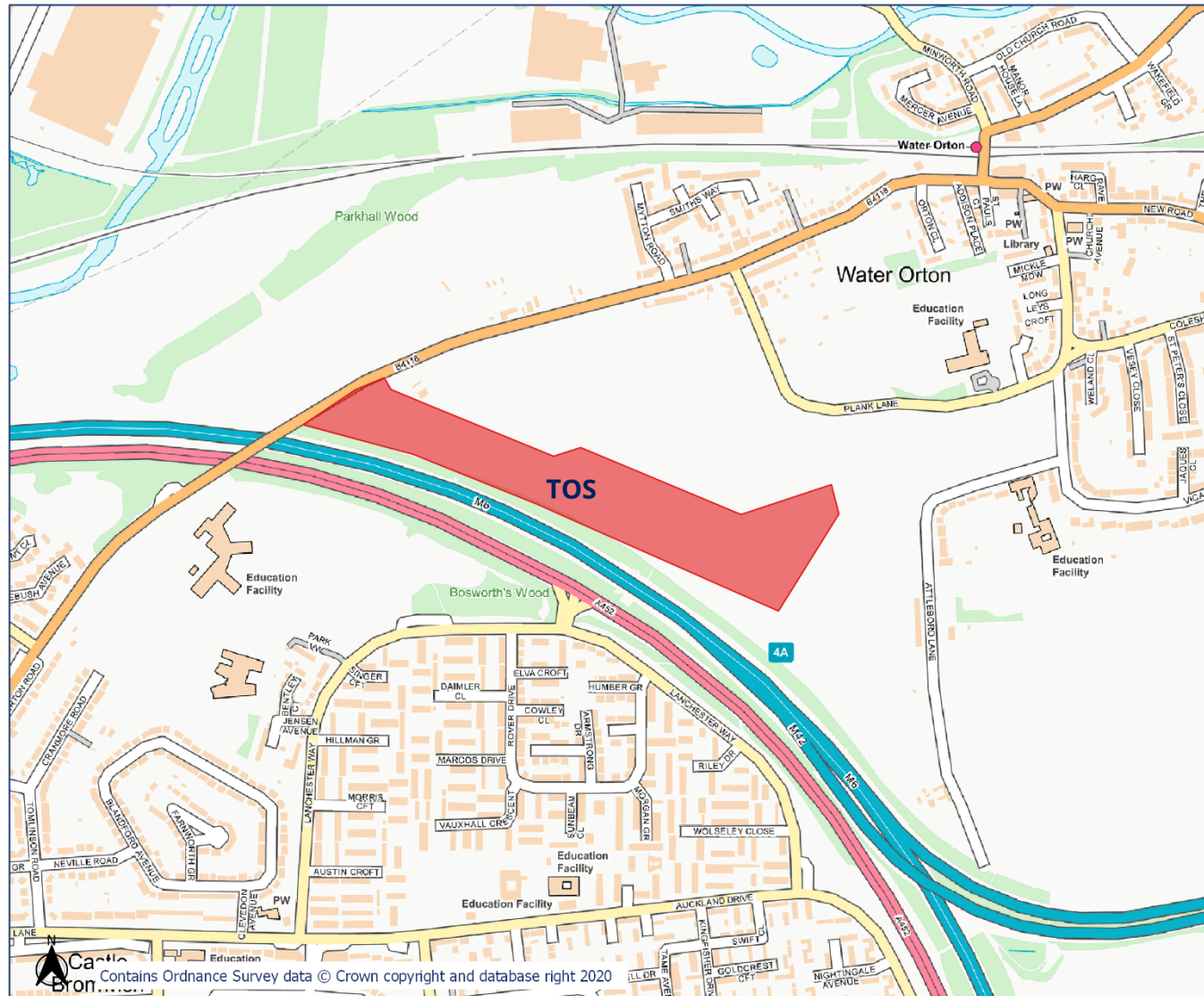




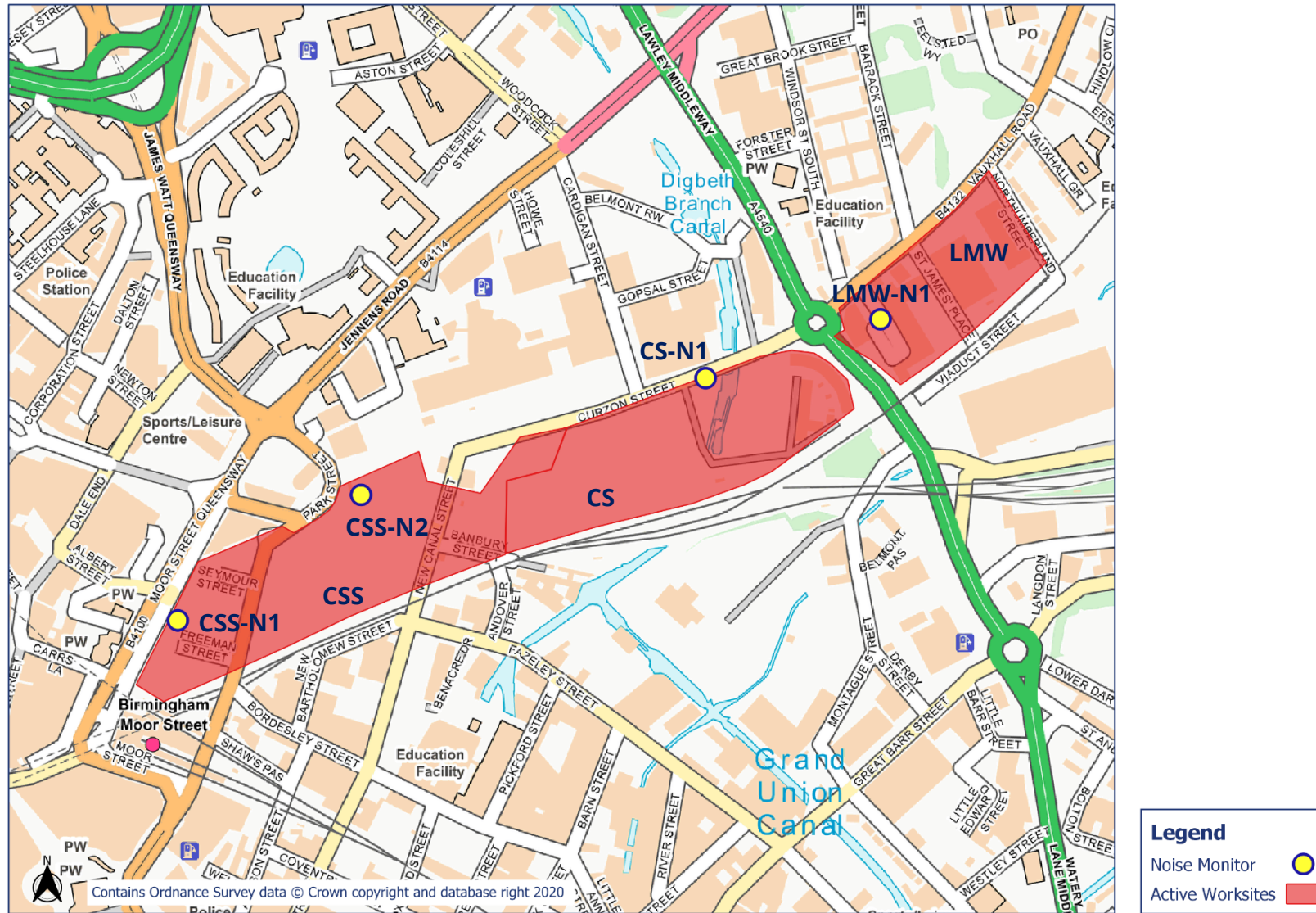






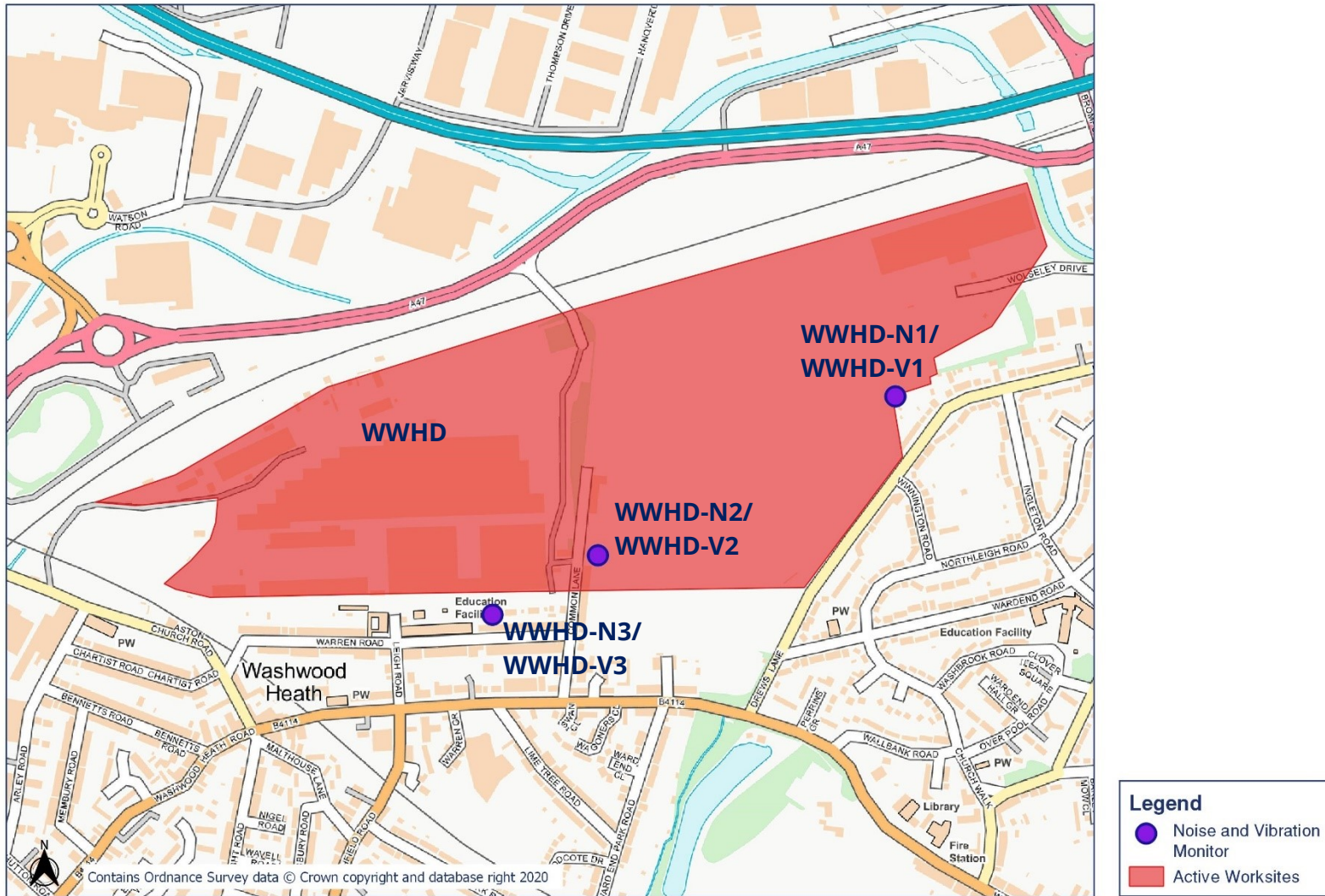


# Appendix B Monitoring Locations



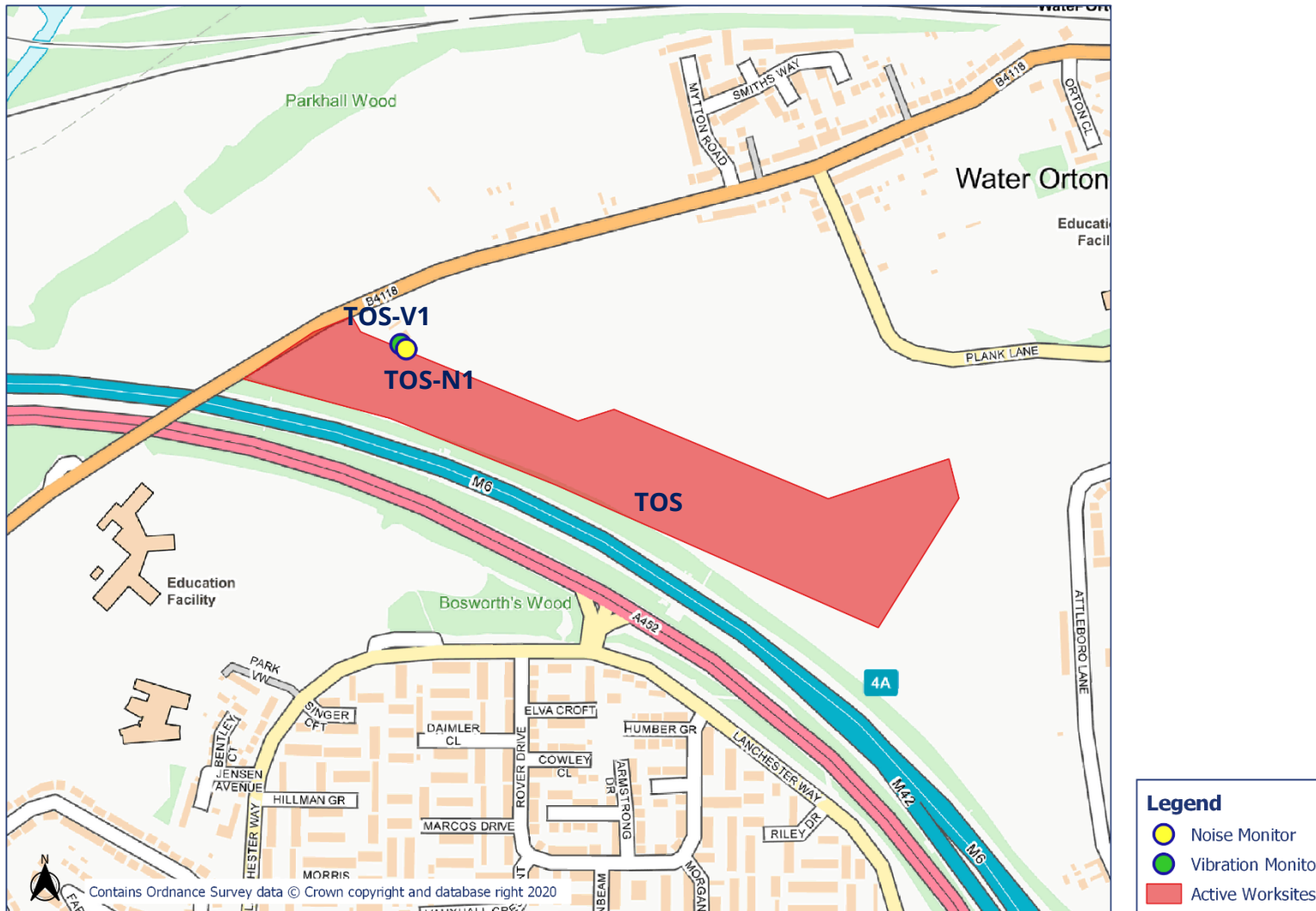






# HS2

## Noise and Vibration Monitoring Plan - 4

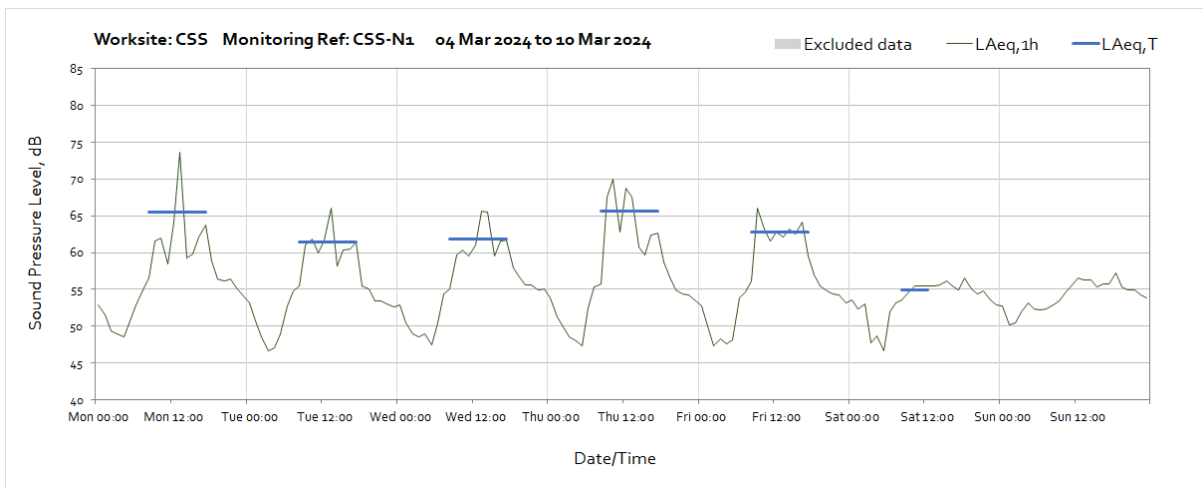
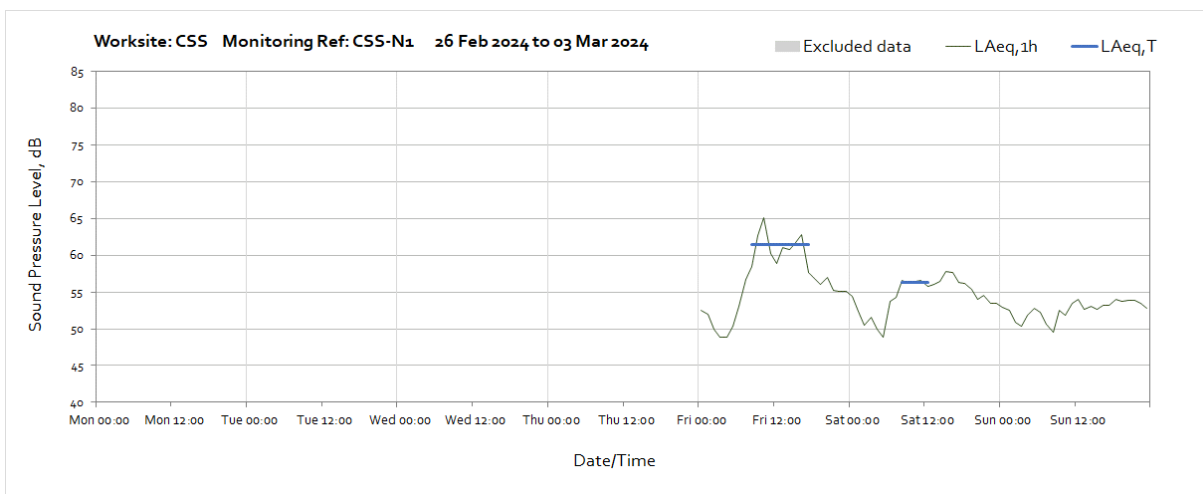


