Appendix B - Air, Noise and Vibration Baseline Monitoring Report

Townsville City Council

Infrastructure, Traffic, Transport & Air Quality

Air, noise and vibration baseline monitoring report

May 2019

Glossary of terms

Abbreviation	Definition
Ambient Noise	The all-encompassing noise associated within a given environment.
ABL	Assessment background level – The single-figure background level representing each assessment period–day, evening and night (i.e. three ABLs are determined for each 24 hour period of the monitoring period). ABL is a measure of background noise level in the absence of noise from the source. Determination of the ABL is by the tenth percentile method described in Department of Science and Environment guideline *Planning for Noise Control*.
Background Noise Level	The A-weighted sound pressure level of the residual noise (dB) exceeded for 90 percent of a given time interval,T, measured using time weighting 'F' and quoted to the nearest whole number of decibels.
dB	Unit of measurement for Sound Pressure Level known as a decibel.
dB(A)	'A-weighted' decibel measurement, developed as a way to represent the sound frequency sensitivity of the human ear.
EPP	Environment Protection Policy .
Free field	A position where there are no reflecting surfaces, other than the ground, close enough to influence the sound pressure level. Taken at 1.2-1.5 metres above ground level and 3.5 – 4 m from the closest building façade.
GDA94	The Geocentric Datum of Australia is a system of latitudes and longitudes, or east and north coordinates used to track locations.
GHD	GHD Pty Ltd
$L_{Aeq\ (Time)}$	Equivalent sound pressure level is the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring. This is considered to represent ambient noise.
$L_{A90\ (Time)}$	The A-weighted sound pressure level that is exceeded for 90 per cent of the time over which a given sound is measured. This is considered to represent the background noise.
$L_{A10\ (Time)}$	The arithmetic average of the sound pressure level that is exceeded for 10 percent of the time specified. This is considered representative of the average maximum noise.
$L_{Amax(Time)}$	The maximum sound level recorded during a specified time interval.
$L_{Amin(Time)}$	The minimum sound level recorded during a specified time interval.
Lin	Lin or linear is a device or circuit with a linear characteristic, meaning that a signal passing through it is not distorted and/or it excludes a filter.
EPP (Noise)	Refers to Queensland Environment Protection (Noise) Policy 2008, a subordinate to the Environment Protection Act 1994 (EP Act).
RBL	Rating background level – The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24 hour period used for the ABL). The RBL (or min$L_{A90,1hour}$) is the level used for assessment purposes
Sensitive Receptor	A place or area where Acoustic Quality Objectives as defined in the Queensland EPP (Noise) are to be met. Column 1, Schedule 1 of the EPP (Noise) lists a range of sensitive places, including schools, offices, kindergartens, retirement homes, domestic residences, natural areas (e.g. national parks or nature reserves), and some commercial premises.

Abbreviation	Definition
Sound Pressure Level (SPL)	The Sound Pressure Level is the change in air pressure above and below the average atmospheric pressure (amplitude) caused by a passing pressure wave; this is then converted to decibels and can be abbreviated as SPL or L_p.
Sound Power Level (SWL)	This is defined as the average rate at which sound energy is radiated from a sound source and is measured in watts (W). The Sound Power Level can be abbreviated as SWL or L_w.

Table of contents

Table index

Figure index

Appendices

1. Introduction

1.1 Context

GHD Pty Ltd (GHD) has been commissioned by Townsville City Council (TCC) to undertake an Infrastructure, Traffic, Transport and Air Quality Study for the Lansdown Planning Scheme Major Amendment (PSMA) in relation to the Lansdown Station site (herein after 'the site') located on the Flinders Highway at 132 Bidwilli Road, Calcium.

The site is currently used for rural pursuits, however, TCC is now considering a major amendment to the Townsville City Plan to remove the land identified as Lansdown Station from Rural zone and include the site within both the Medium and High impact industry zones.

As part of the Infrastructure, Traffic, Transport and Air Quality Study, baseline monitoring of air quality, noise and vibration was carried out at the subject site. The aim of the air, noise and vibration monitoring was to establish baseline ambient levels and obtain a better understanding of the environmental conditions existing on the site.

This report is subject to, and must be read in conjunction with the limitations presented in Section 1.4 and the exclusions, assumptions and qualifications contained throughout the report.

1.2 Purpose of this report

The purpose of this report is to present the results of the baseline air, noise and vibration monitoring carried out as part of the Infrastructure, Traffic, Transport and Air Quality Study works in relation to Lansdown Station site for the Lansdown Planning Scheme Major Amendment.

1.3 Scope

The scope of works for this assessment included:

- Determine indicative locations for baseline noise, vibration and air quality monitoring based on the desktop review of sensitive receivers.

1.3.1 Noise

- Conduct unattended noise monitoring to determine existing background noise levels, which will assist in setting the noise targets for the PSMA under the relevant guidelines or policy.
- Undertake day/evening/night time period attended noise measurements at the noise logging locations (baseline locations) to supplement the unattended measurements, as well as to obtain spectral characteristics of potential existing surrounding noise sources.
- Assess and filter noise dataset to remove invalid data due to extraneous noise or adverse weather conditions.
- Establish baseline noise environmental noise conditions based on the background noise monitoring data above.
- Based on monitoring results above and zoning levels, establish project specific noise criteria for the PSMA.

1.3.2 Vibration assessment

- Installation of unattended vibration logger at the monitoring location.
- Conduct vibration monitoring to determine existing background levels.

- Establish baseline vibration conditions based on the background vibration monitoring data acquired.
- Based on monitoring results above and appropriate standards, establish project specific vibration criteria for the PSMA.

1.3.3 Air quality monitoring

- Conduct baseline air quality monitoring with respect to particulate matter to determine existing background levels.
- Send filter results from the monitoring equipment to a National Association of Testing Authorities (NATA) accredited laboratory (ALS Environmental) for analysis.
- Analyse the site specific air quality data to determine background levels of particulate matter at the monitoring location and in turn, nearby sensitive receptors.

1.3.4 Meteorological monitoring

- Installation of an automatic weather station (AWS) at the monitoring location to aid in the analysis of the noise and air quality data.
- Comparison of the data collected from the AWS with the prognostic meteorological data for the site generated from The Air Pollution Model (TAPM).

1.4 Limitations

This report: has been prepared by GHD for Townsville City Council and may only be used and relied on by Townsville City Council for the purpose agreed between GHD and the Townsville City Council as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Townsville City Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.5 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Townsville City Council and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

1.5 Assumptions

- All data used from monitoring equipment provided accurate measurements unless otherwise stated.
- This report has been written based on the information on hand as of January 2019.
- The selected monitoring locations are reasonably representative of the existing background environment.

2. Existing environment

2.1 Site location

Lansdown Station is located in Calcium, Queensland on Flinders Highway at 132 Bidwilli Road, Calcium. The subject site is surrounded by mainly rural zoned land to the south, north and west and is bounded by Flinders Highway to the East. The site also adjoins the Calcium Quarry to the southwest.

The Lansdown Planning Scheme Major Amendment (PSMA) will involve the currently rural zoned land as per the current Townsville City Council Planning Scheme, forming the Woodstock Industrial Precinct. The extent of the proposed Woodstock Industrial Precinct is shown in Figure 1.

2.2 Sensitive receivers

Relevant sensitive receivers at various directions outside of the site boundary are identified in Table 1.

Table 1 Potential Sensitive Receivers

ID	Easting	Northing	Approx. distance to site boundary	Description/Comment
R1	480222.56 E	7824552.78 S	1,580 m	Appears residential (1)
R2	480820.65 E	7824291.09 S	1,460 m	Appears residential (1)
R3	481643.12 E	7824380.90 S	1,280 m	Appears residential (1)
R4	483028.92 E	7824247.76 S	1,900 m	Appears residential (2)
R5	483530.01 E	7824666.29 S	1,930 m	Appears residential (2)
R6	482414.78 E	7826346.90 S	35 m	Appears residential (2)
R7	482794.61 E	7826382.16 S	240 m	CSRIO Lansdown Pasture Research Station
R8 (3)	483114.58 E	7827121.09 S	540 m	Residential – Refer to Note 3
R9 (3)	482940.40 E	7827195.82 S	340 m	Residential – Refer to Note 3
R10	483349.01 E	7827270.40 S	740 m	Appears residential (2)
R11	482875.85 E	7827648.21 S	240 m	Appears residential (2)
R12	483515.92 E	7827880.61 S	840 m	Appears residential (2)
R13	483356.29 E	7828271.39 S	650 m	Appears residential (2)
R14	483157.63 E	7828905.16 S	450 m	Appears residential (2)
R15	483188.24	7829033.78	480 m	Appears residential (2)
R16	483151.81	7829531.11	470 m	Appears residential (2)
R17	483178.57	7830464.13	480 m	Appears residential (2)
R18	483142.20	7830988.53	450 m	Appears residential (2)
R19	483777.15	7831739.97	1,070 m	Appears residential (1)

ID	Easting	Northing	Approx. distance to site boundary	Description/Comment
R20	482952.14	7832586.95	840 m	Mixed use with potential dwelling (4)
R21	482307.60	7832380.53	560 m	Appears residential (2)
R22	481136.00	7833025.92	1,140 m	Appears residential (1)
R23	477975.08	7834008.29	2,910 m	Appears residential (2)
R24	477059.58	7834293.92	4,000 m	Appears residential (2)
R25	476813.58	7834063.60	3,910 m	Appears residential (1)
R26	476941.78	7832011.56	1,870 m	Appears residential (1)

Notes:

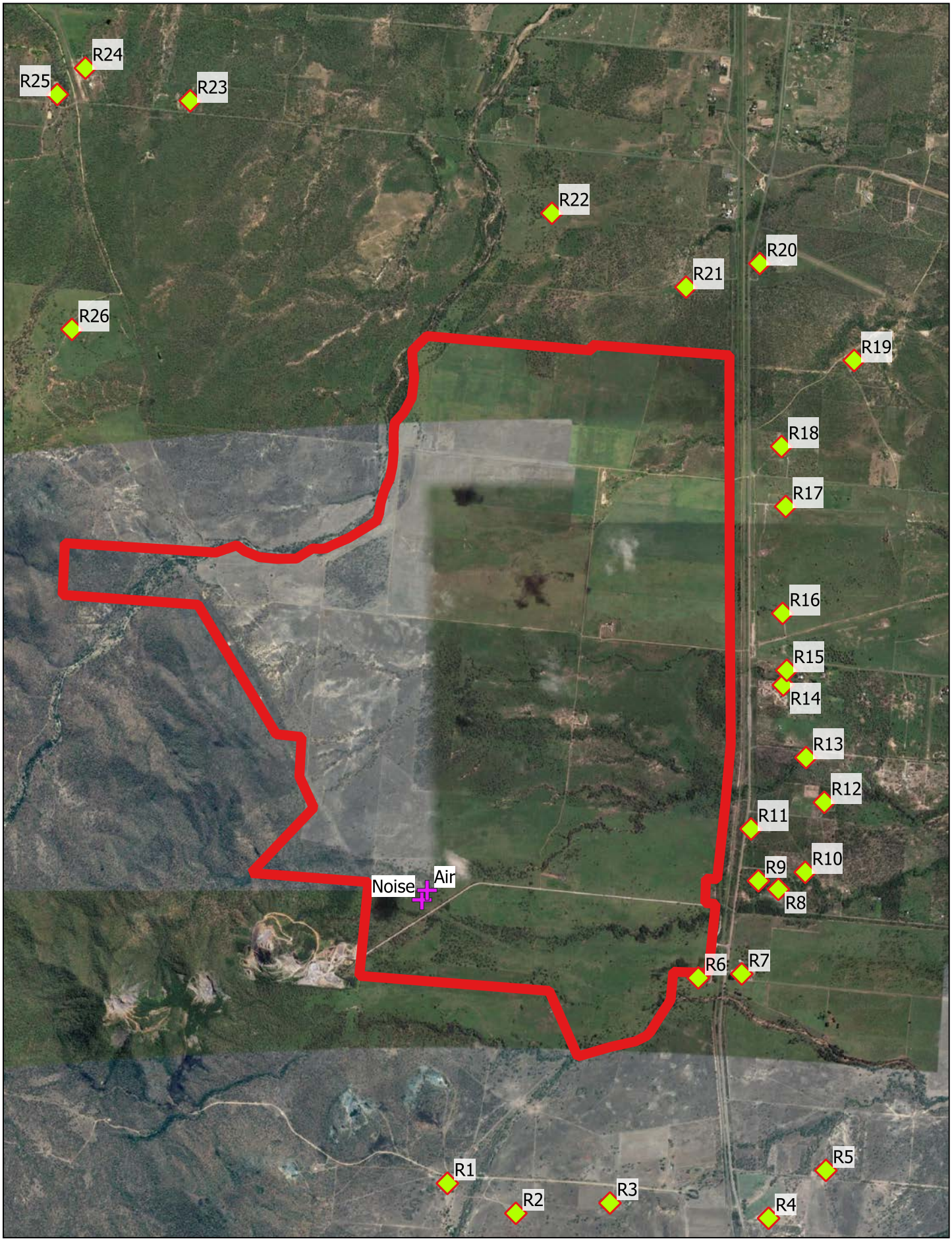
(1) Land identified in the Townsville City Plan with Property Code Description of *Rural - Cattle Grazing (Breeding & Fattening)*.

(2) Land identified in the Townsville City Plan with Property Code Description of *Residential – Single Unit Dwelling*.

(3) R8 and R9 are located on the same land identified in the Townsville City Plan as *Property 361871* and described as *22 Skydiver Road, Woodstock* with Property Code Description of *Residential – Single Dwelling*. From aerial imagery it is not clear which of the R9 or R10 is the single dwelling and hence both are shown here as sensitive receivers.

(4) The land is known as Donnington Airpark, also known as Townsville Satellite General Aviation Airport, a privately owned airfield. The Land is identified in the Townsville City Plan with Property Code Description of *Showgrounds Racecourses Airfields*. From aerial imagery and information available it appears that it also includes a residential dwelling at the front.

It is noted that the majority of the noise sensitive receivers are located along the Flinders Highway and are already exposed to notable levels of traffic noise at times, in particular during day time hours which is expected to assist with masking noise from future industrial developments on the PSMA.



Paper Size ISO A4

0 400 800 1200 m

N

Map Projection: Mercator Auxillary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxillary

Legend

Receivers

Site Area

Logger Locations

Townsville City Council
Infrastructure, Traffic, Transport & Air Quality
Air, noise and vibration baseline monitoring

Site location and identified sensitive receivers

Project No. **42-20641**
Revision No. **B**
Date. **30/01/2019**

FIGURE 1

Document Path: \\ghdnet\ghd\AU\Townsville\Projects\42\20641\GIS\Data\working\TCC PSMA.qgs

Data Source: Google Earth Imagery 2019. Created By: V. Alamshah

3. Monitoring Methodology

3.1 Monitoring locations

Baseline air, noise and vibration was conducted during the period 5 September 2018 to 21 September 2018. Baseline monitoring was conducted at the locations shown in Figure 1 on the south western side of the proposed site. The noise and vibration monitors were co-located, whilst the air quality monitor was located further away (approximately 40 m) to ensure the noise created by the air quality monitor did not influence the noise measurement results. Details of the air, noise and vibration monitoring locations are presented in Table 2.

A weather station was also installed at the location of the noise and vibration monitors to obtain meteorological parameters assisting with assessment of the measured air, noise and vibration results.

Table 2 Air, noise and vibration monitoring

Description	Coordinate (UTM)[1]	Image
Noise, vibration and weather station	479999.53 m E, 7827029.33 m S	
Air quality monitor	480044.87 m E, 7827112.38 m S	

Notes:

1. Coordinates are within ± 3 m error.

3.2 Instrumentation

3.2.1 Noise and vibration

Ambient noise levels were monitored using a SVAN 977 (Class 1) environmental noise logger. Attended noise measurements were conducted using a Type-1 Bruel & Kjaer 2270 Sound Level Meter (SLM), which conforms to the requirements of Australian Standards AS IEC 61672.1-2004: *Electroacoustics – Sound level meters Part 1: Specifications*. The SLM equipment was calibrated before and after the measurements. No discrepancies equal to or greater than 1 dB were noted throughout the measurement exercise as is required under Section 5.6 of Australian Standard AS 1055:12018 *Acoustics – Description and measurement of environmental noise*. Table 3 shows the details of the noise measurement equipment used for the attended and continuous noise monitoring. All noise monitoring instrumentation carry current NATA accredited calibration certificates and could be provided upon request.

An Instantel™ Micromate ® vibration monitor with a tri-axial geophone was installed to measure the ambient vibration levels at the monitoring location. The details of the vibration monitor are provided in Table 3.

Table 3 Noise and vibration monitoring instrumentation

Description	Type/Model	Serial Number
Environmental noise monitor	SVAN 977	36821
Sound level metre	Bruel & Kjaer 2270	3009634
Acoustic Calibrator	G.R.A.S 42 AG	278663
Vibration monitor	Instantel Micromate®	UM10469

Table 4 presents the minimum measurement floor for the environmental noise logger and sound level metre used for the attended and unattended noise measurements. The environmental noise logger was set to low operating range at which noise floor is 15 dB(A).

Table 4 Instrument operating range

Instrument	Type/Model	Instrument dynamic range
Noise monitor	SVAN 977	Low range – 15 dB(A) – 123 dB(A) High range – 26 dB(A) – 140 dB(A)
Sound level metre	Bruel & Kjaer 2270	16.6 dB(A) – 140 dB(A)
Vibration monitor	Instantel Micromate®	0.00788 mm/s – 254 mm/s

3.2.2 Air quality

Ambient particulate monitoring was conducted using a TSI DustTrak II Aerosol Monitor 8530 (DustTrak). The instrument measured ambient concentrations of particulate matter in accordance with the requirements of AS/NZS 3580.12.1:2015: *Methods for sampling and analysis of ambient air - Determination of light scattering - Integrating nephelometer method.*

GHD notes that it is likely that the low inlet flow rate (3 L/min) of the DustTrak was not effective at collecting particles with large equivalent aerodynamic diameters (i.e. greater than 15-20 microns)[1]. Moreover, it is stated in the DustTrak II Aerosol Monitor 8530 spec sheet that the particle size range is between 0.1 to 10 microns. Therefore, GHD has assumed that the typical particle size measured by the DustTrak is 10 microns (i.e. PM_{10}). As a result, GHD has provided

[1] http://www.tsi.com/uploadedFiles/_Site_Root/Products/Literature/Application_Notes/ITI-060.pdf

an assessment of the ambient particulate monitoring results against the PM_{10} criterion (as discussed in Section 7). This is considered to add a layer of conservatism to the monitoring as it is likely the results include particulate matter greater than $PM_{10,}$ therefore increasing the overall measured concentration. It is noted that GHD has referred to the ambient measured particulate matter as PM_{10} throughout assessment.

Where possible all sampling inlet positions complied with the following criteria, as per Australian Standards AS 3580.1.1 – 2016: Methods of sampling and analysis of ambient air: Guide to siting air monitoring equipment for PM_{10} (Standards Australia, 2016):

- Clear sky angle 120º;
- Unrestricted airflow of 270º around sample inlet or 180º if inlet is on side of building;
- 10 m from any object with a height exceeding 2 m below the height of the sample inlet;
- No extraneous sources nearby; and
- 50 m from road.

The details of the instrumentation used for the air quality sampling are presented in Table 5

Table 5 Air quality monitoring instrumentation

Description	Type/Model	Serial Number
Air quality monitor	DustTrak™ Model 8530	8530083615
Sample Filter	37 mm PVC Filter	PVC372012
Blank Filter	37 mm PVC Filter	PVC372013

3.2.3 Meteorology

A weather station was installed at the location of noise and vibration monitor to obtain relevant local meteorological data such as wind speed, direction and rainfall to assist with the assessment of air and noise measurements.

4. Meteorology

Local wind patterns are the primary meteorological parameters relevant to this assessment and to the potential for the transport of air quality and noise pollutants from potential sources to sensitive receptors (as identified in Section 2.2) located within the Lansdown Station site. The weather station at the subject site was installed at a height of 2 meters.

4.1 Measured wind patterns

The local meteorology will largely determine particulate and noise dispersion patterns at the site.

The general wind climate of any particular location is most readily assessed by means of wind rose plots, which show the frequency of various wind directions and wind-speed ranges. The features of particular interest in this assessment are:

- Prevailing wind directions;
- Relative incidence of more stable light wind conditions;
- 'Good' dispersion conditions, involving wind speeds of over 5 m/s.

A distinction can be made for fugitive deposited dust entrained into strong winds, as opposed to dust emissions from process sources where the emission rate is independent of local wind conditions. The 'worst case' in the former class is wind speed greater than 5 m/s, while 'worst case' in the latter is light, stable winds.

The wind rose for the monitoring period is shown in Figure 2 and reveals the following features:

- The average wind speed for the monitoring period was 1.4 m/s.
- The general wind pattern is along the west and east axes, with an influence from the north-northwest.
- Very light winds are measured from the west and southwest sector.
- Strong winds primarily occur from the east-northeast.

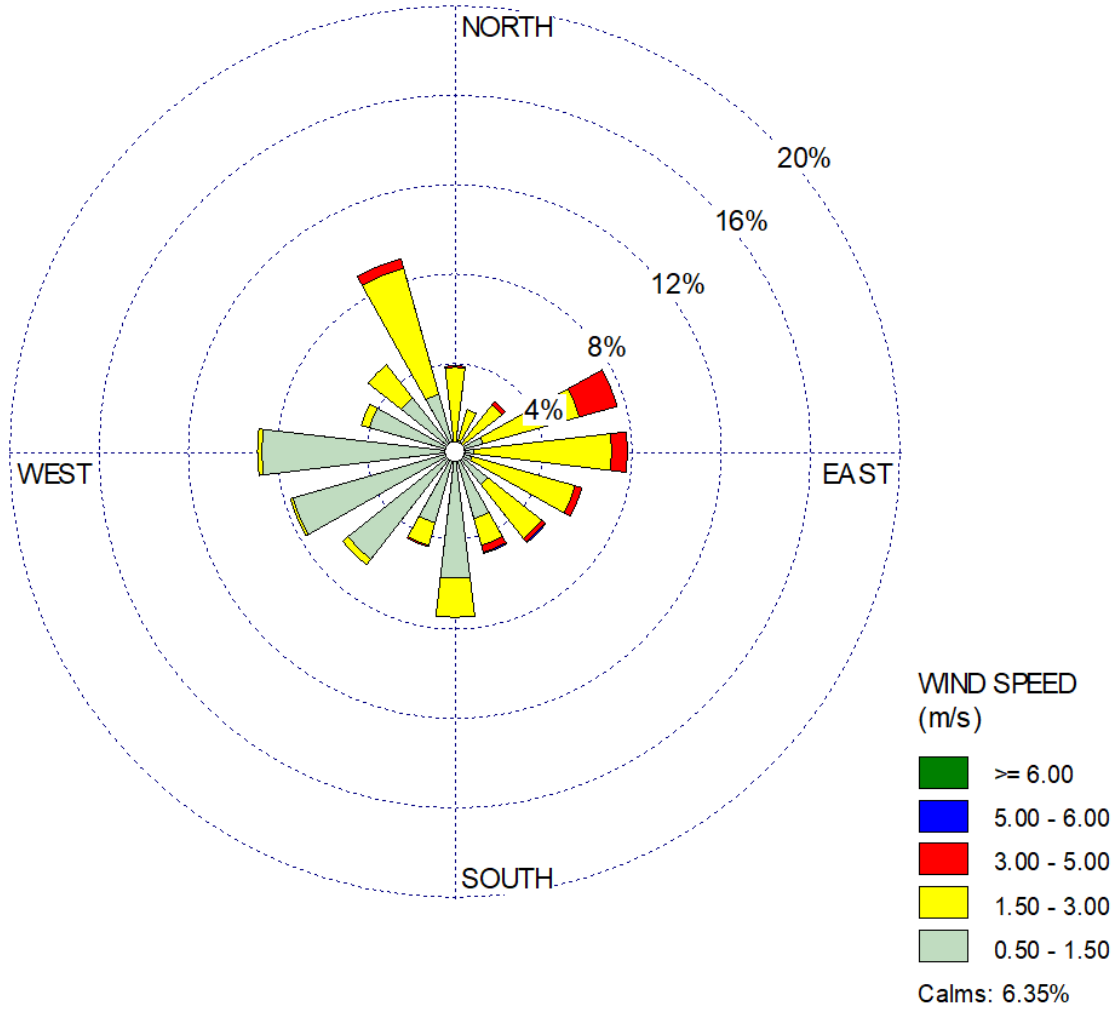


Figure 2 Wind rose for monitoring period (5/9/2018 – 21/9/2018) at 2 meters

4.2 TAPM wind patterns

GHD has also included prognostic meteorological data generated in TAPM. TAPM was utilised to obtain a meteorological dataset for the subject site for the year 2017 for use in the Air Quality Impact Assessment. The year 2017 was selected as it is the most recent year with a complete record. This dataset is based on synoptic observations filtered through a Global Circulation Model (GCM2), local terrain and land use information. The TAPM generated wind rose for the year 2017 is shown in Figure 3. The average wind speed is 2.6 m/s.

