Proposed Residential Development
Land off Caerleon Road
Dinas Powys
CF64

Environmental Noise & Vibration Surveys

3131/ENS2_Rev1

7th July 2017

For: **Kier Living**

c/o Asbri Planning

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1.0 Introduction

It is proposed to develop land off Caerleon Road, Dinas Powys, CF64 for new residential dwellings.

The Vale of Glamorgan twin rail track runs along the western/north-western site boundary, with existing residential dwellings to the south and open farmland to the east. The A4055 Cardiff road lies to the west/north-west beyond the rail line.

This report details results of environmental noise and vibration surveys carried out to establish ambient/rail noise and vibration levels across the proposed development site, and compares results with criteria included in line with current planning guidance for residential sites.

Appendix B explains acoustic terminology used in this report.

2.0 Planning Guidance

2.1 Outline Application Condition

The following planning condition was included on the original outline planning consent (Reference no. 2014/00282/OUT);

"Notwithstanding the submitted noise survey, full details of measures to mitigate for the effect of noise and vibration from the main railway line and Cardiff Road to the north and west of the site, which shall include acoustic glazing, ventilation and acoustic fencing to those properties which are shown to be impacted upon in an updated noise and vibration survey, shall be submitted to and approved in writing by the Local Planning Authority prior to the beneficial occupation of any dwelling hereby approved. The approved mitigation measures shall be undertaken prior to occupation of identified properties.

Reason: To ensure that adequate noise mitigation is implemented for those properties adversely affected in accordance with Policies ENV27, ENV29 of the Unitary Development Plan and national guidance contained in TAN11."

2.2 Technical Advice Note (Wales) 11

Noise bands defining categories A - D of TAN 11 are set in terms of $L_{Aeq,16hr}$ daytime, and $L_{Aeq,8hr}$ night time levels for rail traffic noise, free field 1.2 - 1.5m above ground level as follows;

Table 1. Recommended noise exposure categories for new dwellings near existing noise sources (ref Table 2 of TAN 11 (Wales) October 1997)

Noise Source	Time	Noise Exposure Categories			
		A	B	C	D
Rail Traffic	07:00-23:00	<55	55-66	66-74	>74
	23:00-07:00	<45	45-59	59-66	>66

Note: In addition, sites where individual noise events regularly exceed 82dB(A) L_{max}(slow), several times in any night time hour should be treated as being in NEC C, unless the L_{eq}(8 hour) already puts the site in NEC D.

The above L_{max} guidance included in TAN 11 can be read in conjunction with BS 8233:1999 which recommends individual noise events should not 'normally' exceed 45dB(A) L_{max} (fast) in bedrooms between 2300-0700hrs - night-time.

No guidance on what constitutes 'normally' is given, however World Health Organisation (WHO) Guidelines for Community Noise states *"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10-15 times per night (Vallet & Vernet 1991)"*.

2.3 Proposed Planning Condition - Railway Noise

The following condition has been proposed in Memorandum dated 10/04/2017 from Sue Brown of Vale of Glamorgan Environmental Health;

"Prior to commencement of development a scheme shall be submitted to and approved in writing by the Local Planning Authority to provide that all habitable rooms exposed to external road traffic noise in excess of 55 dBA Leq 16 hour (free field) during the day (07.00 to 23.00 hours) or 45 dBA

Leq 8 hour (free field) at night (23.00 to 07.00 hours) shall be subject to sound insulation measures to ensure that all such rooms achieve an internal noise level of 35 dBA Leq 16 hour during the day and 30 dBA Leq 8 hour at night, with the $L_{Amax,F}$ if 45dB not being exceeded.
The submitted scheme shall ensure that habitable rooms subject to sound insulation measures shall be provided with acoustically treated active ventilation units. Each ventilation unit (with air filter in position), by itself or with an integral air supply duct and cowl (or grille), shall be capable of giving variable ventilation rates ranging from –

1. *an upper rate of not less than 37 litres per second against a back pressure of 10 newtons per square metre and not less than 31 litres per second against a back pressure of 30 newtons per square metre, to*
2. *a lower rate of between 10 and 17 litres per second against zero back pressure.*

No habitable room shall be occupied until the approved sound insulation and ventilation measures have been installed in that room. Gardens shall be designed to provide an area which is at least 50% of the garden area for sitting out where the maximum day time noise level does not exceed 50 dBA Leq 16 hour [free field]."

Reason: To ensure that the amenities of future occupiers are protected."

2.3 Typical Planning Condition - Railway Vibration

"Prior to commencement of development a scheme shall be submitted to and approved in writing by the Local Planning Authority to provide that the dwellings are designed and constructed so as to ensure that vibration dose values do not exceed 0.4m/s$^{1.75}$ between 07.00 and 23.00 hours, and 0.26m/s$^{1.75}$ between 23.00 and 07.00 hours, as calculated in accordance with BS 6472:1992, entitled "Guide to Evaluation of Human Exposure to Vibration in Buildings", [1Hz to 80Hz]. The dwellings shall be constructed in accordance with the approved scheme.

REASON: To ensure that the amenities of future occupiers are protected."

2.4 General Comments

- A central ventilation/extract system designed to the latest Building Regulations Part F may be considered as an alternative to the mechanical vents quoted above - to be confirmed with Local Planning Authority/EHO.

3.0 Site Surveys

The proposed development site is located on land off Caerleon Road, Dinas Powys, CF64.

The Vale of Glamorgan twin rail track runs along the western/north-western site boundary, with existing residential dwellings to the south and open farm land to the east. The A4055 Cardiff road lies to the west/north-west beyond the rail line.

Therefore, the only noise sources are road and rail running along the western/north-western site boundary.

3.1 Procedures

3.1.1 Continuous Noise Monitoring

Site plan 3131/SP1 in Appendix A shows the development site and continuous monitoring location used, namely:

Position 1 Located on fence on western boundary of site, approximately 10m from closest rail line at 1.5m above local ground height.

Continuous noise monitoring was carried out from 1100hrs on 20/02/2017 to 1100hrs on 21/02/2017 in order to assess the existing noise climate at the proposed residential dwellings.

Data including L_{max}, L_{eq}, and L_{90} was logged at 1-minute intervals over the monitoring period.

3.1.2 Continuous Vibration Monitoring

Continuous vibration monitoring was carried out from 1100hrs on 20/02/2017 to 1100hrs on 21/02/2017 covering rail traffic movements on the Vale of Glamorgan rail line.

Vibration levels were monitored in three orthogonal axes: radial (horizontal, perpendicular to line of tracks), tangential (horizontal, parallel to line of tracks) and vertical.

Consecutive 1 minute 1/3rd octave RMS acceleration spectra (arms) were recorded via the accelerometer as well as hourly VDVs at Position 2;

Position 2 Located at the base of concrete fence post, approximately 10 metres from closest rail line.

3.2 Equipment

3131/T1 - Equipment List

Make	Description	Model	Serial Number	Last Calibrated	Certificate No.
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-08723-E0	20-Dec-16	1612652
NTi	Preamplifier	MA220	1820	20-Dec-16	1612650
NTi	Filters	XL2-TA	A2A-08723-E0	20-Dec-16	1612651
NTi	Microphone	Capsule	9381	20-Dec-16	1612650
Svantek	Type 1 - Sound & Vibration Data Logger	SVAN 948	6962	12-Aug-15	1508455
Dytran	Tri-axial Accelerometer	3233A	158	12-Aug-15	1508455
Dytran	Cable	6483A09	-	12-Aug-15	1508455

Measurement systems were calibrated before and after the survey, no variation occurred.

3.3 Weather Conditions

Weather history graph 3131/WH1 in Appendix A shows approximate weather data for monitoring period. To summarise, weather conditions were mainly dry with some patches of light rain through-out the night-time and early morning period, warm with no significant winds.

