

# **Appendix F**

**Noise and Vibration assessment**



**Department of Infrastructure, Transport,  
Regional Development and  
Communications**

Norfolk Island MPS DSC  
Noise Assessment (Concept Design)

November 2020

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# Document Status

## *Document Restriction Level*

UNCLASSIFIED

## *Document Revision Status*

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# Glossary

Ambient noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.
Background noise	The underlying level of noise present in the ambient noise when extraneous noise is removed. This is described using the $L_{A90}$ descriptor (see also Rating background level).
Decibel	Decibel, which is 10 times the logarithm (base 10) of the ratio of a given sound pressure to a reference pressure; used as a unit of sound.
Ground-borne vibration	Ground-borne vibration is transmitted from source to receiver through the ground.
$L_{AN}$	Statistical sound measurement recorded on the 'A' weighted scale.
$L_{A1}$ (period)	The sound pressure level that is exceeded for one percent of the measurement period.
$L_{A90}$ (period)	The A-weighted sound pressure level that is exceeded for 90 percent of the time over which a given sound is measured. This is considered to represent the background noise e.g. $L_{A90}$ (15 min).
$L_{Aeq}$ (period)	Equivalent sound pressure level: The steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{Amax}$	The maximum sound level recorded during the measurement period.
$L_{Amin}$	The minimum sound level recorded during the measurement period.
Mitigation	Reduction in severity
Noise sensitive receiver	An area or place potentially affected by noise including residential dwellings, schools, child care centres, places of worship, health care institutions and active or passive recreational areas.
Peak particle velocity	Current practices for assessments of the risk of structural damage to buildings use measurements of peak particle velocity (PPV) in millimetres per second.
Rating background level	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period. This is the level used for assessment purposes.
Receiver	A noise modelling term used to describe a map reference point where noise is predicted.
Short-term vibration	Vibration that occurs so infrequently that it does not cause structural fatigue nor does it produce resonance in the structure.
Sound pressure level (SPL)	20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level of 20 micropascals.
Tonality	Noise containing a prominent frequency or frequencies characterised by a definite pitch.
Vibration dose value	As defined in BS6472 – 1992, the vibration dose value is given by the fourth root of the integral of the fourth power of the frequency weighted acceleration.
Vibration	The variation of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value or reference.  Vibration can be measured in terms of its displacement, velocity or acceleration. The common units for velocity are millimetres per second (mm/s).

# List of abbreviations

AVTG	<i>Assessing Vibration: A Technical Guideline</i>
CoRTN	Calculation of Road Traffic Noise
CNMLs	Construction Noise Management Levels
CNVG	Construction Noise and Vibration Guideline (RMS 2016)
dB	Decibel
dB(A)	Unit used to measure 'A-weighted' sound pressure levels
DEC	Department of Environment and Conservation (former)
DECCW	NSW Department of Environment, Climate Change and Water (former)
EPA	Environment Protection Authority
ICNG	<i>Interim Construction Noise Guideline</i>
NPI	<i>Noise Policy for Industry</i>
RBL	Rating background level
RMS	Root mean square
RNP	<i>Road Noise Policy</i>
VDV	Vibration dose value
$V_{rms}$	The vibration velocity presented as a root mean square value.
PPV	Peak particle velocity
m	Metres
mm	Millimetres
s	Seconds
kHz	Kilohertz
Hz	Hertz

# 1. Introduction

## 1.1 Introduction

The Norfolk Island Health and Residential Aged Care Service (NIHRACS) Multi-Purpose Service (MPS) Facility Replacement Project (the Project) includes the design and construction of a new MPS Facility for NIHRACS. GHD has been engaged as the Design Services Consultant (DSC) for the project.

The existing NIHRACS facility was originally constructed in the 1940s by the New Zealand Army, with a range of additional health related infrastructure developed in the adjacent area since this time. These facilities include the main health building, and a range of detached ancillary buildings including physiotherapy unit, workshop, mortuary, dental clinic, archive store workshop and Mawsons House Units, and carpark, accessed from Grassy Road along an internal access road/driveway.