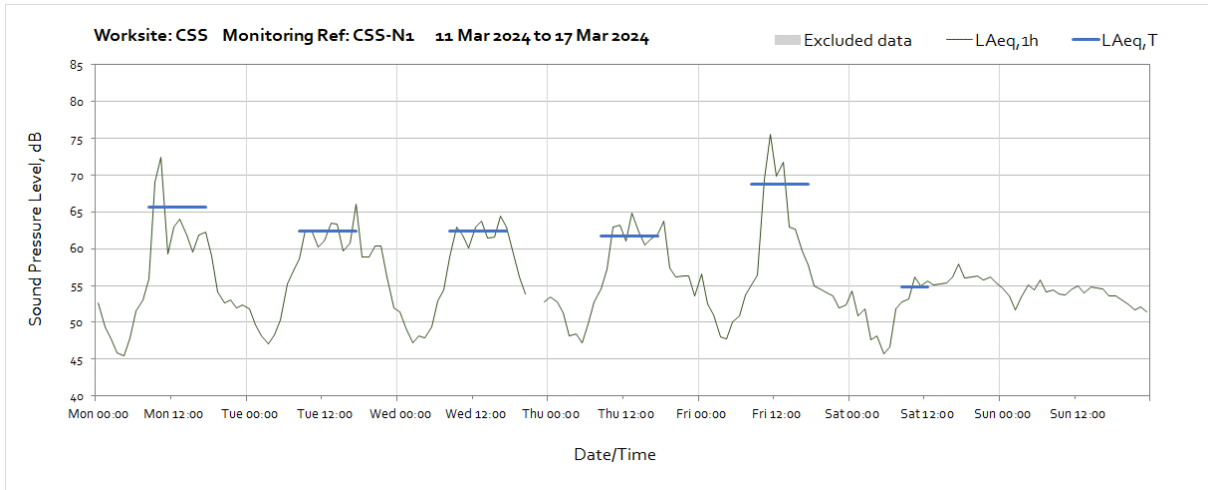
# Appendix C Data

## Noise

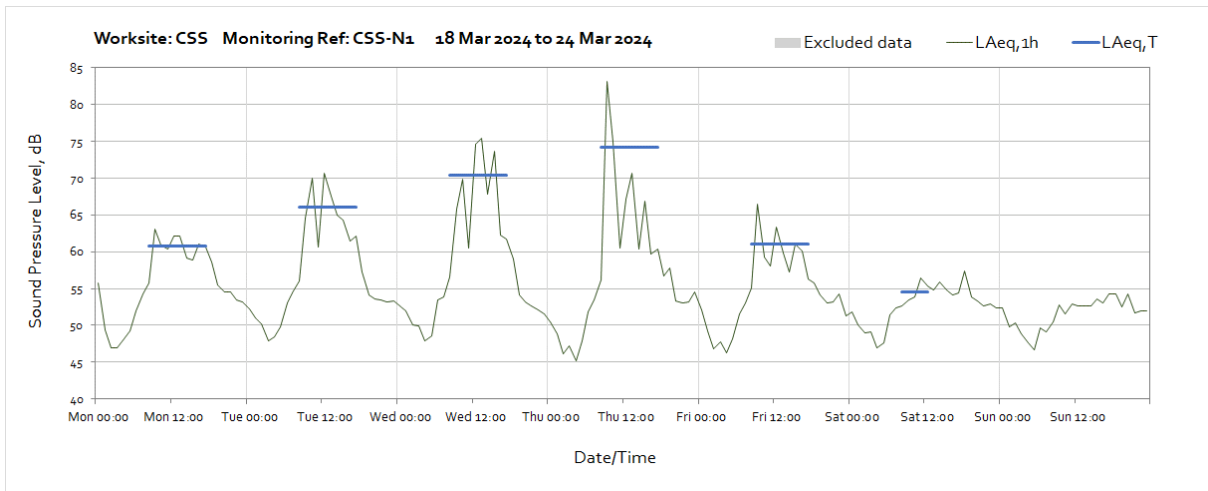
The following graphs show the hourly measured ambient noise level  $L_{Aeq,1h}$  and, where relevant, the averaged noise level  $L_{Aeq,T}$  values, where the time period T is as specified in Table 1 of HS2 Information Paper E23. Periods where noise levels are adversely affected by weather or only measured for part of the period, which are not representative of HS2 construction works, have been greyed out and excluded from the calculation of the  $L_{Aeq,T}$  values in Table 3 of the main report.

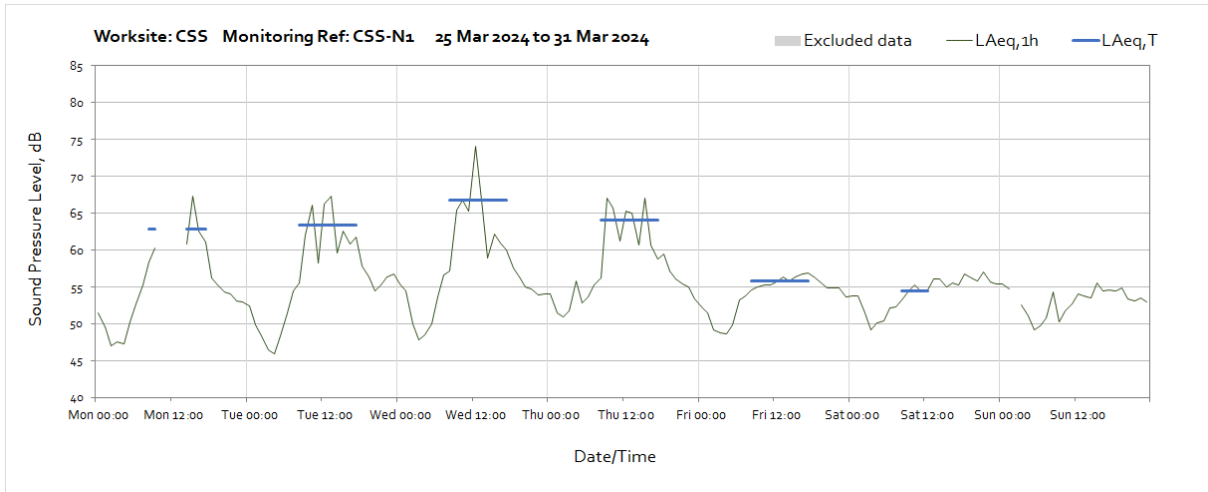
### Worksite: CSS – Monitoring Ref: CSS-N1





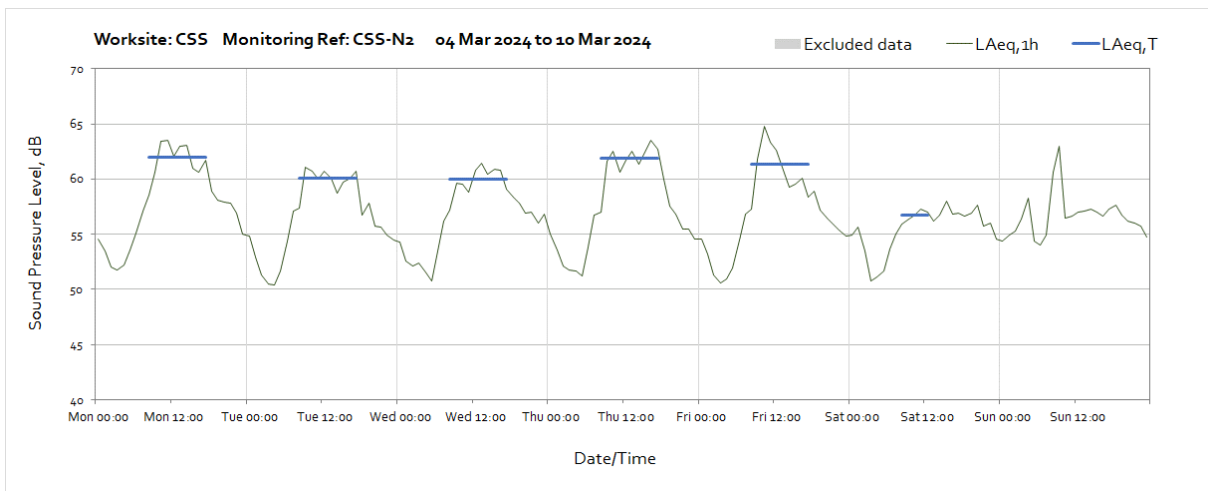
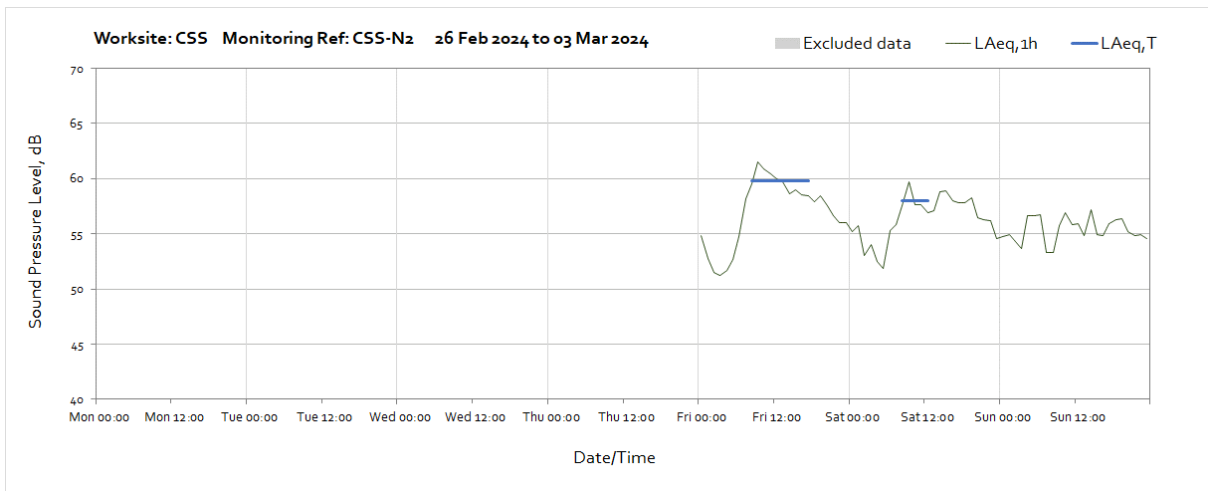
Note: Missing data between 21:00 and 23:00 on Wednesday 13<sup>th</sup> March was due to an ongoing issue with the site power supply causing a loss of power at the monitoring station.



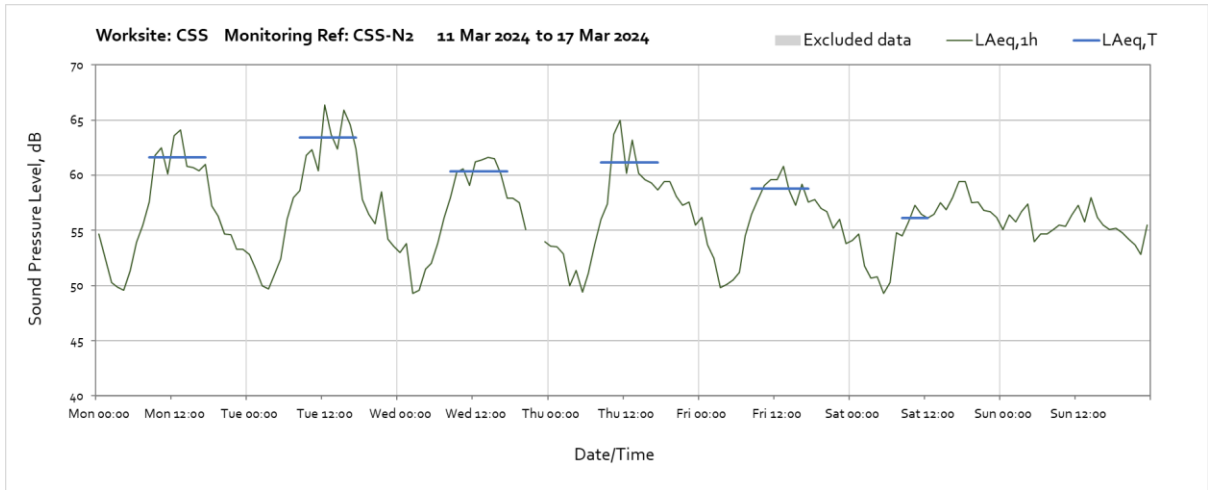


Note: Missing data between 10:00 and 14:00 on Monday 25<sup>th</sup> March was due to an ongoing issue with the site power supply causing a loss of power at the monitoring station. Missing data between 02:00 and 03:00 on Sunday 31<sup>st</sup> March is due to a monitor time adjustment at the start of British Summer Time.

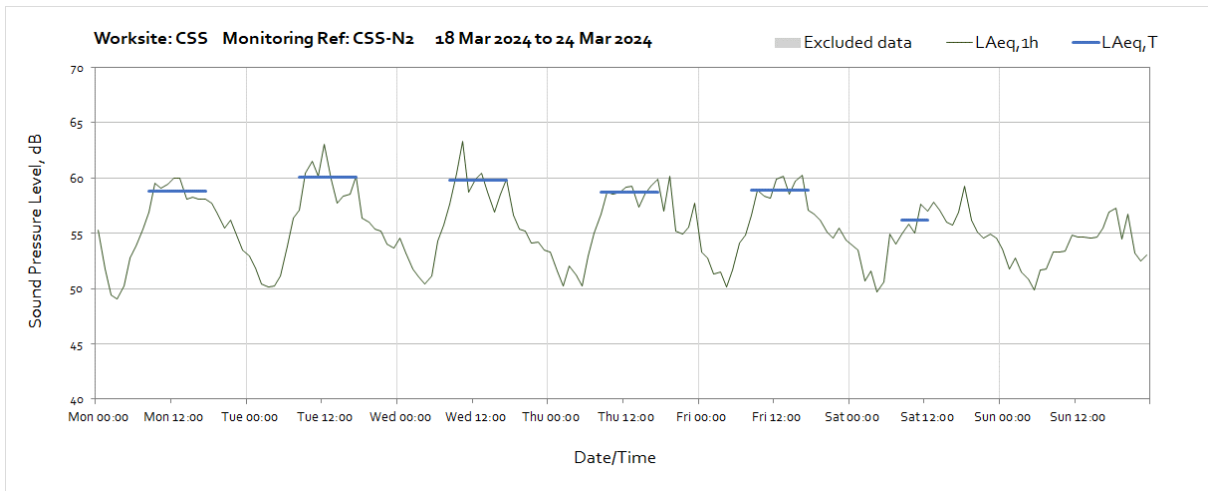
**Worksite: CSS – Monitoring Ref: CSS-N2**