4.0 Results

4.1 Continuous Noise Monitoring

Results of the survey are shown in time history 3131/TH1 in Appendix A.

The ambient noise levels on site were controlled by road traffic noise on the A4055 to the west/north-west and the Vale of Glamorgan rail line along the west/north-western boundary. The following $L_{Aeq,16hr}$ daytime and $L_{Aeq,8hr}$ night-time noise levels have been measured;

- Daytime (0700-2300hrs) $L_{eq,16hr}$ = 62.0dB(A) NEC B
- Night-time (2300-0700hrs) $L_{eq,8hr}$ = 56.7dB(A) NEC B *

* Two $L_{max,F}$ events above 82dB were recorded during the night, these were caused by train pass-bys.

Note: We understand from the freight department in Network Rail that the Swansea to London main line is often closed for maintenance, every night for 1 week in maybe 4 or 5 weeks at some point between Bridgend and Cardiff. During this maintenance period, freight is re-routed down the Vale of Glamorgan line.

The Swansea to London main line was closed during our survey and therefore night-time rail movements down this line are likely to indicate worst case levels. Audio recording identify 19 train pass-bys during the night-time period.

Rail noise is therefore indicated to fall under NEC B of TAN11 during both the daytime and night-time along the western/north-western boundary.

Worst-case L_{eq} and L_{max} freight spectra at position 1 are shown in graph 3131/G1 in Appendix A.

4.2 Continuous Vibration Monitoring

Table 3131/T2 shows hourly vibration dose values measured at Position 2, together with the daytime (0700-2300hrs) and night-time (2300-0700hrs) VDV levels for comparison with criteria quoted in the typical local authority planning condition.

Graphs 3131/G2 and 2876/G3 show third-octave band RMS vibration spectra for typical sprinter and freight train pass-by respectively. These include the old BS 6472:1992 curves (for information only).

For train movements the vertical axis of vibration is assessed as critical, therefore vertical VDV_b figures are assessed.

VDVs for comparison with the typical planning condition are as follows:

$VDV_{b,day(0700-2300hrs)}$ = 0.038 $m/s^{1.75}$ Limit = 0.4 $m/s^{1.75}$

$VDV_{b,night(2300-0700hrs)}$ = 0.037 $m/s^{1.75}$ Limit = 0.26 $m/s^{1.75}$

5.0 Noise Predictions

Due to the size of the site and screening provided by proposed dwellings, a noise map has been plotted to allow the future noise climate to be predicted across the site.

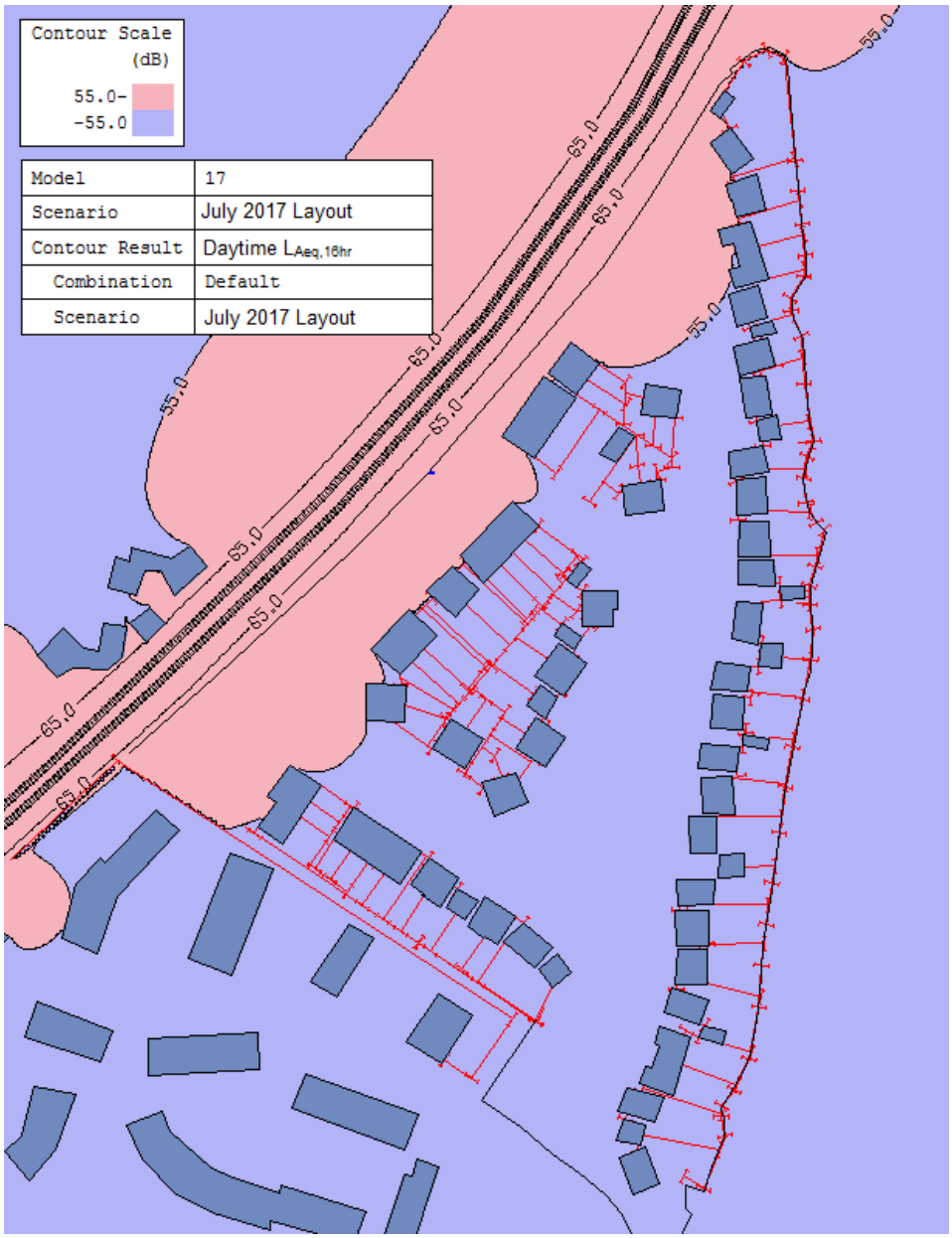
Proposed site layout plan shown in 3131/D1 in Appendix A has been used.

Note: 1.8m high closed boarded fences have been modelled around gardens as indicated on the housing layout plan in Appendix A.