Ongoing deficiencies of ageing assets on NIHRACS site would potentially impact community access to adequate emergency, aged care, health, and wellbeing services. The project will reinvest in essential facilities that will enable health services on Norfolk Island to meet the needs of the community now and into the future.

## 1.2 Purpose and scope of this report

The environmental noise assessment involved a noise survey to establish the existing noise environment parameters and noise modelling to understand the expected noise impact for the Concept Design stage.

The scope of work undertaken by GHD for this assessment is summarised below:

- Initial review of project information including construction methodology, design plans and proximity of identified sensitive receivers.
- Short term background noise monitoring at two locations near the proposal. Background noise monitoring was conducted to capture existing ambient noise levels from sources such as road traffic and enable site-specific noise goals to be set for the construction and operations of the proposal.
- Noise data was assessed and filtered to remove extraneous noise or adverse weather conditions. Weather data over the monitoring period was obtained from the nearest Bureau of Meteorology automatic weather station.
- The noise monitoring data was used to establish the Project Specific Noise Level (PSNL) for the construction (based on the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009)) and the operational (based on the *Noise Policy for Industry* (NPI) (EPA 2017)) noise generated.
- A noise model was developed for the proposal based on site layout, plant and equipment sound power levels, and topography. The noise model provided an indication of noise impacts (construction and operational) on the identified nearby noise sensitive receivers.
- Based on the noise model results, the predicted construction noise and operational noise at nearby noise sensitive receivers were compared to the established PSNLs. Where exceedances were predicted, in-principle advice was provided on possible noise attenuation measures to mitigate operational impacts from the site.

### **1.2.1 Assumptions**

GHD has undertaken this assessment based on the following assumptions:

- An environmental noise assessment will be conducted in subsequent phases as more details of the site design and equipment selection is confirmed.
- Activities from within the MPS building(s) will not generate noise impacts.

## 2. Existing environment

### 2.1 Project locality

The project site is located off Grassy Road in Burnt Pine, Norfolk Island. The property subject to the development application and EIS is Lot 36 Portion 24c, Lot 60 Portion 24b2, Lot 33 Portion 24a3, Lot 34 Portion 24k and Lot 35 Portion 24b1.

### 2.2 Sensitive receivers

There are a number of sensitive receivers near the Project area, which may be impacted by noise and vibration from the construction works and operation of the project. Figure 2-1 shows the Project and the surrounding area. Surrounding sensitive receivers identified, via aerial imagery, are categorised as:

- Residential
- Commercial/retail
- Hotel/motel (Bounty Lodge, Nuffka Apartments, Burnt Pin Boutique Apartments and Daydreamer Apartments)
- Industrial

The closest receivers have been identified for the assessment as compliance at these receivers would typically imply compliance at all other surrounding receivers. Table 2-1 lists the closest sensitive receivers to the site and are shown visually in Figure 2-1.

**Table 2-1 Sensitive receivers**

ID	Receiver type	Approximate distance and direction from site
R01	Residential	15 metres – North-west
R02	Residential	30 metres - North-west
R03	Residential	30 metres – North-west
R04	Commercial	15 metres – North-west
R05	Residential	Adjacent <sup>1</sup> - North
R06	Residential	Adjacent <sup>1</sup> - North
R07	Residential	Adjacent <sup>1</sup> - East
R08	Commercial	Adjacent <sup>1</sup> - South
R09	Residential/Commercial	15 metres - South-west

<sup>1</sup> Adjacent refers to a shared property boundary.

### 2.3 Noise levels

Baseline unattended noise monitoring was conducted in accordance with the procedures in the *Noise Policy for Industry* (NPI, 2017) guideline at two locations. Noise loggers were deployed along Grassy Road and Burglars Lane, near the site boundary.