A comparison between the TAPM generated meteorological data and the meteorological data obtained from the installed weather station is provided in Figure 4. It is noted that the meteorological data from TAPM has been extracted at a height of 10 meters, in comparison to the baseline data, which was measured at 2 meters. As a result the wind speeds output from TAPM are greater than those recorded from the onsite weather station. The month of September has been selected from the TAPM data as it represents a similar period as the monitoring period.

A comparison of the wind roses assessments show that:

- Both wind roses include similar wind direction trends.
- Both wind roses include an influence of light winds (<1.5 m/s) from the west, west-southwest and west-northwest.
- Strong winds (>3 m/s) occur mainly from the northeast and southeast in both wind roses.
- The baseline data wind rose includes frequent winds from the north-northwest which are not observed in the TAPM data.
- The TAPM wind rose includes influences from the south-southwest, southwest and north which are not reflected in the monitored data.

Based on the similarities between the two datasets, GHD is of the opinion that the TAPM generated data is representative of the site. Therefore, this data will be used in the Air Quality Impact Assessment.

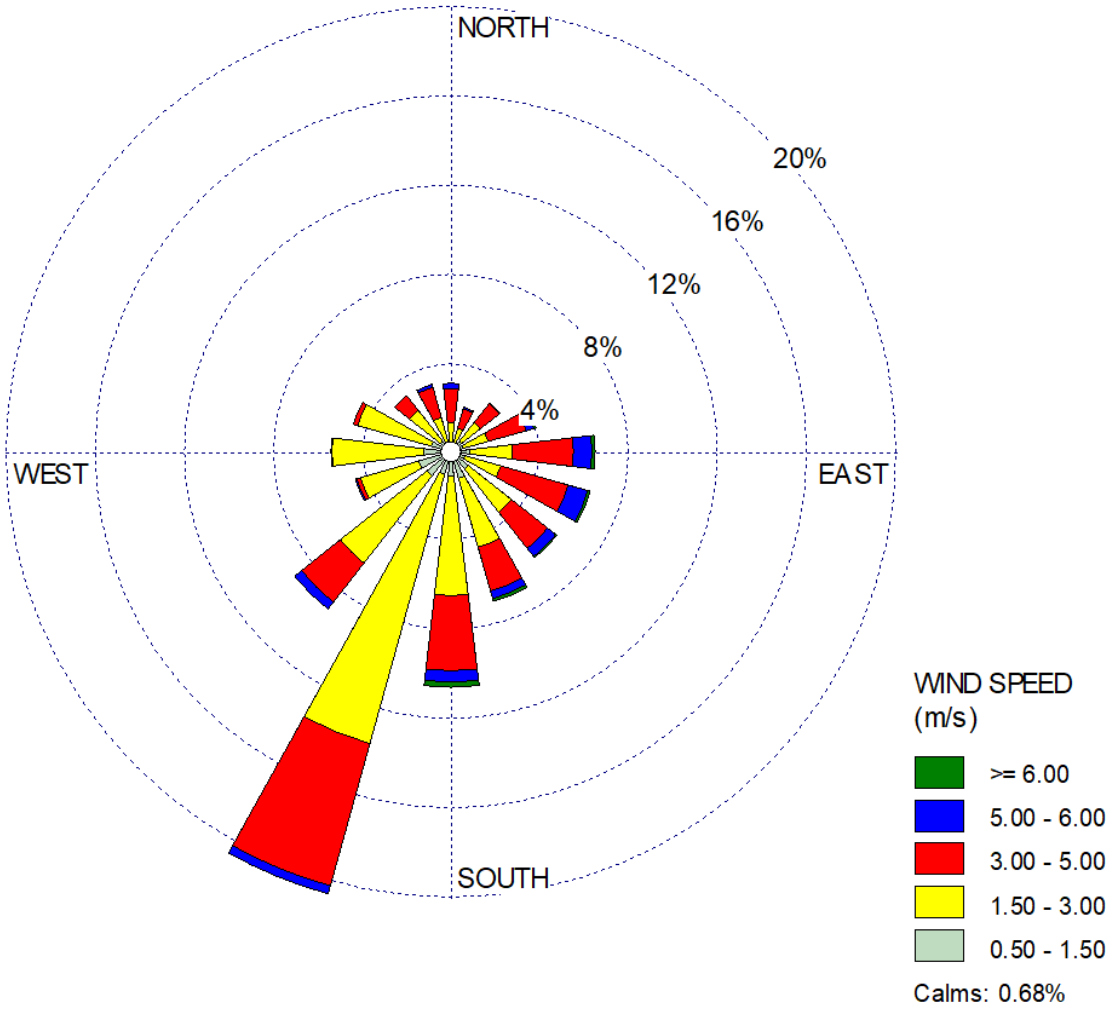


Figure 3 TAPM generated wind rose (1/1/2017 – 31/12/2017) at 10 m

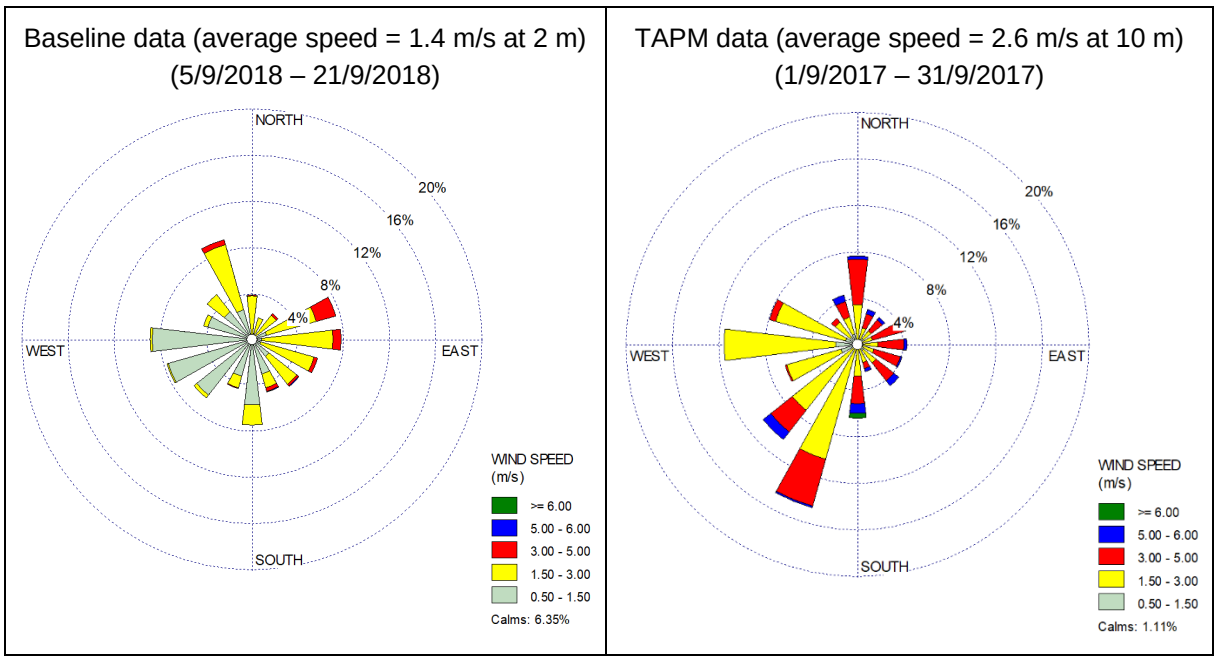


Figure 4 Baseline and TAPM generated wind roses

5. State Planning Policy (SPP 2017)

The State Planning Policy (SPP) expresses the state's interests in land use planning and development. The SPP has effect throughout Queensland and sits above regional plans and planning schemes in the hierarchy of planning instruments under the *Planning Act 2016*.

The SPP identifies statewide planning matters requiring protection and enhancement and outlines seventeen state interests and relevant policies that must be appropriately integrated in the planning and development outcomes where relevant.

The following SPP State Interest is applicable to the environmental emissions including air, odour and noise impacts relevant to the PSMA:

- Emissions and hazardous activities

5.1 Emissions and hazardous activities

Statement

Community health and safety, and the natural and built environment, are protected from potential adverse impacts of emissions and hazardous activities. The operation of appropriately established industrial development, major infrastructure, and sport and recreation activities is ensured.

Relevance

Some activities have the potential to cause nuisance to communities and other sensitive land uses through environmental emissions such as air, odour and noise pollution.

Relevant Policies

(1) Industrial development, major gas, waste and sewerage infrastructure, and sport and recreation activities are located, designed and managed to avoid or mitigate adverse impacts of emissions on sensitive land uses and the natural environment.

(5) Protect the following existing and approved land uses or areas from encroachment by development that would compromise the ability of the land use to function safely and effectively:

(a) Medium-impact, high-impact and special industries.

(6) Development that is incompatible with the existing and approved land uses or areas included in policy 5 above, is located to avoid adverse impacts of environmental emissions, or health and safety risks, and where the impacts cannot be practicably avoided, development is designed to minimise the impacts.

The provisions of the SPP in relation to control of environmental noise, vibration and air pollution are addressed via the following requirements:

- *Environmental Protection Act 1994* (EP Act)
- *Environment Protection Regulation 2008* (EP Regulation)
- *Environmental Protection (Noise) Policy 2008* (EPP (Noise))
- *Environmental Protection (Air) Policy 2008* (Air EPP)

6. Noise and vibration

6.1 Noise Criteria

SPP requirements for “Emissions and hazardous activities” relating to control of noise pollution are addressed with consideration to the following legislations:

- *Environmental Protection Act 1994* (EP Act)
- *Environment Protection Regulation 2008* (EP Regulation)
- *Environmental Protection (Noise) Policy 2008* (EPP (Noise))

6.1.1 Environmental Protection Act

In Queensland, the environmental impacts of noise emissions are regulated under the *Environmental Protection Act 1994* (EP Act) and subordinate legislation including the *Environment Protection Regulation 2008* (EP Regulation) and the *Environmental Protection (Noise) Policy 2008* (EPP (Noise)).

The EP Act and EP Regulation provide for protection of environmental values relating to maintenance of public amenity including noise amenity. In relation to noise, the EP Act and EP Regulation are supported by the *Environmental Protection (Noise) Policy 2008* (EPP (Noise)) outlining requirements to satisfy the objectives of the EP Act and EP Regulation.

6.1.2 Environmental Protection (Noise) Policy

6.1.2.1 Objectives and Requirements

The EPP (Noise) aims to satisfy the objectives of the EP Act in relation to the acoustic environment by providing a framework to assess the acoustic quality objectives required to enhance or protect environmental values. The environmental value relate the physical, aesthetic, social and cultural values of a location. Environmental values specific to noise impact are defined in the EP Act and the EPP (Noise). Under the EP Act, public amenity, public safety and ecological health are identified as environmental values and those prescribed under the EPP (Noise) include:

a) *The qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems; and*

b) *The qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following –*

   (i) *Sleep;*

   (ii) *Study or learn;*

   (iii) *Be involved in recreation, including relaxation and conversation; and*

   (iv) *The qualities of the acoustic environment that are conducive to protecting the amenity of the community.*

6.1.2.2 Acoustic Quality Objectives

For each environmental value, EPP (Noise) prescribes a range of relevant acoustic quality objectives designed to protect that value. The acoustic quality objective is the maximum noise that could be experienced in the acoustic environment while protecting the environmental values relevant to that location. The acoustic quality objective is expressed as an acoustic

descriptor measured and assessed at relevant noise sensitive receivers. Table 6 sets out the acoustic quality objectives for relevant noise sensitive receivers to this development.

Table 6 Acoustic Quality Objectives for noise sensitive receivers

Sensitive Receiver	Time of Day	Acoustic Quality Objectives (measured at receptor) dB(A)			Environmental Value
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$	
Dwelling (for outdoors)	Daytime and evening	50	55	65	Health and wellbeing
Dwelling (for indoors)	Daytime and evening	35	40	45	Health and wellbeing
	Night-time	30	35	40	Health and wellbeing, in relation to the ability to sleep
Library and educational institution (including a school, college and university) (for indoors)	When open for business or when classes are being offered	35	–	–	Health and wellbeing
Commercial and retail activity (for indoors)	When open for business	45	–	–	Health and wellbeing, in relation to the ability to converse

The daytime, evening and night periods are defined in the EPP (Noise) as:

- Daytime, period after 7 am – 6 pm on the day ;
- Evening, period after 6 pm – 10 pm on the day; and
- Night, period after 10 pm on the day to 7 am on the next day.

6.1.2.3 Control of Background Creep

Section 10 of the EPP (Noise) outlines provisions for control of background noise creep in the local environment by the accumulation of industries in the area over time. To control background creep, EPP (Noise) requires that where reasonable to do so, noise from an activity must not be:

- Over 5 dB(A) above the existing acoustic environment measured by $L_{A90,T}$ for noise that varies over time measured by $L_{Aeq,adj,T}$, OR
- Over the existing acoustic environment measured by $L_{A90,T}$ for noise that is continuous, measured by $L_{A90,T}$.

6.1.3 Planning for noise control guideline

Guidance on the assessment of operational noise impacts for planning purposes on residential premises is provided within the QLD Department of Environment and Science (DES) *Planning for Noise Control* (PNC) guideline, 2016. The guideline includes noise criteria that are designed to protect sensitive receivers from background noise creep due to steady state noise, variable and short-term noise events, and prevention of sleep disturbance.

The PNC guidelines is currently under review by DES and the new revision has not yet been issued. As a result the previous published 2016 guidelines is used for this assessment. The application of the PNC guidelines to establish the relevant planning criteria for the site is discussed in Section 6.4.

6.2 Vibration Criteria

Vibration is also be considered an environmental emission that have potential to cause nuisance to communities and other sensitive land uses.

SPP requirements for "Emissions and hazardous activities" relating to control of vibration pollution are addressed with consideration to the following:

- Human Comfort vibration control
- Structural Damage vibration control

6.2.1 Human Comfort Vibration Criteria

In the absence of any Queensland guidelines, human comfort vibration criteria have been set with consideration to the following:

- NSW EPA Environmental Noise Management – Assessing Vibration: A Technical Guideline (AVTG) (NSW EPA, February 2006).
- British Standard 6472: Guide to Evaluation of Human Exposure to Vibration in Buildings Part 1: Vibration Sources Other than Blasting (British Standards, 2008).
- BS 5228-2:2009 Code of Practice for Noise and Vibration on Construction and Open Sites – Part 2: Vibration (British Standards, 2009).

Table 7 summarises the recommended human comfort targets specified as Peak Particle Velocity (PPV) vibration levels as measured within an occupied space.

Table 7 Recommended Human Comfort Vibration Levels

Location	Peak Particle Velocity (PPV) , mm/s	
	Preferred	Maximum
Critical areas[1]	0.14	0.28
Residences – daytime[2]	0.28	0.56
Residences – night time[2]	0.2	0.4
Offices, schools, educational institutions and places of worship	0.56	1.1
Workshops	1.1	2.2

(1) Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be need to assess intermittent values against the continuous or impulsive criteria for critical areas.

(2) Day-time is 7.00 am to 10.00 pm and night-time is 10:00 pm to 7.00 am.

Table 8 presents typical degree of perception of vibration based on guidance provided in the BS 5528-2. It can be seen from Table 8 that peak vibration levels below 0.14 mm/s are unlikely to be perceptible with vibration levels below 0.3 mm/s described as just perceptible in residential environments.

Table 8 Guidance on the Effects of Vibration Levels (BS 5228.2)

Approximate vibration level	Typical degree of perception
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

6.2.2 Structural damage

Currently, there is no Australian Standard that sets criteria for the assessment of building or other structural damage caused by vibration. Australian Standard 2436:2010 (R2016) – *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites;* does refer to the control of vibration in Section 4.8.1. The information in AS 2436 is general in nature and refers to other standards and guidelines if a more detailed assessment is required, i.e. quantification of vibration exposure. British Standard BS 7385.2:1993 – *Evaluation and Measurement for Vibration in Buildings: Part 2 – Guide to Damage Levels from Ground Borne Vibration* and British Standard BS 5228.2:2009 – *Code of Practice for Noise and Vibration Control on Construction and Open Sites: Part 2 Vibration*; are referenced in AS 2436 as being able to supply detailed vibration quantification.

Additional to the detailed British Standards, the German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of Vibration on Structures* (German Standards, 1999) provides more stringent vibration criteria as opposed to BS7385.2:1993 for above ground structures, but less stringent criteria for below ground structures when compared to BS 5228.2:2009. Therefore, a combination of the German and British Standards is recommended, in the absence of specific criteria being supplied by the asset owner, as shown in Table 9.

Table 1 of Section 5 of DIN 4150.3:1999 presents guideline values for the maximum absolute value of the velocity "*at the foundation and in the plane of the highest floor of various types of building. Experience has shown that if these values are compiled with, damage that reduces the serviceability of the building will not occur. If damage nevertheless occurs, it is to be assumed that other causes are responsible.*"

Measured values exceeding those listed in Table 9 "*… does not necessarily lead to damage; should they be significantly exceeded, however further investigations are necessary.*"

Table 9 Guidance values for short-term vibration on structures

Line	Type of structure	Guideline values for velocity v(t)[a] (mm/s)		
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[b]
At grade structures (DIN 4150.3:1999)				
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20

Line	Type of structure	Guideline values for velocity v(t)[a] (mm/s)		
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[b]
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10
Underground structures (BS 5228.2:2009)				
Competent structure such as steel or concrete pipeline		30		
Dilapidated brickwork		15		

[a] The term vi refers to vibration levels in any of the x, y or z axis..

[b] Where frequencies are above 100 Hz the values given in this column may be used as minimum values.

The vibration criteria related to structural damage exceeds the human comfort criteria. Therefore, for facilities that people occupy the human comfort criteria should override the structure damage criteria for the assessment of any vibration.

6.3 Noise monitoring results

6.3.1 Attended noise measurements

Attended noise measurements were undertaken during day, evening and night time periods as defined in the Environmental Protection (Noise) Policy 2008 on 5 September 2018 at the noise monitoring location shown in Figure 1 to assist with understanding of existing acoustic environment on site.

A Bruel & Kjaer 2270 Sound Level Meter was used to undertake a 15 minute attended noise measurement at each period. The equipment was field calibrated before and after the measurements, no significant drift was noted. Short term 1 second noise levels were recorded during the attended ambient noise measurements to allow for identification and quantification of observed noise sources. A summary of attended ambient noise measurements are provided in Table 10 and graphs of the short-term noise level profile for the measured period are presented in Figure 5 – Figure 7.

The attended noise measurement at the location of noise monitoring (see Figure 1) indicated:

- During daytime, background noise is expected to be controlled by general ambient noise sources such as birds, insects as well as distant noise from quarry operations.
- During evening and night time the ambient noise levels in the environment is expected to be controlled by ambient sources associated with the natural environment such as birds, inspects and distant traffic from Flinders Highway.
- From Table 10, it could be seen that background noise levels (i.e. L_{A90}), increases for evening period compared to day and night. This was associated with increased insects' noise at the time of measurement.

.

Table 10 Summary of attended noise measurement results

Period	Time	Measured noise		Observations/comments
		Descriptor	dB(A)	
Day	5 Sep 2018 16:00 – 16:15	L_{90}	36	• Ambient noise dominated by noise from birds, insects, road train and truck pass-bys on Manton-Quarry Road and distant quarry noise such as heavy machinery and crushing. • Occasional road train and/or articulated dump truck passbys with levels between 60 – 66 dB(A) and maximum instantaneous levels of up to L_{max} 70 dB(A) • Insects noise 35 – 37 dB(A), Quarry 38 – 43 dB(A), Birds 38 – 45 dB(A) • Noise from quarry such as distant heavy machinery and crushing noise with levels 42 – 43 dB(A) • Average wind speed: 1 m/s (1 – 3 m/s), Relative Humidity: 51 %, Ambient temperature: 27 ˚C
		L_{eq}	47	
		L_{max}	70	
Evening	5 Sep 2018 19:30 – 19:45	L_{90}	38	• Ambient noise dominated by insects, occasional bird noise and distant traffic. • Distant commercial aircraft flyovers was also recorded during measurement period. • Commercial aircraft flyover 42 - 46 dB(A) • Occasional bird noise up to 46 dB(A), insect noise 38 – 42 dB(A)
		L_{eq}	42	
		L_{max}	$74^{(1)}$ / $54^{(1)}$	
Night	5 Sep 2018 22:00 – 22:15	L_{90}	32	• Ambient noise dominated by insects, wind gust and distant traffic. • Background noise also included buzzing noise from nearby power lines. • Typical ambient level 31 – 35 dB(A), Distant traffic 35 – 40 dB(A) • Power lines buzzing noise 30 – 34 dB(A) • Average wind speed: 1 m/s (1 – 2 m/s), Relative Humidity: 75 %, Ambient temperature: 20 ˚C
		L_{eq}	34	
		L_{max}	$59^{(2)}$ / $49^{(2)}$	

Notes

(7) Reported value of 74 dB(A) is associated with operator noise, maximum noise level of 54 dB(A) excluding operator generated noise was measured.

(8) Reported value of 59 dB(A) is associated with operator noise, maximum noise level of 49 dB(A) excluding operator generated noise was measured.