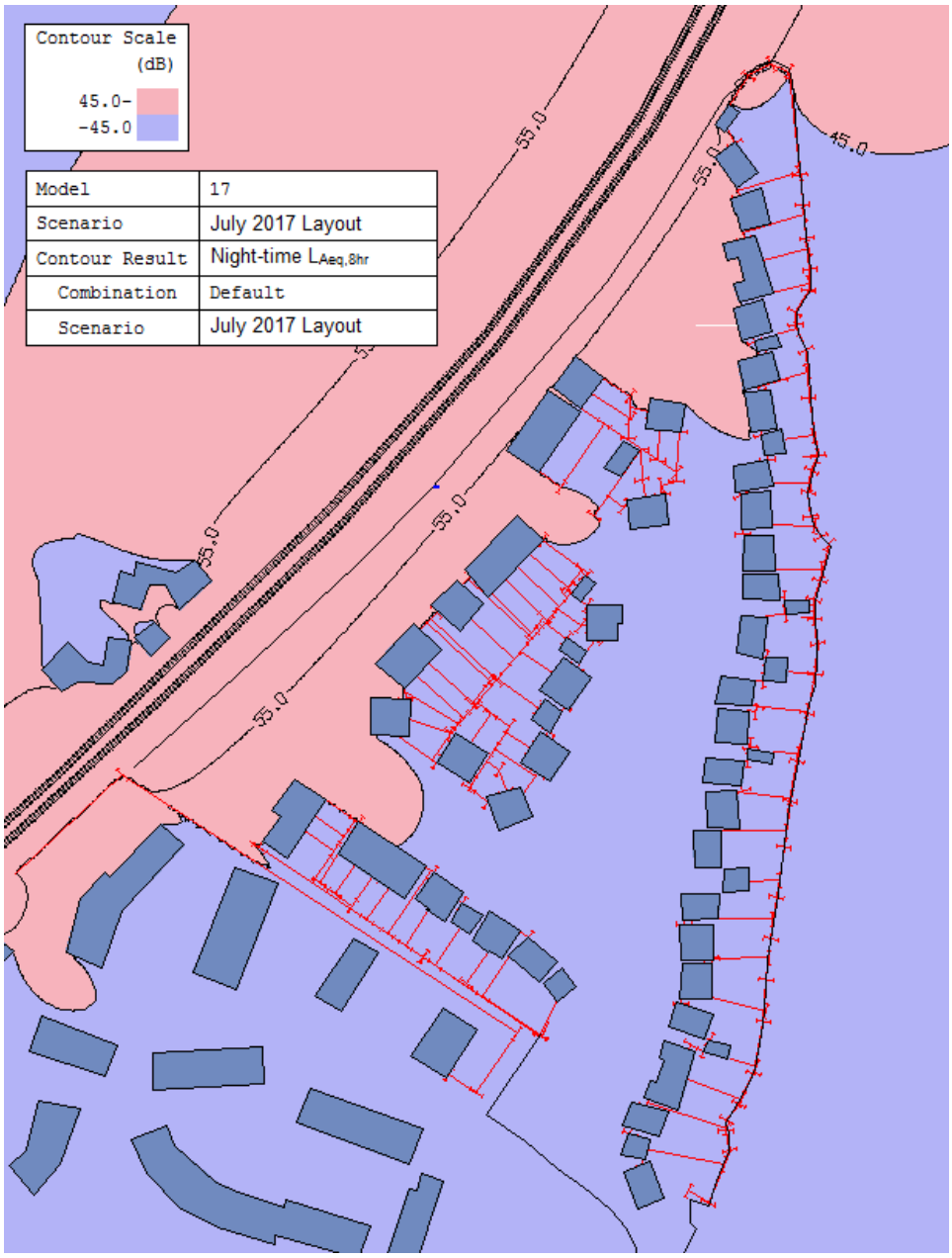
Results from the noise surveys discussed above have been used to aid calibration of the noise maps. Noise maps have been plotted using Noise Map Five software.

Noise map 3131/NM1 and NM2 below show daytime and night-time noise levels respectively, compared against the 55dB / 45dB trigger levels quoted in the proposed planning condition.

3131/NM1 – Daytime Comparison with 55dB $L_{Aeq,16hr}$ Trigger Level (Ground Floor)



3131/NM2 – Night-time Comparison with 45dB $L_{Aeq,8hr}$ Trigger Level (Ground Floor)



6.0 Discussion

6.1 Vibration

Vibration levels at the western/north-western boundary are not indicated to be excessive and fall well below the vibration dose value (VDV) limits quoted in the typical local planning authority condition.

Third-octave band RMS vibration spectra for sprinter and freight train pass-bys are also shown to fall below the old BS 6472:1992 curves – see graphs 3131/G2 and G3.

Subjectively on site during a freight pass-by vibration was not perceptible.

6.2 Noise

Both daytime $L_{Aeq,16hr}$ and night-time $L_{Aeq,8hr}$ noise levels on the western/north-western boundary are indicated to exceed L_{eq} trigger levels set out in the proposed planning condition. With a typical R_w 27dB reduction for standard thermal double glazing and trickle ventilation, this is indicated to be sufficient to control average daytime and night-time L_{Aeq} levels to achieve the 35dB L_{Aeq} day and 30dB L_{Aeq} night-time criteria. However the typical condition requests an active ventilation unit (mechanical ventilation) on plots that exceed trigger levels.

Since our earlier report, British Standard 8233 has been superseded with BS 8233:2014. The $L_{max,F}$ criterion in bedrooms of 45dB $L_{Amax,F}$ has now been removed however in the latest standard under Note 4 of Table 4 it states;

"NOTE 4 Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values."

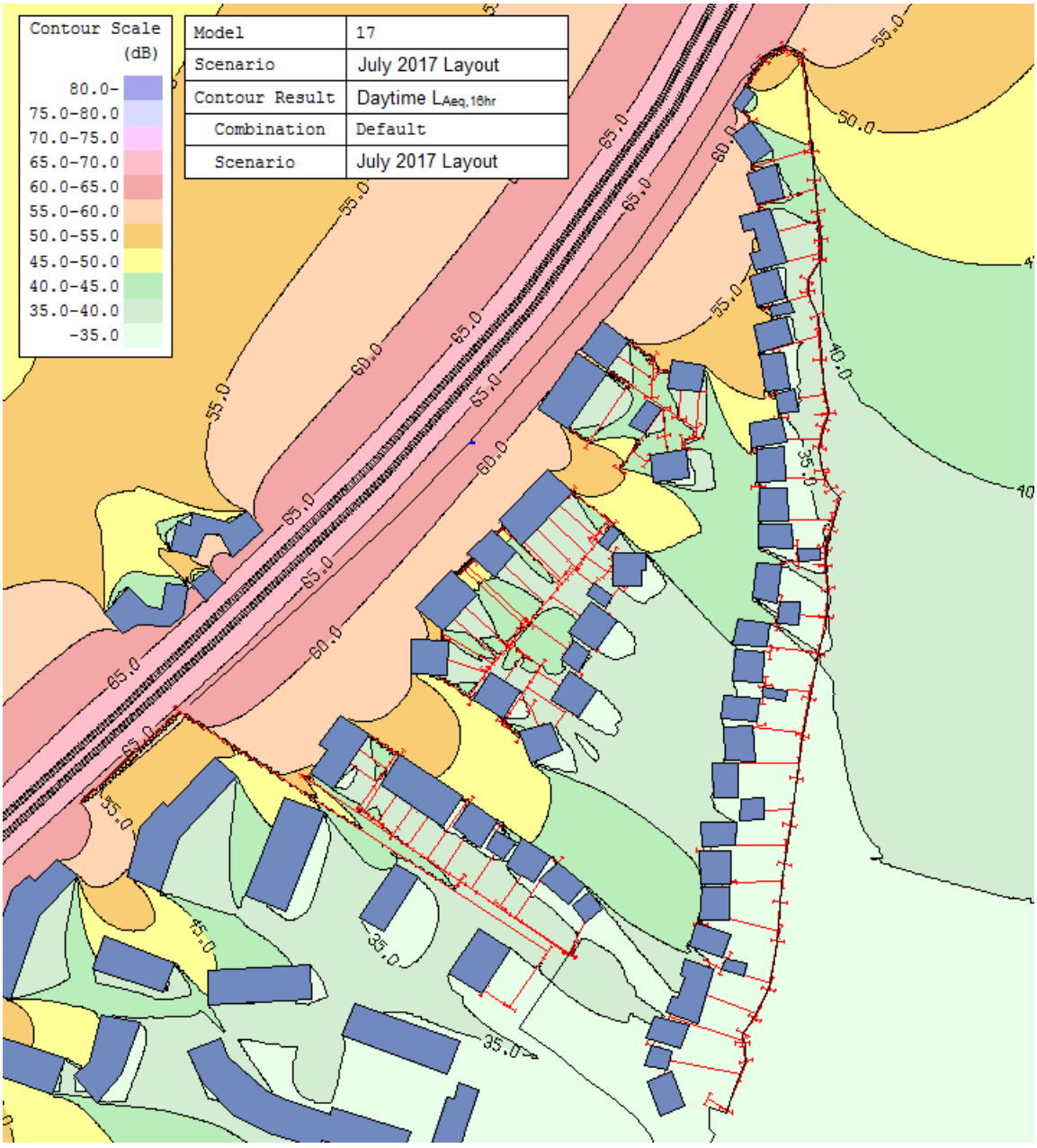
With a significant number of rail movements down the line during the night, bedrooms with direct line of sight to the rail line should include up-rated acoustic glazing and mechanical ventilation. Refer to external building fabric assessment in section 7.0.