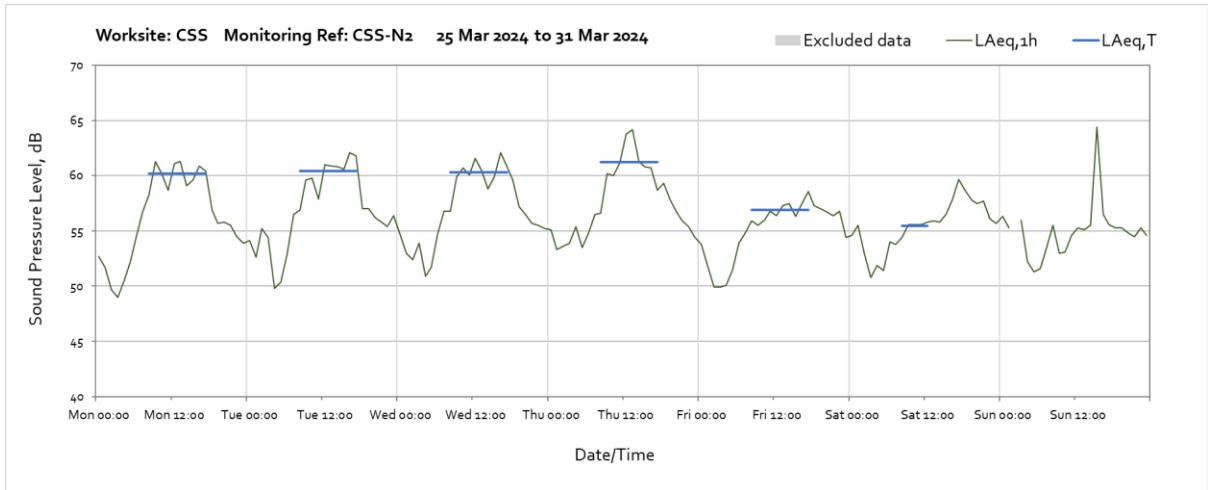


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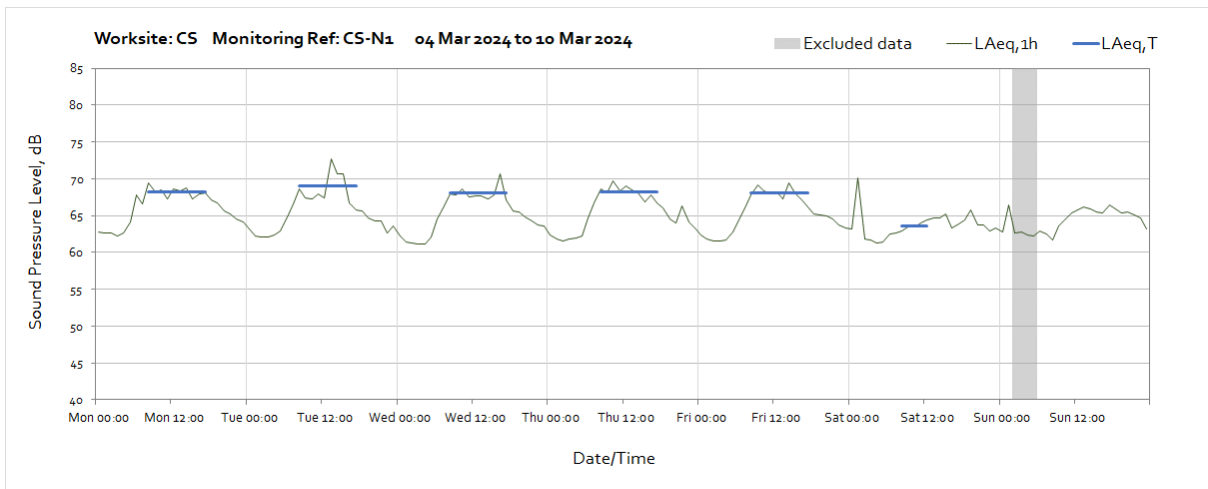
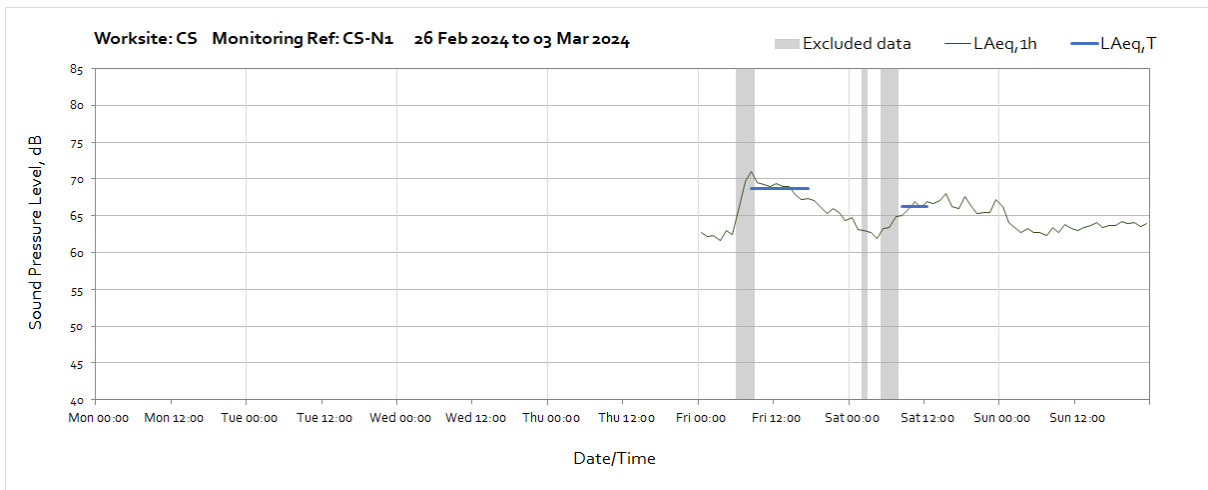
Note: Missing data between 21:00 and 23:00 on Wednesday 13<sup>th</sup> March was due to an ongoing issue with the site power supply causing a loss of power at the monitoring station.

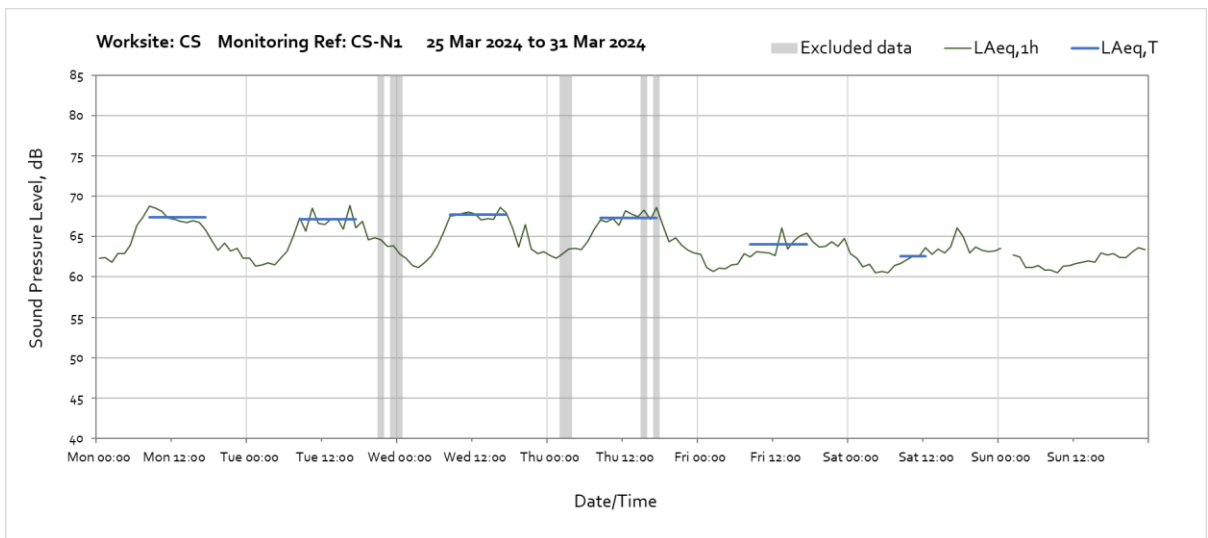
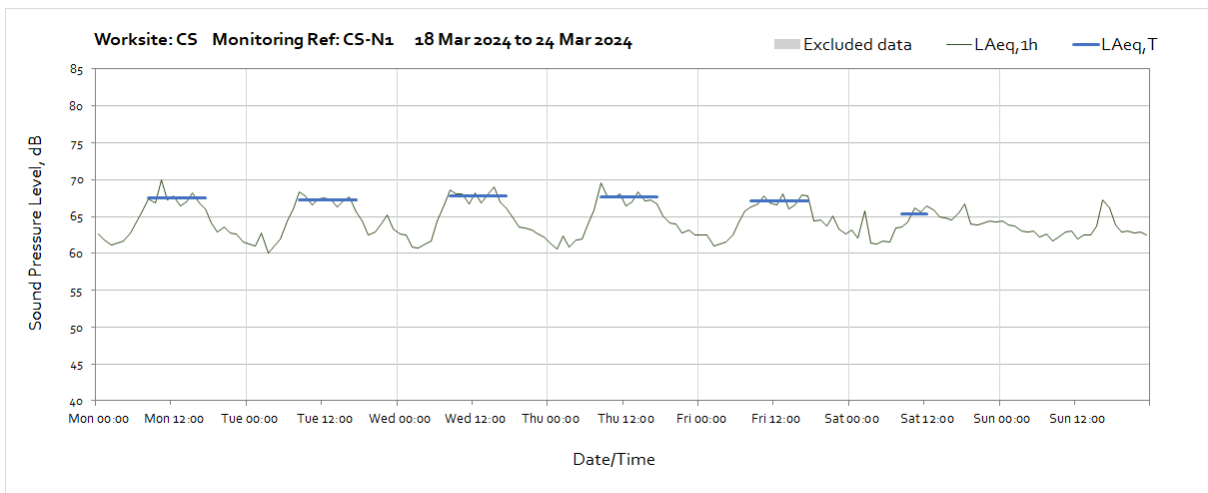
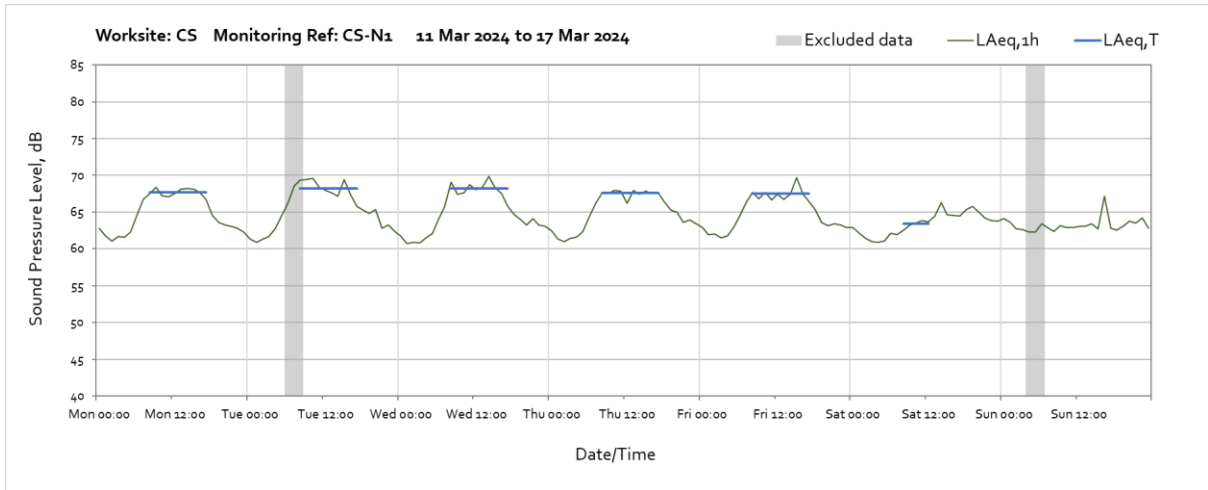




Note: Missing data between 02:00 and 03:00 on Sunday 31st March is due to a monitor time adjustment at the start of British Summer Time.

**Worksite: CS – Monitoring Ref: CS-N1**



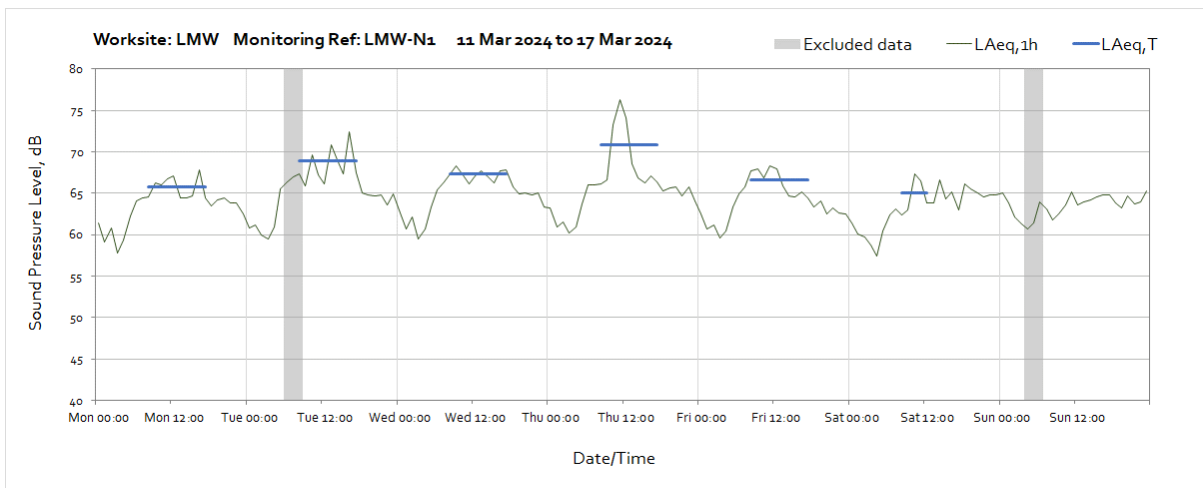
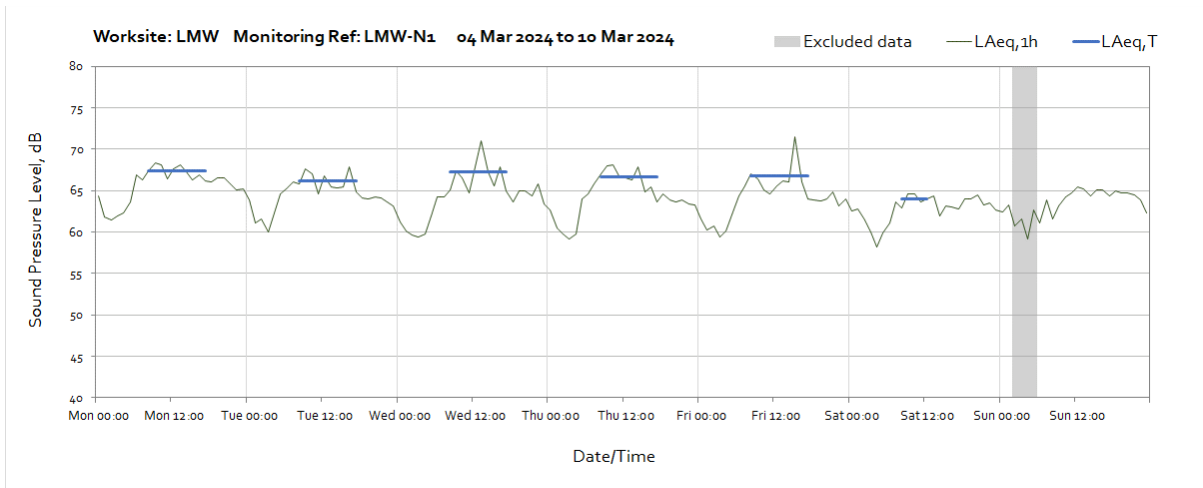
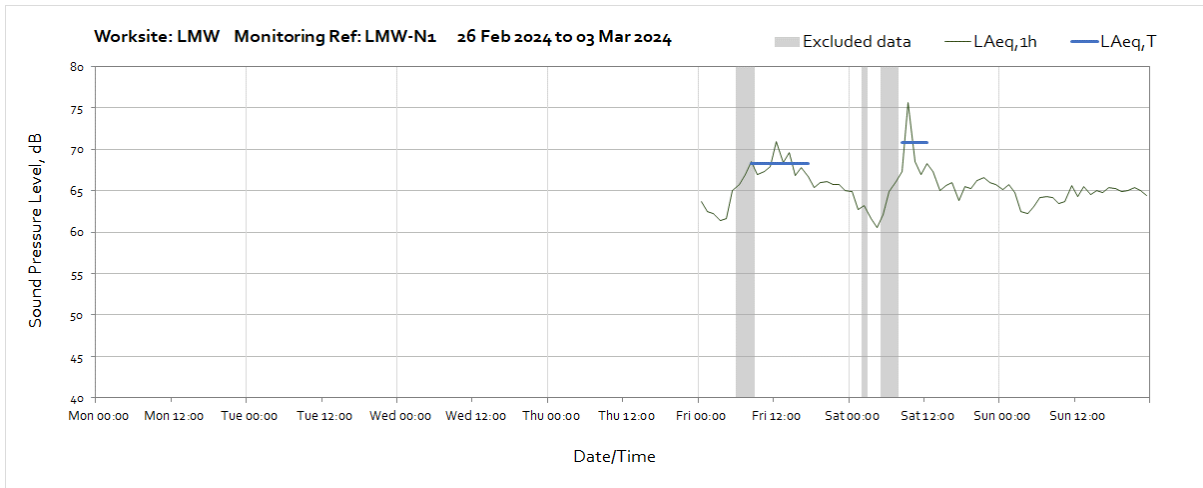


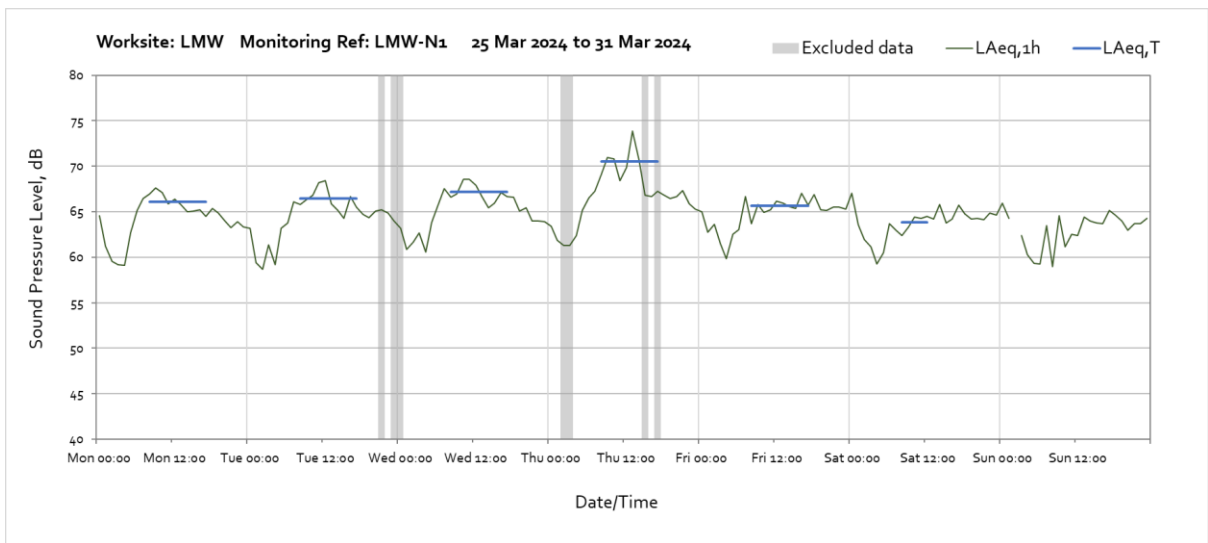
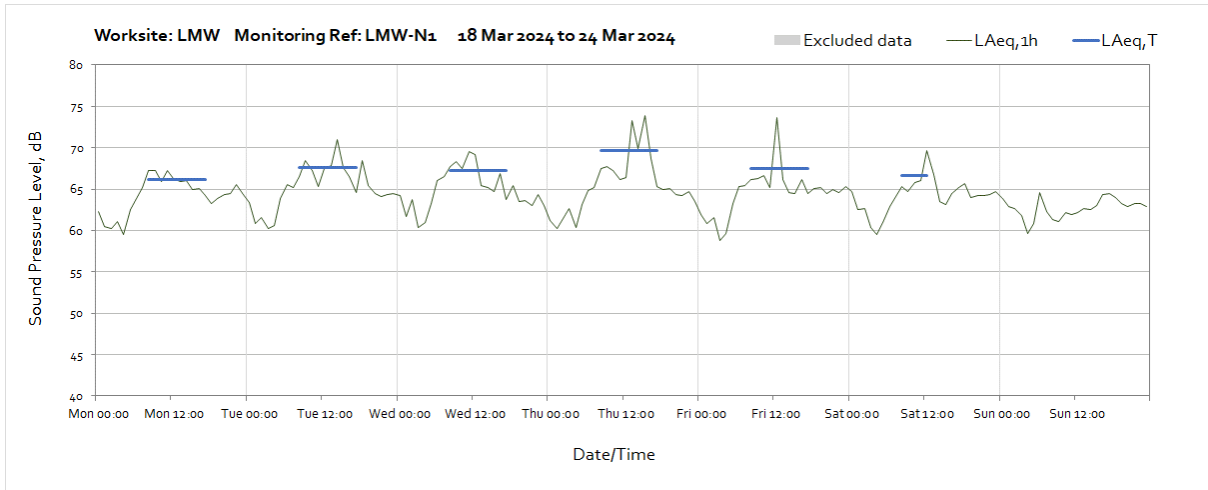
Note: Missing data between 01:00 and 02:00 on Sunday 31st March is due to a monitor time adjustment at the start of British Summer Time.