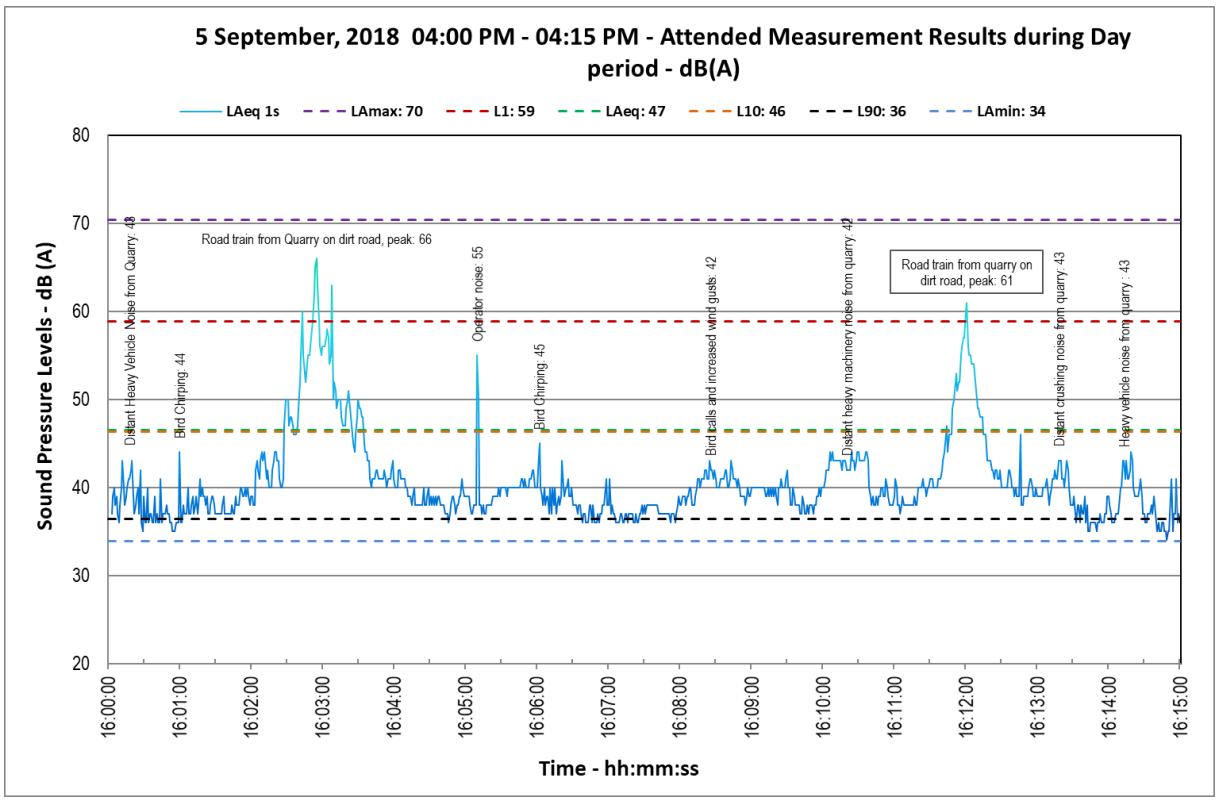


Figure 5 Daytime attended noise measurement results

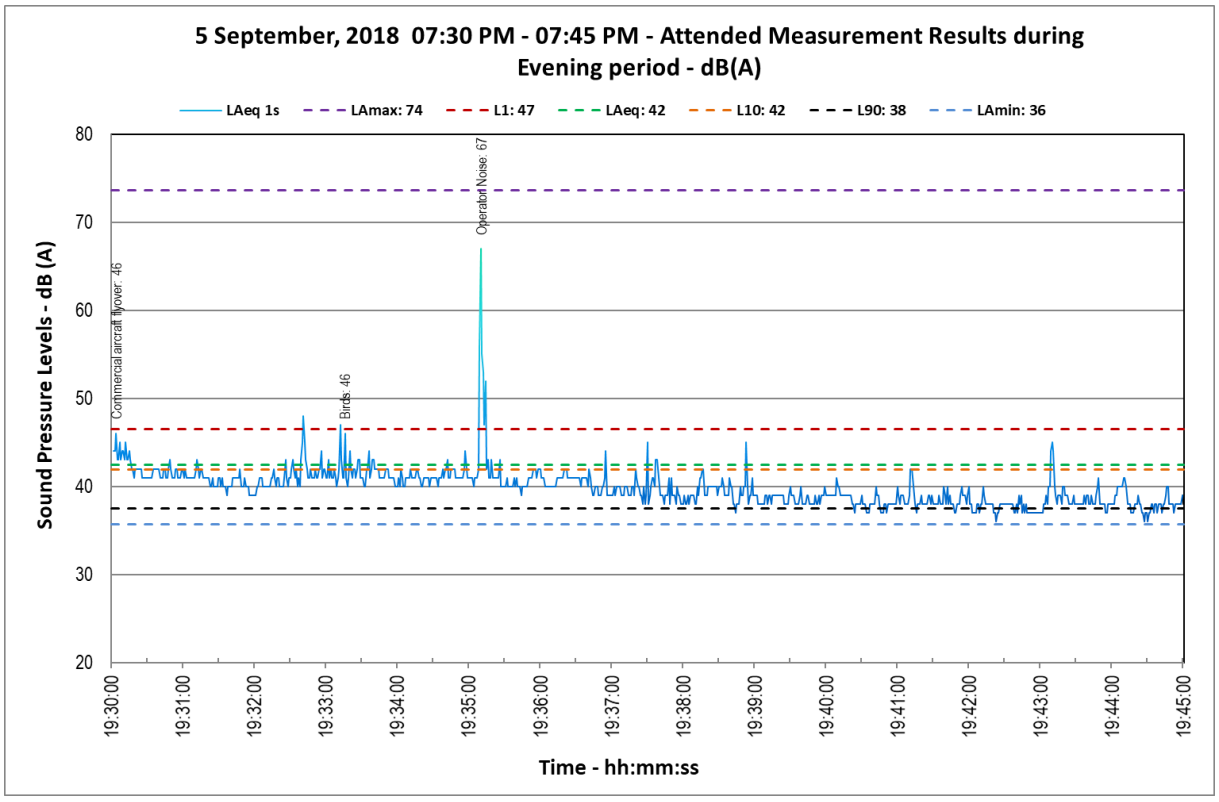


Figure 6 Evening attended noise measurement results

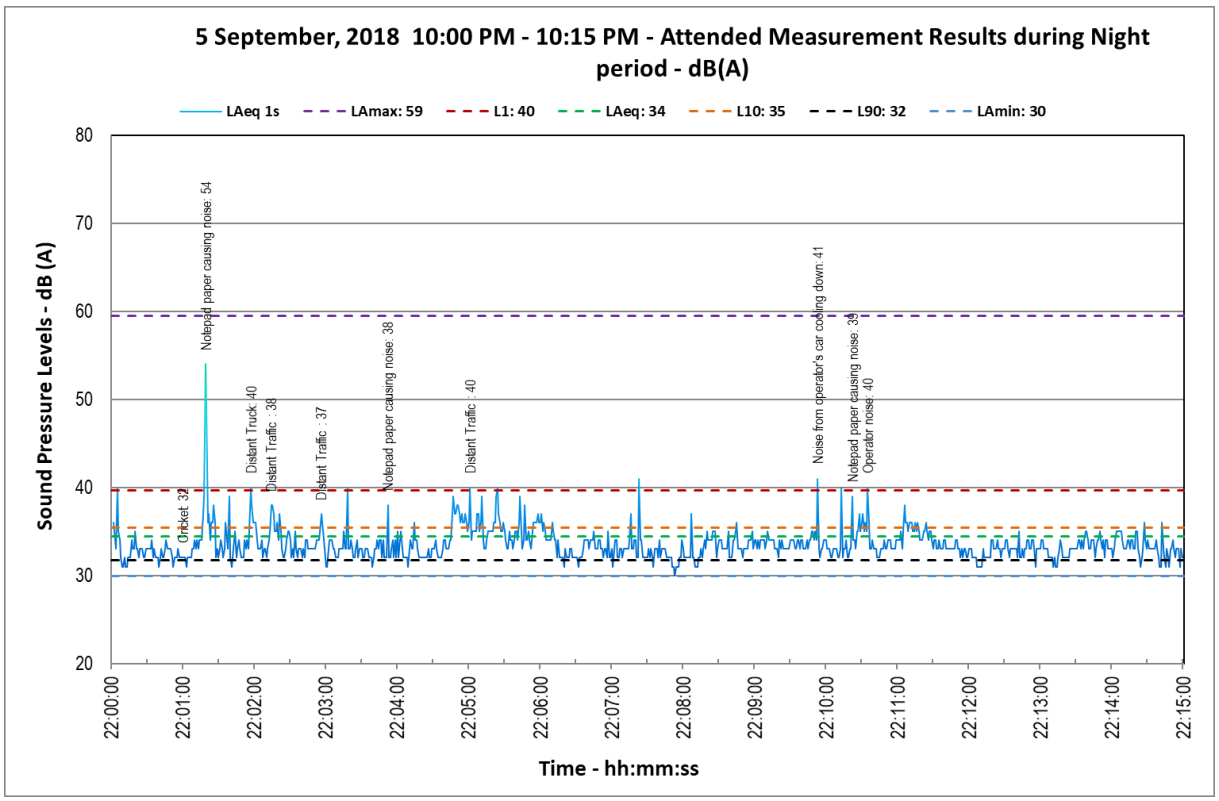


Figure 7 Night attended noise measurement results

6.3.2 Unattended noise measurements

Continuous noise monitoring was conducted from 6 pm Wednesday 5 September 2018 to 9 am Friday 21 September 2018. Noise monitoring result graphs are presented in Appendix A. Summary of unattended noise monitoring results are also presented in Table 11. The results have been filtered to exclude adverse weather conditions and levels below instrument noise floor as follows:

- Periods of rain;
- Periods of winds higher than 5 m/s at the microphone height; and
- Raw instrument data below 15 dB (A) have also been excluded to reflect the minimum instrument measurement range.

Table 11 shows the Assessment Background Level (ABL) for each day within the monitoring period and resulting overall Rated Background Level (RBL) and ambient (L_{Aeq}) noise levels measured during day, evening and night-time periods. The ABL and RBL levels are calculated based on the guidance provided in the DES PNC 2016.

The results show that background noise levels at the site are generally very low, which is expected of a rural area. The noise levels outlined in Table 11 have been used to derive project specific noise level criteria detailed in Section 6.4.

Table 11 Summary of unattended noise monitoring results

Date	Assessment Background Level (ABL) dB(A)			Ambient L_{eq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
Wednesday-5-Sep-18	–	–	29	–	36	43
Thursday-6-Sep-18	32	29	29	55	40	43

Date	Assessment Background Level (ABL) dB(A)			Ambient L_{eq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
Friday-7-Sep-18	29	28	28	46	37	36
Saturday-8-Sep-18	27	33	23	40	40	33
Sunday-9-Sep-18	26	22	29	39	37	43
Monday-10-Sep-18	31	21	21	47	36	46
Tuesday-11-Sep-18	31	28	27	49	38	42
Wednesday-12-Sep-18	30	28	27	45	40	40
Thursday-13-Sep-18	30	27	27	42	39	38
Friday-14-Sep-18	29	25	26	42	38	35
Saturday-15-Sep-18	26	27	29	37	35	34
Sunday-16-Sep-18	25	29	21	38	36	46
Monday-17-Sep-18	27	31	27	39	40	38
Tuesday-18-Sep-18	28	26	26	39	40	36
Wednesday-19-Sep-18	30	28	25	42	38	38
Thursday-20-Sep-18	26	28	27	39	37	37
	Rated Background Level (RBL)			Ambient L_{eq} dB(A)		
Overall	29	28	27	46	38	41

Correction for meteorological conditions

Analysis of background noise levels have been conducted based on guidance provided in Queensland Department of Environment and Heritage Protection 2013, *Noise Measurement Manual* (DEHP NMM) and DES PNC 2016:

The DEHP NMM 2013 stipulates:

> "*A noise measurement should be taken on a day with a calm to gentle breeze and without rain. Some conditions to avoid are high wind (generally, do not conduct the assessment if the wind is higher than 5 meters/second (m/s)), or rain*".

Australian Standard *AS 1055:2018: Acoustics – Description and Measurement of Environmental Noise* specifies:

> *"Where the maximum wind speed exceeds 5 m/s at the measurement position and noise measurement are required, caution should be applied and special windscreens should be utilized, if available"* (AS1055:2018, p. 13).

Rainfall and wind speed during the period of noise measurements were recorded using a weather station located adjacent to the noise monitoring equipment. Where measured wind speed was greater than 5 m/s or whenever rainfall occurred, noise data was excluded from the assessment. The excluded periods are highlighted in the noise monitoring result graphs in Appendix A.

6.4 Project specific noise criteria

6.4.1 EPP (Noise) control of background creep

Potential noise emissions from PSMA are generally expected to vary over time due to various expected industrial sites, sources and operating conditions. Therefore the EPP (Noise) continuous noise criteria for control of noise creep is not relevant, as the noise from development is expected to be variable in nature. Hence the $L_{Aeq, adj, T}$ criteria is applicable to the for the PSMA site noise emissions that vary over time. The relevant EPP (Noise) background creep criterion at the relevant noise sensitive receivers around the PSMA site is based on background noise monitoring results on site are presented in Table 12.

Table 12 Noise (EPP) background noise creep criteria

Receivers	Noise criterion $L_{Aeq,adj,T}$, dB(A) measured at receptor in NCA		
	Day (7 am – 6 pm)	Evening (6 pm – 10 pm)	Night (10 pm – 7 am)
All receivers	34	33	32

6.4.1 PNC Planning noise criteria

The *Planning for Noise Control* (PNC) is a non-statutory guideline and generally considers control of noise at residential receivers for planning purposes. As per PNC requirements, within a 200 m radius of the receivers nearest to the site, the land use could be categorised as:

- Residential Receivers along the Flinders Highway (i.e. R3 – R22), residential and near busy road with low density transportation (less than 200 vehicle an hour).
- Receivers away from Flinders Highway (i.e. R1 – R2, and R23 – R26), purely residential and purely rural.
- Note that receiver R7 is considered commercial/educational premises and therefore PNC criteria is not applicable.
- Receiver R20 appears to be a residential dwelling within a mixed use land being a small private airfield for which planning criteria based on PNC is established.

Attended noise measurements identified that the existing environment at the nearest noise sensitive receiver is dominated by natural noise sources such as birds and insects with no significant observed contribution from existing industry.

Based on the available traffic count information from the Queensland Government Department of Transport and Main Roads (TRM) Road Location and Traffic Data[2], an Average Annual Daily Traffic count of 2367 and average hourly count of 98 is expected for the section of the Flinders Highway applicable to the site. Therefore no correction for traffic noise is applicable based on PNC requirements.

Table 13 and Table 14 shows the derivations of $L_{Aeq, 1hr}$ noise criteria with consideration to PNC Guideline for relevant noise sensitive receivers based on the noise monitoring results conducted on site which is considered representative of the nearest potentially affected residential receivers away from the Flinders Highway. The background noise levels at the receivers along the Flinders Highway (i.e. R3 – R22) are expected to be slightly higher than those measured due to likely higher traffic noise levels and therefore established criteria for these receivers are potentially slightly conservative.

[2] https://data.qld.gov.au/dataset/road-location-and-traffic-data

Note that tonality and impulsiveness may be considered as intrusive noise characteristics. The PNC guideline requires any tonality and impulsiveness noise characteristics emanating from the proposal activities to be adjusted and assessed for compliance assessment against the PNC noise criteria. These however, will need to be considered when, noise from the proposed industrial developments are assessed against the applicable criteria.

PNC guideline specifies slightly different daytime period for Sundays and Public holidays compared to the EPP (Noise) which specifies the same periods for all days. The Daytime period on Sundays and public holidays as per PNC is 9 am – 6 pm. The daytime, evening and night periods are defined in the PNC as:

- Daytime, 7 am – 6 pm all days except on Sundays and public holidays, 9 am – 6 pm;
- Evening, 6 pm – 10 pm on the day; and
- Night, 10 pm on the day to 7 am on the next day.

Table 13 PNC Planning noise levels for residential premises R1 – R2 and R23 – R26

Description	Day	Evening	Night
Specific/component noise level ($L_{Aeq,1\ hour}$)	37	28	28
Max Planning Noise Levels $L_{Aeq,1\ hour}$ (PNL)	36	28	31
Project Specific Planning Criteria ($L_{Aeq,1\ hour}$) Receivers (R1 – R2, R23 – R26)	**36**	**28**	**28**

Table 14 PNC Planning noise levels for residential premises (R3 – R22)

Description	Day	Evening	Night
Specific/component noise level ($L_{Aeq,1\ hour}$)	37	36	35
Maximum Planning Noise Levels $L_{Aeq,1\ hour}$ (PNL)	55	50	43
Project Specific Planning Criteria ($L_{Aeq,1\ hour}$) Receivers (R3 – R22)	**37**	**36**	**35**

6.4.2 PNC maximum noise level for sleep disturbance

The PNC guideline includes criteria for control of sleep disturbance from transient noise sources. Examples are heavy truck or rail operations. The sleep disturbance criteria may be used for assessing noises that contain impulsive components, but it is not suitable for assessing noise that consists solely of discrete impulses, for example gunfire and blasting.

The PNC guidelines state that:

> *As a rule in planning for short-term or transient noise events, for good sleep over eight hours, the indoor sound pressure level measured as a maximum instantaneous value should not exceed approximately 45 dBA maxLpA more than 10-15 times per night. The corresponding external noise level, assuming partially closed windows, is 52dBA maxLpA, measured in the free field.*

Where number of transient events are likely to be more than 10 – 15 then lower maximum noise levels criterion is applicable. Table 15 presents the number of permissible noise events based on PNC guideline for different external maximum noise levels for a probability of 10 percent awakening for partially closed windows. This criterion has been selected to protect at least 90 percent of the population from the adverse effects of transient noise. Note that sleep disturbance criteria is only applicable during night time period. Note that where the noise

receiver uses mechanical ventilation with closed windows then higher external maximum noise could be used for various windows types. Refer to the PNC document Table 7 for further guidance.

Table 15 Maximum noise levels criteria and number of permissible events for transient noise sources with partial open windows

Maximum noise level ($L_{max,}$ dB(A))	Number of Events permissible
47	32
52	10
57	3
62	1

6.4.1 Summary of project specific criteria

Table 16 summarises all applicable noise criteria for each relevant noise sensitive receiver based on EPP (Noise) and PNC guideline requirements.

Table 16 Summary of applicable project external noise criteria

Receivers	Period	Criteria	Noise level criteria (dB)			
			$L_{Aeq,adj,1hr}$	$L_{10A,adj,1hr}$	$L_{1A,adj,1hr}$	L_{Amax}
R1 – R2 R23 – R26	Day	EPP AQ	50	55	65	
		EPP BG	34			
		PNC	36			
	Evening	EPP AQ	50	55	65	
		EPP BG	33			
		PNC	28			
	Night	EPP AQ	45(2)	50(2)	60(3)	
		EPP BG	32			
		PNC	28			52
R3 – R22	Day	EPP AQ	50	55	65	
		EPP BG	34			
		PNC	37			
	Evening	EPP AQ	50	55	65	
		EPP BG	33			
		PNC	36			
	Night	EPP AQ	45(2)	50(2)	60(3)	
		EPP BG	32			
		PNC	35			52
R7	(When open)	EPP AQ	60(2)			
Notes :						

Receivers	Period	Criteria	Noise level criteria (dB)			
			$L_{Aeq,adj,1hr}$	$L_{10A,adj,1hr}$	$L_{1A,adj,1hr}$	L_{Amax}

(1) Abbreviations are as follow :

EPP AQ: EPP (Noise) Acoustic Quality Objectives

EPP BG : EPP(Noise) Background Creep Criteria

PNC: Planning for Noise Control Criteria

(2) Based on a 15 dB outdoor to indoor correction adopted based on difference between EPP (Noise) Outdoor and Indoor $L_{Aeq,adj,1hr}$ and $L_{A10,adj,1hr}$ day and evening criteria. Refer to Table 6.

(3) Based on a 20 dB outdoor to indoor correction adopted based on difference between EPP (Noise) Outdoor and Indoor $L_{1A,adj,1hr}$ day and evening criteria. Refer to Table 6.

Compliance with the most stringent criteria will ensure that all other applicable requirements are also achieved. The lower applicable criteria for each receiver based on EPP (Noise) requirements and PNC guidelines is presented in Table 17

Table 17 Lowest applicable project specific criteria

Receivers	Period	Noise level criteria (dB)(1)			
		$L_{Aeq,adj,1hr}$	$L_{10A,adj,1hr}$	$L_{1A,adj,1hr}$	L_{Amax}
R1 – R2 R23 – R26	Day	34	55	65	
	Evening	28	55	65	
	Night	28	50	60	52
R3 – R22	Day	34	55	65	
	Evening	33	55	65	
	Night	32	50	60	52
R7	(When open)	60			

Notes:

(1) $L_{Aeq,adj,1hr}$, $L_{10A,adj,1hr}$, $L_{1A,adj,1hr}$ are adjusted noise levels for tonal and impulsive characters where relevant in accordance with the guidelines provided in PNC.

6.5 Project noise criteria discussion

The lowest applicable $L_{Aeq,adj,1hr}$ noise criteria presented in Table 17, is generally expected to be the limiting noise criterion for the future industrial developments. $L_{Aeq,adj,1hr}$ criteria of 28 – 34 dB is applicable to the residential receivers during different periods of the day.

For receivers along the Flinders Highway (i.e. R3 – R22) which are the closest receivers, the lowest applicable $L_{Aeq,adj,1hr}$ noise criterion is defined by the Noise (EPP) control of background noise creep.

For receivers away from the Flinders Highway (i.e. R1 – R2 and R23 – R26), the lowest applicable $L_{Aeq,adj,1hr}$ noise criteria for evening and night are defined by recommended PNC criteria. Adopting the EPP (Noise) criteria will result in 5 dB and 4 dB higher criteria for Evening and Night periods.

The EPP (Noise) criteria is a statutory requirement while the PNC criteria are only used as a guide and will typically be enforced when formally called under planning scheme or planning conditions. We note that the PNC document is listed in SC6.4.3.15.1 item 3 of the Townsville City Plan as one of the Reference and Source Documents (Australian Guidelines) applicable for Noise and Vibration Assessments.

Nevertheless both EPP (Noise) requirements or PNC guidelines result in relatively low noise level criteria due to rural nature of the existing environment. These noise criteria are understood as levels adjusted for any tonal and impulsive noise characters that may be associated with the noise emissions and will need to be considered when, noise from the proposed industrial developments are assessed against the applicable criteria or more information about potential noise characters from the noise sources is available. Based on our experience of noise assessment at medium and large-scale industrial sites, noise characters such as tonality may be present.

Achieving such low noise level criteria at noise sensitive receivers in particular at receivers such as R6 which are at close proximity to the PSMA site boundary may be difficult for medium and heavy industrial sites and requires careful consideration of noise emissions at planning stages.

Generally, it is expected that industries proposed closest to the site boundary (i.e. closest to the noise sensitive receivers) will require high level of engineering noise control to mitigate noise emissions while those proposed further towards the west will likely require medium and low levels of engineering noise control.

Further case by case assessment of operational noise emissions from any proposed industrial developments on the PSMA site prior to grant of planning approvals is recommended in accordance with the requirements of the EPP (Noise) and the Council should consider if the stricter noise criteria in accordance with the PNC guidelines (as established in 6.4.1) deems to be appropriate.

6.6 Encroachment of noise sensitive receivers

6.6.1 Noise sensitive land uses

As the PSMA and surrounding areas develop over time, new land uses could potentially encroach on the existing approved developments on the PSMA site. Appropriate planning measures should be put in place to prevent noise sensitive land uses from being approved in close proximity of the boundary of the PSMA site or where relevant new noise sensitive land uses encroaching on the PSMA to be designed and constructed to prevent any adverse impact on the acoustic amenity of the occupants.

6.6.2 Drive it NQ

Drive it NQ is a motor sport racing facility approved by Council that is to be located within the PSMA area. Motor sport racing facilities generate significant levels of noise emissions that are typically managed through a combination of measures established on a case by case basis following a noise impact assessment.

As PSMA and surrounding areas develop, consideration should be given to prevention of noise sensitive receiver's encroachment upon the Drive it NQ. Noise encroachment is expected from the following:

- Future industrial uses within the PSMA area
- Other future noise sensitive uses such as residential, hospitals, schools close to the PSMA boundary.

Future uses within PSMA

The future industrial uses on the PSMA site will include medium and heavy industries which are not considered noise sensitive and are not expected to have any constraint on the Drive it NQ.

Where any commercial and retail activities are considered as part of the larger industrial developments within the PSMA such as showrooms and the like, it is recommended that future

industrial uses are required to incorporate appropriate noise attenuation measures to such uses to meet Indoor Acoustic Quality Objective within the EPP (Noise) for Commercial and Retail activity.

Other noise sensitive uses outside PSMA

To protect the Drive IT NQ facility from encroachment (per the requirements of SPP 'Emissions and hazardous activities') by noise sensitive receivers outside of the PSMA boundary, it is recommended that a buffer be implemented surrounding the facility within the Townsville City Council planning scheme.

It is understood that a detailed noise assessment has been undertaken for the Drive IT NQ facility as part of the approval process and a number of noise mitigation measures considered. A detailed acoustic assessment requiring noise modelling of the proposed Drive IT NQ and approved mitigations is recommended to establish an appropriate reverse amenity buffer to protect Drive it NQ from encroachment.