6.3 Garden Noise

Noisemap 3131/NM3 below shows that all gardens on the scheme achieve a level of 50dB $L_{Aeq,16hr}$ in at least 50% of the garden area.

The proposed housing layout shows garden areas do not back on to the rail lines and are screened by the houses and therefore have no line of sight to the rail tracks.

3131/NM3 – Daytime Noise Contours at 1.5m above Local Ground Height

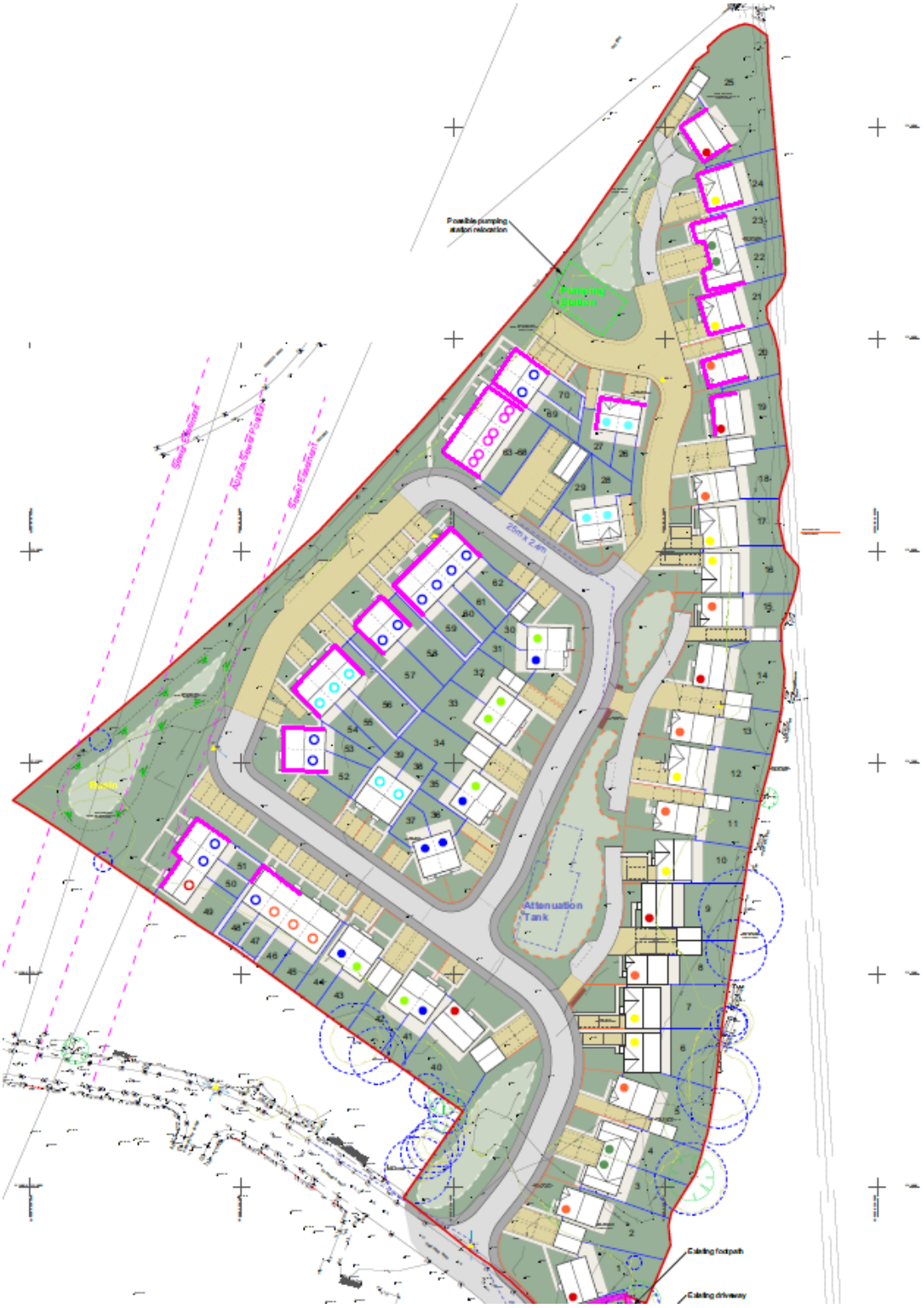


7.0 External Building Fabric Assessment

Based on survey results, we have carried out an external building fabric assessment with the aim of controlling $L_{Amax,F}$ events during the night to bedrooms and highlighting plots requiring mechanical ventilation in line with the proposed planning condition.

Critical plots where additional attenuation measures are required are shown below;

3131/SP2 – Facades Requiring Additional Attenuation Measures



All bedrooms on the façades highlighted above in **PINK** require up-rated acoustic glazing and all habitable rooms require active ventilation units as specified below. Standard thermal double glazing should be sufficient on remaining habitable rooms.

Standard thermal double glazing and trickle ventilation should be sufficient on remaining non-critical plots.

7.1 External Walls

The following external wall construction has been used in our analysis;

- *Brick / 75mm cavity / 100mm block*

The following SRI performance figures are taken from BS 8233:2014: "Brick and block external wall";

3131/T3 – Wall Sound Reduction Index Figures

Element	Description	Sound Reduction Index (SRI: BS EN ISO 140) at Octave Band Centre Frequency (Hz)				
		125	250	500	1k	2k
Wall	Brick / cavity / block	40	44	45	51	56

7.2 Roof

The following roof construction has been used in our analysis;

- *Pitched tiled roof, timber trusses, plasterboard ceiling with 100mm mineral wool insulation.*

The following minimum SRI performance figures are taken from BS 8233:2014: "*tiles on felt roof with 100mm mineral wool on plasterboard ceiling*";

3131/T4 – Roof Sound Reduction Index Figures

Element	Description	Sound Reduction Index (SRI: BS EN ISO 140) at Octave Band Centre Frequency (Hz)				
		125	250	500	1k	2k
Roof	Pitched tiled roof, timber trusses, plasterboard ceiling with 100mm mineral wool	28	34	40	45	49

There should be no rooms in roof/mansard sections included on critical plots.

7.3 Ventilation

All habitable rooms highlighted in **PINK** require a whole house ventilation system meeting the requirements of Part F of the Building Regulations) and specification included in the proposed planning condition (section 2.3 – to be confirmed acceptable by the local planners/EHO. This should be ducted from the non-critical façade.

Alternatively, a through-wall active acoustic ventilator could be included in each critical habitable room meeting the performance requirements quoted in the proposed planning condition.

Do not include standard trickle ventilation within window frames on critical facades.

Final proposals should be confirmed acceptable with Building Control and Environmental Health.

7.4 Glazing

Site plan 3131/SP2 shows façades where bedroom windows require up-rating. The following sound reduction index figures shall be met for glazing to bedrooms only on critical facades:

3131/T5 – Bedroom Window Sound Reduction Index Figures

Element	Description	Sound Reduction Index (SRI: BS EN ISO 140) at Octave Band Centre Frequency (Hz)				
		125	250	500	1k	2k
Bedroom windows	For budgetary guidance, based on secondary glazing 4/100/6	26	34	44	56	53

For initial budgetary guidance, systems that should be capable of achieving these figures are included in the table, however;

The successful glazing suppliers shall provide independent laboratory test data confirming their proposed systems (including frames/seals) meet the quoted octave band sound reduction performance figures above.