This logger location was selected to capture noise characteristics considered representative of the proposal area. Selection considerations included location of sensitive receivers, land topography and contribution from other noise activities, such as road noise. The logger location used for the assessment was considered to be representative of the existing background and ambient noise environment in the study area and can be seen in Figure 2-1.

The objectives of the monitoring were to measure the existing background noise levels in the areas surrounding the proposal area.

The noise logger was programmed to accumulate  $L_{A90}$ ,  $L_{A10}$ ,  $L_{Aeq}$  and  $L_{Amax}$  noise descriptors continuously over sampling periods of 15 minutes for the entire monitoring period. An attended noise measurement was also conducted for a 15 minute duration to identify ambient noise sources and validate unattended logger data. Instantaneous noise levels for operator-identified noise sources were observed and noted during the measurements.

Prior to deployment, a calibration check was performed on the noise monitoring equipment using a Casella CEL-110/2 sound level calibrator (serial number 097197). Upon completion of the measurements, the equipment was checked to ensure the sensitivity of the noise monitoring equipment had not varied. The noise loggers were found to be within the acceptable tolerance of  $\pm 0.5$  dB(A).

The data collected by the logger was downloaded and analysed and any invalid data removed. Invalid data generally refers to periods of time where average wind speeds were greater than 5 m/s at the logger, or when rainfall occurred in accordance with the NPI. Concurrent half hourly weather data was sourced from the Bureau of Meteorology's (BoM) automatic weather station at Norfolk Island Airport (ID 200288) to identify any periods of weather which may have affected the monitoring results.

All sampling activities were undertaken with consideration to the specifications outlined in AS1055 (2018) *Acoustics - Description and Measurement of Environmental Noise* and the *Noise Policy for Industry* (NPI, 2017). Table 2-2 provides details of the noise logger used for unattended monitoring.

**Table 2-2 Unattended noise logger details**

Noise logger	M01
Location	Grassy Road, Burnt Pine 2899, Norfolk Island (site boundary)
Equipment type (serial)	SVAN 977 (s/n 36821)
Measurement started	21/9/20 5:30 pm
Measurement ceased	25/9/20 10:50 am
Frequency weighting	A-weighted

Noise logger	M02
Location	Burglars Lane, Burnt Pine 2899, Norfolk Island (site boundary)
Equipment type (serial)	SVAN 977 (s/n 92124)
Measurement started	21/9/20 6:50 pm
Measurement ceased	25/9/20 11:00 am
Frequency weighting	A-weighted

Calibration certificates for the equipment can be found in Appendix A.

The measured rating background levels (RBL) and ambient noise levels are summarised in Table 2-3.

**Table 2-3 Unattended noise monitoring results**

Location	L <sub>A90</sub> RBL noise levels dB(A)			L <sub>Aeq</sub> ambient noise levels dB(A)		
	Day	Evening	Night	Day	Evening	Night
M01	36	28	26	56	51	52
M02	33	25	21	52	38	38

Note: Day time: 7:00 am to 6:00 pm Monday to Saturday; or 8:00 am to 6:00 pm on Sundays and public holidays.  
Evening: 6:00 pm to 10:00 pm. Night time: remaining period (NSW *Noise Policy for Industry* (NPI), 2017)

In most instances, the measured background levels are lower than the minimum assumed RBL defined in the NPI. The minimum assumed RBL has been used as the adopted RBL and is shown in Table 2-4.