6.7 Vibration Monitoring Results

The baseline vibration levels measured at monitoring location shown in Figure 1 are presented in Appendix B and summarised in Table 18. The vibration level data shown in Appendix B represent maximum peak particle velocity vibration levels during 15 min periods. The measured short term vibration levels were analysed and five isolated events were identified as extraneous vibration which were excluded from the analysis of results. These periods are highlighted in the vibration result graphs presented in Appendix B.

Typical ambient vibration levels of about 0.05 – 0.16 mm/s were measured at the site which are well below the recommended human comfort vibration targets at residential premises and typical threshold of perception. Based on the measured baseline vibration levels, adoption of human comfort vibration criteria as outlined in Section 6.2.1 is considered appropriate for new industrial developments.

Table 18 Summary of Measured Vibration Levels

Statistical Descriptor	Highest of tri-axial PPV vibration levels mm/s
Maximum ambient	0.213 mm/s (213 µm/s)
90th percentile (level exceeded 10 % of the time)	0.158 mm/s (158 µm/s)
Average	0.111 mm/s (111 µm/s)
10th percentile (level exceeded 90 % of the time)	0.063 mm/s (63 µm/s)
Minimum	0.047 mm/s (47 µm/s)

Generally, it is not expected that general industrial activities within the PSMA will result in vibration levels exceeding Human Comfort or Building Damage criteria at the sensitive receivers located more than 100 m from the vibration source. However, adopting human comfort vibration criteria as outlined in Section 6.2.1 where the noise sensitive receiver falls within 100 m of the industrial uses will act as appropriate planning mechanism addressing SPP requirements and assessment framework where significant vibration sources are proposed or where complaint are made in future.

7. Air quality

7.1 Relevant criteria

SPP requirements for "emissions and hazardous activities" relating to control of air pollution are addressed with consideration to the following:

- *Environmental Protection (Air) Policy 2008* (Air EPP)

7.1.1 Environmental Protection (Air) Policy 2008 (Air EPP)

The *Environmental Protection (Air) Policy 2008* (Air EPP) is the Queensland state policy containing objectives for a number of air pollutants. The relevant criteria for PM_{10} has been reproduced in Table 19 below. The Air EPP states the criteria must be met at all times, unless otherwise specified. It is noted that for PM_{10} an exceedance of the criteria is allowed for no more than 5 days each year.

Table 19 Derived air quality criteria for pollutants

Pollutant	Averaging Period	Air quality objective
PM_{10}	1 day	50 µg/m^3

7.2 Ambient PM_{10} results

The results of ambient PM_{10} taken between 6 September and 20 September 2018 are presented in Table 20 and Figure 8 as daily averages.

GHD notes that a k-factor of 1.26 was calculated based on all data available. The application of the k-factor to the data reduces the impact relative humidity may have on the data, as 'false' data associated with relative humidity does translate to actual particulates deposited on the filter.

PM_{10} measured over the monitoring period did not exceed the Air EPP 24 hour criterion of 50 µg/m^3. The overall measured PM_{10} values range between 8 µg/m^3 and 28 µg/m^3. The maximum recorded 24 hour average occurred on 10 September 2018.

Table 20 Measured PM_{10} values

Date	PM_{10} concentration (µg/m^3)
6 September 2018	17
7 September 2018	18
8 September 2018	8
9 September 2018	8
10 September 2018	28
11 September 2018	17
12 September 2018	18
13 September 2018	14
14 September 2018	14
14 September 2018	11
16 September 2018	13

Date	PM_{10} concentration ($\mu g/m^3$)
17 September 2018	20
18 September 2018	15
19 September 2018	17
20 September 2018	10

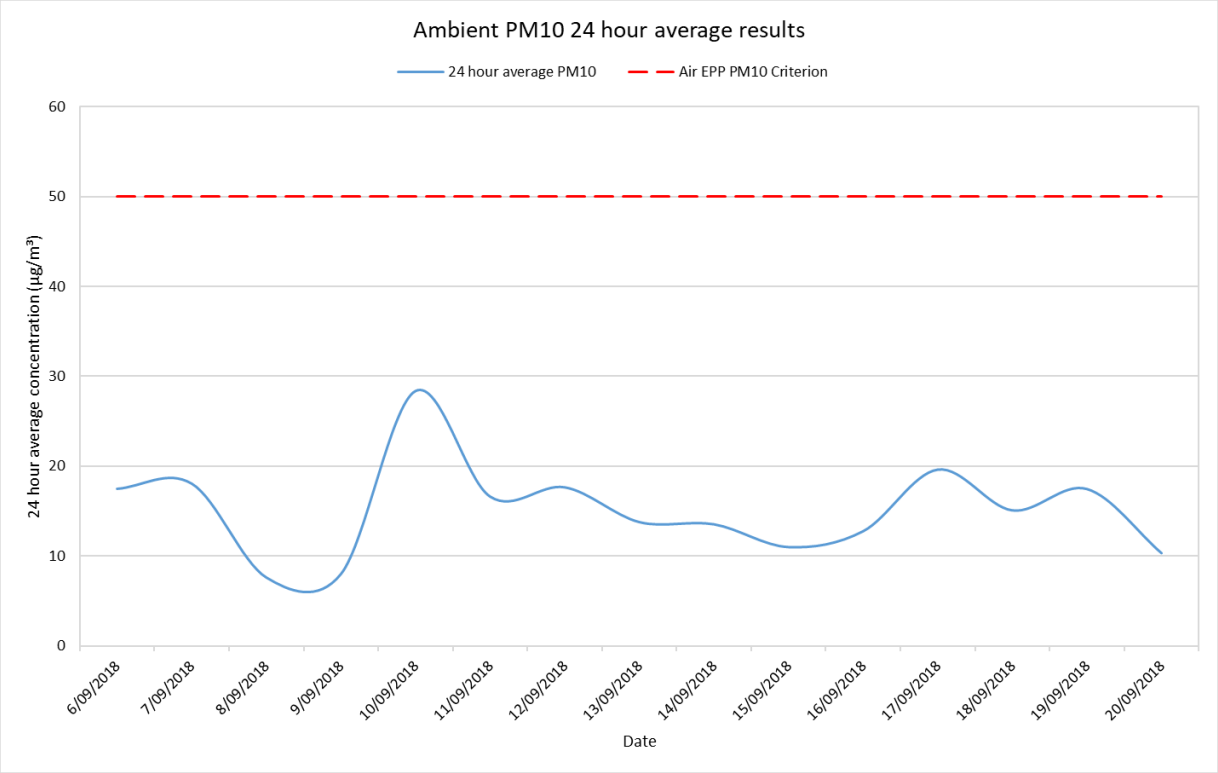


Figure 8 Time series of 24 hour PM_{10} values

Air quality recommendations with regards to the future industrial uses within the site are addressed in GHD report titled Infrastructure, Traffic, Transport & Air Quality – Air Quality Impact Assessment dated April 2019.

8. Conclusion and Recommendations

GHD Pty Ltd (GHD) has been commissioned by Townsville City Council (TCC) to undertake an Infrastructure, Traffic, Transport and Air Quality Study for the Lansdown Planning Scheme Major Amendment (PSMA) in relation to the Lansdown Station site located on the Flinders Highway at 132 Bidwilli Road, Calcium.

As part of the Infrastructure, Traffic, Transport and Air Quality Study, baseline monitoring of air quality, noise and vibration was carried out at the subject site. The aim of the air, noise and vibration monitoring was to establish baseline ambient levels and obtain a better understanding of the environmental conditions existing on site.

Baseline air, noise and vibration monitoring was conducted during the period 5 September 2018 to 21 September 2018 at the south western side of the site. A weather station was also installed at the location of the noise and vibration monitors to obtain meteorological parameters assisting with assessment of the measured noise and vibration and determination of particulate and noise dispersion patterns at the site.

SPP requirements for “Emissions and hazardous activities” relating to control of noise, vibration and air pollution were addressed in this report with consideration to the following legislations:

- *Environmental Protection Act 1994* (EP Act)
- *Environment Protection Regulation 2008* (EP Regulation)
- *Environmental Protection (Noise) Policy 2008* (EPP (Noise))
- *Environmental Protection (Air) Policy 2008* (Air EPP)

The results of noise monitoring were utilised to establish applicable environmental noise criteria for the proposed site based on the requirements of the EPP (Noise) as well as guidelines provided in the DES Planning for Noise Control guidelines.

The assessment of baseline air, noise and vibration results concluded that:

- Synthesized meteorological data showed similar trends to that measured on site using the weather station and therefore considered representative of the site.
- Measured particulate matter (PM_{10}) did not exceed the Air EPP 24 hour PM_{10} criterion.
- Typical ambient vibration levels measured at the site were well below the recommended human comfort vibration targets at residential premises and typical threshold of perception.
- Generally, it is not expected that general industrial activities within the PSMA will result in vibration levels exceeding Human Comfort or Building Damage criteria at the sensitive receivers located more than 100 m from the vibration source.
- Established noise criteria for the PSMA site were considered particularly low due to rural nature of the existing environment.
- Achieving the noise level criteria at some of the applicable noise sensitive receivers due to close proximity to the PSMA site boundary may be difficult for medium and heavy industrial sites and requires careful consideration of noise emissions at planning stages.
- As the PSMA and surrounding areas develop over time, new land uses could potentially encroach upon the existing approved developments on the PSMA site. Appropriate planning measures should be put in place to prevent noise sensitive land uses from being approved in close proximity to the boundary of the PSMA site or where relevant any new noise sensitive land uses encroaching upon the PSMA should be designed and constructed to prevent any adverse impact on the acoustic amenity of the occupants.

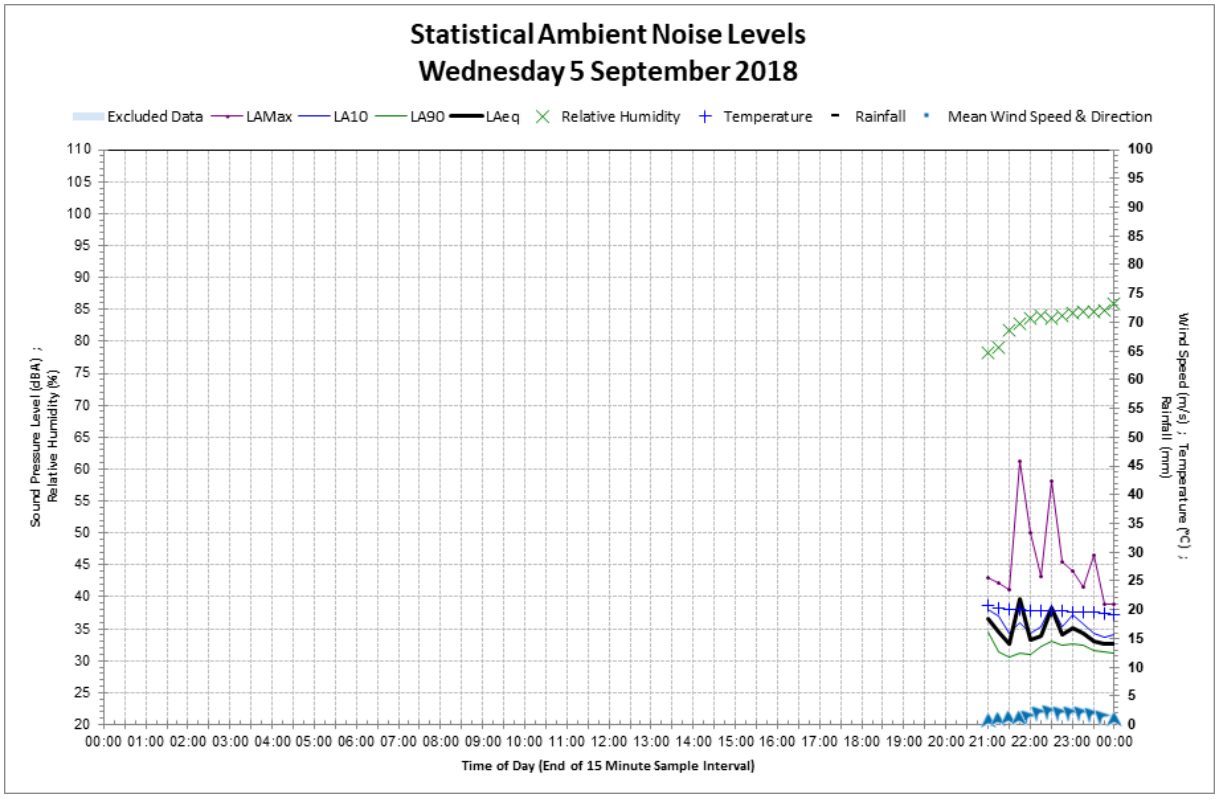
- Air quality recommendations with regards to the future industrial uses within the site are addressed in GHD report titled Infrastructure, Traffic, Transport & Air Quality – Air Quality Impact Assessment dated April 2019.

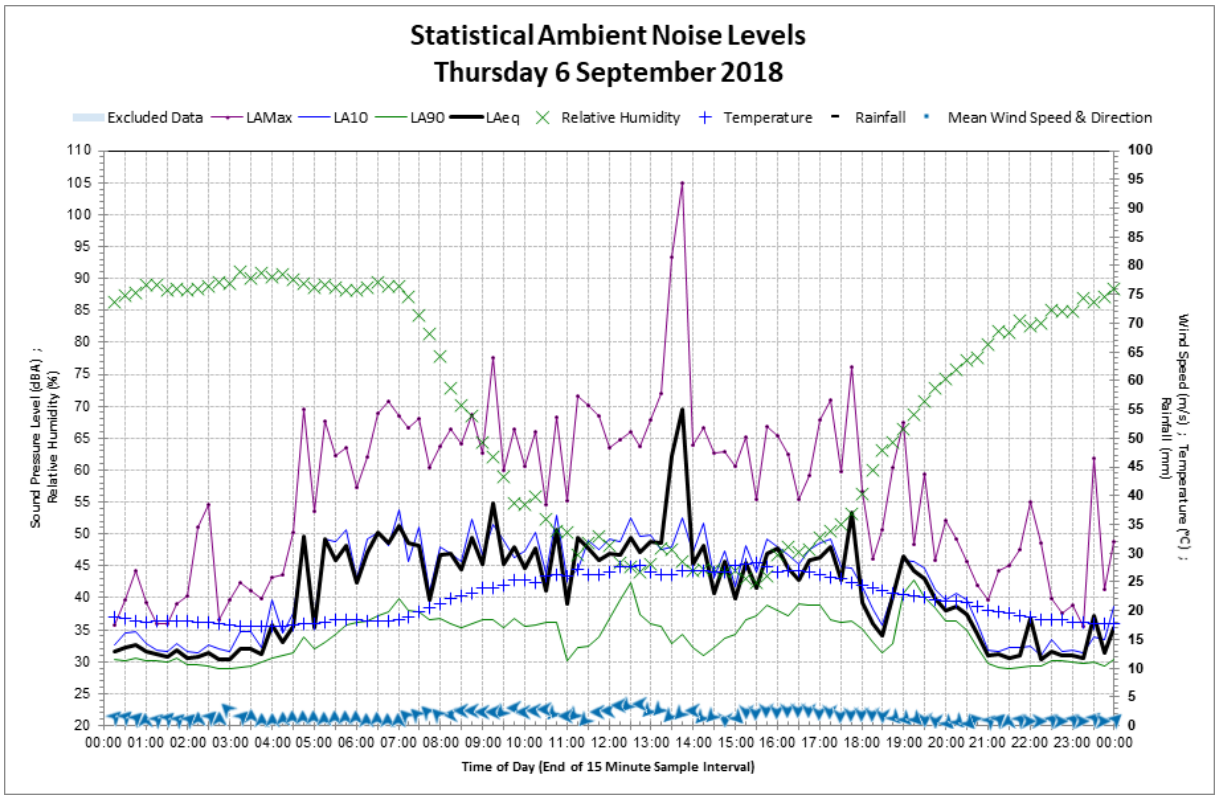
Based on the findings of this assessment and to for address SPP requirements for “Emissions and hazardous activities” relating to control of noise and vibration, the following is recommended:

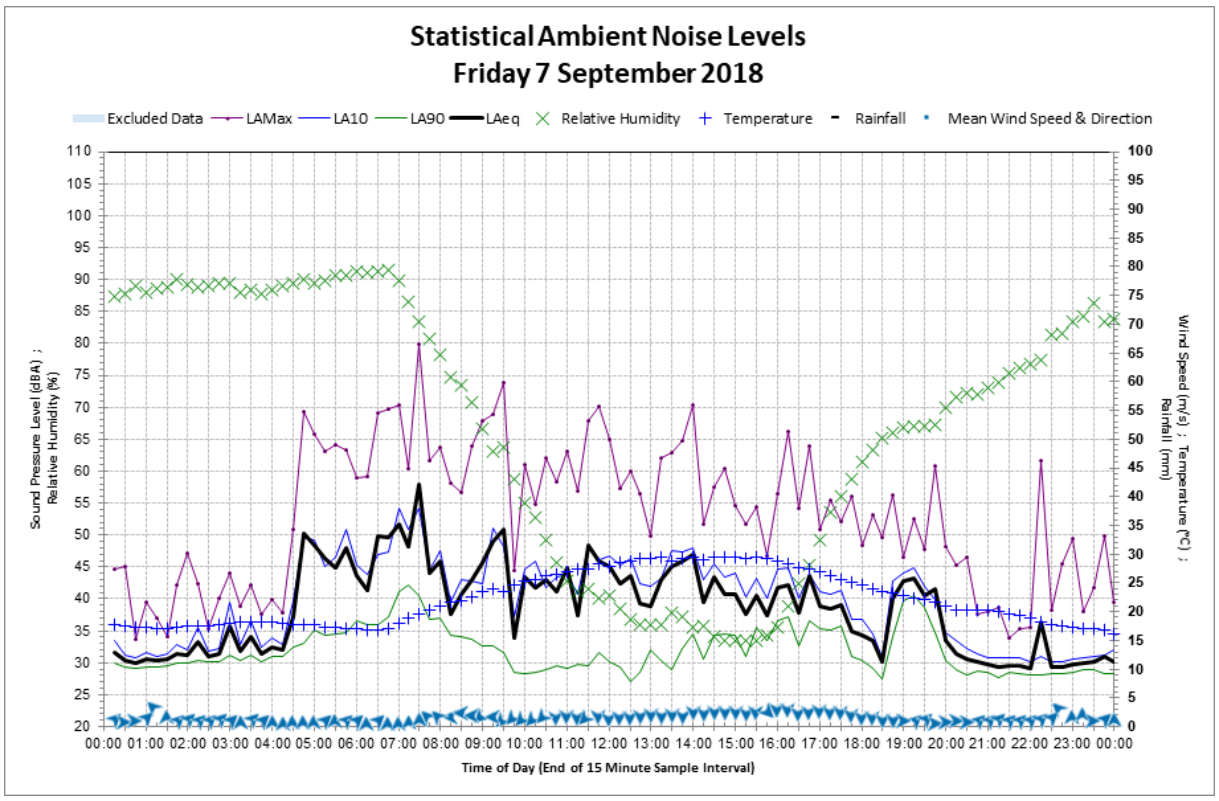
- Appropriate planning requirements to be included in the PSMA that require assessment of operational noise and vibration emissions from proposed industrial developments at the PSMA site. This includes planning conditions or clauses in PSMA that require:
  - Provision of an acoustic report from a suitably qualified acoustic engineer/consultant to demonstrate compliance of the proposed development and ongoing operation of the facility with requirements of the EPP (Noise).
  - Provision of a vibration impact assessment from a suitably qualified acoustic engineer/consultant where the proposed development is located less than 100 m from the nearest sensitive receivers demonstrating that the proposed development and ongoing operation of the facility achieves the Human Comfort Vibration limits (as outlined in Section 6.2.1 of this report) at nearest sensitive receivers.
- TCC should consider if stricter noise criteria in accordance with the PNC guidelines (as established in Section 6.4.1) is appropriate and where relevant incorporate demonstration of compliance with PNC requirements to the appropriate planning conditions/clauses in the PSMA.
- To control future encroachment on the Drive IT NQ, the following is recommended:
  - Where any commercial and retail activities are considered as part of the larger industrial developments within the PSMA such as showrooms and the like, it is recommended that such uses are required to incorporate appropriate noise attenuation measures such that Indoor Acoustic Quality Objective within the EPP (Noise) for Commercial and Retail activity is achieved.
  - To protect the Drive IT NQ facility from encroachment (per the requirements of SPP ‘Emissions and hazardous activities’) by noise sensitive receivers outside of the PSMA boundary, it is recommended that a reverse amenity buffer be implemented surrounding the facility within the Townsville City Council planning scheme. A detailed acoustic assessment requiring noise modelling of the proposed Drive IT NQ and approved mitigations is recommended to establish an appropriate reverse amenity buffer to protect Drive IT NQ from encroachment.