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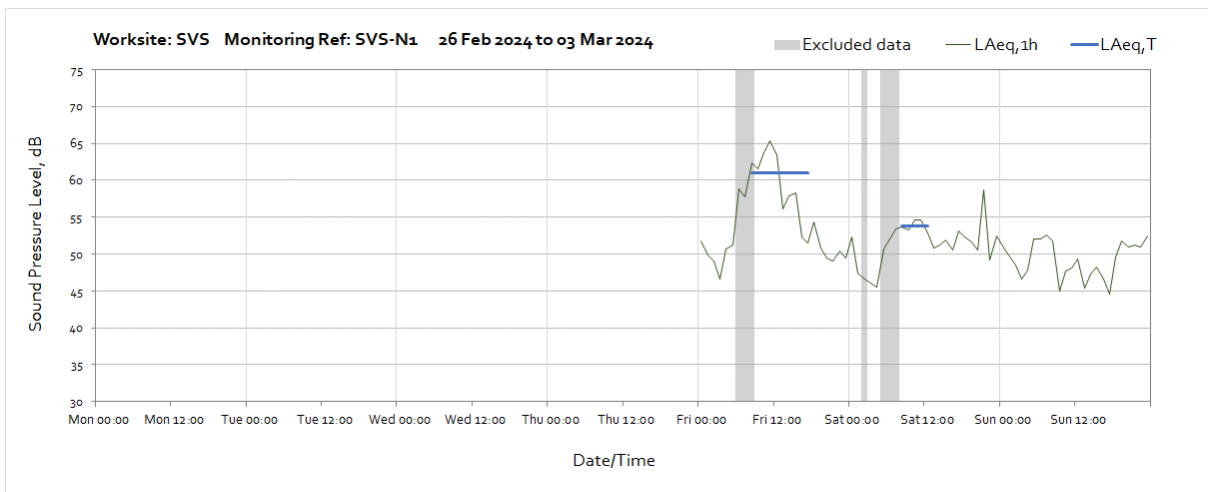
## Worksite: LMW – Monitoring Ref: LMW-N1



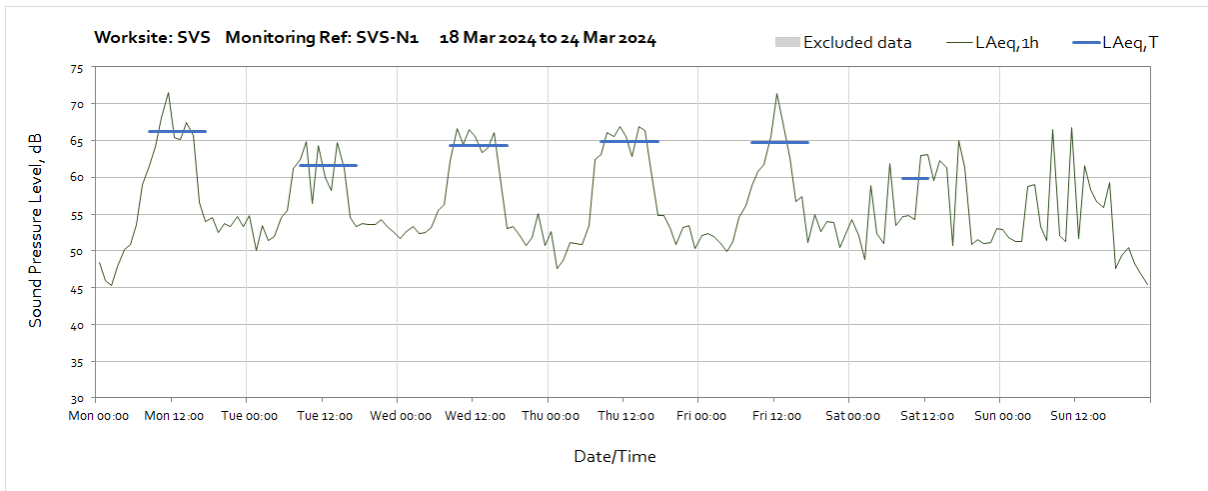
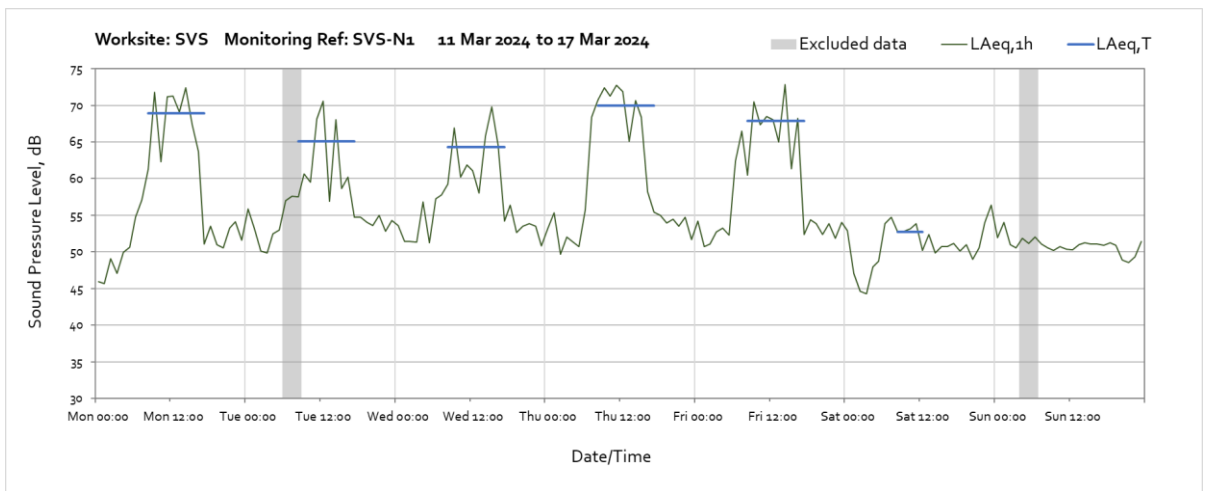
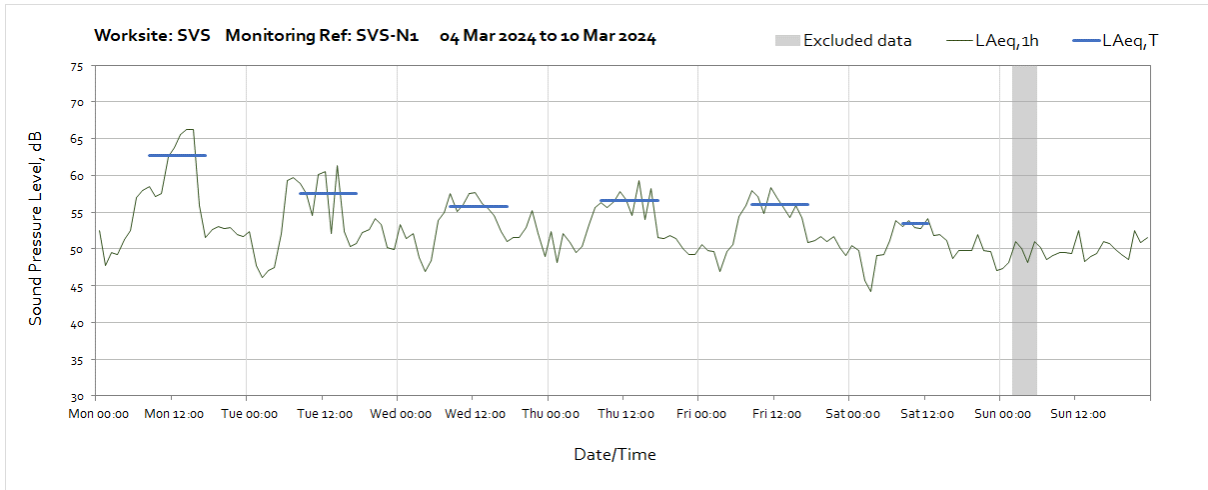


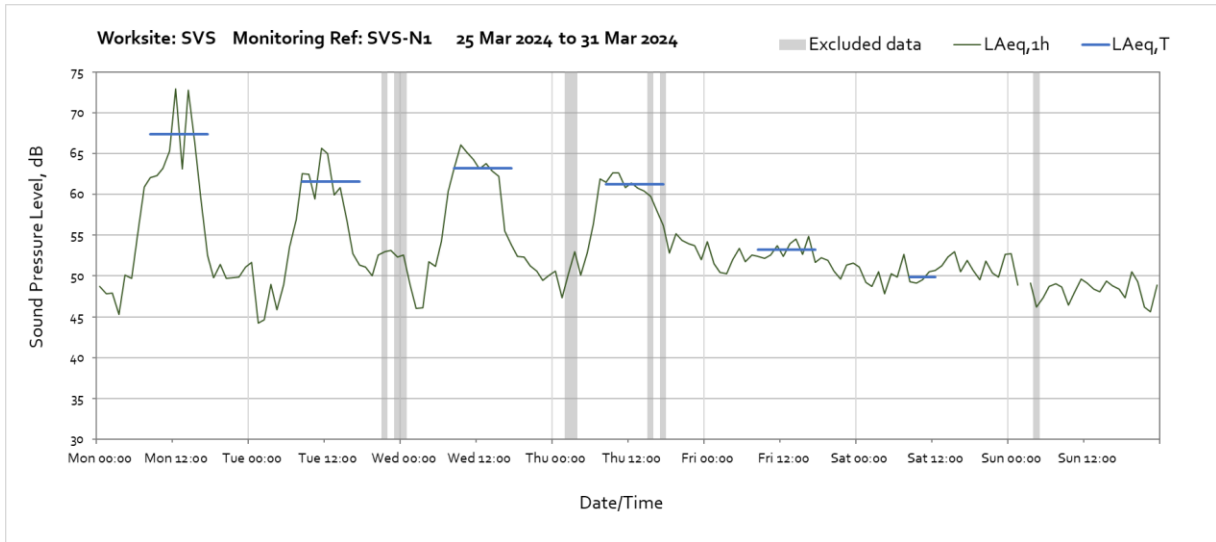
Note: Missing data between 02:00 and 03:00 on Sunday 31st March is due to a monitor time adjustment at the start of British Summer Time.

**Worksite: SVS – Monitoring Ref: SVS-N1**



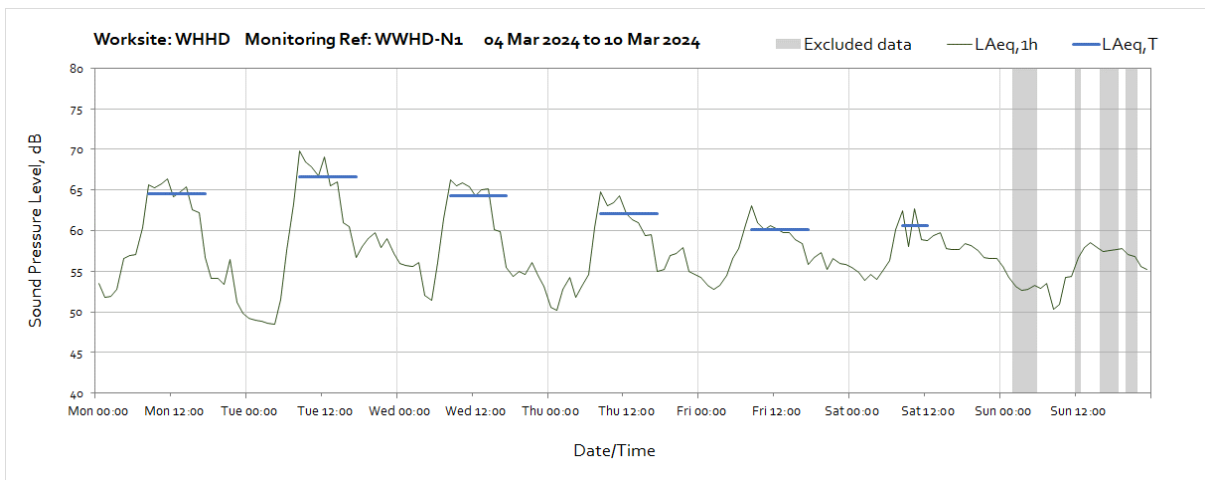
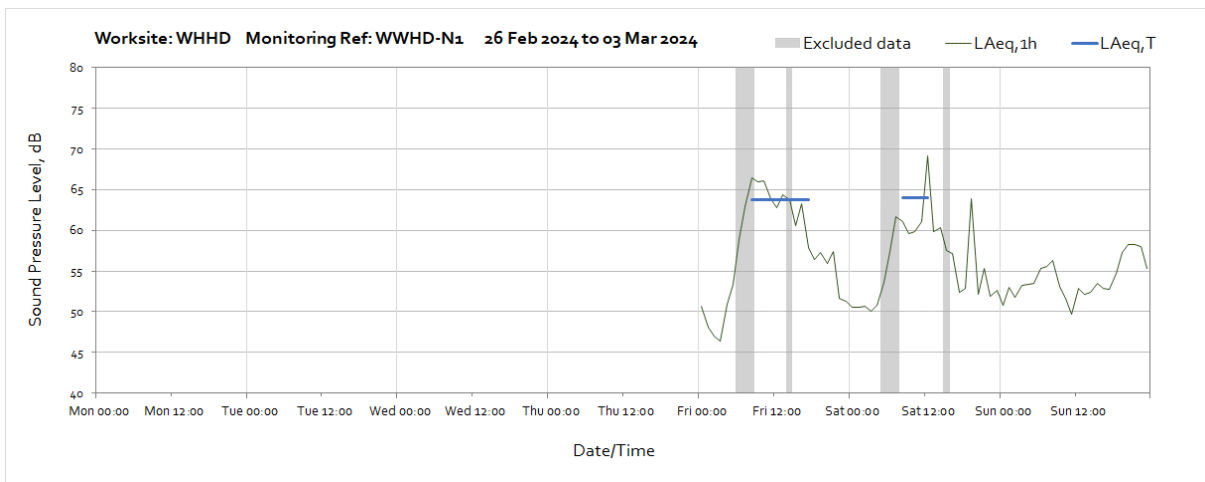
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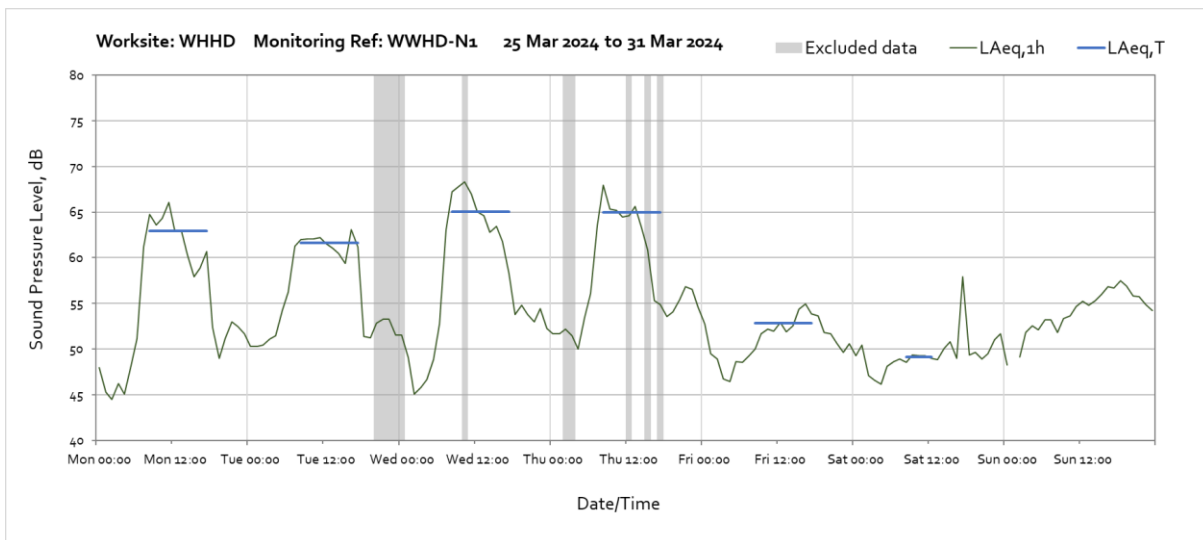
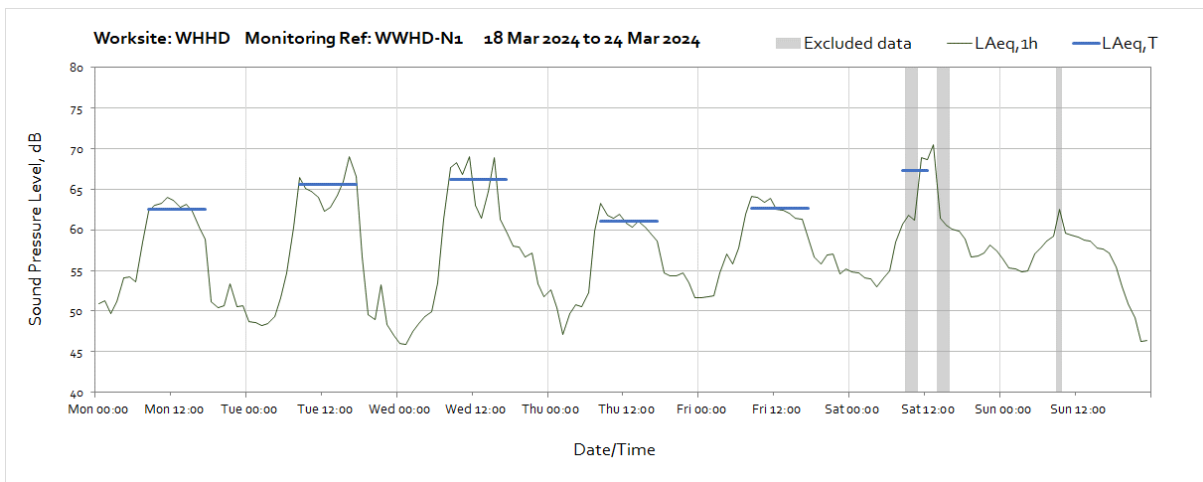
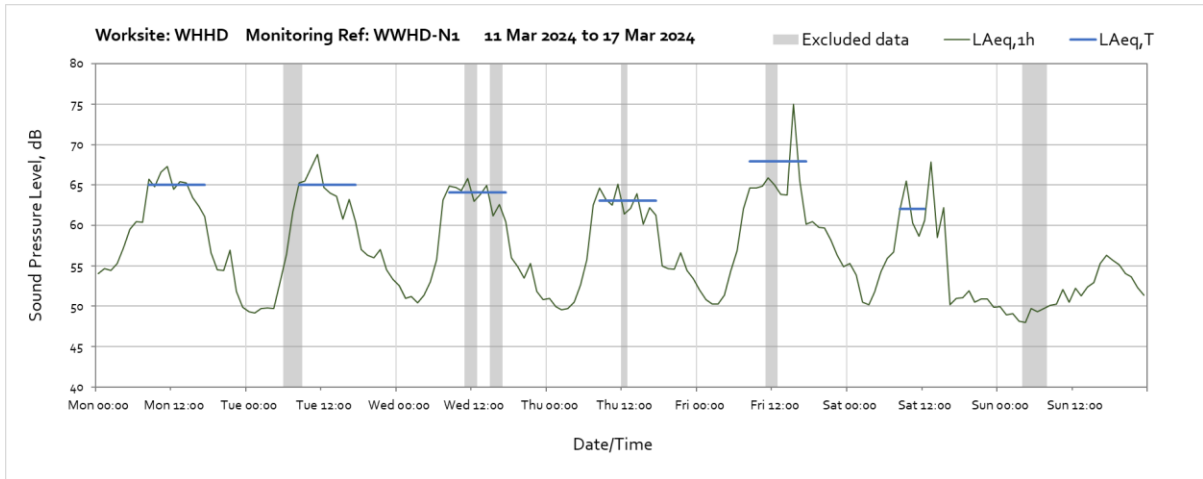