**Table 2-4 Adopted rating background level (RBL)**

Period	L <sub>A90</sub> RBL noise levels dB(A)
Day	35
Evening	30
Night	30

Note: Day time: 7:00 am to 6:00 pm Monday to Saturday; or 8:00 am to 6:00 pm on Sundays and public holidays.  
Evening: 6:00 pm to 10:00 pm. Night time: remaining period (NSW *Noise Policy for Industry* (NPI), 2017)

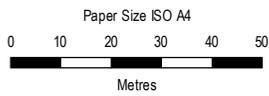


**Legend**

- Receiver location
- Logger location
- Project footprint / site



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Map Projection: Transverse Mercator  
 Horizontal Datum: WGS 1984  
 Grid: WGS 1984 UTM Zone 59S

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 Norfolk Island MPS DSC  
 Noise and Vibration Impact Assessment**

Project No. 12517635  
 Revision No. A  
 Date 19/11/2020

**Project locality**

**FIGURE 2-1**

# 3. Regulatory requirements

## 3.1 Construction noise

### 3.1.1 General

Construction noise criteria were developed in accordance with the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) for each noise catchment area. Standard hours defined in the guideline are:

- 7:00 am to 6:00 pm Monday to Friday
- 8:00 am to 1:00 pm on Saturday
- No work on Sundays or public holidays

It is anticipated that construction activities will take place during standard construction hours.

The ICNG acknowledges that the following activities can be justified to be conducted outside the recommended construction hours:

- The delivery of oversized plant or structure
- Emergency work
- Works for which it can be demonstrated that there is a need to operate outside the recommended standard hours
- Works which maintain noise levels at receivers below the night time noise affected construction noise management levels

For recommended standard hours, the following terms are used in relation to establishment of construction noise criteria:

- The 'noise affected level' represents the point above which there may be some community reaction to noise. For standard construction hours this level is established with reference to the measured rating background level (RBL) (described in Table 3-1) plus 10 dB(A). Outside standard construction hours this level is the RBL plus 5 dB(A).
- The 'highly noise affected level' represents the point above-which there may be strong community reaction to noise. This level is set at  $L_{Aeq(15min)}$  75 dB(A).

The construction noise management levels (CNMLs) that apply to sensitive receivers within each noise catchment area during construction of the Project are presented in Table 3-1.

**Table 3-1 ICNG CNMLs at identified receivers, dB(A)**

Receiver type	ICNG Construction Noise Management Level $L_{Aeq(15min)}$ dB(A)			
	Highly affected noise level	During standard construction hours <sup>[1]</sup>	Outside standard construction hours (day <sup>[2]</sup> )	Outside standard construction hours (night <sup>[3]</sup> )
Residential	75 dB(A)	45 dB(A)	40 dB(A)	35 dB(A)
School	-	45 dB(A) internal (when in use)	-	-
Commercial	-	70 dB(A) external (when in use)		

<sup>1</sup>Standard construction hours (day) is defined as 7:00 am to 6:00 pm Monday to Friday and 8:00 am to 1:00 pm on Saturdays.

<sup>2</sup>Outside standard construction hours (day) is defined as 7:00 am to 8:00 am and 1:00 pm to 6:00 pm on Saturdays, 8:00 am to 6:00 pm Sundays and public holidays.

<sup>3</sup> Outside standard construction hours (night) is defined as 6:00 pm to 7:00 am Monday to Friday and 6:00 pm to 8:00 am on Saturdays, Sundays and public holidays.

### 3.1.2 Construction vibration criteria

#### Human comfort

Vibration criteria for human comfort have been established with consideration to the, *Assessing Vibration: A Technical Guideline* (AVTG) (February 2006) for guidance on human exposure to vibration.

The AVTG separates sources of vibration into continuous, impulsive and intermittent and explains that each category should be assessed differently. Vibration from construction work, passing heavy vehicles, and piling is provided as an example of an intermittent source of vibration which is to be assessed using the vibration dose value (VDV) method.

While the AVTG recommends that for intermittent vibration VDV is used as the primary indicator for human comfort, the British Standard BS 5228-2:2009 *Code of practice for noise and vibration on construction and open sites – Part 2: Vibration* guidance can be used as an additional indicator of perceptibility. BS 5228-2 recommends the guidance values presented in Table 3-2. These values are often more suitable for construction works as available information for construction activities and equipment is typically in the form of a peak particle velocity value rather than a dose value.