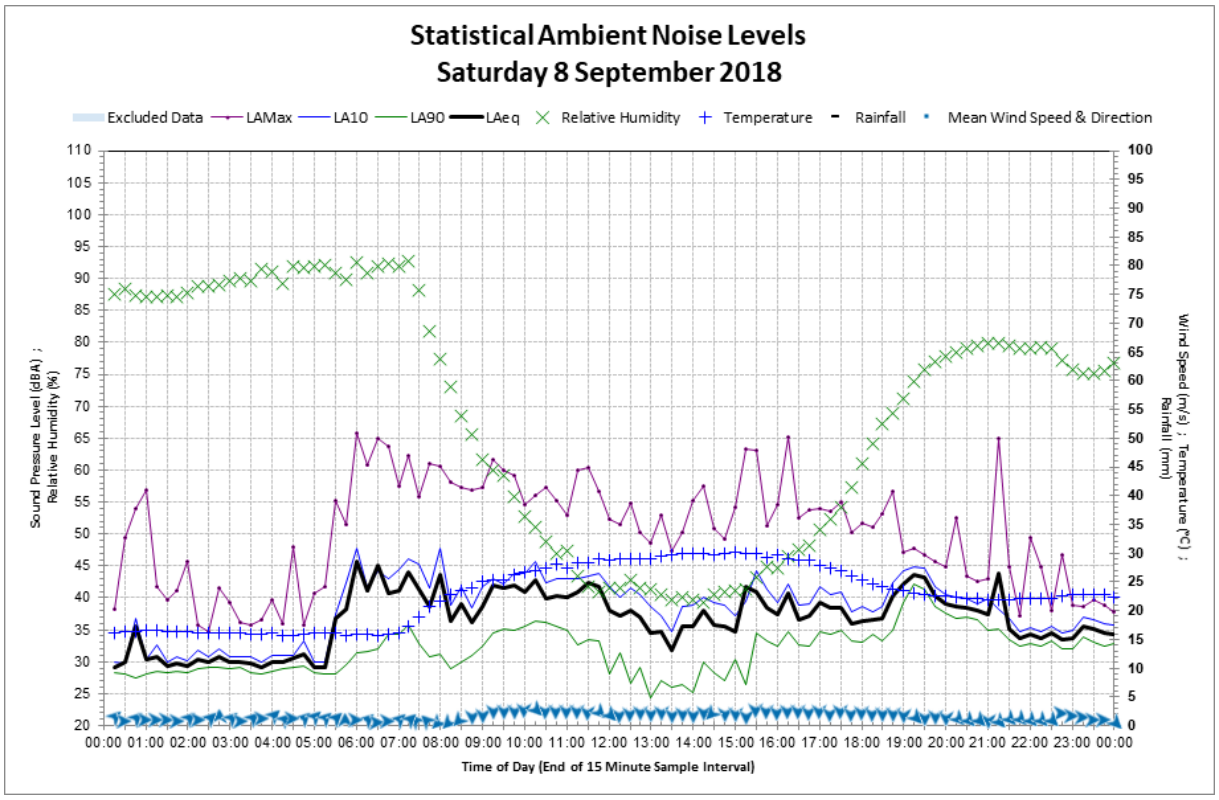
Appendices

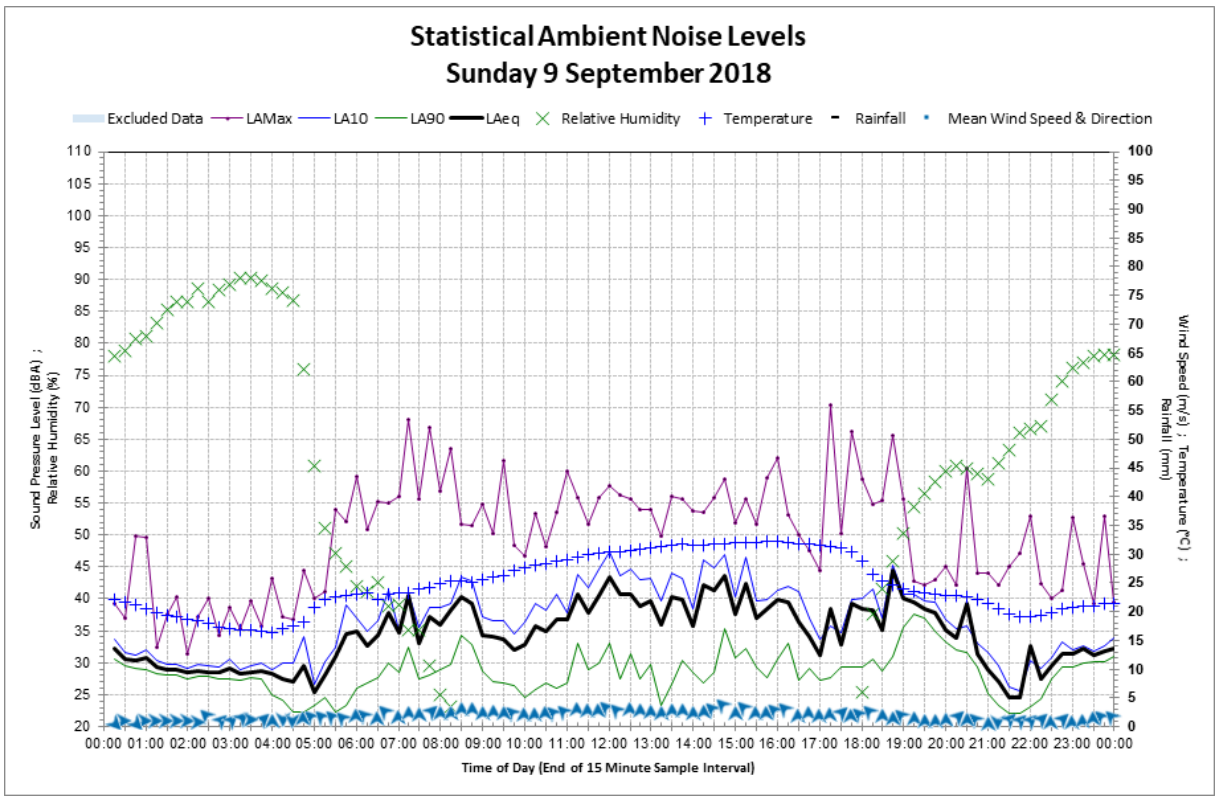
Appendix A – Noise monitoring results

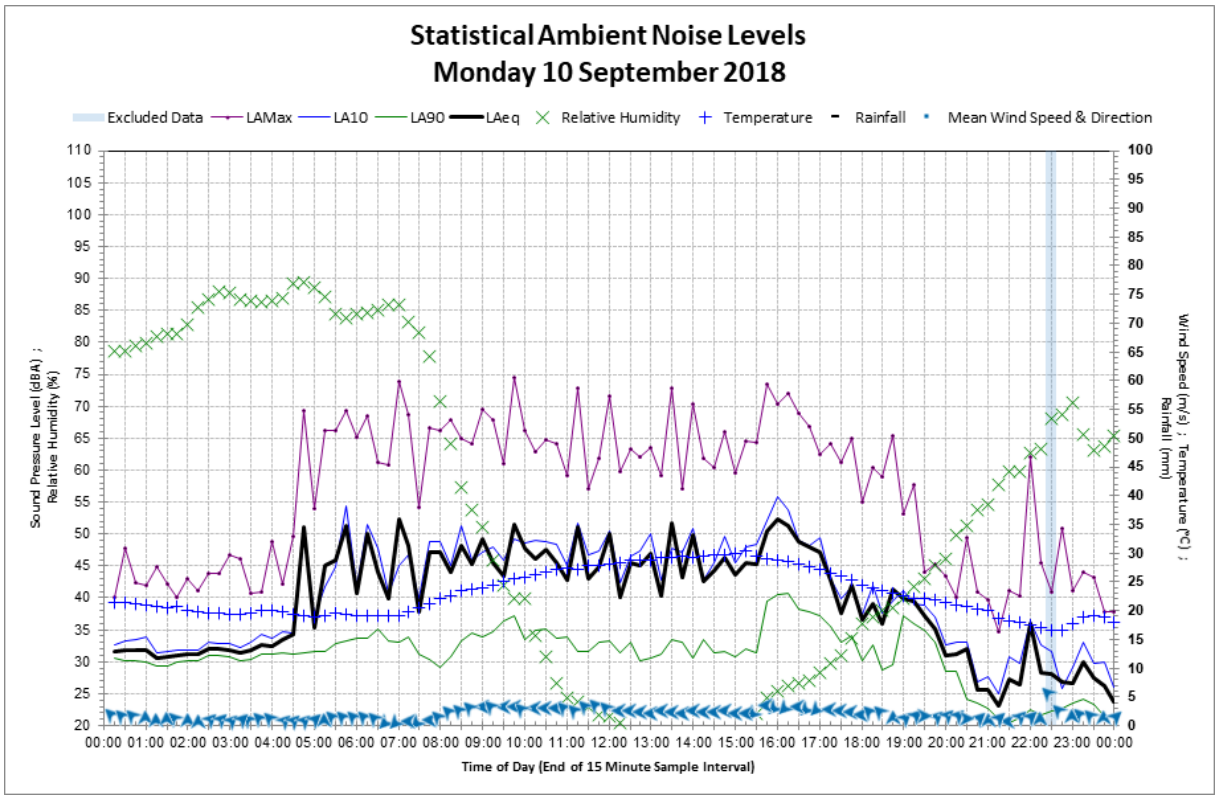


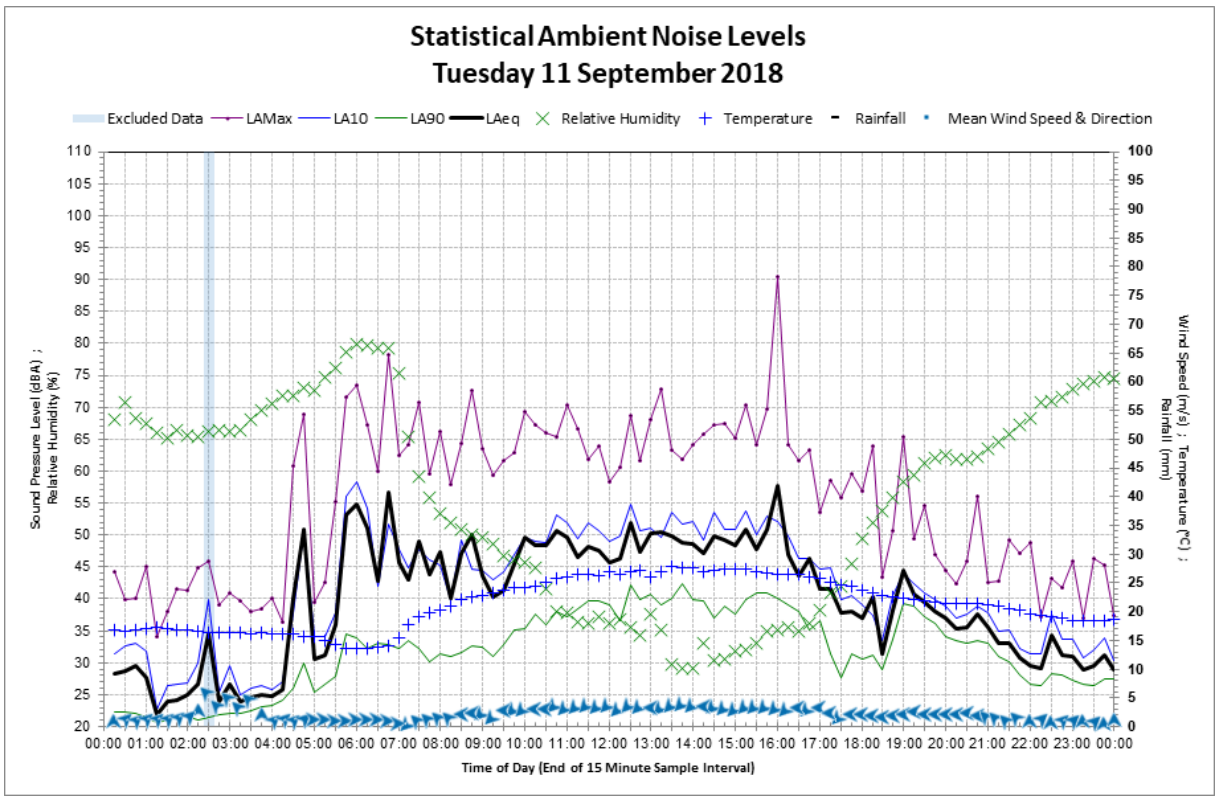


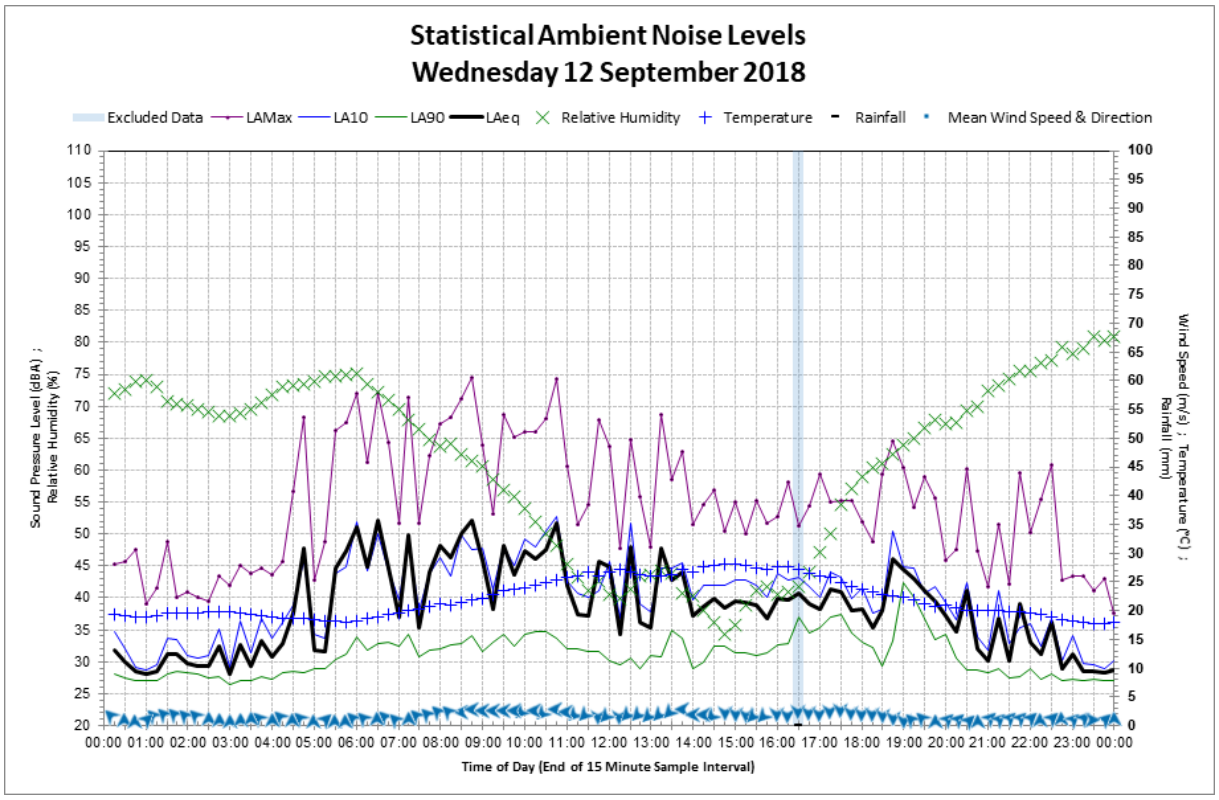

Statistical Ambient Noise Levels
Friday 7 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

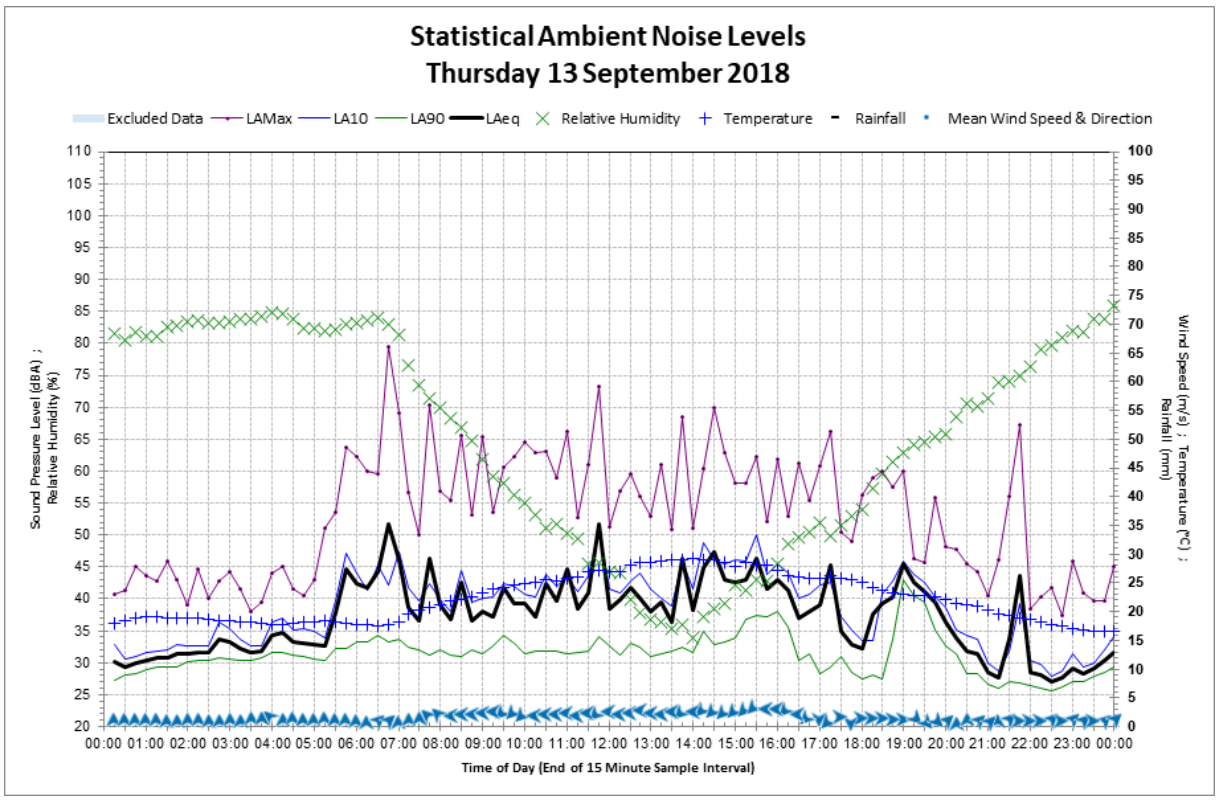

Statistical Ambient Noise Levels
Saturday 8 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

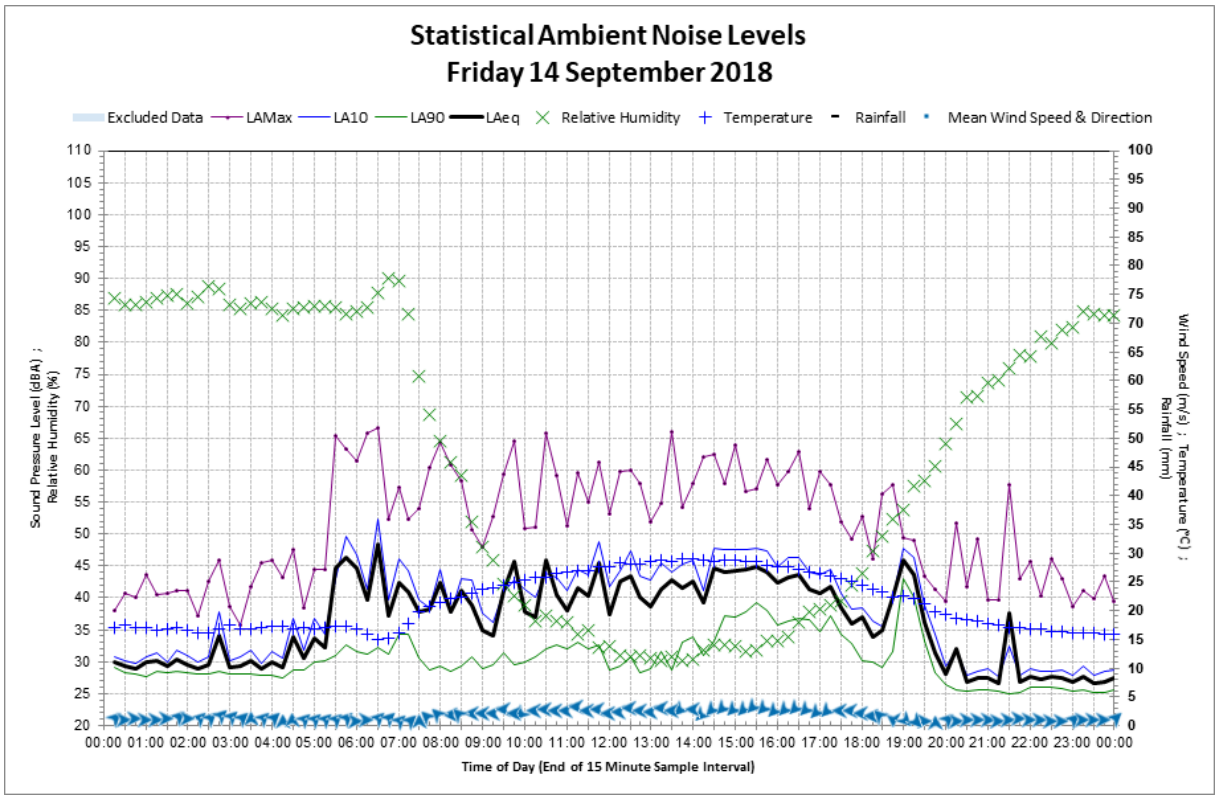

Statistical Ambient Noise Levels
Sunday 9 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

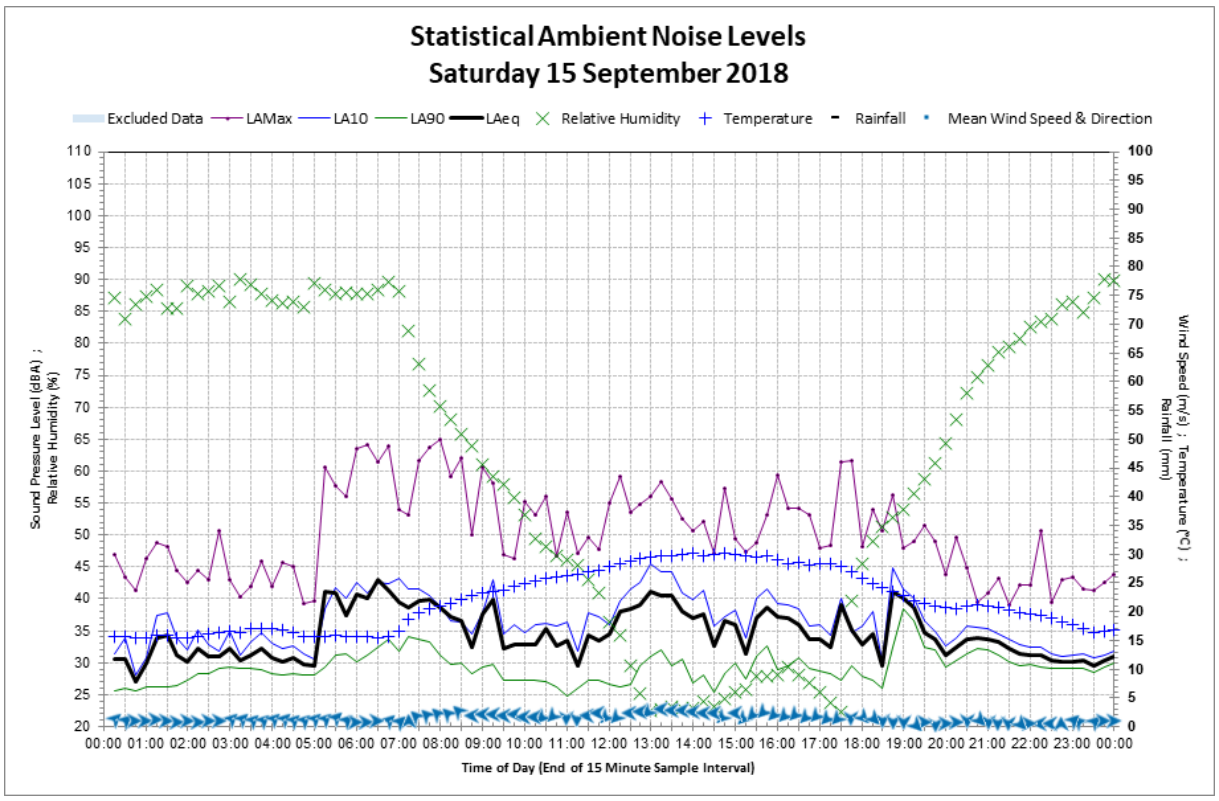

Statistical Ambient Noise Levels
Monday 10 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

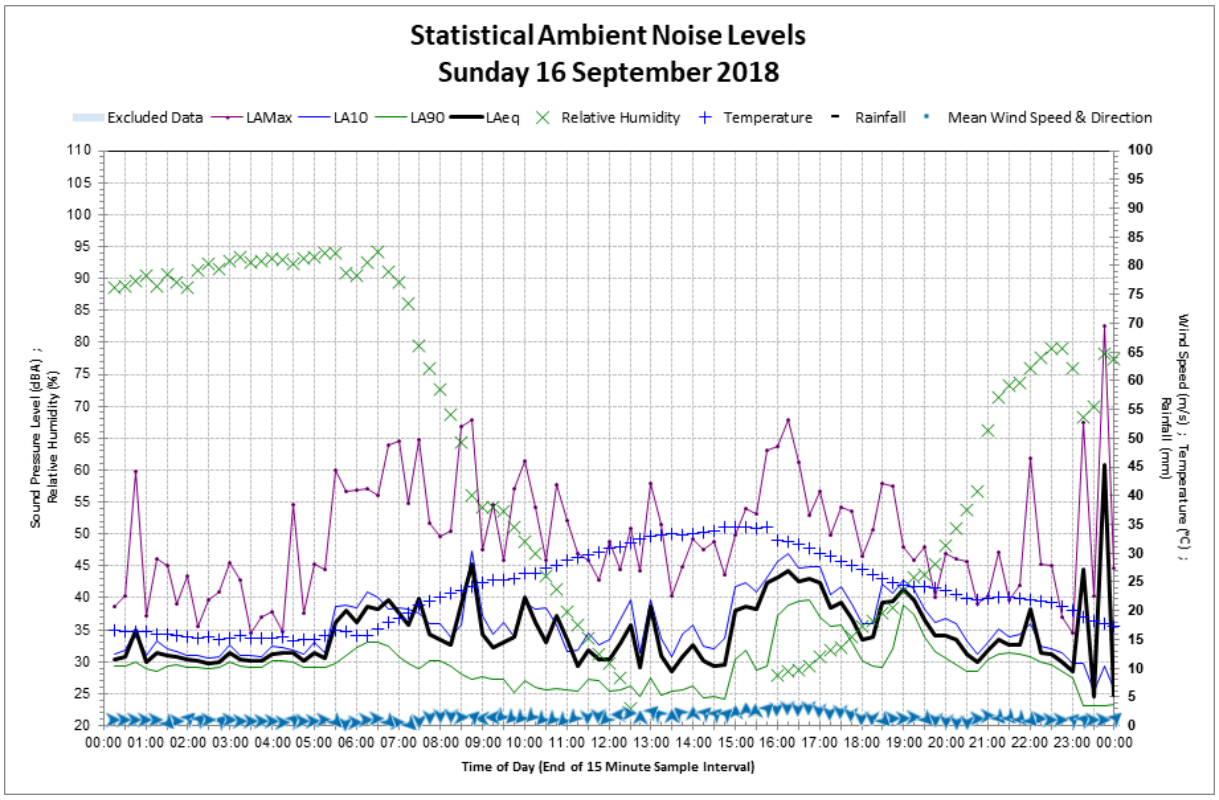

Statistical Ambient Noise Levels
Tuesday 11 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