Note: Missing data between 02:00 and 03:00 on Sunday 31st March is due to a monitor time adjustment at the start of British Summer Time.

### Worksite: WWHD – Monitoring Ref: WWHD-N1

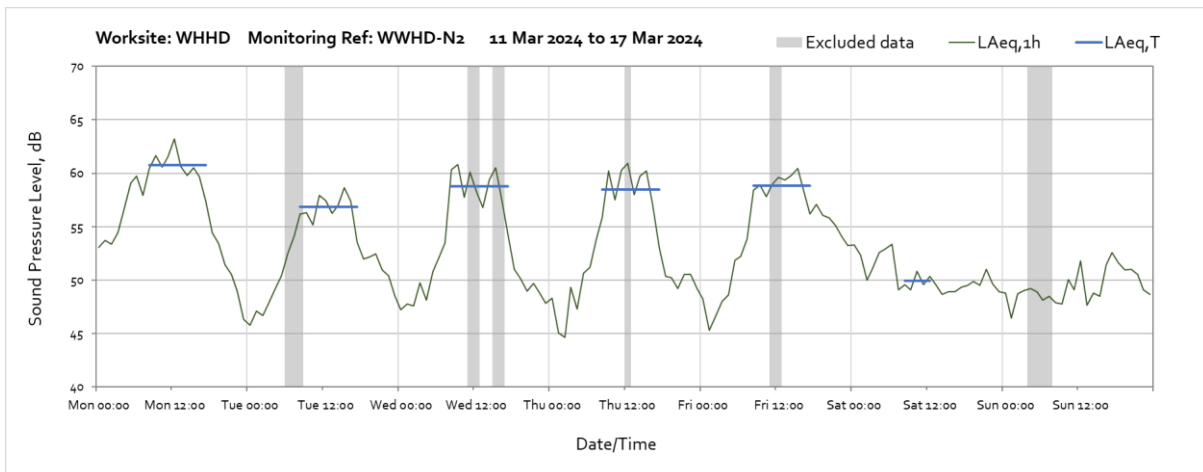
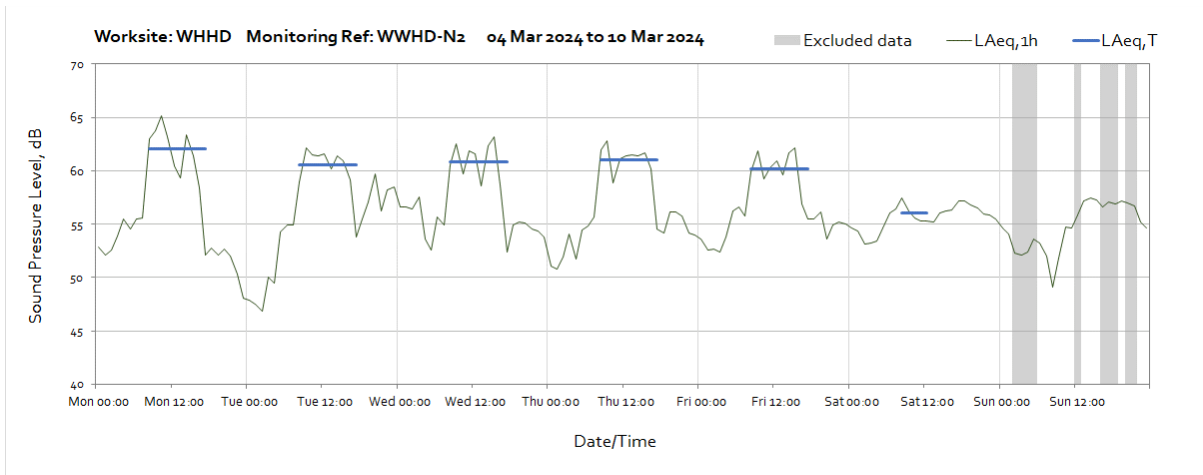
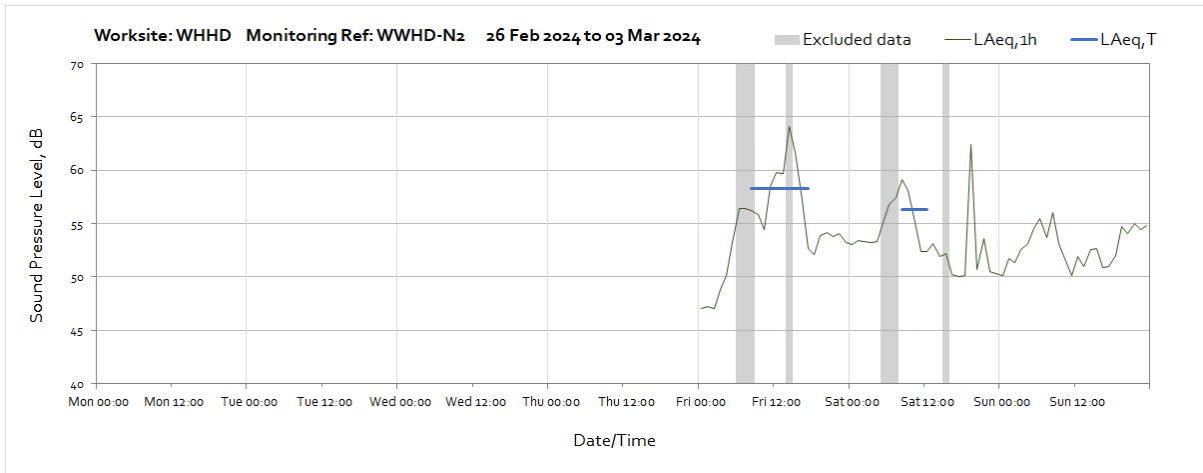




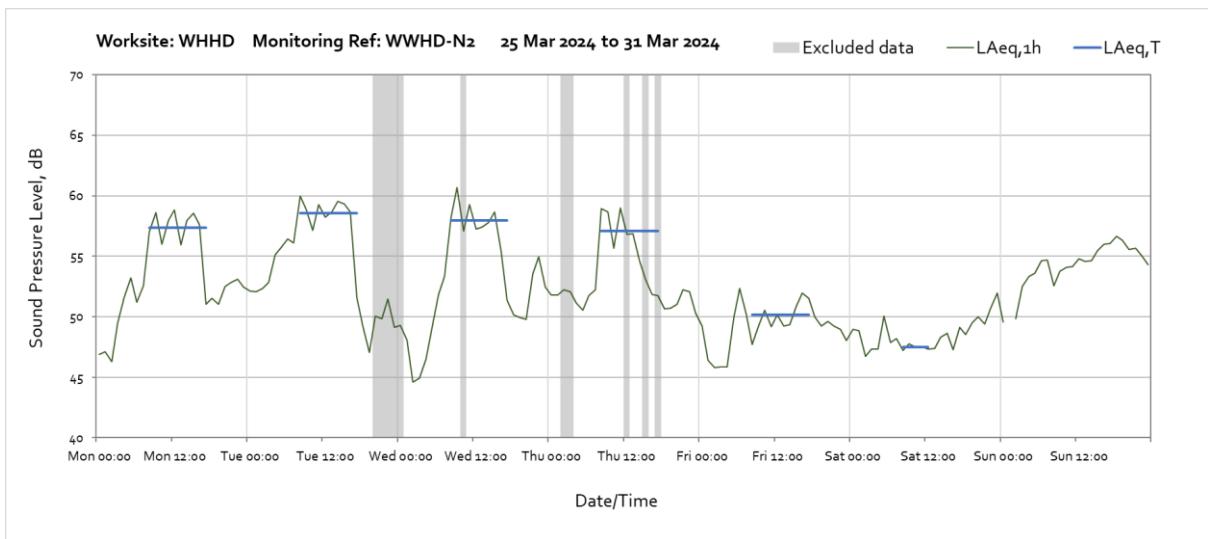
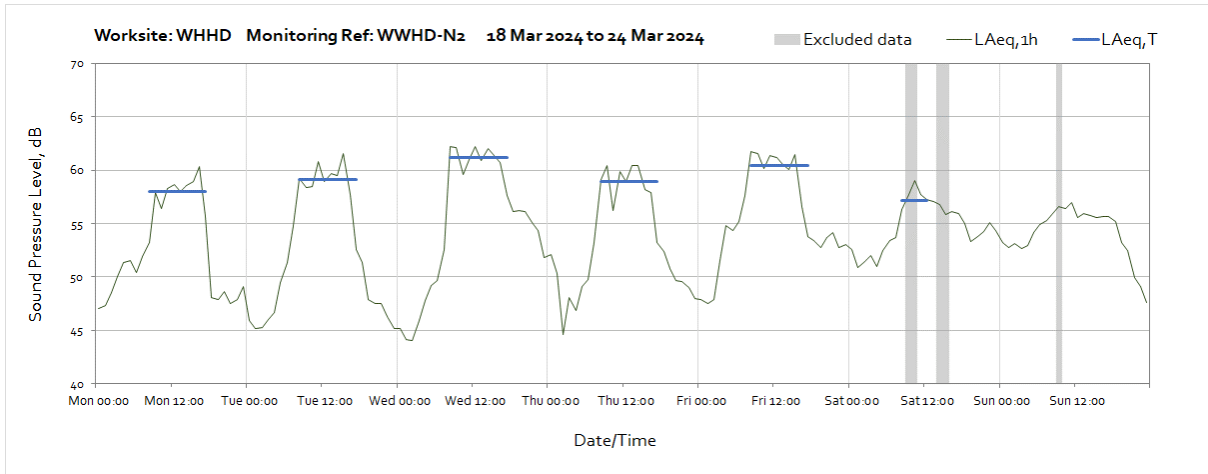
Note: Missing data between 01:00 and 02:00 on Sunday 31st March is due to a monitor time adjustment at the start of British Summer Time.

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## Worksite: WWHD – Monitoring Ref: WWHD-N2

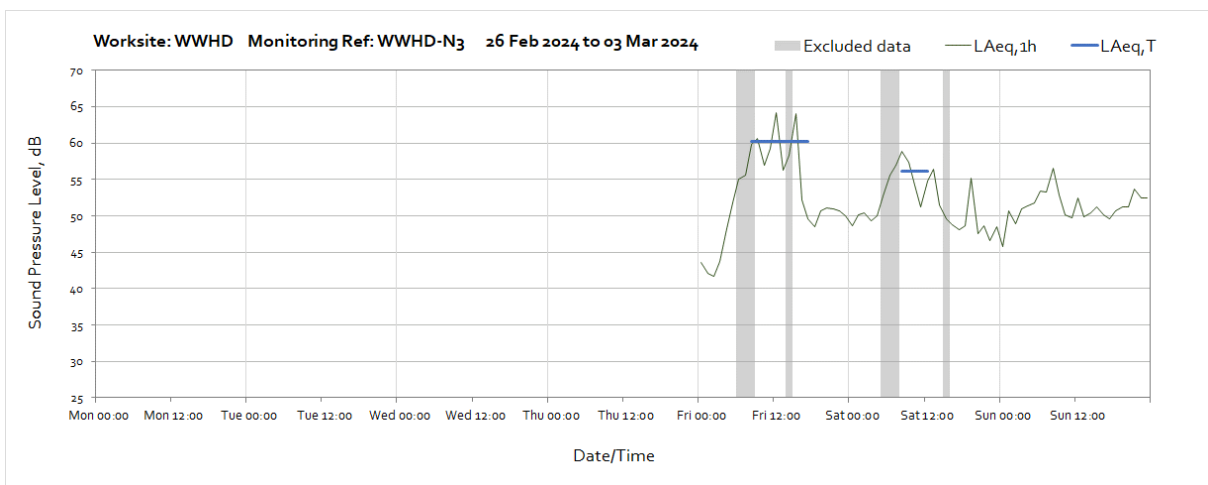


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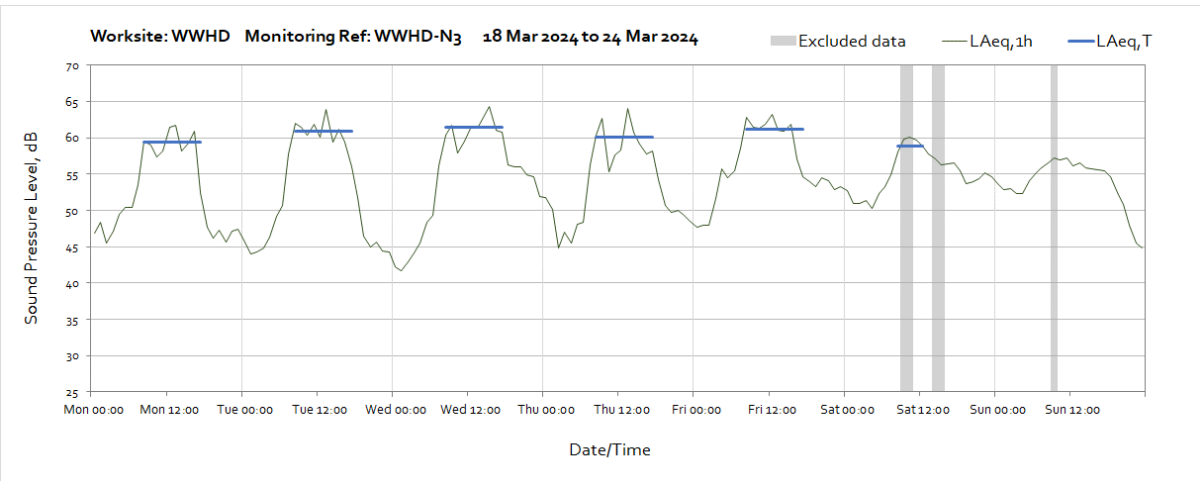
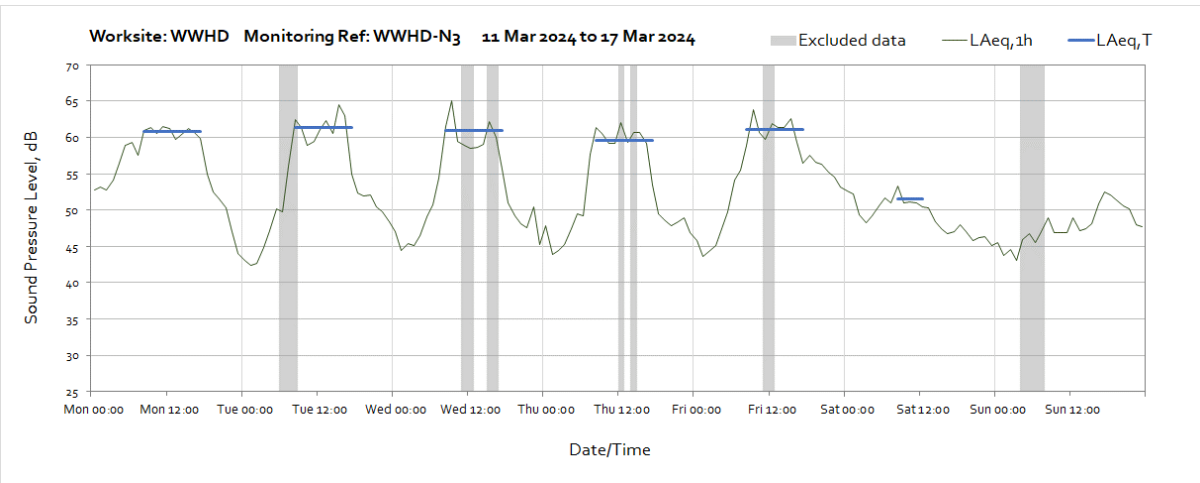
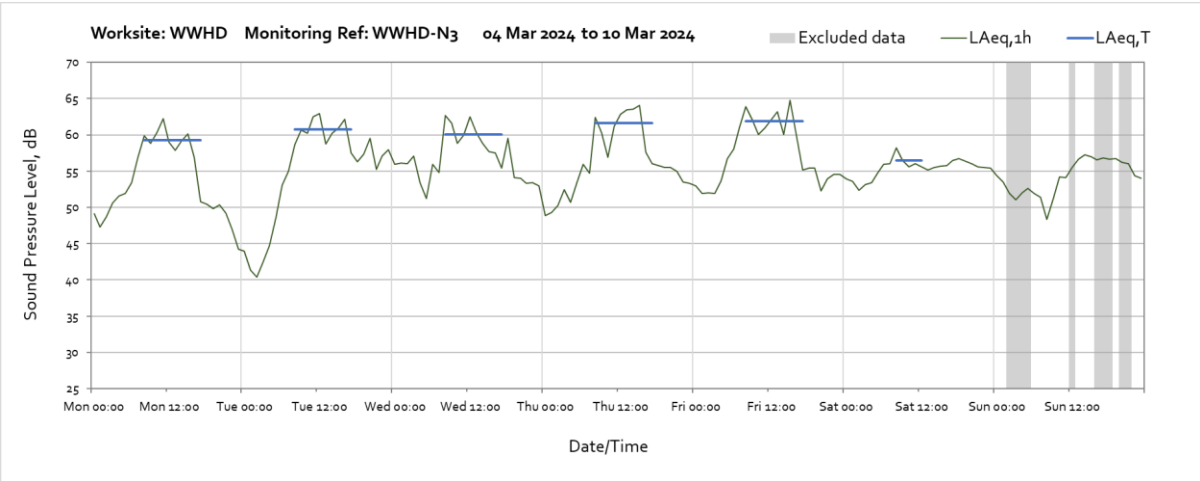


Note: Missing data between 01:00 and 02:00 on Sunday 31st March is due to a monitor time adjustment at the start of British Summer Time.