**Table 3-2 Guidance on effects of vibration levels**

Vibration level	Effect
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.
0.30 mm/s	Vibration might be just perceptible in residential environments.
1.00 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.
10.0 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

#### Cosmetic damage

Vibration criteria for cosmetic damage have been established with consideration to:

- British Standard BS 7385:1993 *Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Ground Borne Vibration* for guidance on cosmetic damage to residential buildings.

- German Standard DIN 4150-3: 2016 *Vibrations in buildings – Part 3: Effects on structures* for guidance on cosmetic damage to heritage buildings.

BS 7385:1993 provides guidance on vibration level likely to cause cosmetic damage to residential buildings or reinforced structures. The guide is reproduced below in Table 3-3.

**Table 3-3 Transient vibration guide for cosmetic damage (BS 7385:1993)**

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	

**Table 3-4 Guideline values for short term vibration on structures (DIN 4150-3)**

Type of structure	Guideline values for velocity, (mm/s)		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (for example heritage listed buildings)	3	3 to 8	8 to 10

## 3.2 Operational noise

### 3.2.1 Project noise trigger level

The *Noise Policy for Industry* (EPA, 2017) provides guidance on the assessment of operational noise impacts. Operational noise impacts from a development is assessed against a Project noise trigger level that, if exceeded, indicates a potential noise impact on the community. The Project noise trigger level is the lower value of the intrusiveness noise level and the amenity noise level.

#### *Project intrusiveness noise level*

The intrusiveness noise level aims to protect against significant changes in noise levels. Typically, this will be the Project noise trigger level in areas with low existing background noise levels. The intrusiveness noise level is determined by a 5 dBA addition to the measured background noise level. The NPI (EPA, 2017) recommends that the intrusive noise criteria for the evening period should not exceed the day-time period and the night-time period should not exceed the evening period. The intrusive noise criteria are only applicable to residential receivers.

### **Project amenity noise level**

The recommended amenity noise level is the noise level objective for total industrial noise at a receiver and are determined based on the overall acoustic characteristics of the receiver area, the receiver type and the existing level of industrial noise.

The Project amenity noise level represents the noise level objective for noise from a single development. It aims to limit the cumulative noise impacts from other industries and developments on all receiver types. The Project amenity noise level is determined by a 5 dBA subtraction from the recommended amenity noise level for receivers that are not impacted by more than four individual industrial noise sources.

To standardise the time periods for the intrusiveness and amenity noise levels, the Project amenity noise level is corrected using a 3 dBA addition such that noise is assessed over a 15 minute period and not over the standard day, evening and night-time periods.

The Project amenity noise level may be modified in the following cases:

- Developments within high traffic noise levels
- Developments located near or inside an existing or proposed industrial cluster
- Where the project amenity noise level is at least 10 dBA lower than the existing industrial noise level
- Where there are no other existing or proposed industries within the development area

The NPI amenity criteria for the identified receiver types surrounding the Project area are provided in Table 3-5.

**Table 3-5 Noise Policy for Industry amenity noise levels**

Receiver type	Time of day	Recommended amenity $L_{Aeq(15min)}$ noise level, dB(A)
Residential – Suburban	Day	55
	Evening	45
	Night	40
Hotels/motels		5 dB(A) above residential amenity noise level
Commercial	All	65

### **Maximum noise level events**

The NPI recommends a maximum noise level assessment to assess the potential for sleep disturbance impacts which include awakenings and disturbance to sleep stages. An initial screening test for the maximum noise levels events should be assessed to the following levels.

- $L_{Aeq(15min)}$  40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and/or
- $L_{AFmax}$  52 dBA or the prevailing RBL plus 15 dB, whichever is greater

If the screening test indicates there is a potential for sleep disturbance then a detailed maximum noise level assessment should be undertaken. The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

### **Project noise trigger levels**

The Project noise trigger levels for the sensitive receivers identified are provided in Table 3-6.