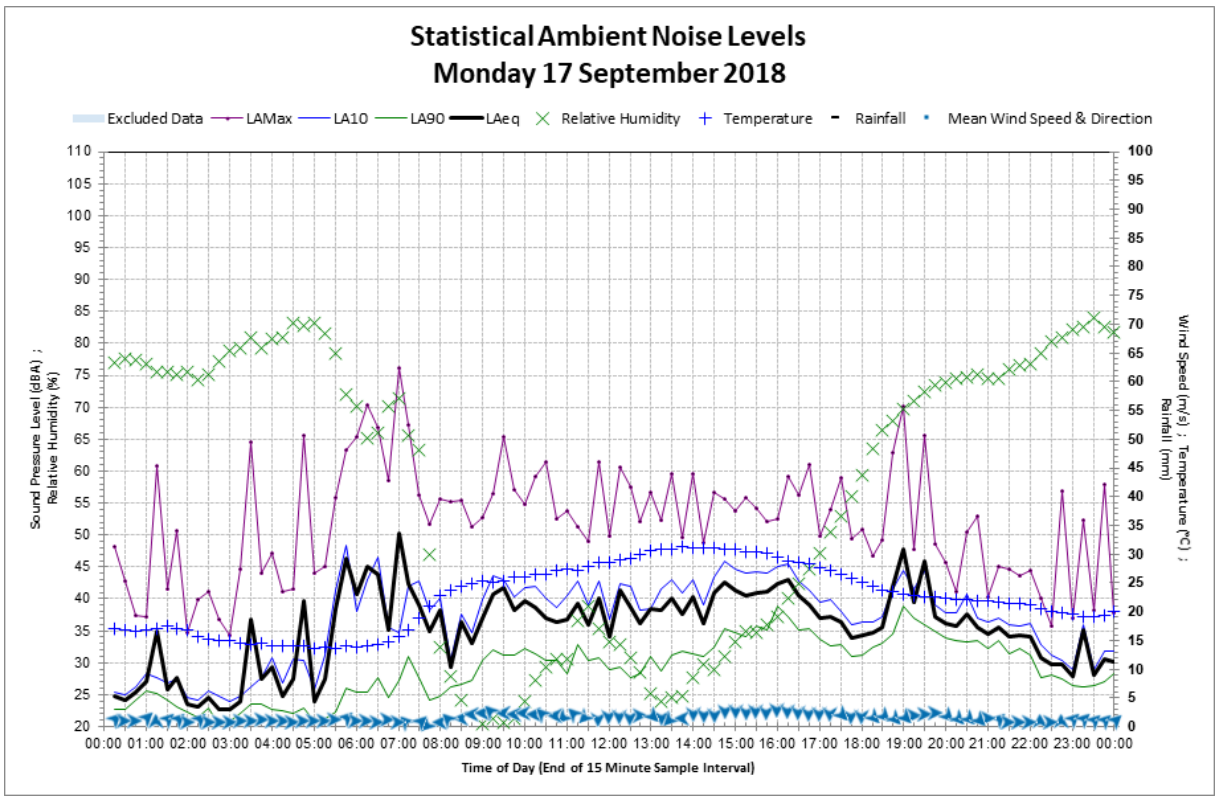

Statistical Ambient Noise Levels
Wednesday 12 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

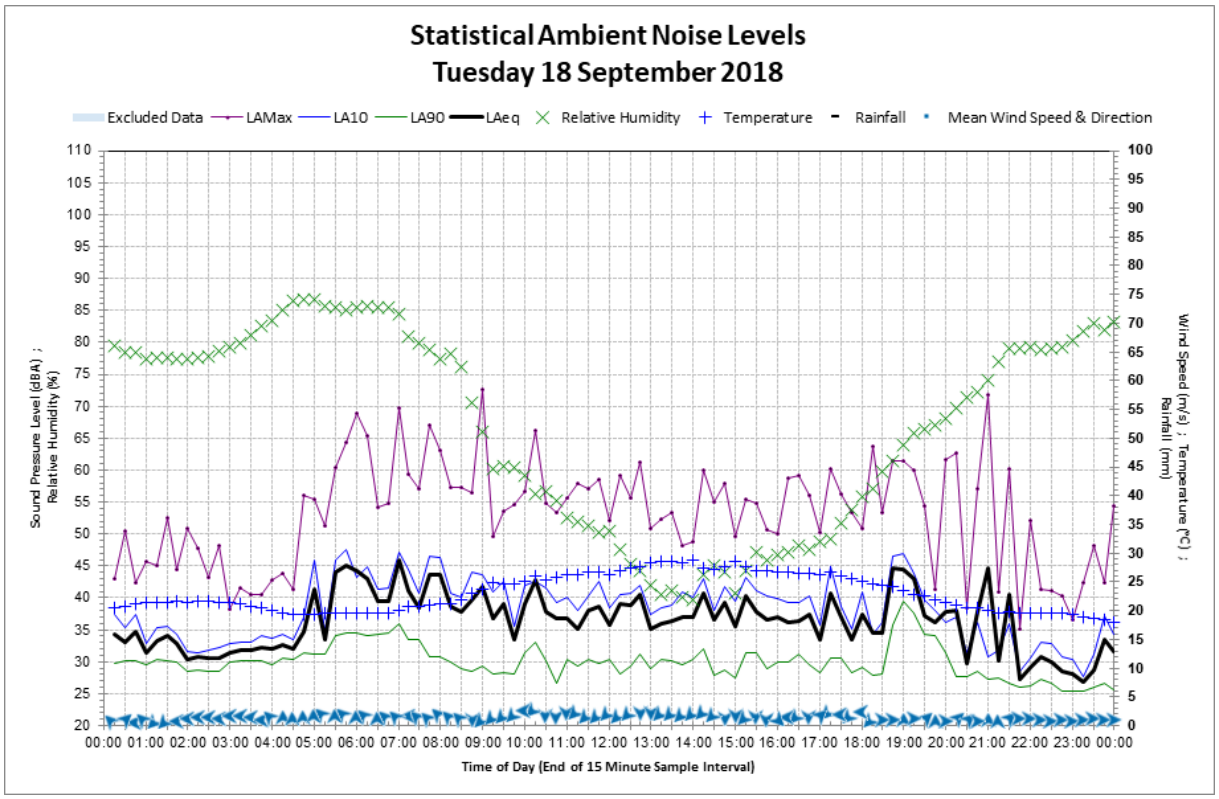

Statistical Ambient Noise Levels
Thursday 13 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

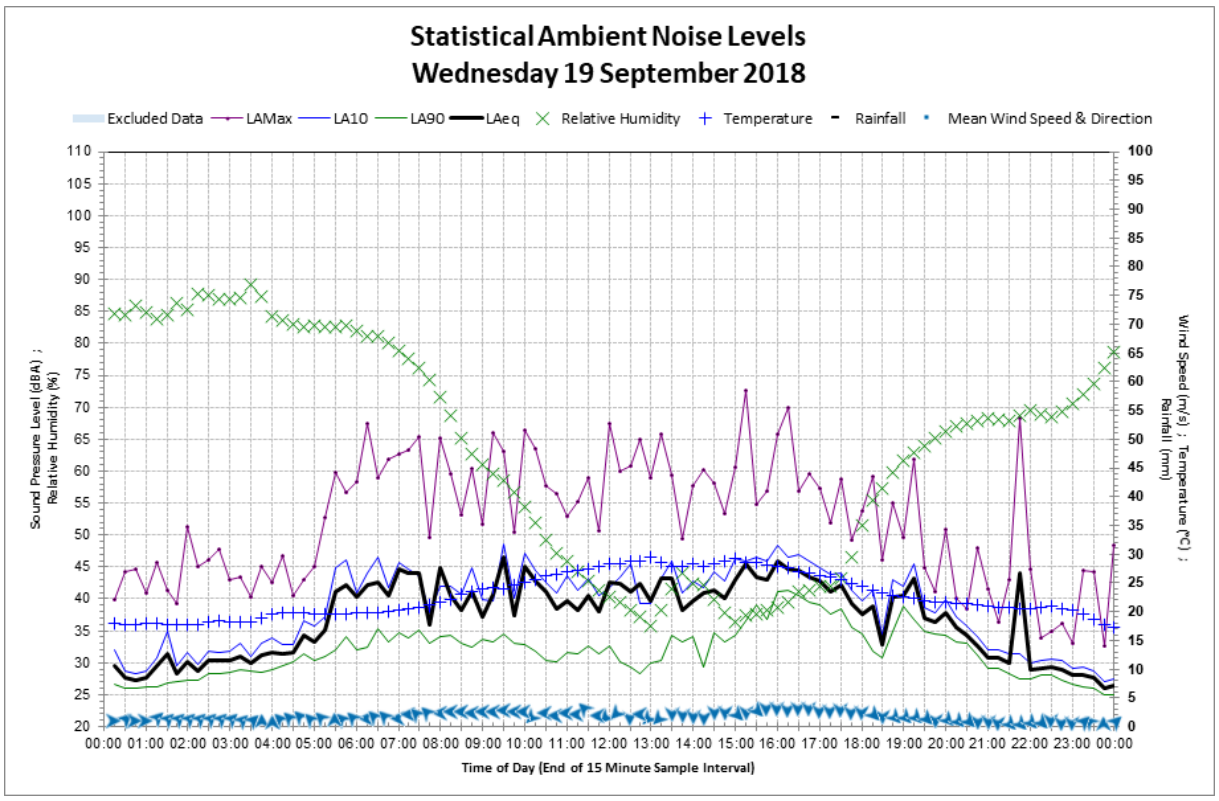

Statistical Ambient Noise Levels
Friday 14 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

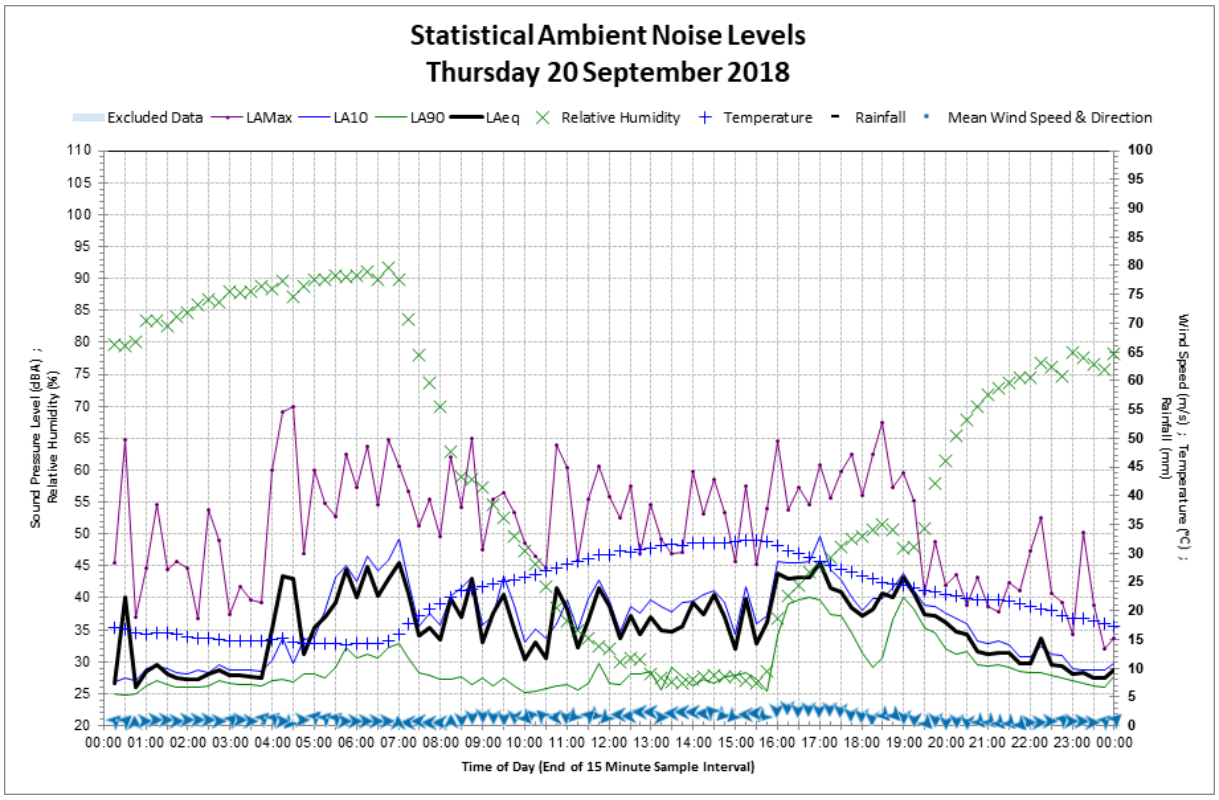

Statistical Ambient Noise Levels
Saturday 15 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

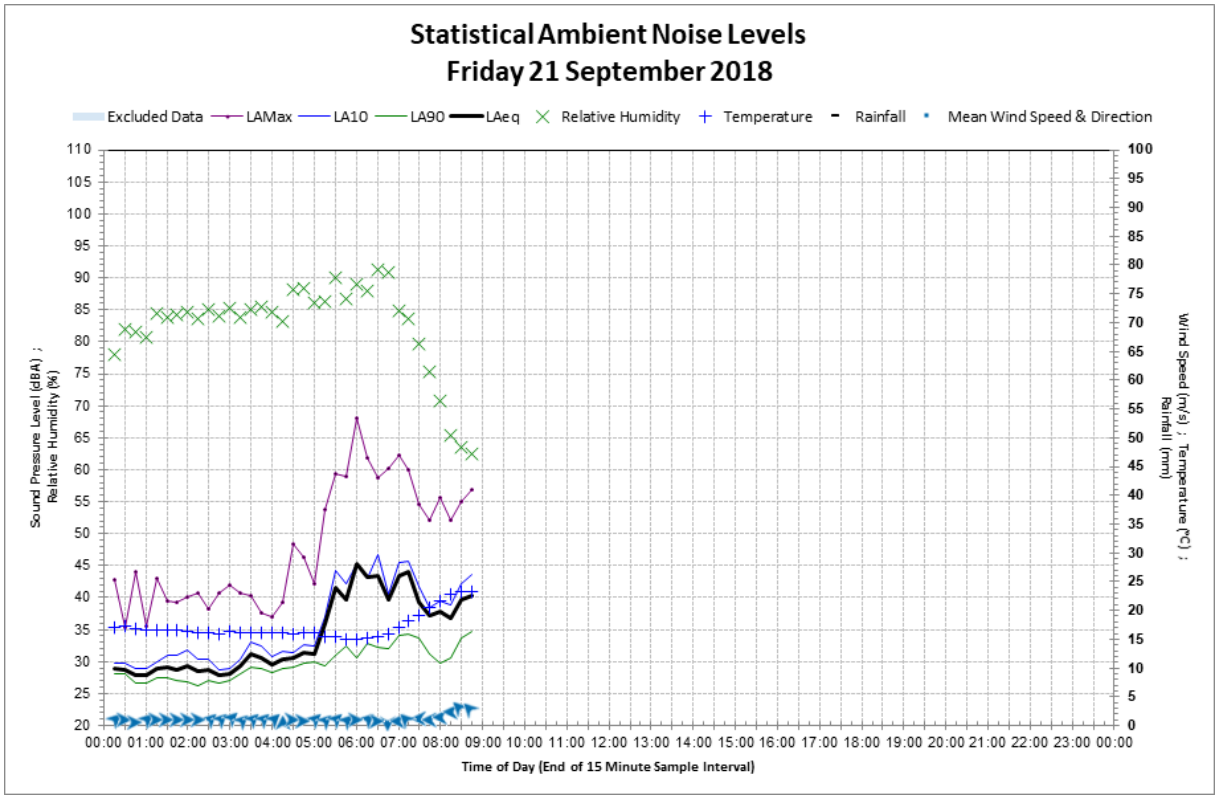

Statistical Ambient Noise Levels
Sunday 16 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Monday 17 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

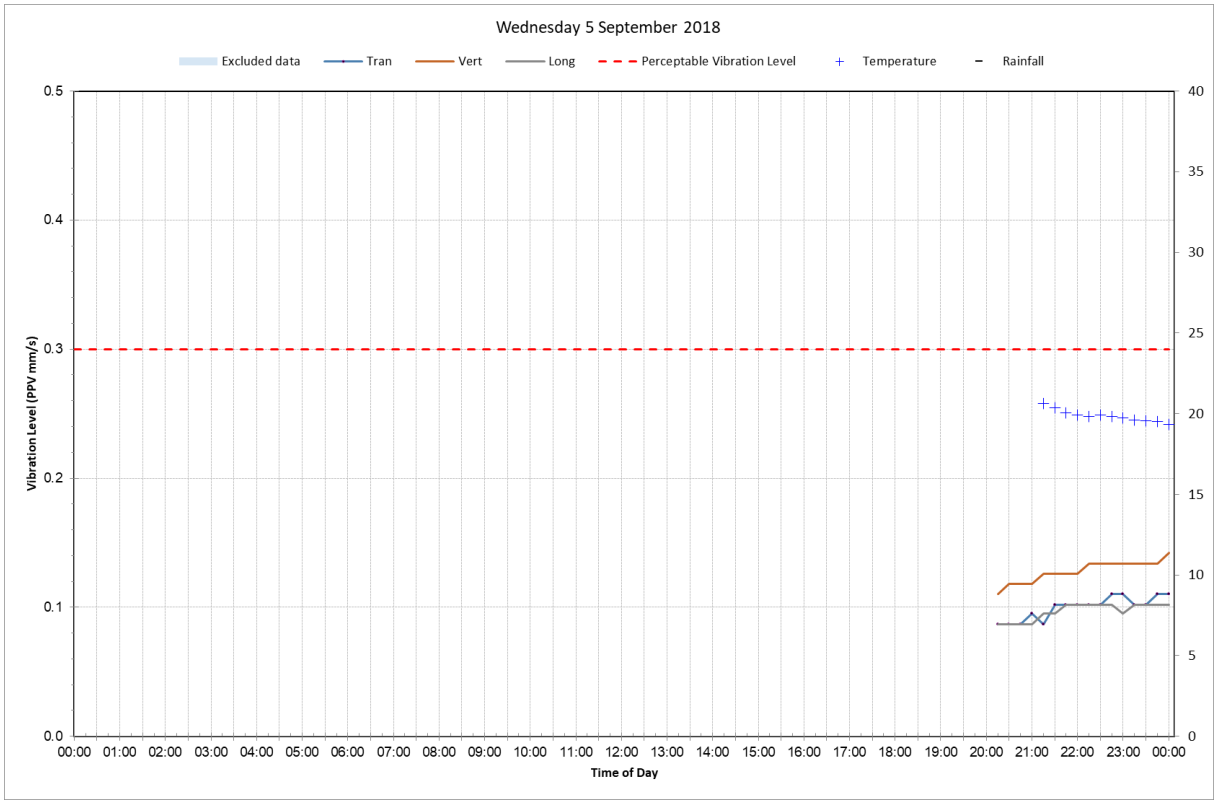

Statistical Ambient Noise Levels
Tuesday 18 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

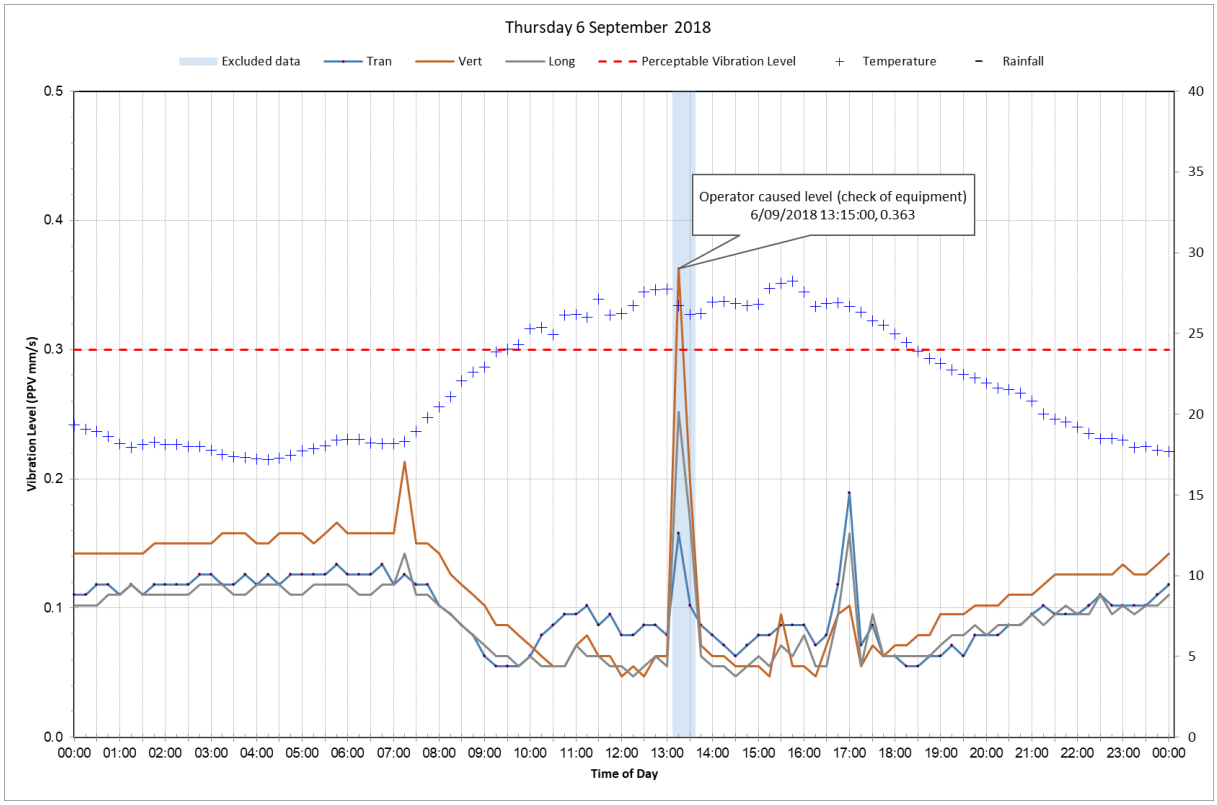

Statistical Ambient Noise Levels
Wednesday 19 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