For all other facades and habitable rooms (not bedrooms) standard thermal double-glazing is indicated to be sufficient.

8.0 Conclusion

Environmental noise and vibration surveys have been carried out to assess existing ambient and background noise levels impinging on the proposed development site from local road and rail traffic.

Survey results have been used for comparison with typical local planning authority conditions. The majority of the site falls under NEC B of TAN 11.

Vibration levels on the western/north-western boundary fall well below the day and night-time vibration dose value (VDV) limits quoted in the typical local planning authority condition.

Both daytime $L_{Aeq,16hr}$ and night-time $L_{Aeq,8hr}$ noise levels on the western/north-western boundary are indicated to exceed trigger levels set out in the typical planning condition.

Up-rated acoustic glazing to bedrooms and mechanical ventilation to all habitable rooms of critical plots are indicated to be required.

Noisemap models indicate the garden noise level of 50dB $L_{Aeq,16hr}$ in 50% of garden area is achieved with the current housing and fencing layout.

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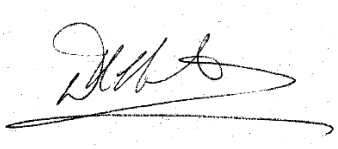

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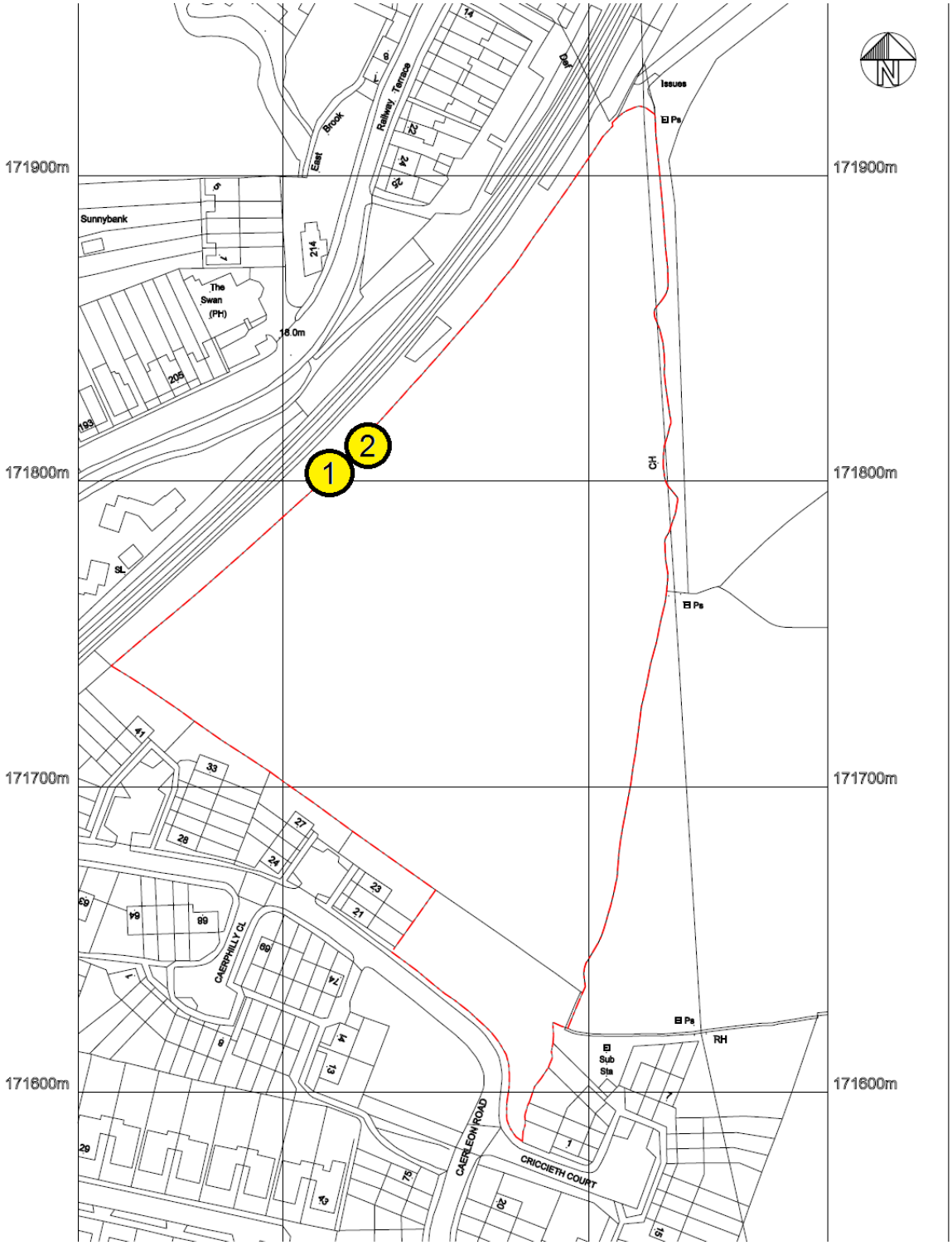
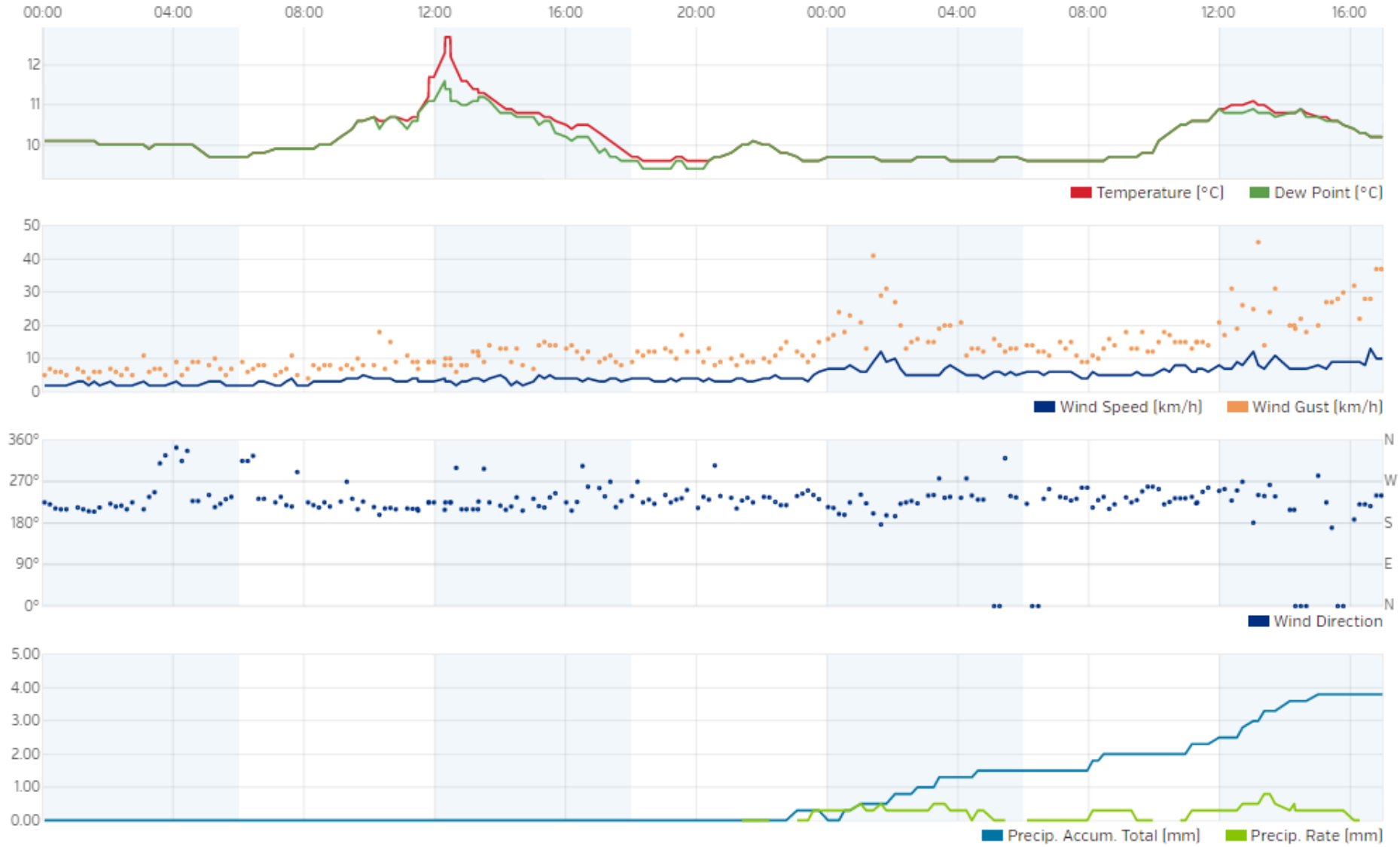
Appendix A - Graphs, Tables and Diagrams