**Table 3-6 Project noise trigger levels, dB(A)**

Receiver	Time period	Project amenity noise level <sup>[1,2]</sup> , $L_{Aeq(15\ min)}$	Intrusiveness noise level, $L_{Aeq(15\ min)}$ <sup>[3]</sup>	Project noise trigger level, dB(A)
Residential – suburban	Day	53	40	40 $L_{Aeq(15\ min)}$
	Evening	43	35	35 $L_{Aeq(15\ min)}$
	Night	38	35	35 $L_{Aeq(15\ min)}$
				52 $L_{AFMax}$ 40 $L_{Aeq(15\ min)}$ ( <i>Sleep disturbance</i> )
Hotels/motels	Day	58	-	58 $L_{Aeq(15\ min)}$
	Evening	48	-	48 $L_{Aeq(15\ min)}$
	Night	43	-	43 $L_{Aeq(15\ min)}$
Commercial	All	63	-	63 $L_{Aeq(15\ min)}$

Note 1: The project amenity noise levels have been calculated by subtracting 5 dB(A) from the recommended amenity noise levels as the identified receivers are not impacted by more than four individual industrial noise sources.

Note 2: The NPI recommends applies a 3 dB(A) addition to the  $L_{Aeq(15\ min)}$  noise level to convert the amenity noise level to a  $L_{Aeq(15\ min)}$

Note 3 Intrusiveness noise level is equal to the recommended RBL plus 5 dB(A).

### 3.2.2 Low frequency, tonal and impulsive noise

The NPI (EPA, 2017) requires that modifying factor adjustments are added to the measured or predicted noise levels if the noise sources contain tonal, low frequency or impulsive noise characteristics. These noise characteristics can cause greater annoyance to the community than other noise at the same noise level. The modifying factor adjustments are summarised in Table 3-7 and are assessed at the receiver.

Low frequency noise is assessed through a comparison between the measured or predicted C and A weighted levels at each receiver. The A-weighting curve is used to approximate the sensitivity of the human ear at low levels. The C-weighting curve is designed to be more responsive to low-frequency noise.

**Table 3-7 Modifying factor adjustments**

Factor	Assessment/ measurement	When to apply	Correction <sup>[1,2]</sup>
Tonal noise	One-third octave or narrow band analysis	<p>Level of one-third octave band exceeds the level of the adjacent bands on both sides by:</p> <ul style="list-style-type: none"> <li>• 5 dB or more if the centre frequency of the band containing the tone is in the range 500 – 10,000 Hz</li> <li>• 8 dB or more if the centre frequency of the band containing the tone is in the range 160 – 400 Hz</li> <li>• 15 dB or more if the centre frequency of the band containing the tone is in the range 25 – 125 Hz</li> </ul>	5 dB(A) <sup>[2]</sup>

Factor	Assessment/ measurement	When to apply	Correction <sup>[1,2]</sup>
Low frequency noise	Measurement of C-weighted and A-weighted level	<p>Measure/assess C and A weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more and:</p> <ul style="list-style-type: none"> <li>Where any of the one-third octave noise threshold level are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period</li> <li>Where any of the one-third octave noise threshold levels are exceeded by more than 5 dB and cannot be mitigated, a 5 dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2 dB(A) positive adjustment applies for the daytime period.</li> </ul>	5 dB(A) <sup>[2]</sup>
Impulsive noise	A-weighted fast response and impulse response	If the difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB.	Apply the difference in measured noise levels as the correction up to a maximum of 5 dB(A)
Intermittent noise	Subjectively assessed	<p>The source noise heard at the receiver varies by more than 5 dB(A) and the intermittent nature of the noise is clearly audible.</p> <p>This adjustment is applied to the night-time period only.</p>	5 dB(A)
Duration <sup>3</sup>	<p>If the duration of the noise event in any 24 hour period is as follows:</p> <ul style="list-style-type: none"> <li>1.0 to 2.5 hours then increase the noise criteria by 2 dB(A) day and 0 dB(A) night</li> <li>15 minutes to 1 hour then increase the noise criteria by 5 dB(A) day and 0 dB(A) night</li> <li>6 minutes to 15 minutes then increase the noise criteria by 7 dB(A) day and 2 dB(A) night</li> <li>1.5 minutes to 6 minutes then increase the noise criteria by 15 dB(A) day and 5 dB(A) night</li> <li>less than 1.5 minutes then increase the noise criteria by 20 dB(A) day and 10 dB(A) night</li> </ul>		

Note 1: Where two or more modifying factors are present the maximum correction is limited to 10 dB(A).