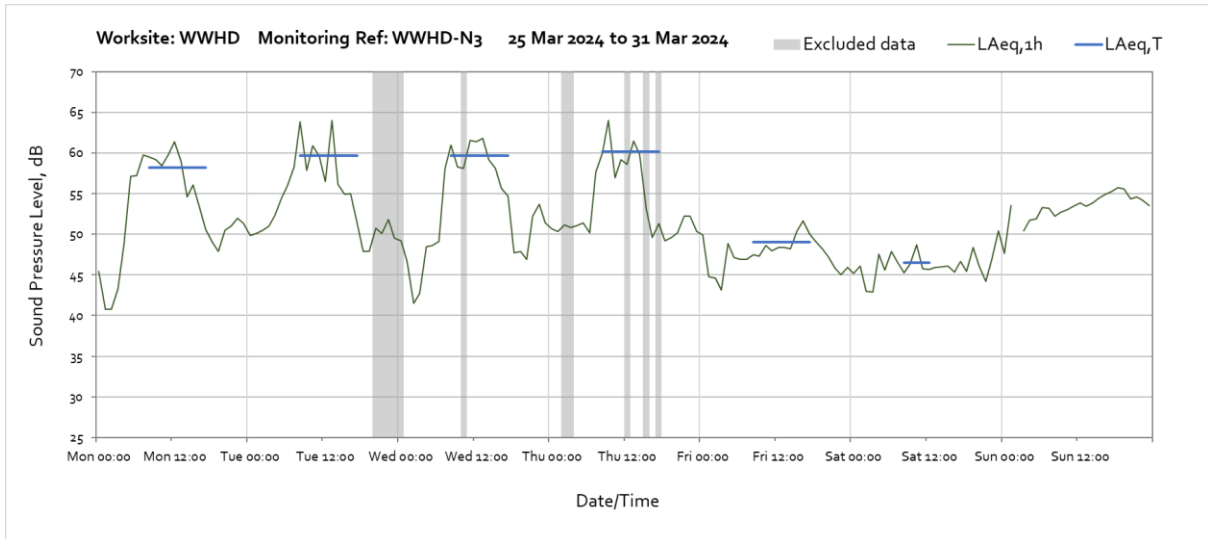
### Worksite: WWHD - Monitoring Ref: WWHD-N3



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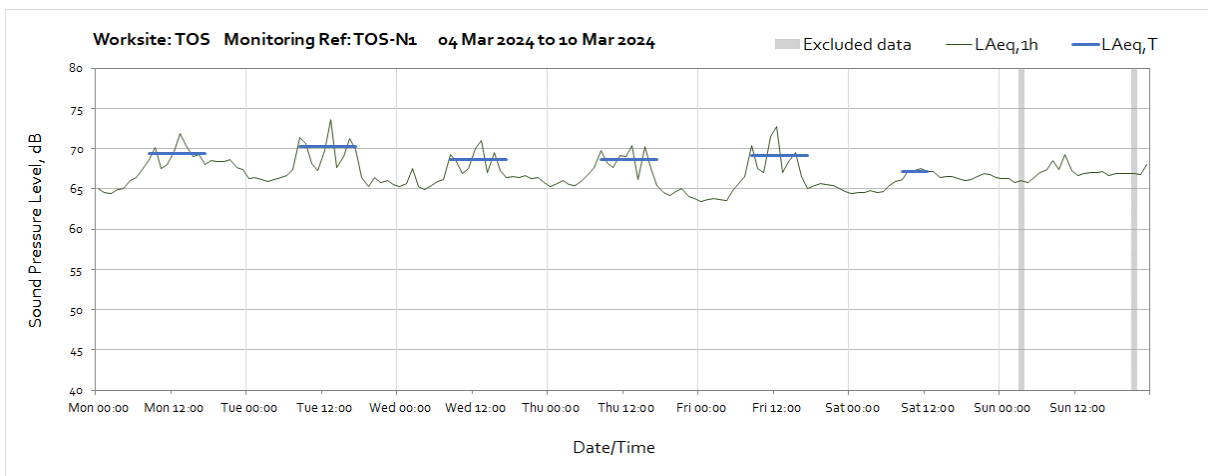
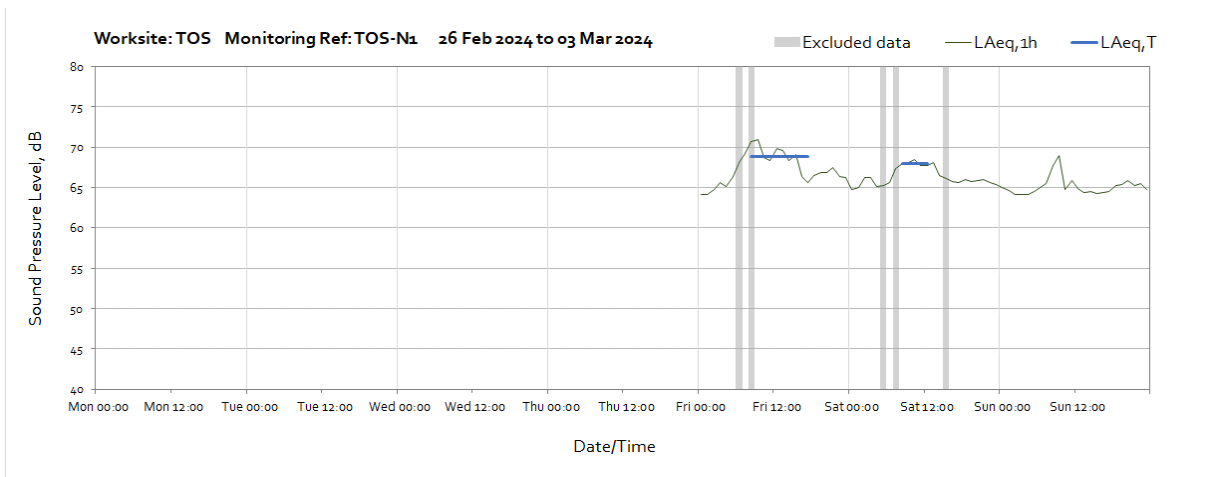


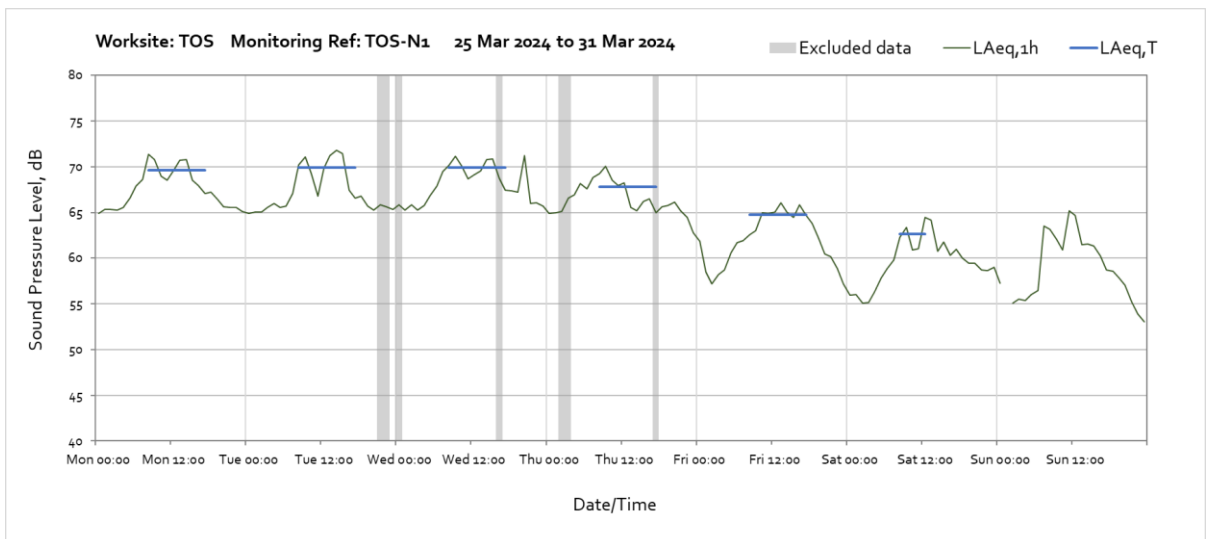
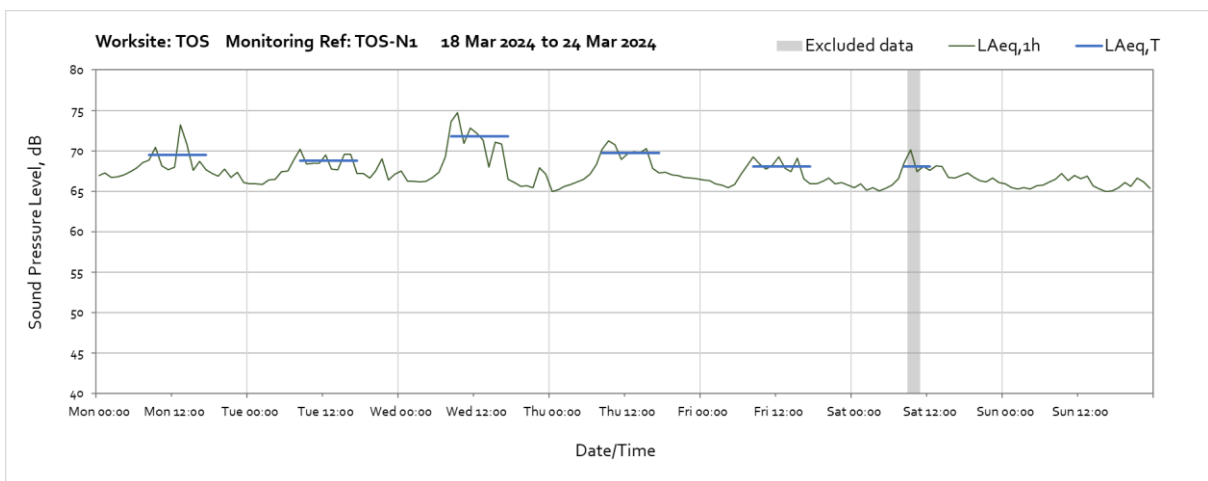
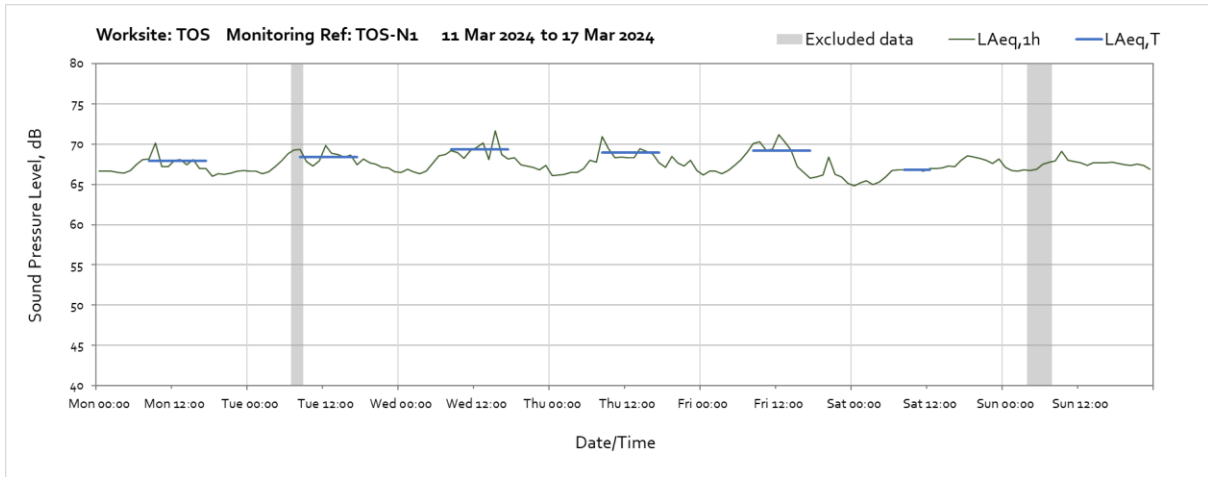




Note: Missing data between 02:00 and 03:00 on Sunday 31st March is due to a monitor time adjustment at the start of British Summer Time.

### Worksite: TOS – Monitoring Ref: TOS-N1





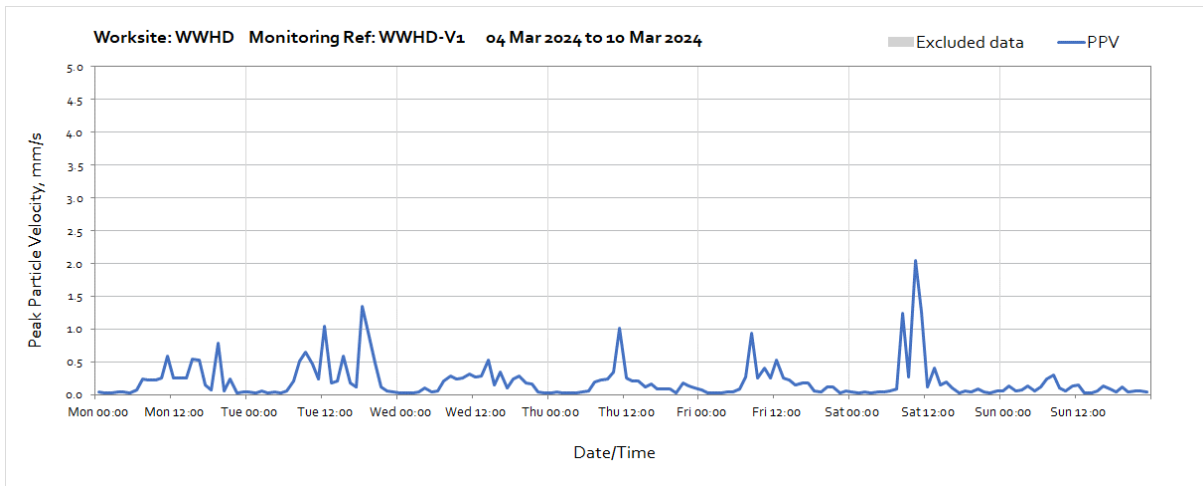
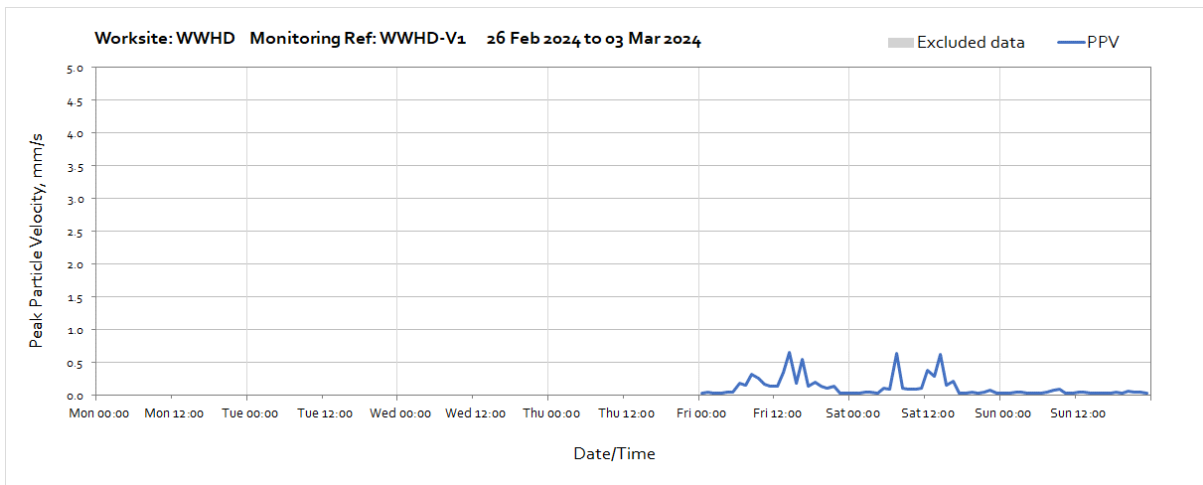
Note: Missing data between 01:00 and 02:00 on Sunday 31st March is due to a monitor time adjustment at the start of British Summer Time.