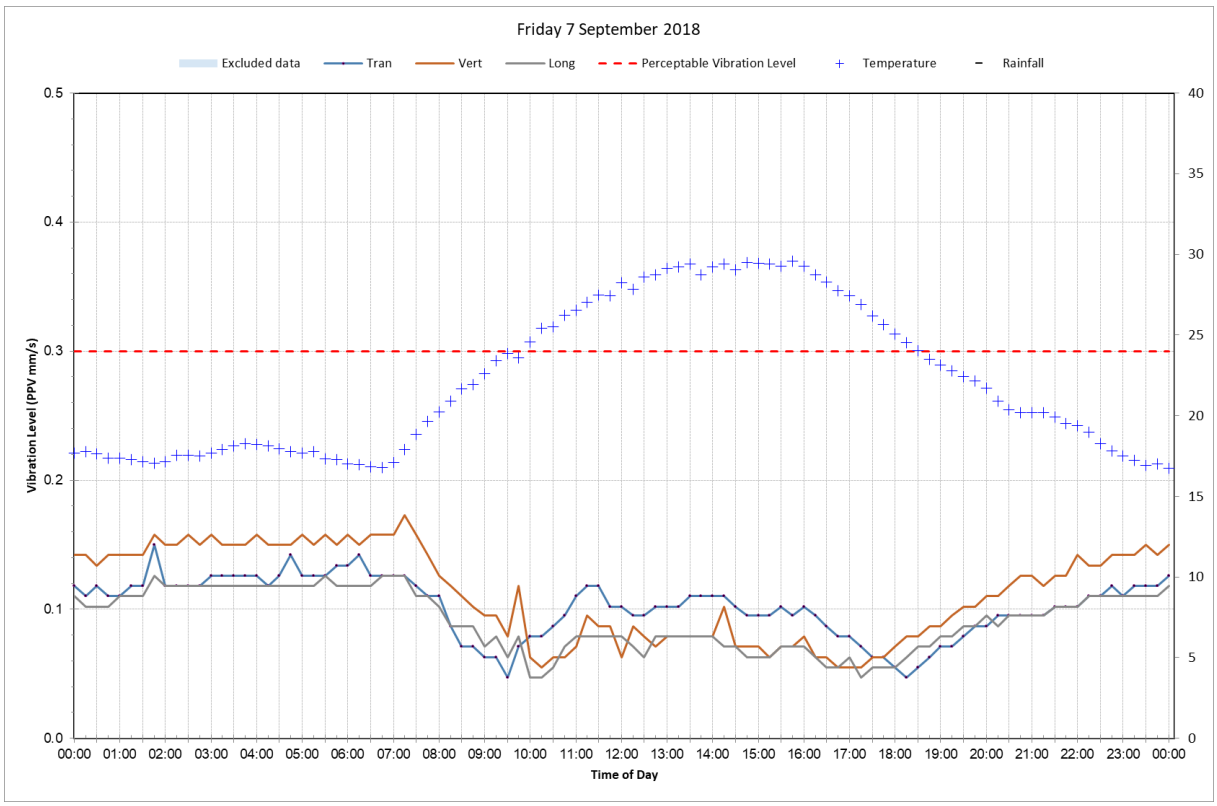

Statistical Ambient Noise Levels
Thursday 20 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

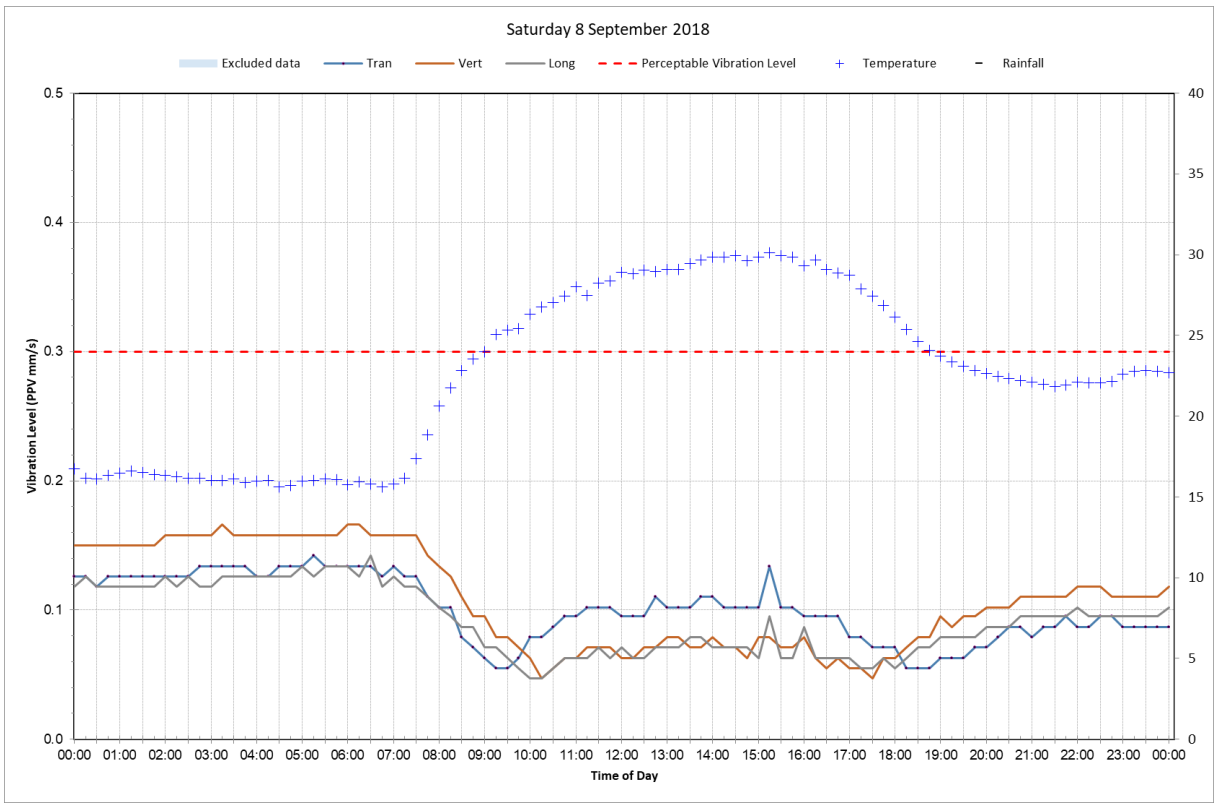

Statistical Ambient Noise Levels
Friday 21 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

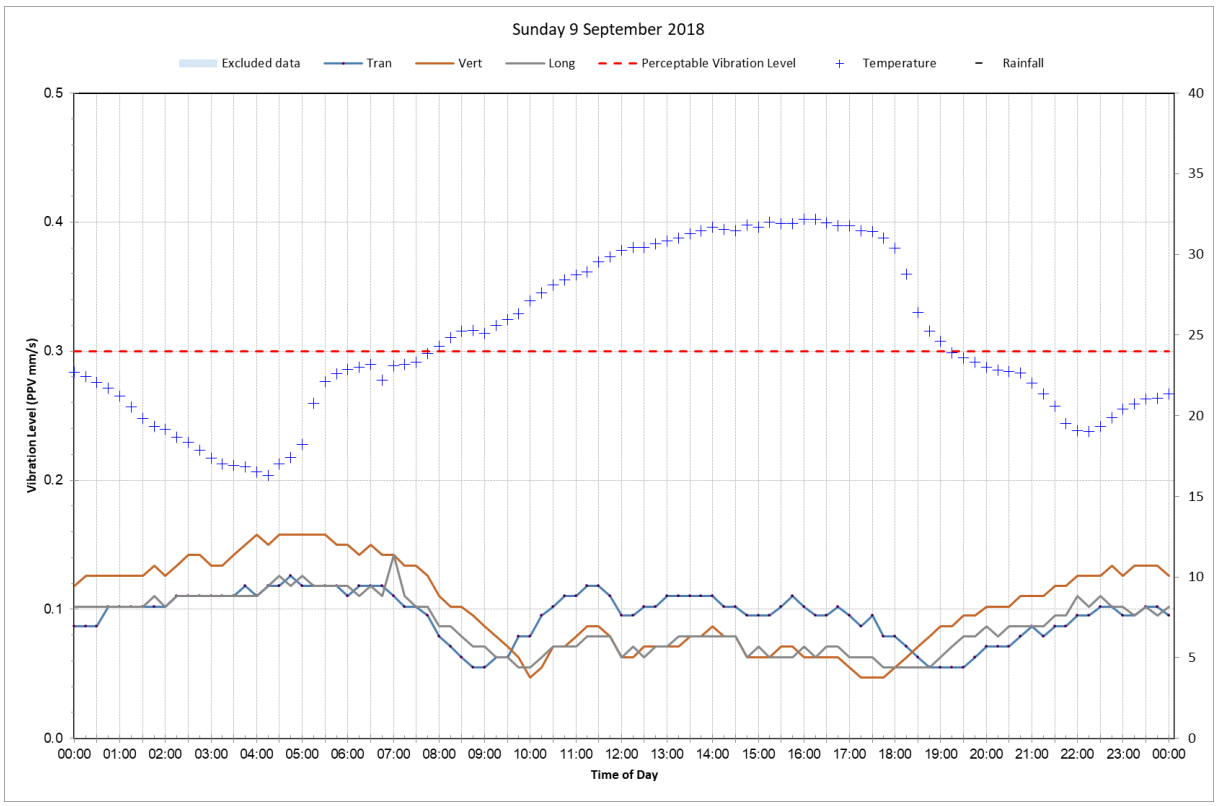
Appendix B – PPV Vibration levels

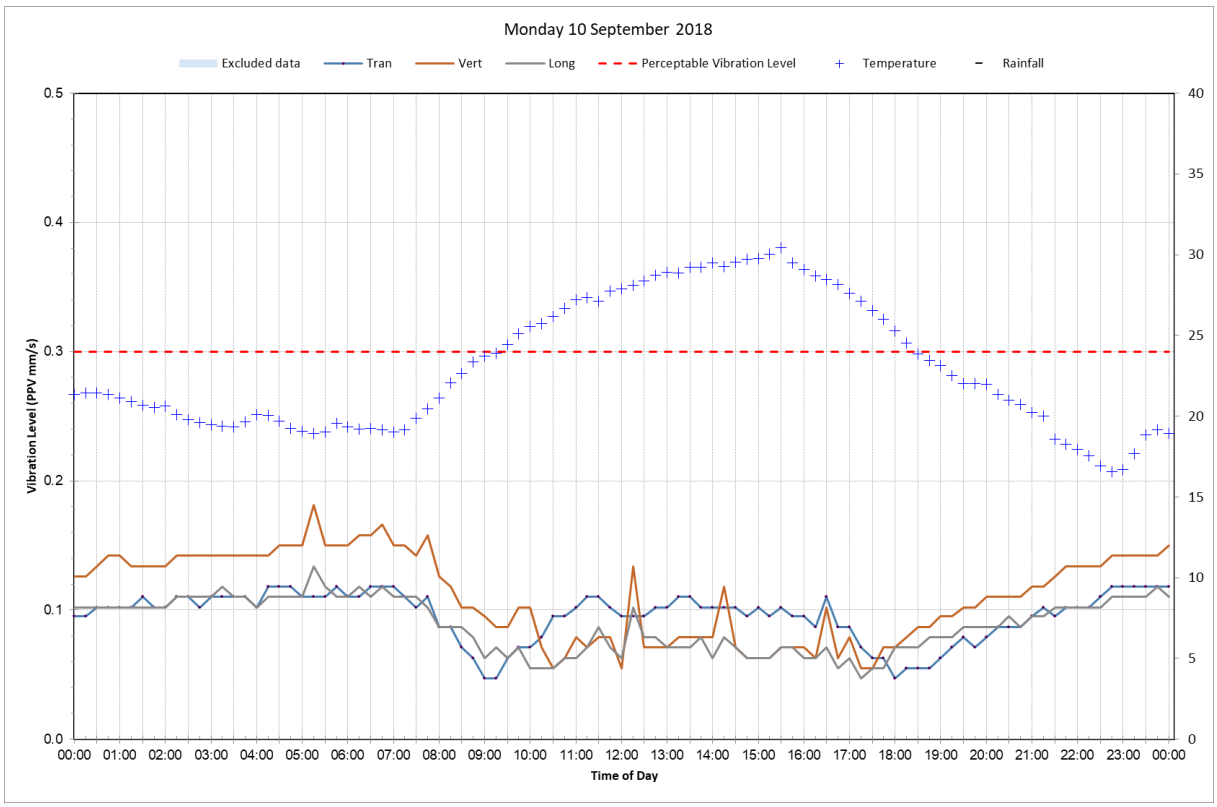


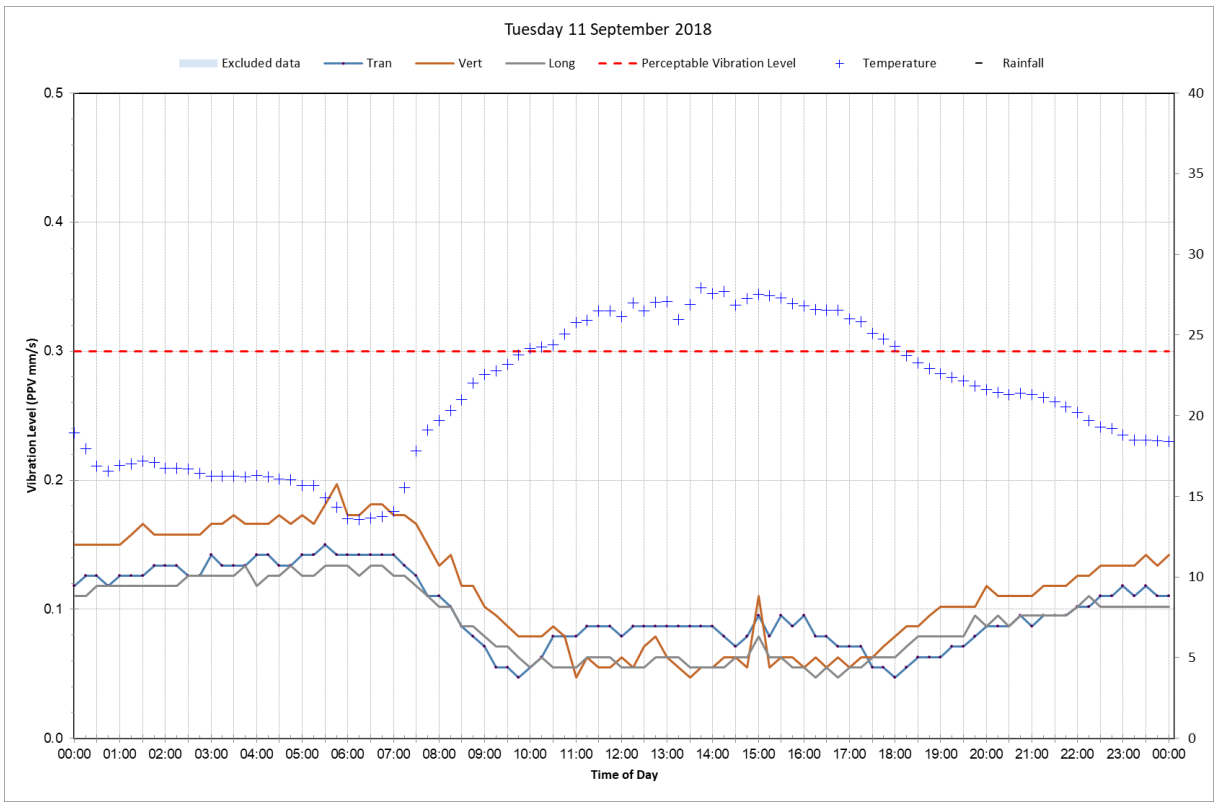


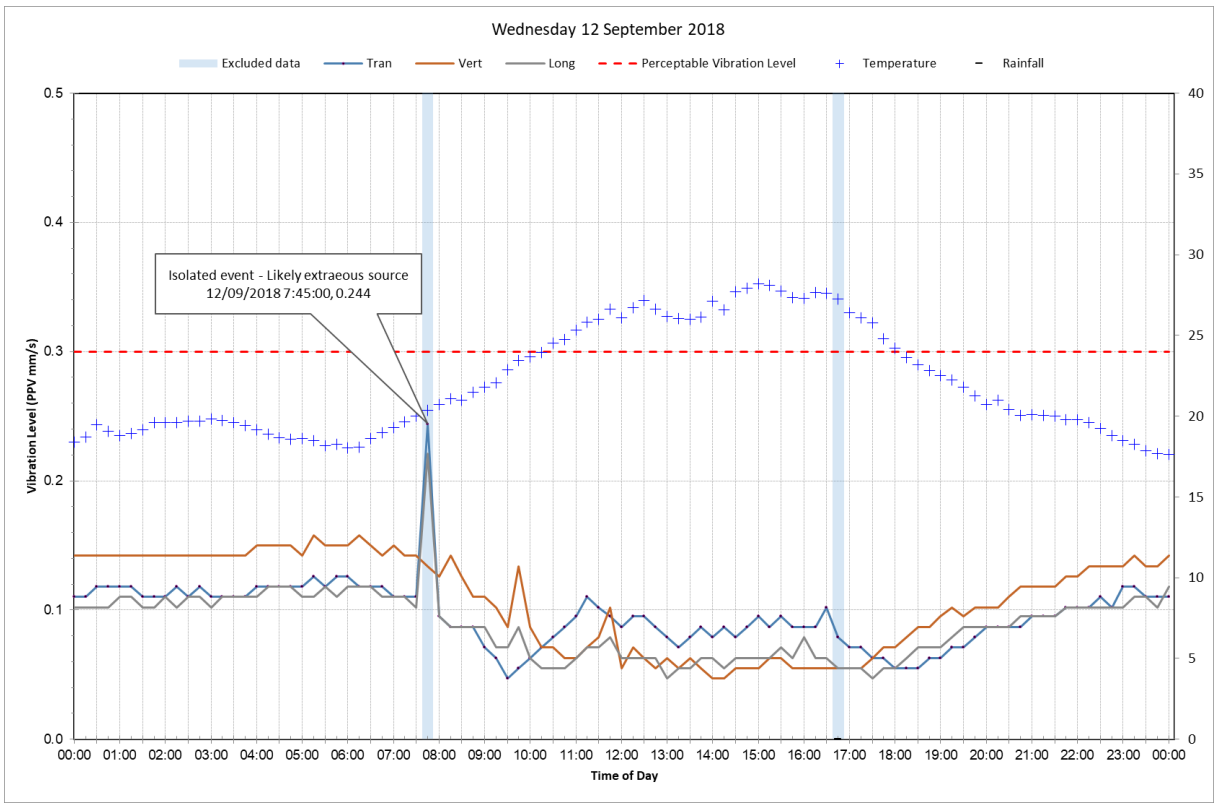

Friday 7 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Vibration Level (PPV mm/s)
Time of Day

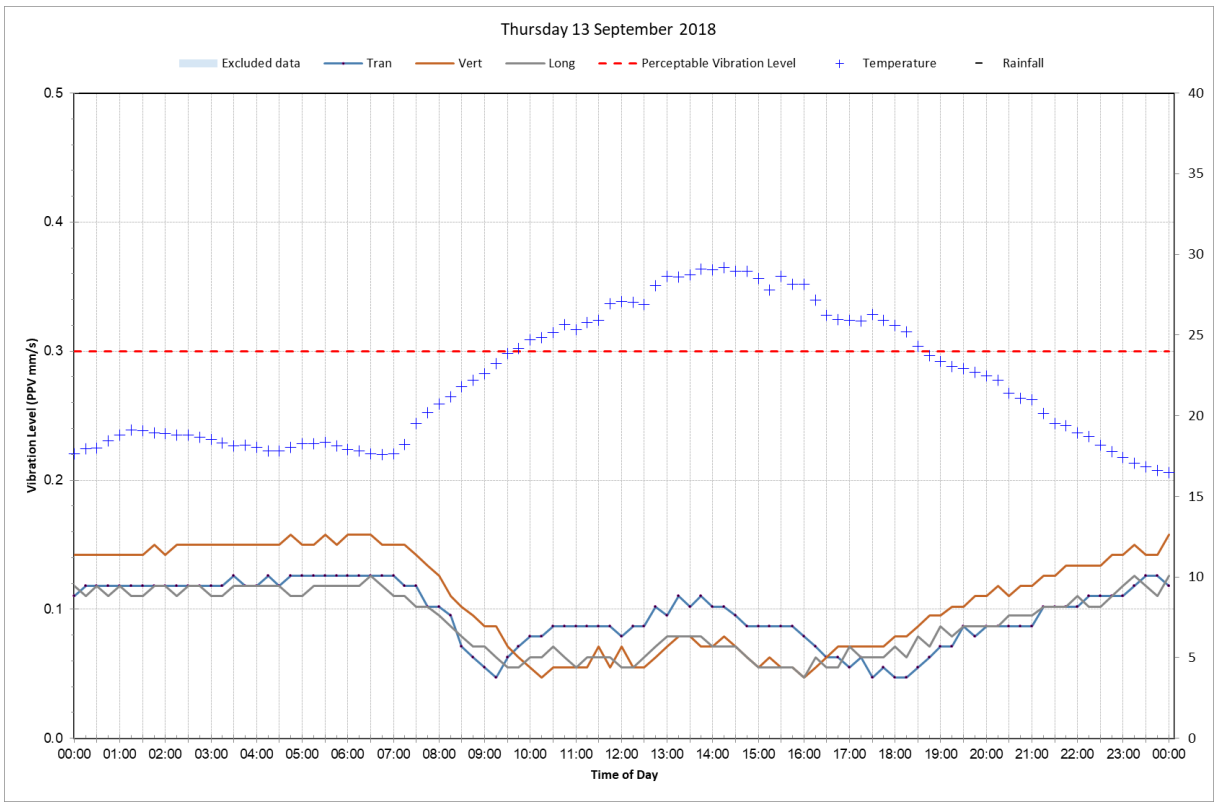

Saturday 8 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Vibration Level (PPV mm/s)
Time of Day

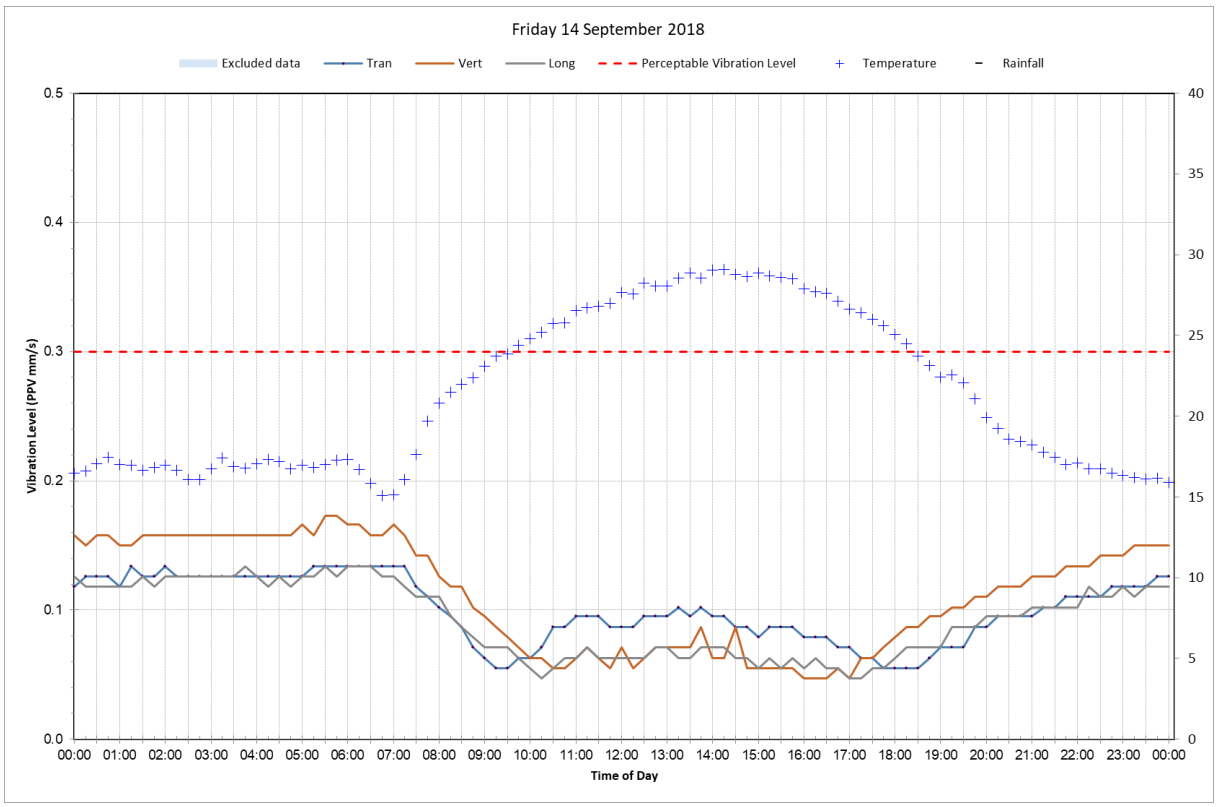

Sunday 9 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Vibration Level (PPV mm/s)
Time of Day