3131/SP1 - Site Plan Showing Measurement Locations

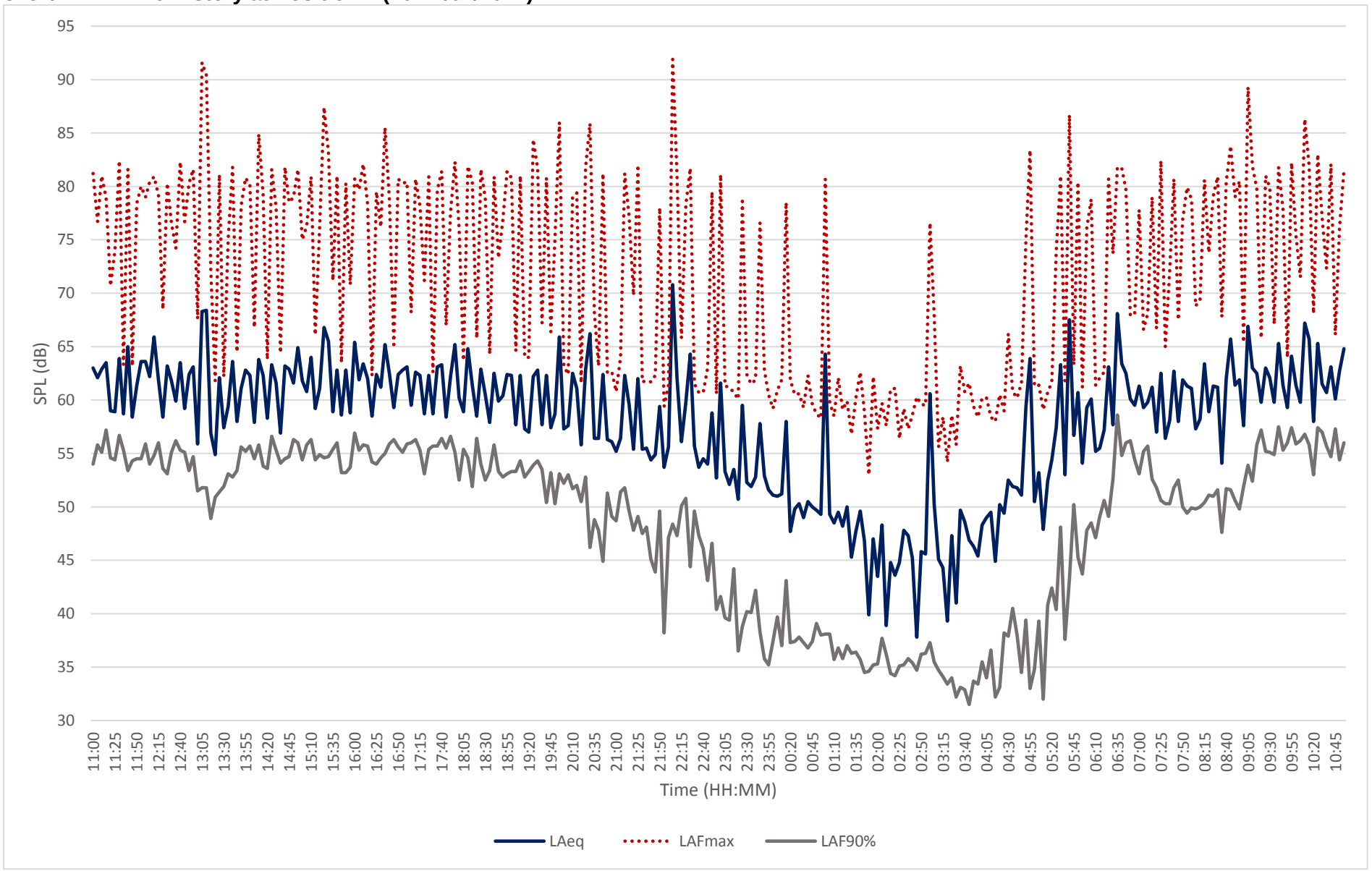


3131/WH1 – Approximate Weather History Graph (20-21/02/2017)