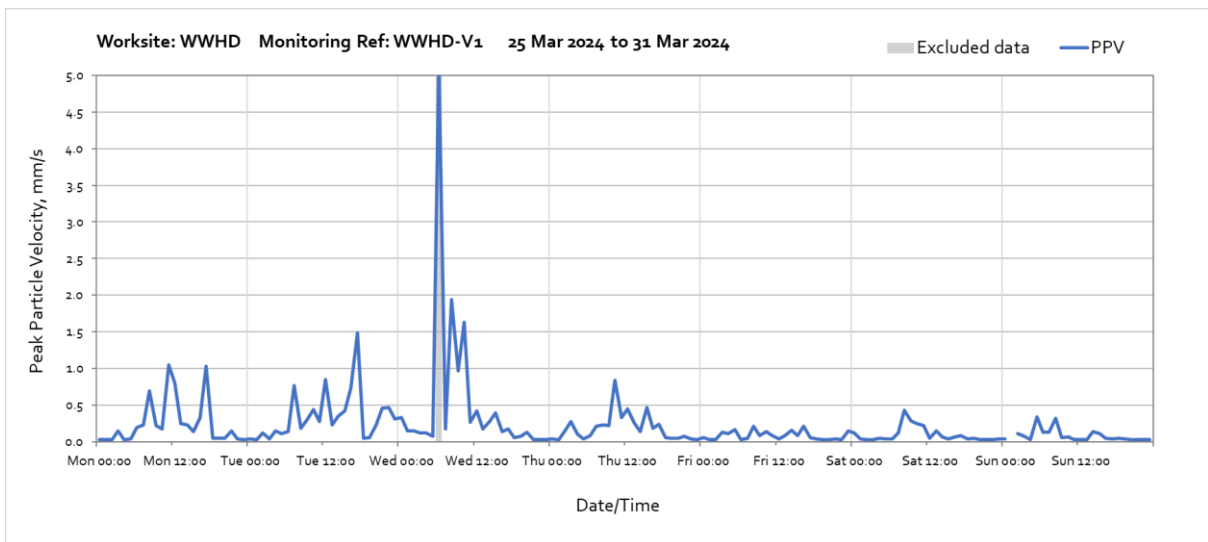
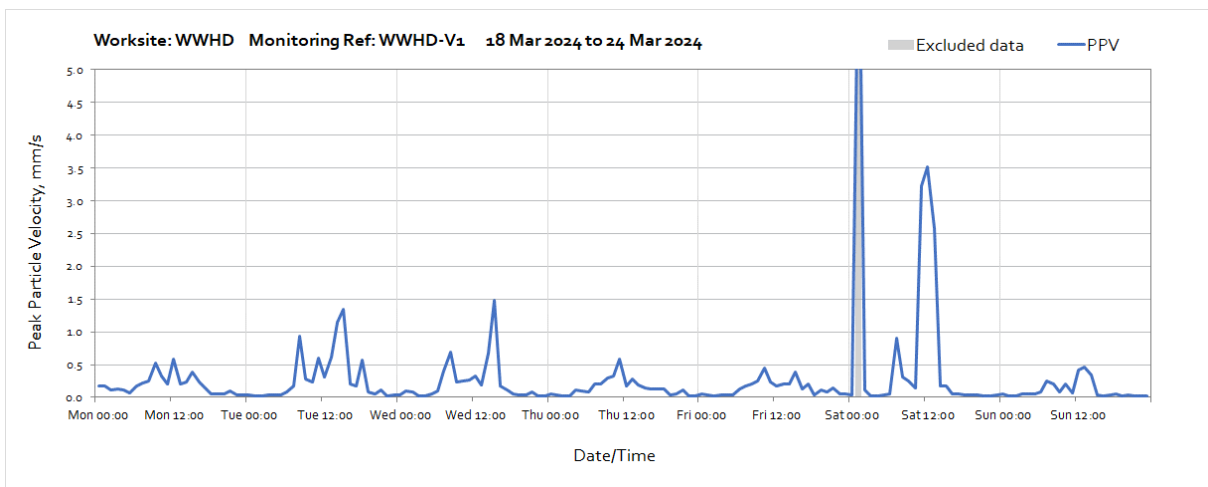
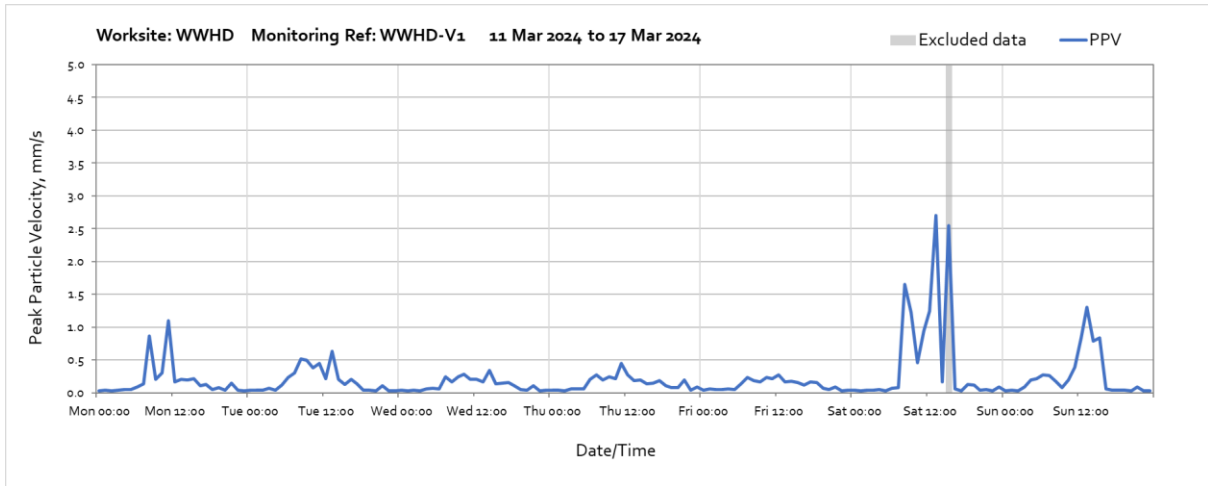
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# Vibration

The following graphs show the hourly measured peak particle velocity PPV recorded during the monitoring period. The graphs show the resultant PPV due to vibration components on three orthogonal axis x, y, and z. Periods where PPV values have been affected by local interference with the vibration monitor or only measured for part of the period, which are not representative of HS2 construction works, have been greyed out and excluded when calculating values in Table 4 of the main report.

## Worksite: WWHD – Monitoring Ref: WWHD-V1

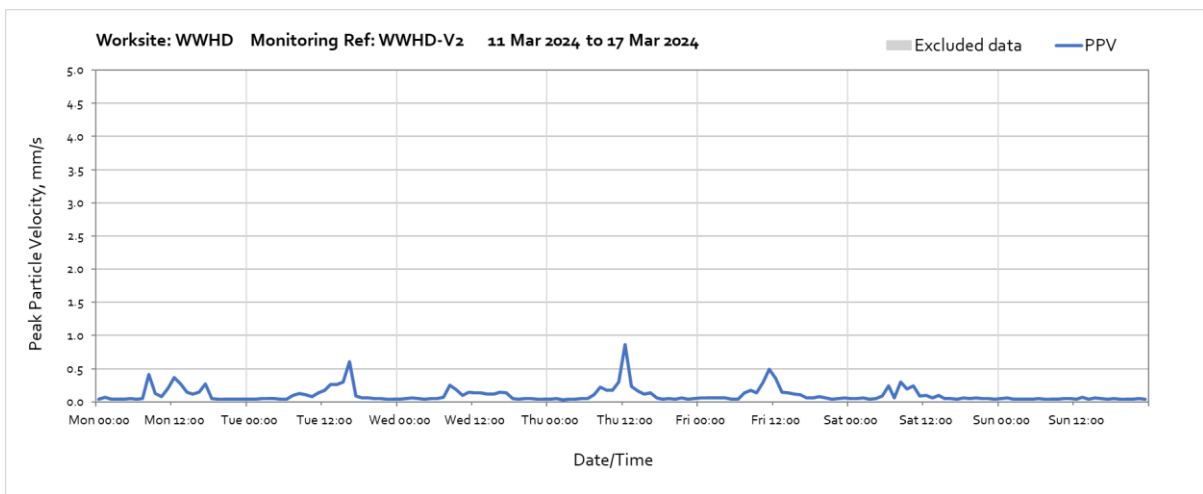
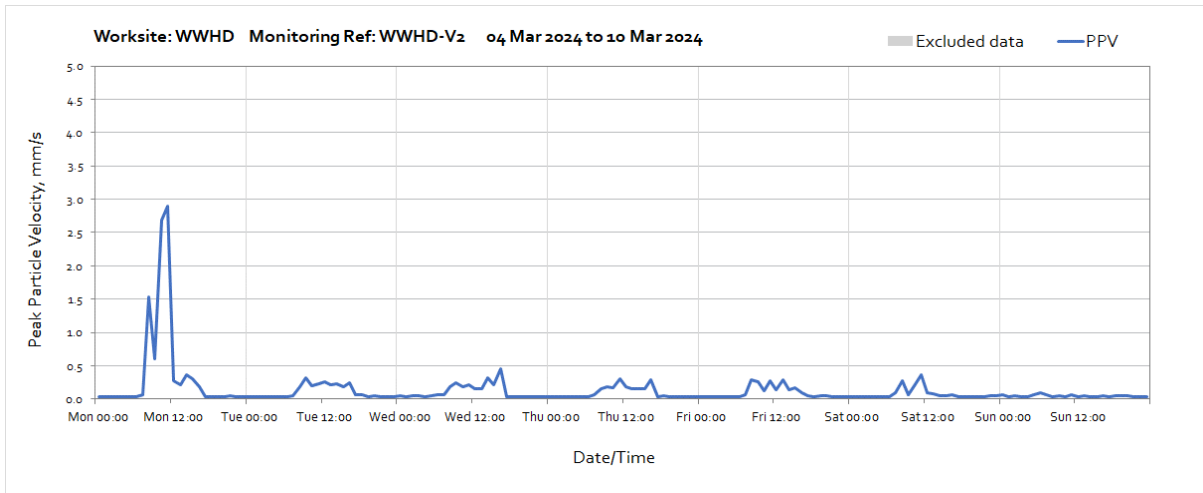
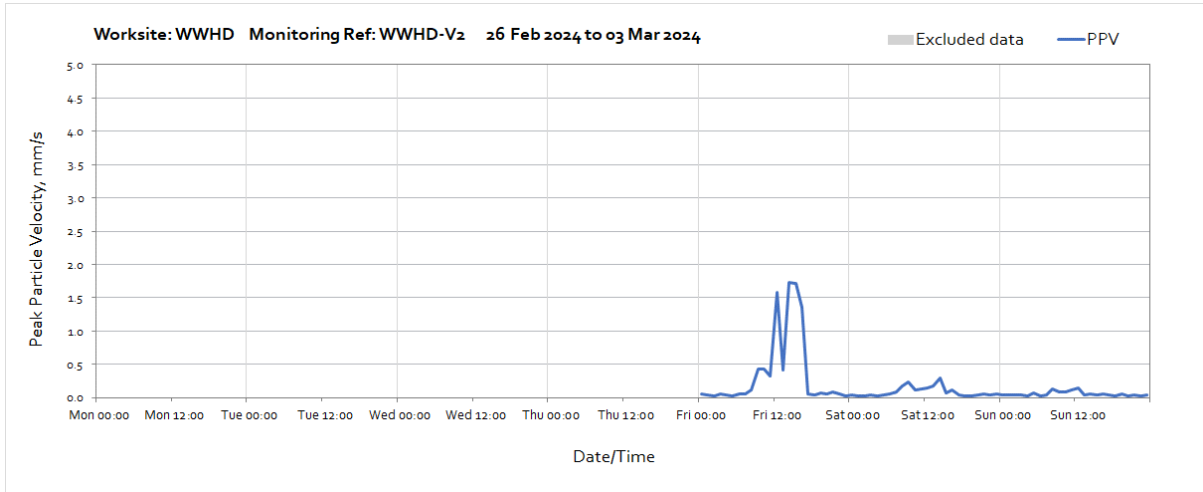


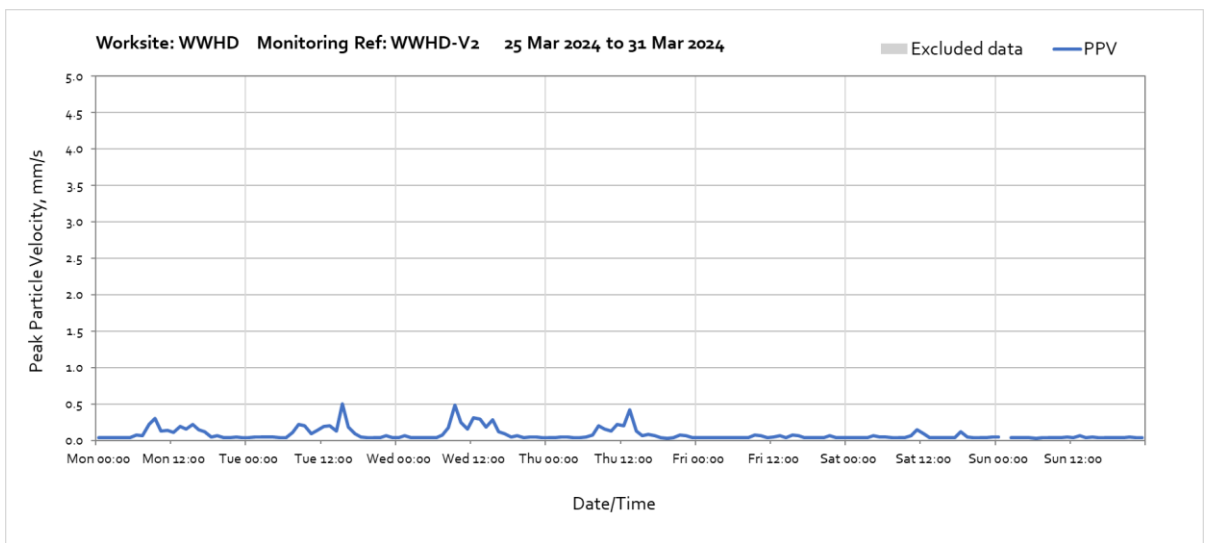
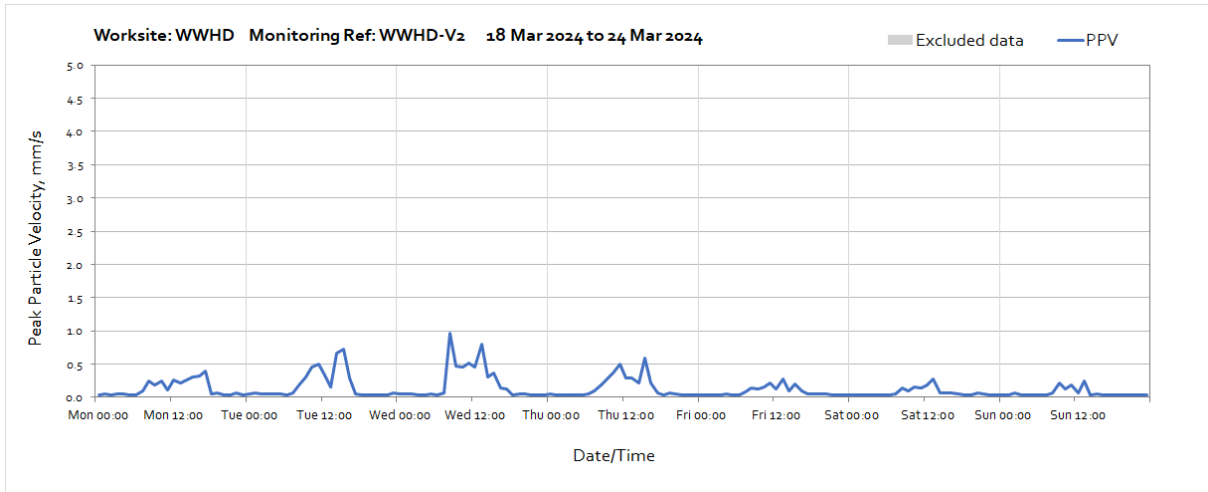


Note: Missing data between 01:00 and 02:00 on Sunday 31st March is due to a monitor time adjustment at the start of British Summer Time.