Note 2: Where a source emits a tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low frequency range.

Note 3: Duration correction is a negative correction which increases the noise criteria.

# 4. Construction impact assessment

## 4.1 Construction noise assessment

There are sensitive receivers within close proximity to the site. Due to the inherent nature of construction, it is expected that the noise impacts from construction works will impact the receivers. Noise from construction should be minimised where possible.

The construction works for the site is expected to take place over three years. According to the ICNG, a quantitative assessment method should be applied to evaluate the potential noise impact from the construction activities.

The exact layout and construction methodology has not been confirmed during concept design phase. To provide an understanding of potential noise impacts, Table 4-1 shows a list of indicative construction equipment, their associated sound power levels (SWL) and their distances to comply with the established construction noise management levels.

**Table 4-1 Indicative equipment and noise impact distances**

Equipment	SWL dBA	Noise impact distances, metres		
		Residential		Commercial (Noise affected) (70 dB(A))
		Highly noise affected (75 dB(A))	Noise affected (45 dB(A))	
Excavator	99	4	64	7
Loader	96	2	46	4
Roller	108	9	125	15
Grader	115	18	249	28
Concrete truck	107	9	125	15
Compactor	106	7	105	12
Crane	98	3	54	5
Generator	90	1	28	2
Compressor	95	2	46	4
Heavy vehicle	102	5	75	8

Based on the distances shown in Table 6-1 and the distance of the site to the nearby sensitive receivers, it is expected that noise from certain construction activities will will exceed the Construction Noise Management Levels.

Section 6 outlines general mitigation measures, which are recommended to reduce the noise impact. These should be applied where reasonable and feasible. Community engagement and consultation should be carried out with the surrounding area to minimise community reaction to noise.

For the concept design stage, a high level quantitative construction noise assessment has been conducted. An update on quantitative noise assessment of the construction noise impacts

should be conducted as part of subsequent phases as details of activities, equipment and locations are understood.

## 4.2 Construction vibration assessment

Construction activities would result in a short-term increase in localised vibration levels, as energy from equipment is transmitted into the ground and transformed into vibration, which attenuates with distance. The magnitude and attenuation of ground vibration is dependent on a range of factors including the method of energy transfer, the vibration frequency and type and the characteristics of the ground and surrounding topography. Due to complicated ground conditions and other variables associated with construction vibration, an exact vibration assessment result is generally not expected from available prediction methods.

Exact details of the equipment sizing and type were not known at the time of writing this report. This is generally selected by the construction contractor. For reference, an extract of the safe working buffer distances to comply with human comfort and cosmetic damage for standard dwellings were sourced from the *Construction Noise and Vibration Strategy* (Transport for NSW, 2018). Note that construction will require use of other plant and equipment, but excavators and vibratory rollers are some of the typical equipment that generate the most vibration.