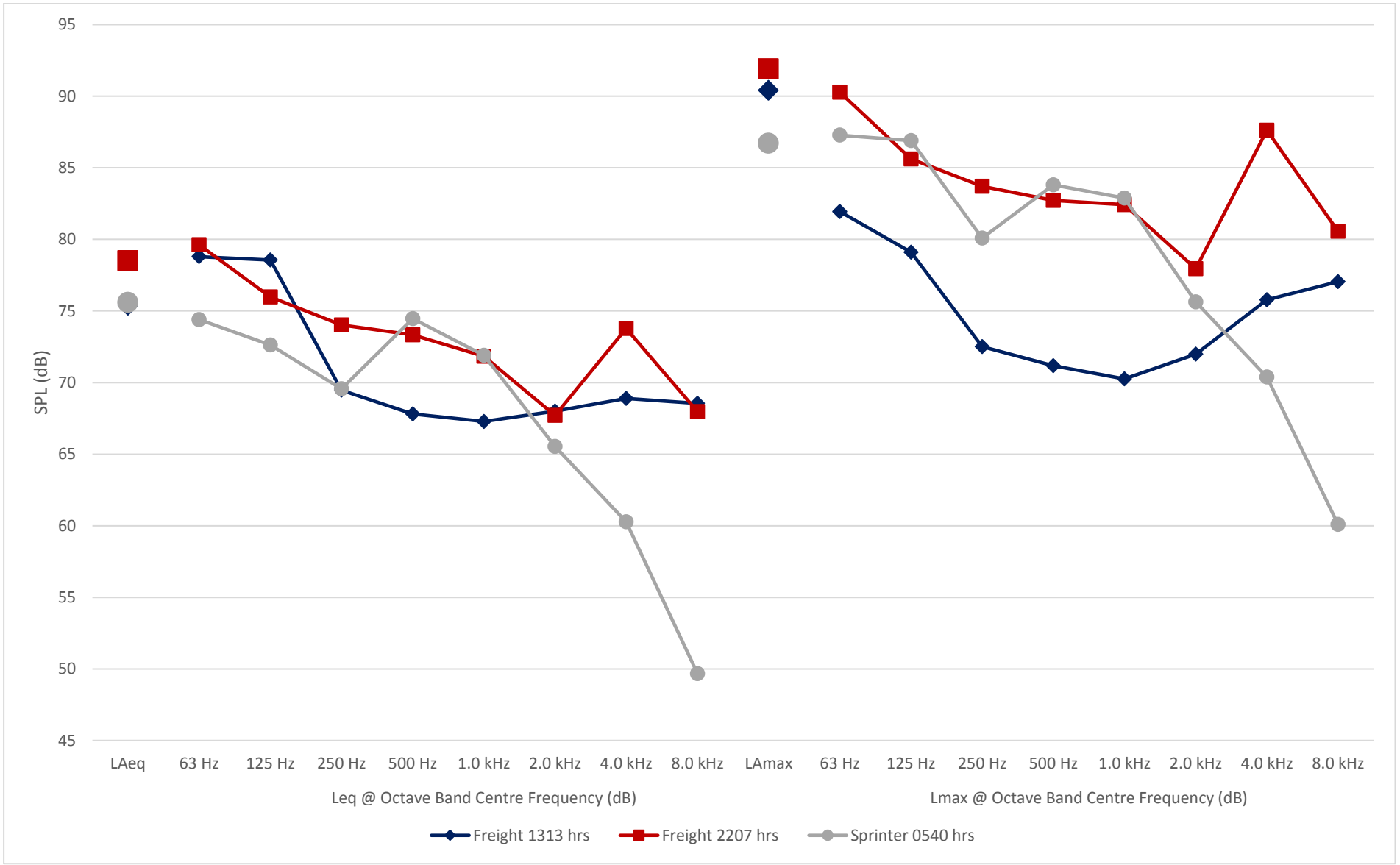


*Data taken from www.wunderground.com. Weather Station: IPENARTH5, located in Penarth [*N 51 ° 25 ' 41 ", W 3 ° 10 ' 37 "*]*

3131/TH1 - Time History at Position 1 (20-21/02/2017)



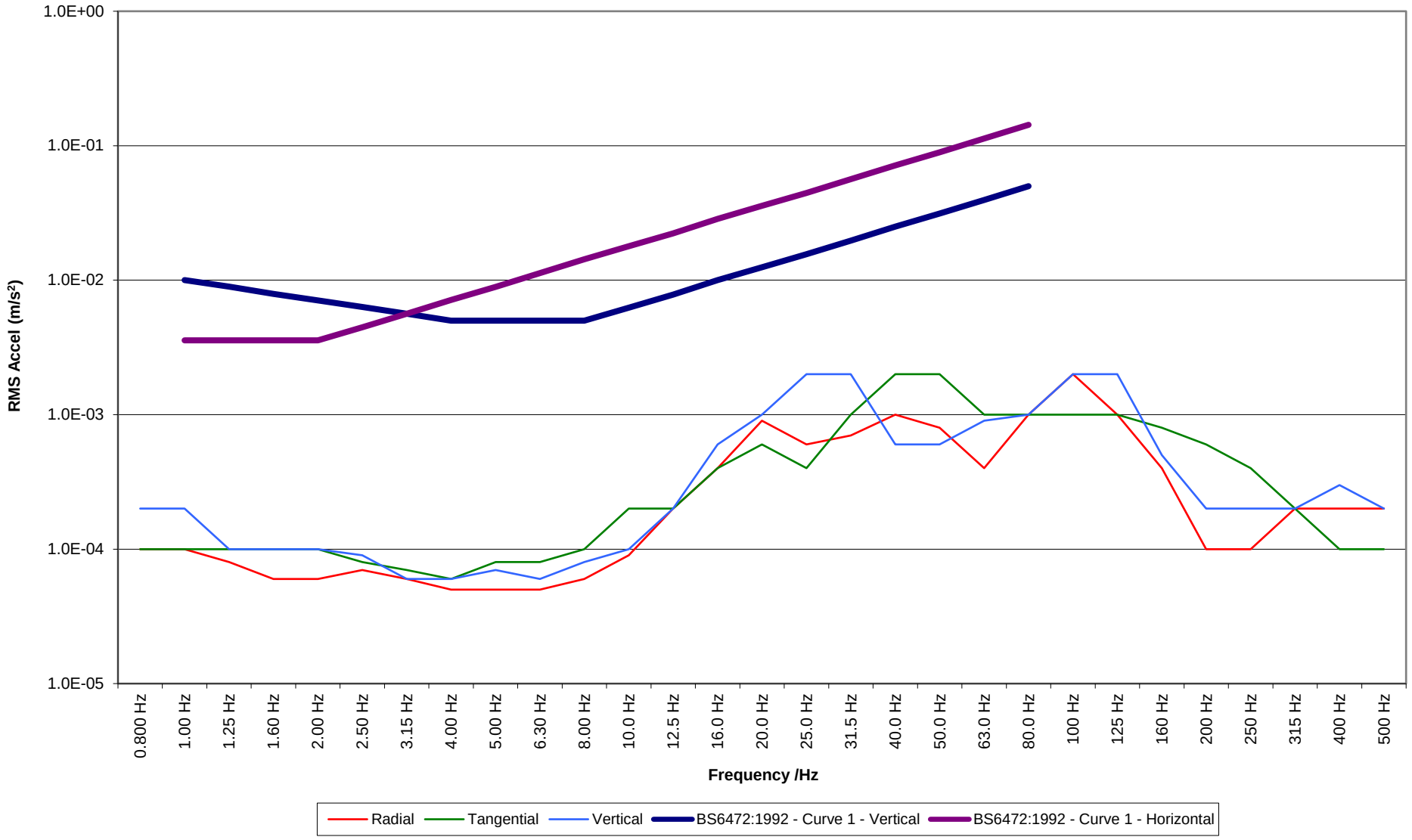
3131/G1 – Worst Case Octave Band L_{eq} & L_{max} Spectra at Position 1



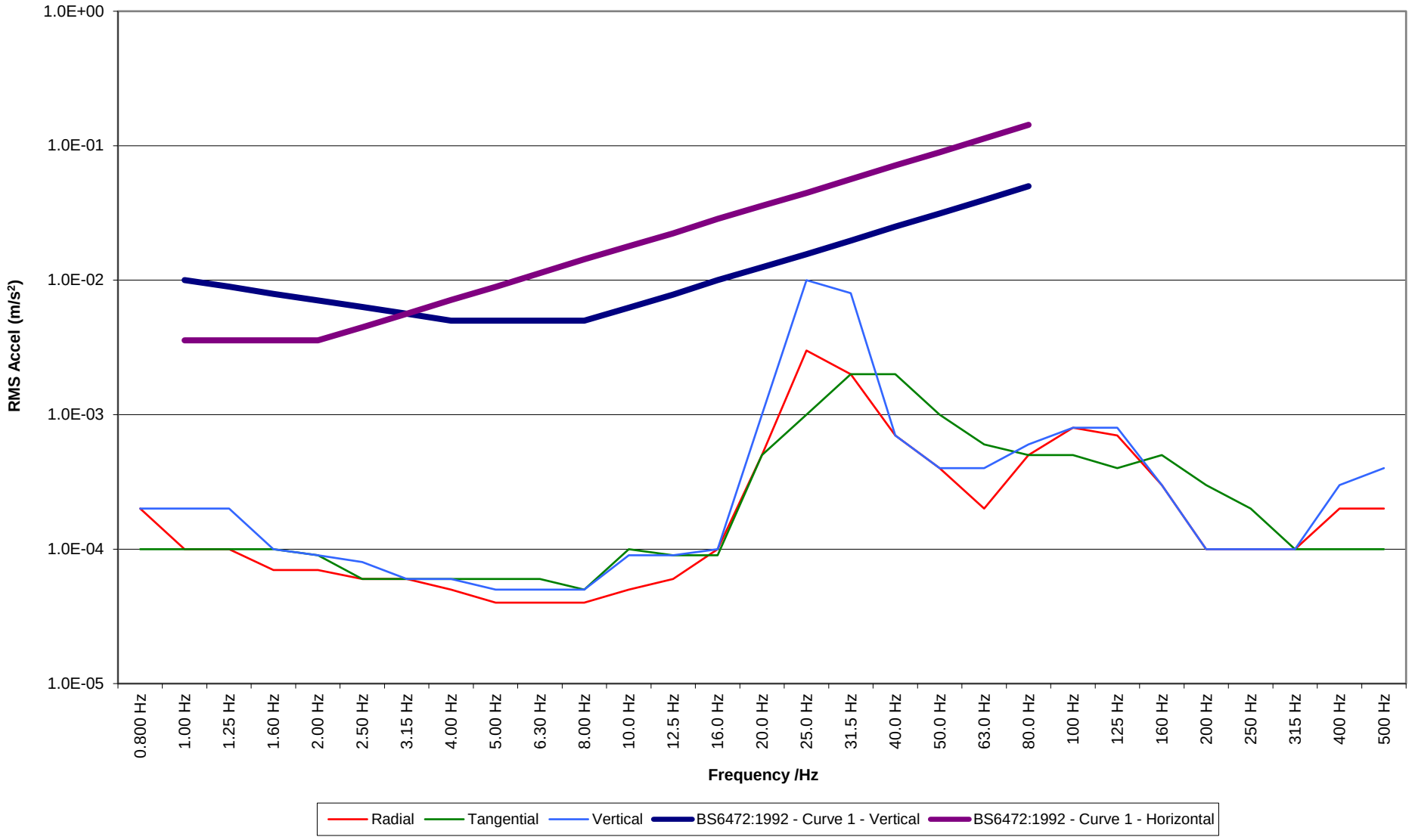
3131/T2 - Hourly Vibration Dose Values at Position 2