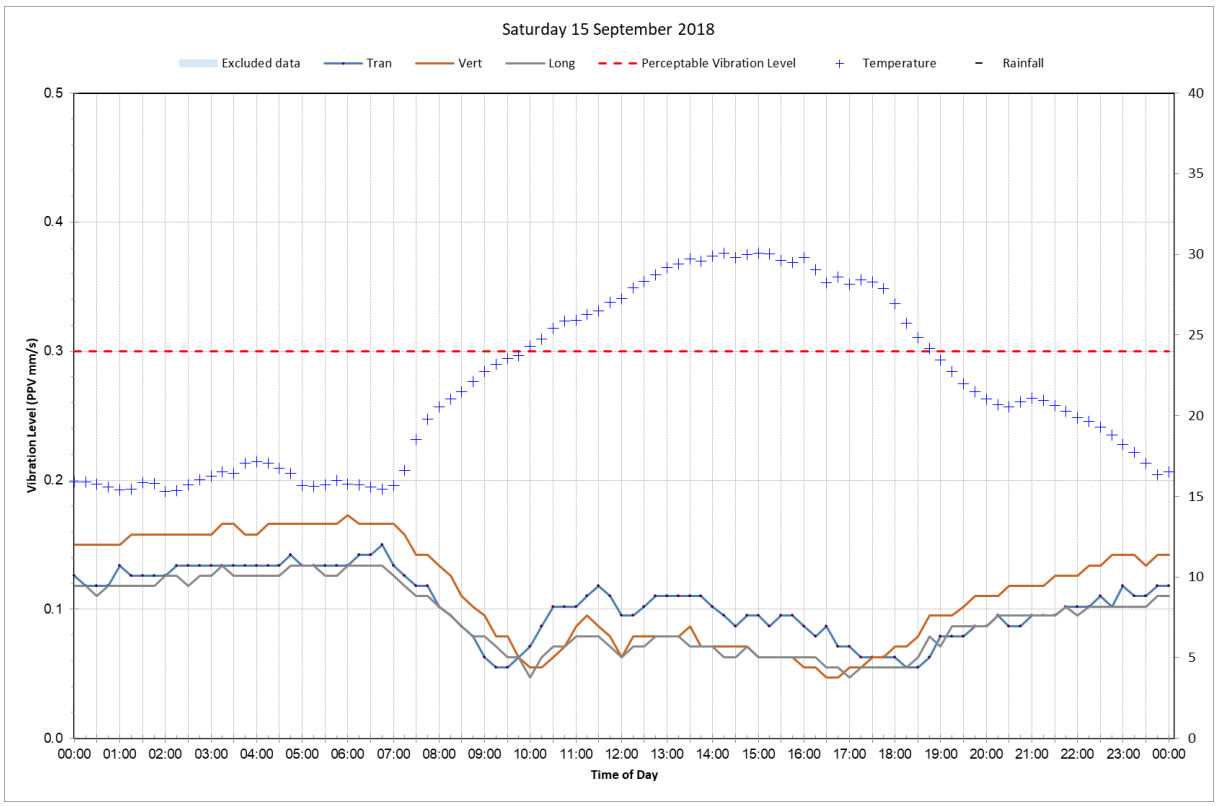

Monday 10 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Vibration Level (PPV mm/s)
Time of Day

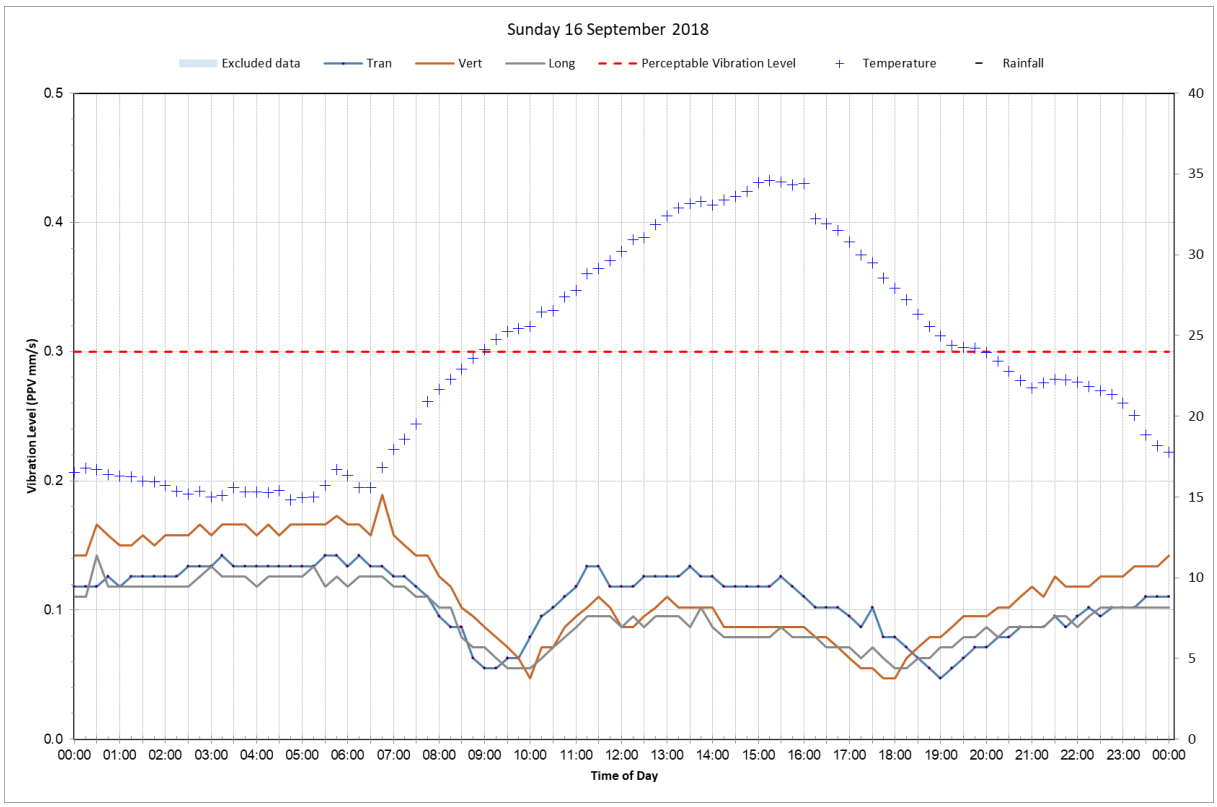

Tuesday 11 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Vibration Level (PPV mm/s)
Time of Day

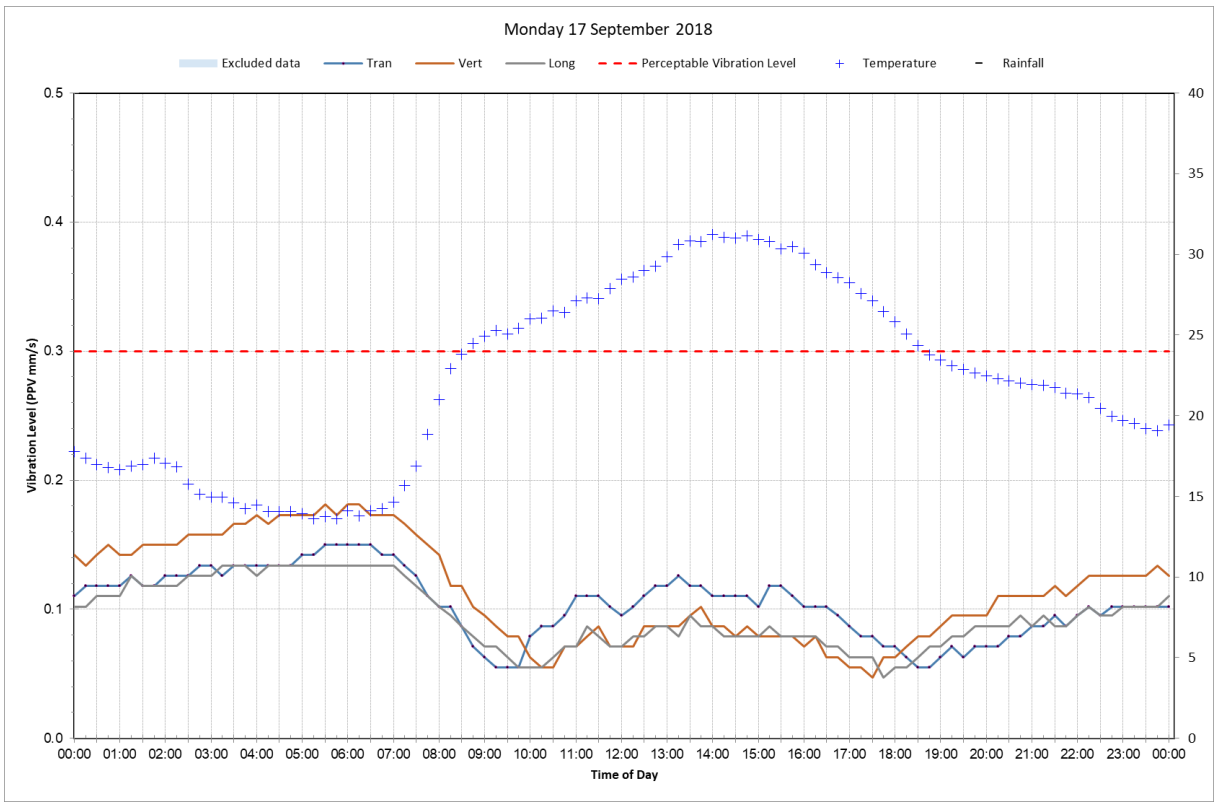

Wednesday 12 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Isolated event - Likely extraeous source
12/09/2018 7:45:00, 0.244
Vibration Level (PPV mm/s)
Time of Day

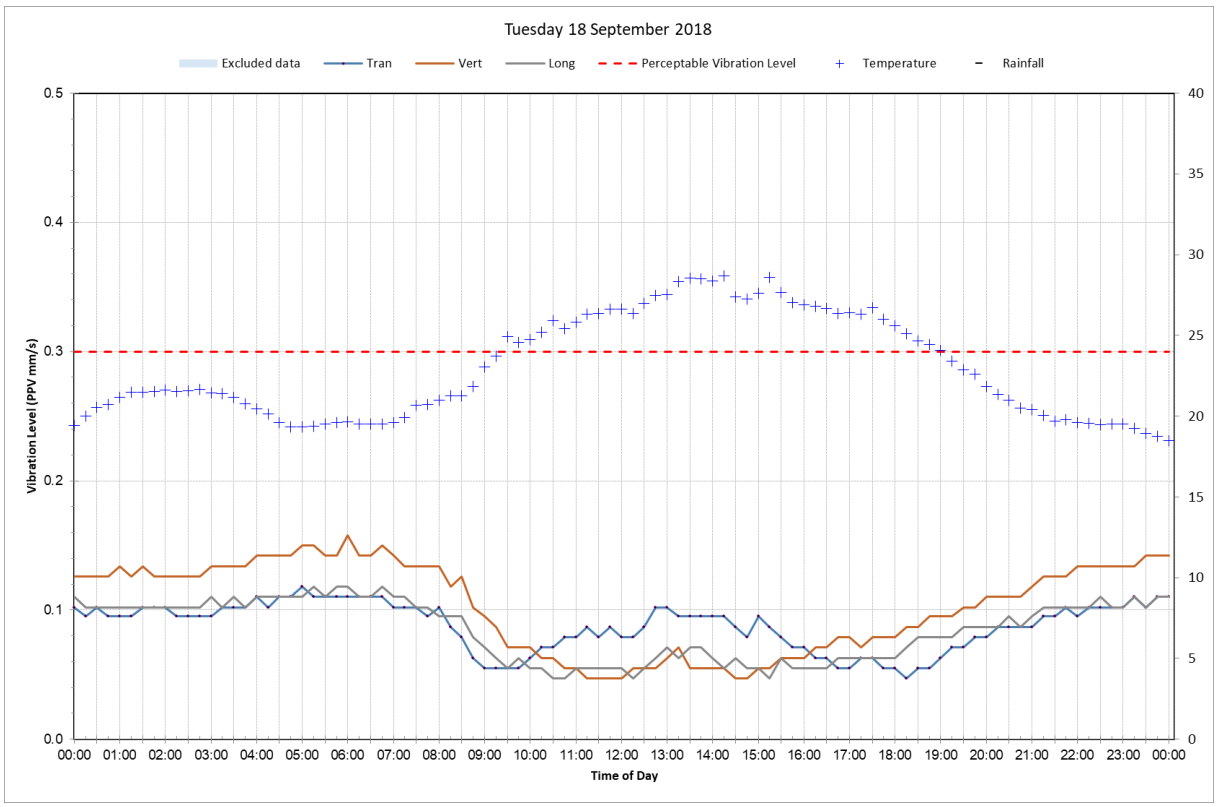

Thursday 13 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Vibration Level (PPV mm/s)
Time of Day

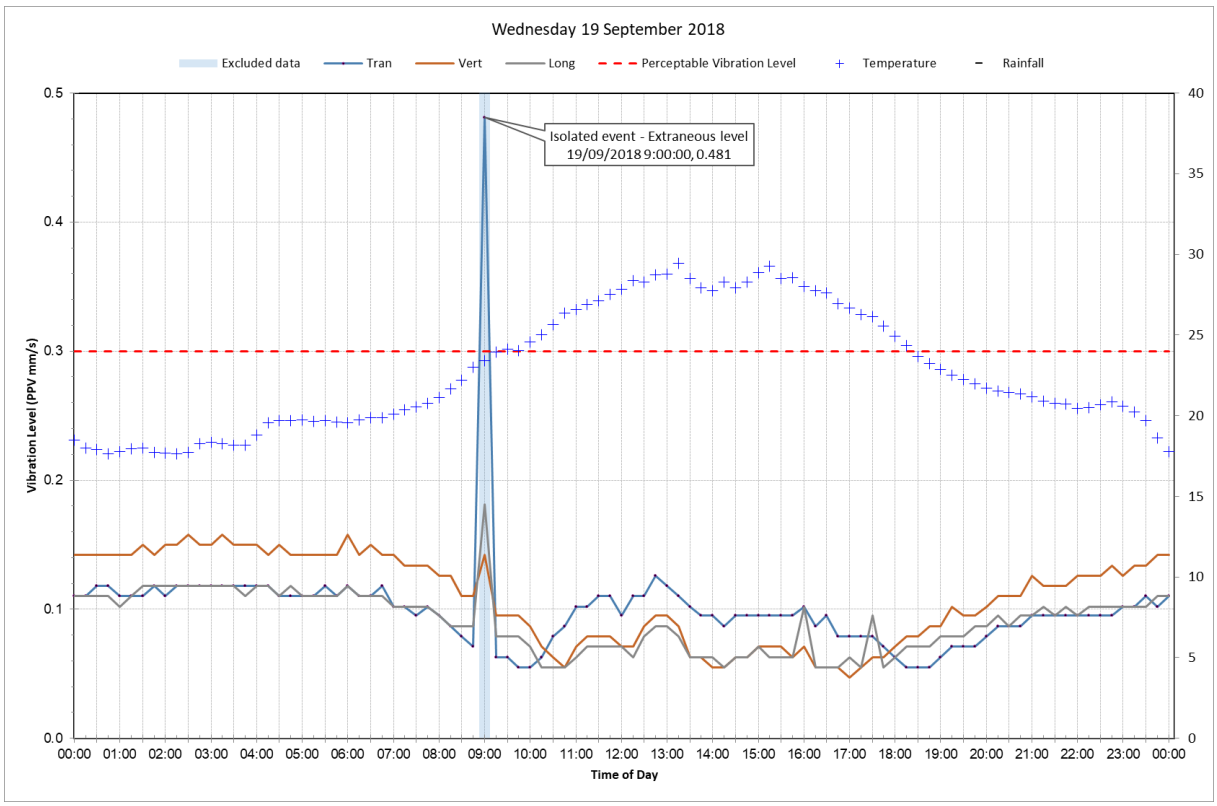

Friday 14 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Vibration Level (PPV mm/s)
Time of Day

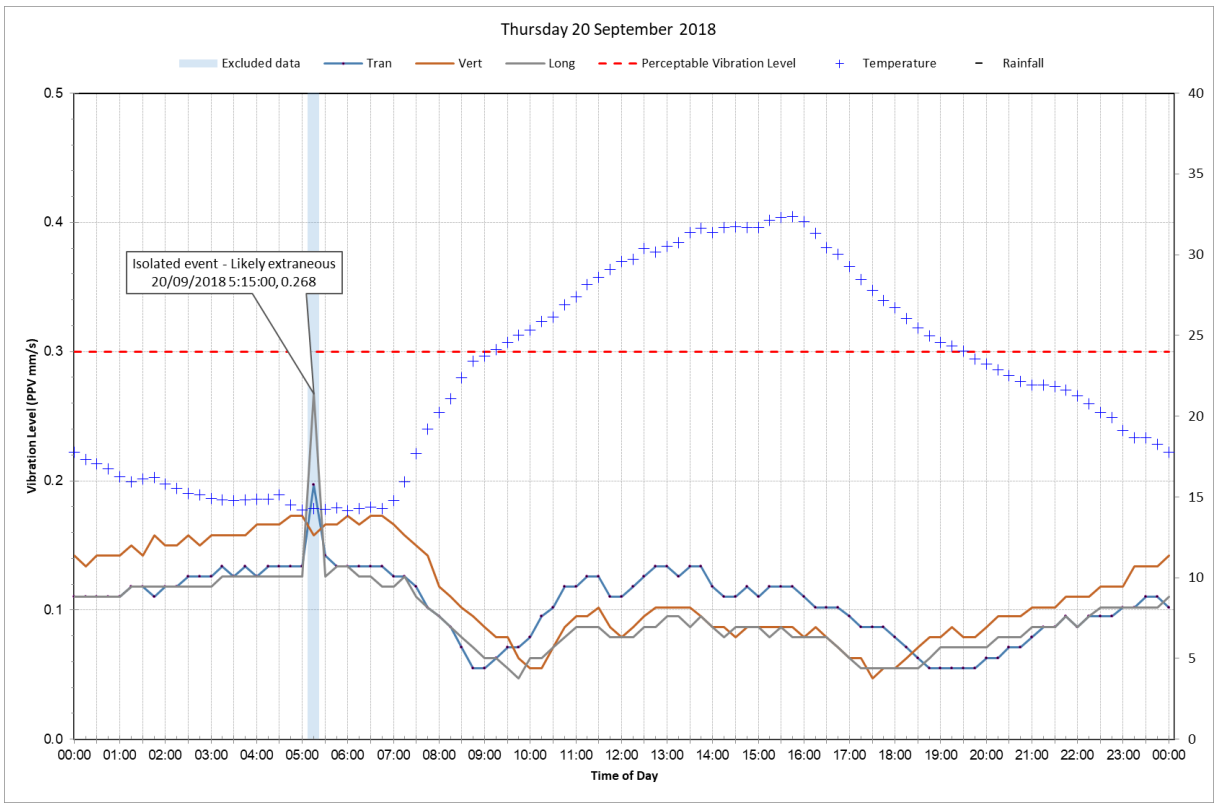

Saturday 15 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Vibration Level (PPV mm/s)
Time of Day

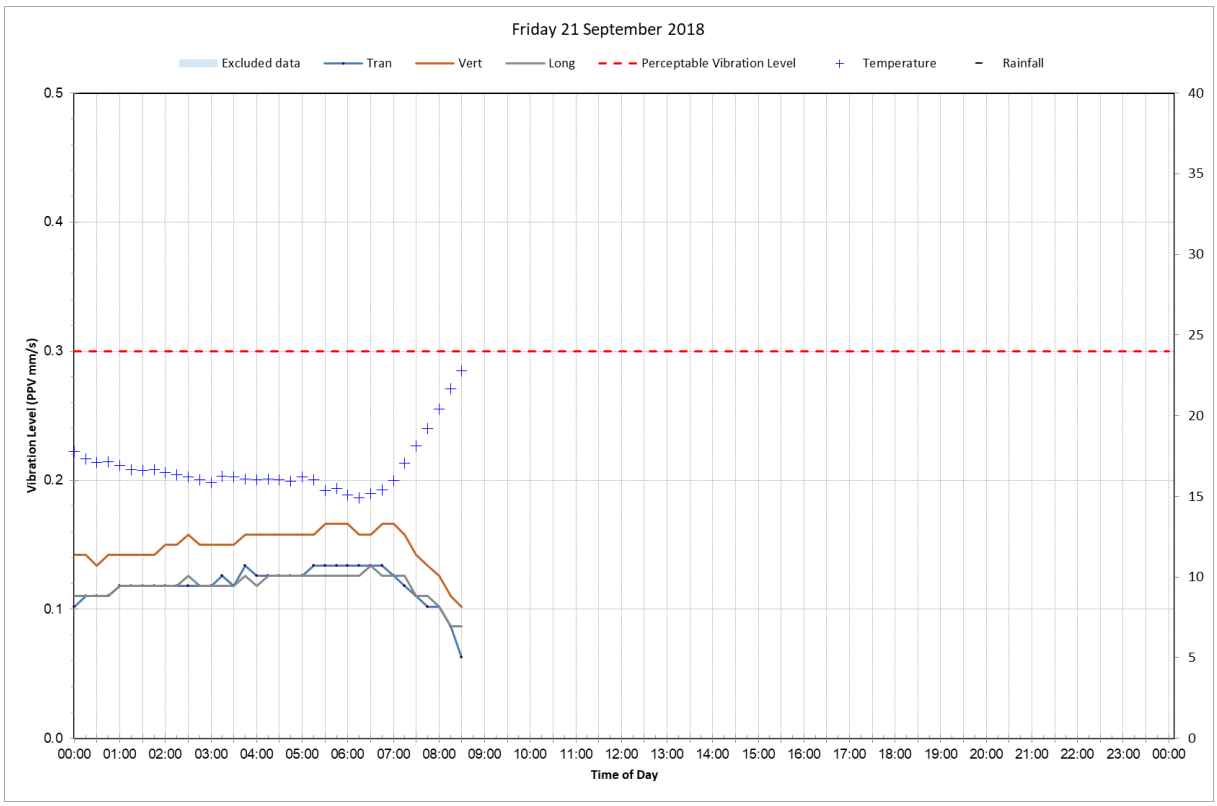

Sunday 16 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Vibration Level (PPV mm/s)
Time of Day


Monday 17 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Vibration Level (PPV mm/s)
Time of Day


Tuesday 18 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Vibration Level (PPV mm/s)
Time of Day


Wednesday 19 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Isolated event - Extraneous level
19/09/2018 9:00:00, 0.481
Vibration Level (PPV mm/s)
Time of Day


Thursday 20 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Isolated event - Likely extraneous
20/09/2018 5:15:00, 0.268
Vibration Level (PPV mm/s)
Time of Day


Friday 21 September 2018
Excluded data
Tran
Vert
Long
Perceptable Vibration Level
Temperature
Rainfall
Vibration Level (PPV mm/s)
0.5
0.4
0.3
0.2
0.1
0.0
40
35
30
25
20
15
10
5
0
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Time of Day

GHD

71 Stanley Street
Townsville City QLD 4810
T: 61 7 4720 0400 F: 61 7 4772 6514 E: tsvmail@ghd.com

4220641-43360/https://projects.ghd.com/oc/nqoc1/infrastructuretraffi/Delivery/Documents/4220641-REP-1-Air noise and vibration baseline monitoring report.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	[redacted]	[redacted]	[redacted]			
0	[redacted]	[redacted]	[redacted]			24/04/19
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	02/05/19

www.ghd.com