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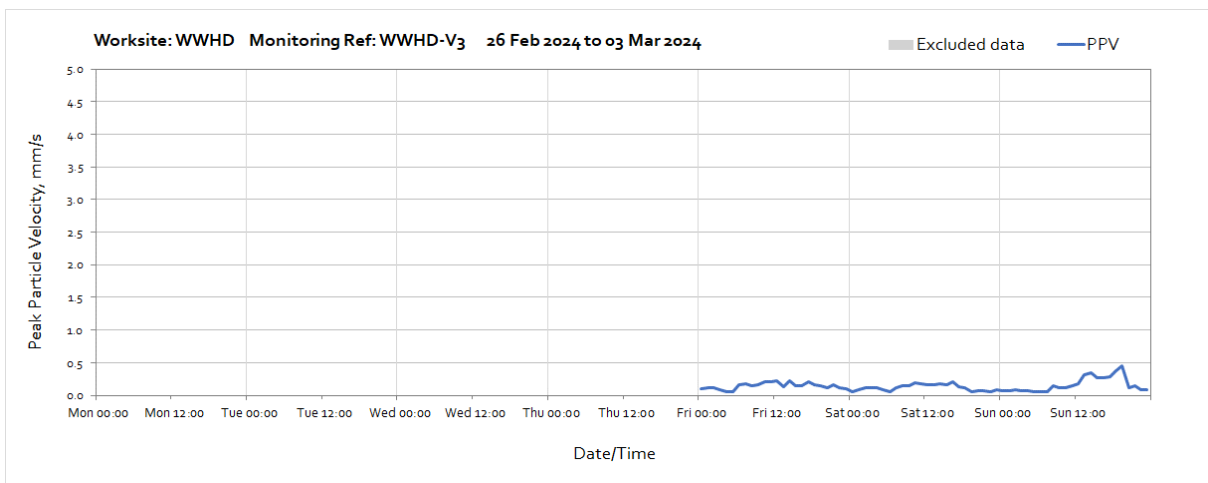
## Worksite: WWHD – Monitoring Ref: WWHD-V2



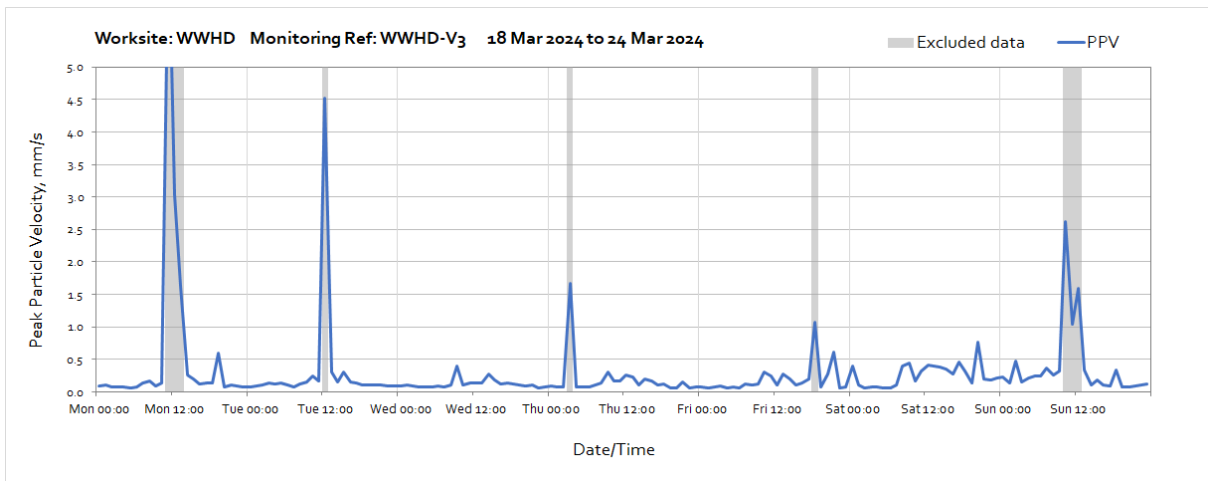
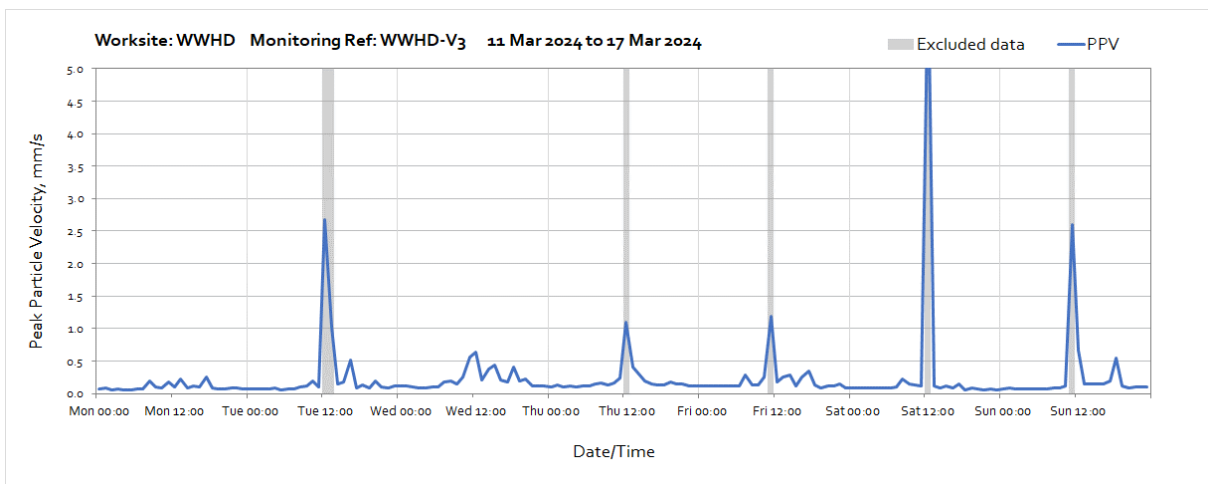
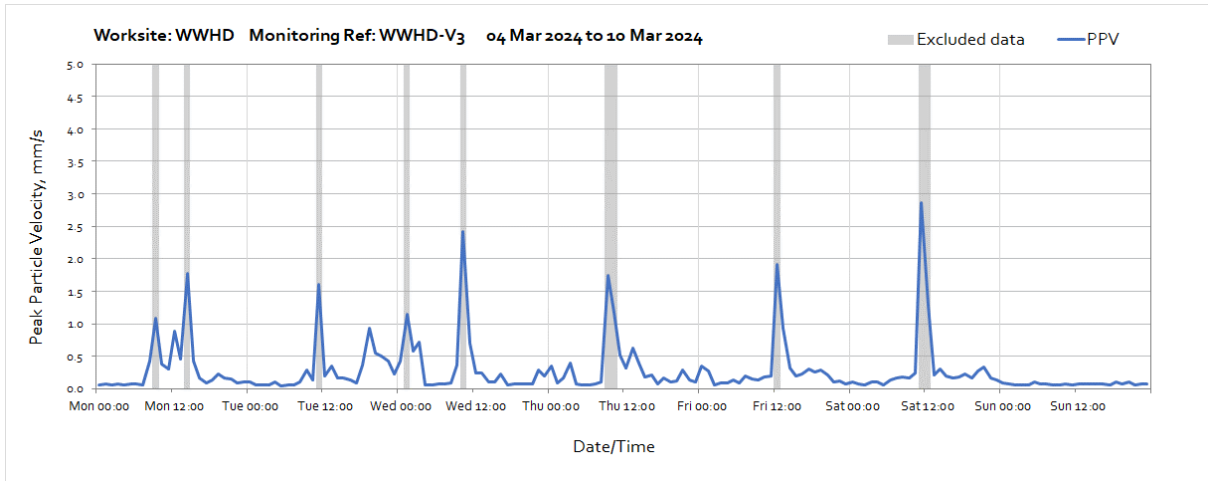


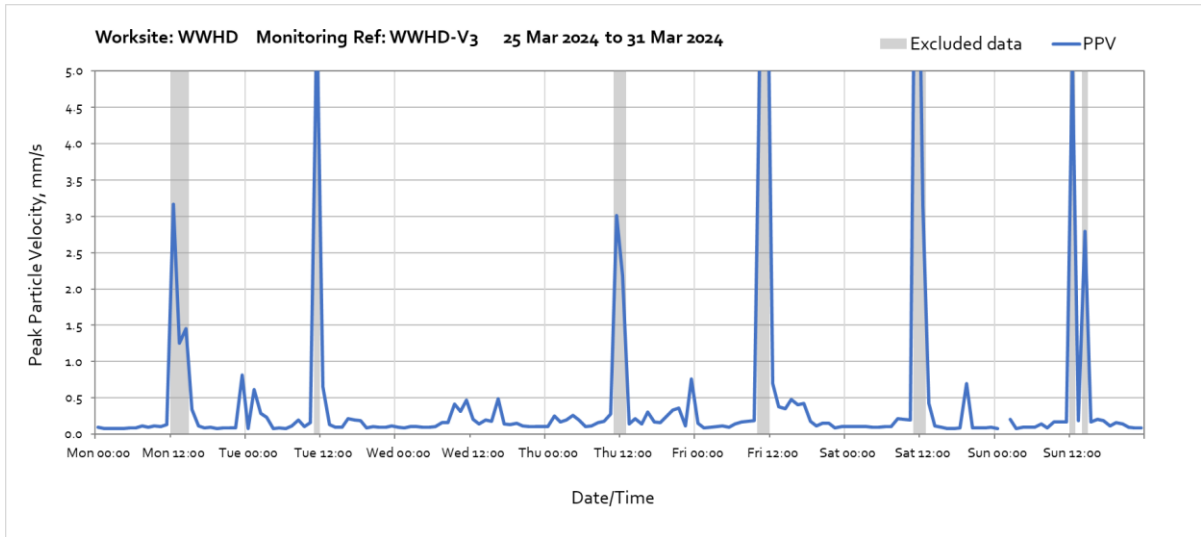
Note: Missing data between 01:00 and 02:00 on Sunday 31st March is due to a monitor time adjustment at the start of British Summer Time.

### Worksite: WWHD – Monitoring Ref: WWHD-V3



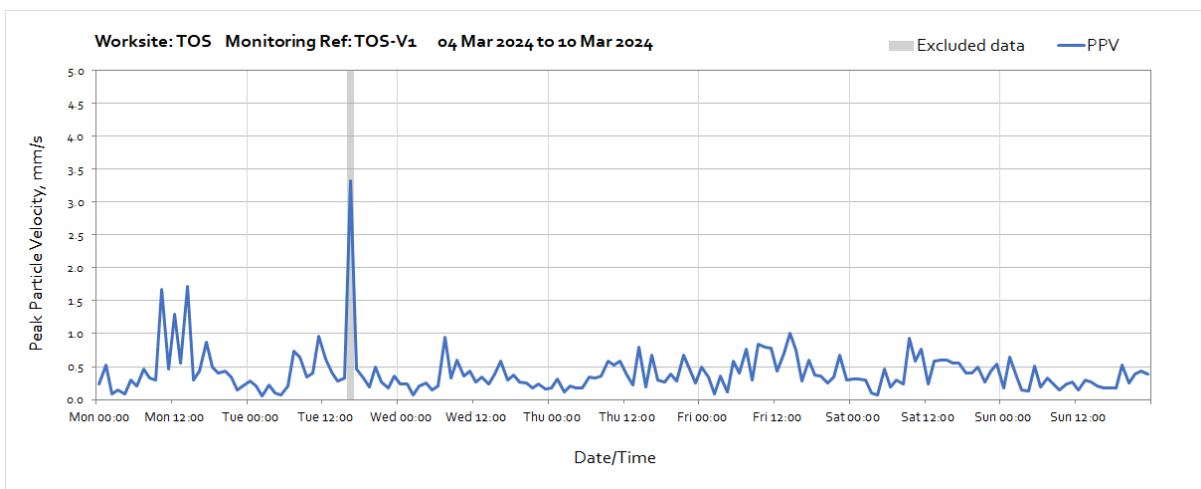
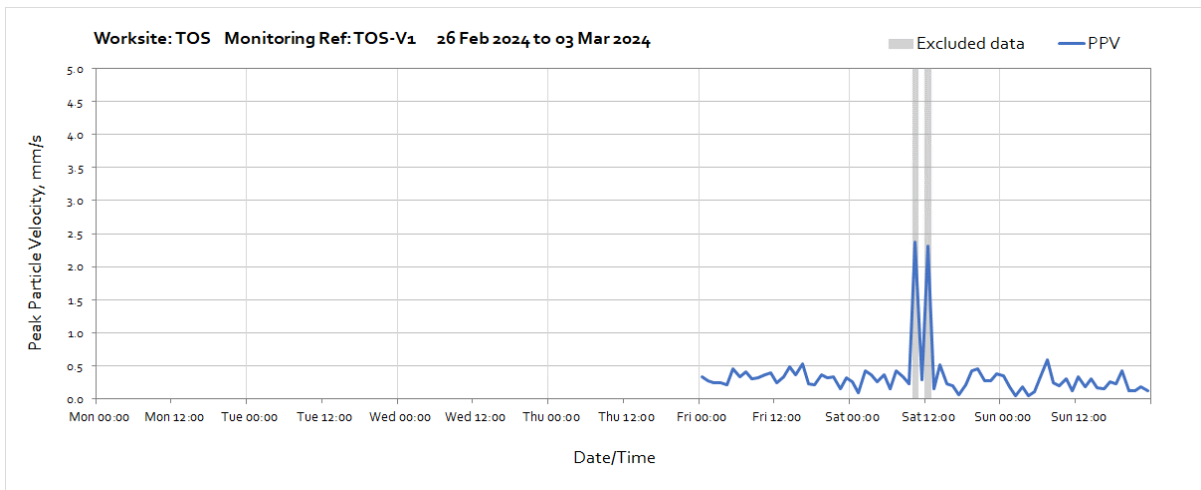
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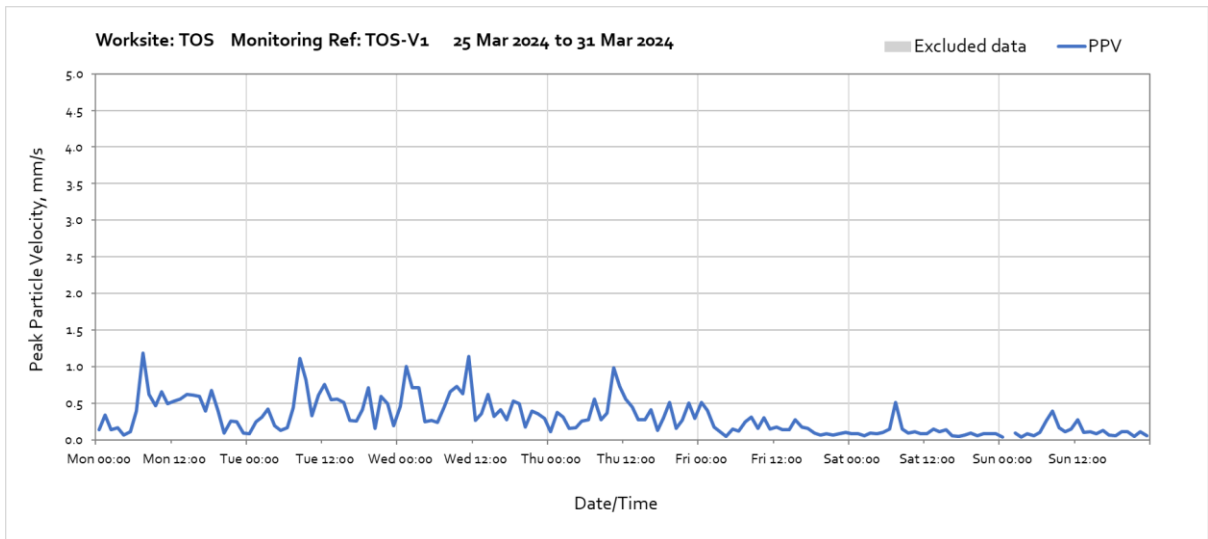
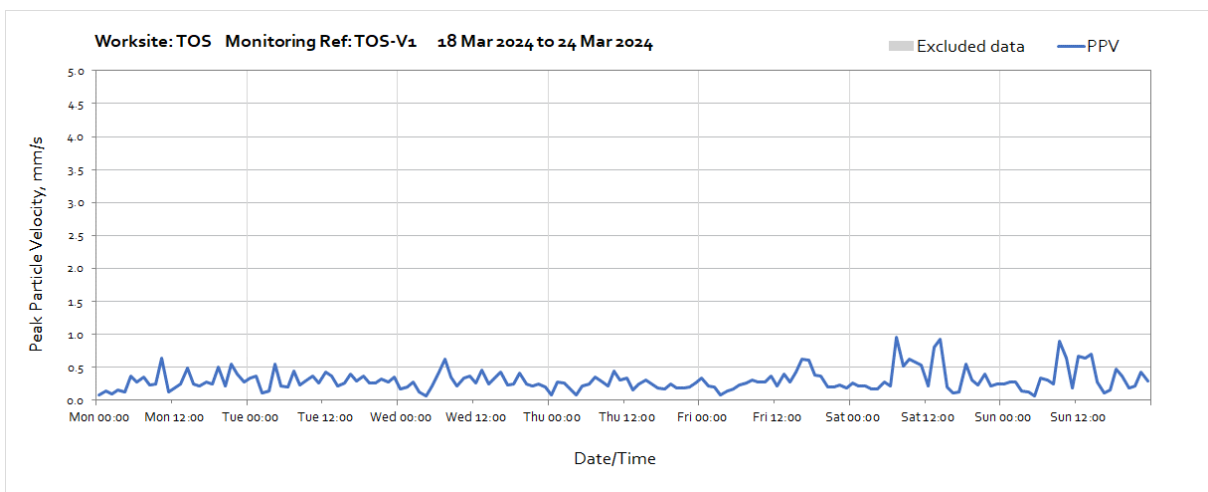
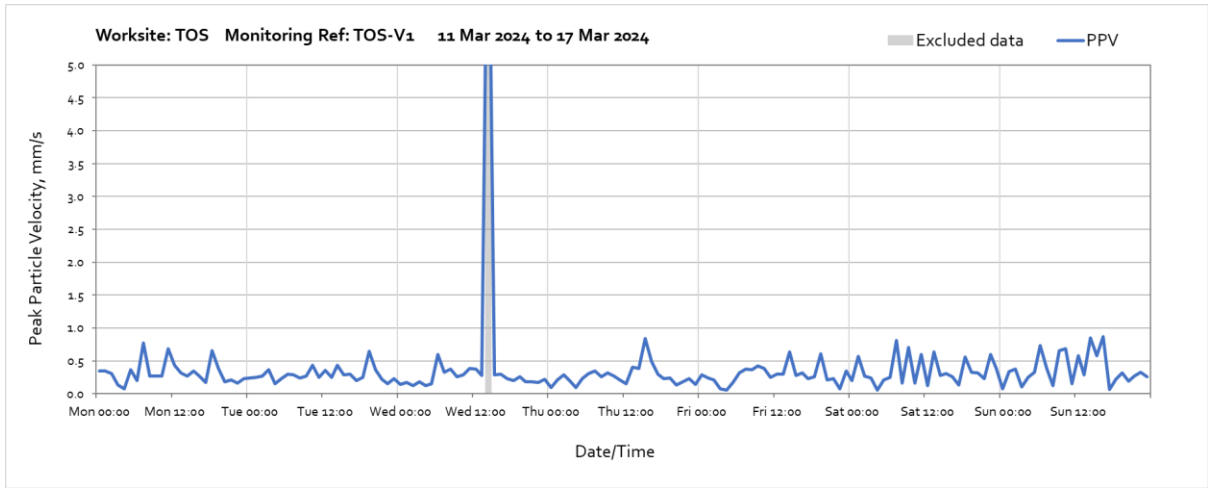
Note: Missing data between 01:00 and 02:00 on Sunday 31st March is due to a monitor time adjustment at the start of British Summer Time.

**Worksite: TOS – Monitoring Ref: TOS-V1**



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Note: Missing data between 01:00 and 02:00 on Sunday 31st March is due to a monitor time adjustment at the start of British Summer Time.

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