Date	Start	Channel	Weighting	VDV, $ms^{-1.75}$	Date	Start	Channel	Weighting	VDV, $ms^{-1.75}$
20/02/2017	11:00	Radial	W_d	1.75E-02	11/06/2013	23:00	Radial	W_d	1.04E-02
20/02/2017	11:00	Tangential	W_d	2.07E-02	11/06/2013	23:00	Tangential	W_d	6.11E-03
20/02/2017	11:00	Vertical	W_b	2.91E-02	11/06/2013	23:00	Vertical	W_b	2.13E-02
20/02/2017	12:00	Radial	W_d	7.25E-03	11/06/2013	00:00	Radial	W_d	1.89E-02
20/02/2017	12:00	Tangential	W_d	6.24E-03	11/06/2013	00:00	Tangential	W_d	6.93E-03
20/02/2017	12:00	Vertical	W_b	1.17E-02	11/06/2013	00:00	Vertical	W_b	1.81E-02
20/02/2017	13:00	Radial	W_d	9.43E-03	11/06/2013	01:00	Radial	W_d	1.24E-02
20/02/2017	13:00	Tangential	W_d	7.31E-03	11/06/2013	01:00	Tangential	W_d	1.18E-02
20/02/2017	13:00	Vertical	W_b	1.14E-02	11/06/2013	01:00	Vertical	W_b	1.45E-02
20/02/2017	14:00	Radial	W_d	7.67E-03	11/06/2013	02:00	Radial	W_d	1.92E-02
20/02/2017	14:00	Tangential	W_d	6.10E-03	11/06/2013	02:00	Tangential	W_d	1.29E-02
20/02/2017	14:00	Vertical	W_b	1.19E-02	11/06/2013	02:00	Vertical	W_b	3.49E-02
20/02/2017	15:00	Radial	W_d	8.67E-03	11/06/2013	03:00	Radial	W_d	1.62E-02
20/02/2017	15:00	Tangential	W_d	9.13E-03	11/06/2013	03:00	Tangential	W_d	1.44E-02
20/02/2017	15:00	Vertical	W_b	1.29E-02	11/06/2013	03:00	Vertical	W_b	1.50E-02
20/02/2017	16:00	Radial	W_d	7.32E-03	11/06/2013	04:00	Radial	W_d	9.24E-03
20/02/2017	16:00	Tangential	W_d	5.57E-03	11/06/2013	04:00	Tangential	W_d	7.30E-03
20/02/2017	16:00	Vertical	W_b	1.02E-02	11/06/2013	04:00	Vertical	W_b	1.20E-02
20/02/2017	17:00	Radial	W_d	7.88E-03	11/06/2013	05:00	Radial	W_d	7.01E-03
20/02/2017	17:00	Tangential	W_d	5.94E-03	11/06/2013	05:00	Tangential	W_d	1.00E-02
20/02/2017	17:00	Vertical	W_b	1.11E-02	11/06/2013	05:00	Vertical	W_b	1.07E-02
20/02/2017	18:00	Radial	W_d	7.38E-03	11/06/2013	06:00	Radial	W_d	7.89E-03
20/02/2017	18:00	Tangential	W_d	5.62E-03	11/06/2013	06:00	Tangential	W_d	4.82E-03
20/02/2017	18:00	Vertical	W_b	1.25E-02	11/06/2013	06:00	Vertical	W_b	9.74E-03
20/02/2017	19:00	Radial	W_d	7.23E-03	11/06/2013	07:00	Radial	W_d	8.29E-03
20/02/2017	19:00	Tangential	W_d	6.54E-03	11/06/2013	07:00	Tangential	W_d	5.18E-03
20/02/2017	19:00	Vertical	W_b	1.23E-02	11/06/2013	07:00	Vertical	W_b	1.08E-02
20/02/2017	20:00	Radial	W_d	7.01E-03	11/06/2013	08:00	Radial	W_d	1.83E-02
20/02/2017	20:00	Tangential	W_d	8.36E-03	11/06/2013	08:00	Tangential	W_d	9.72E-03
20/02/2017	20:00	Vertical	W_b	1.23E-02	11/06/2013	08:00	Vertical	W_b	3.16E-02
20/02/2017	21:00	Radial	W_d	6.52E-03	11/06/2013	09:00	Radial	W_d	7.28E-03
20/02/2017	21:00	Tangential	W_d	4.92E-03	11/06/2013	09:00	Tangential	W_d	5.75E-03
20/02/2017	21:00	Vertical	W_b	1.16E-02	11/06/2013	09:00	Vertical	W_b	1.16E-02
11/06/2013	22:00	Radial	W_d	7.83E-03	11/06/2013	10:00	Radial	W_d	6.66E-03
11/06/2013	22:00	Tangential	W_d	7.25E-03	11/06/2013	10:00	Tangential	W_d	6.00E-03
11/06/2013	22:00	Vertical	W_b	1.28E-02	11/06/2013	10:00	Vertical	W_b	1.17E-02
					VDV_b (Day : 0700-2300hrs)			0.038	$ms^{-1.75}$
					VDV_b (Night : 2300-0700hrs)			0.037	$ms^{-1.75}$

3131/G2 - 1/3 Octave Band RMS Vibration Spectra for Typical Freight Pass-by (2207hrs)



3131/G3 - 1/3 Octave Band RMS Vibration Spectra for Typical Sprinter Pass-by (0540hrs)



3131/D1 – Site Layout Plan

Note: Blue lines indicate 1.8m high closed boarded fences around gardens.

Appendix B - Acoustic Terminology

Human response to noise depends on a number of factors including; Loudness, Frequency content, and variations in level with time. Various frequency weightings and statistical indices have been developed in order to objectively quantify 'annoyance'. The following units have been used in this report:

dB(A): The sound pressure level weighted to correspond with the frequency response of the human ear, and therefore a persons' subjective response to frequency content.

L_{eq}: The equivalent continuous sound level is a notional steady state level, which over a quoted time period would have the same acoustic energy content as the actual fluctuating noise measured over that period.

L_{90}: The sound level which is exceeded for 90% of the measurement period.
i.e. The level exceeded for 54 minutes of a 1-hour measurement. It is often used to define the background noise level.

L_{10}: The sound level which is exceeded for 10% of the measurement period.
i.e. The level exceeded for 6 minutes of a 1-hour measurement

L_{max}: The highest instantaneous sound level recorded during the measurement period.