**Table 4-2 Vibration safe working distances**

Activity	Approx. size/weight/model	Human comfort (OE&H vibration guideline)	Cosmetic damage in standard dwelling (BS 7385)
Vibratory roller	1-2 t	15 m to 20 m	5 m
	2-4 t	20 m	6 m
	4-6 t	40 m	12 m
	7-13 t	100 m	15 m
	13-18 t	100 m	20 m
	> 18 t	100 m	25 m
Small hydraulic hammer	300 kg (5 to 12 t excavator)	7 m	2 m
Medium hydraulic hammer	900 kg (12 to 18 t excavator)	23 m	7 m
Large hydraulic hammer	1600 kg (18 to 34 t excavator)	73 m	22 m
Pile driver - Vibratory	Sheet piles	20 m	2 m to 20 m
Jackhammer	Handheld	Avoid contact with structure	1 m

These safe working distances are indicative only and may vary depending on the specific equipment used, nearby receiver dwelling type and the ground conditions. If operation of any of the above equipment are within the safe working distances, it is recommended that the vibration mitigation measures covered in Section 6.2 be implemented.

# 5. Operation impact assessment

## 5.1 Operational noise

### 5.1.1 Methodology

Operational noise has been modelled using CadnaA 2020 MR2. CadnaA is a computer program for the calculation, assessment and prognosis of noise exposure. CadnaA calculates environmental noise propagation according to 'ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors' algorithm.

**Table 5-1 Construction noise modelling assumptions**

Modelling component	Assumption
Prediction algorithm	ISO 9613 – 2 Acoustics – Attenuation of sound during propagation outdoors
Modelling period	Typical worst case 15 minute period of operation where all listed equipment are running simultaneously at full power
Meteorology	ISO 9613 considers the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights or 'downwind' conditions which are favourable to sound propagation
Atmospheric absorption	Average temperature of 15°C and an average humidity of 75%
Terrain	1 m terrain - site design terrain has not been included
Ground absorption coefficient	G = 0.75
Receiver heights	1.5 m above building ground level (ground floor)
Shielding	The modelled scenario takes into account the shielding effect from buildings and structures on the site. It assumes onsite building height of 4 metres and water tank heights of 5 metres. Equipment/plant is in free-field environment – not inside buildings and no shielding around it.

### 5.1.2 Noise sources and scenarios

Table 5-2 lists the indicative outdoor plant/equipment located on the MPS site and their associated sound power levels.

**Table 5-2 Operational noise sources**

Equipment	Quantity	Height above ground level (m)	Typical Operation Cycle	SWL <sup>1</sup>
Heat pumps SCXHS224	3	1	Continuous	88 dBA
Kitchen exhaust fan	1	4.5	Continuous	90 dBA
Generator 350 kVA	1	1.5	Continuous (during testing - 1 hour per week)	98 dBA
Fire pump	1	1	Continuous (during testing - 1 hour per year)	104 dBA
Water treatment pump	1	1	Continuous	104 dBA

<sup>1</sup>Sound power level (SWL) is based on indicative equipment sizing/selection during concept design.

The noise assessment considers the below three operational scenarios on the site.

1. Worst case day– All plant/equipment, including emergency equipment, which would occur during the day This scenario would occur during the day infrequently - when emergency equipment is tested.
2. Typical day/evening – Equipment associated to standard operation of the site during day and evening period.
3. Typical night – Equipment associated to standard operation of the site during the night period.

The equipment associated used with each operation scenario is summarised in Table 5-3. The operation of emergency equipment during evening and night period is assumed to only occur during emergencies and is therefore not assessed.

**Table 5-3 Assessed operational scenarios and associated equipment use**

Equipment	Worst case day/evening	Typical day/evening	Typical night
Heat pumps	✓	✓	✓
Kitchen exhaust	✓	✓	-
Generator	✓	-	-
Fire pump	✓	-	-
Water treatment pump	✓	✓	✓

### 5.1.3 Predicted noise levels

#### Site layout option 1

**Table 5-4 Predicted noise impacts for layout option 1**

Receiver	Predicted noise level, $L_{Aeq(15min)}$ dB(A) <sup>1</sup>			
	Worst case Day	Typical scenario		
		Day	Evening	Night
R01	<b>44</b>	40	<b>40</b>	<b>39</b>
R02	<b>44</b>	39	<b>39</b>	<b>37</b>
R03	<b>46</b>	<b>41</b>	<b>41</b>	<b>38</b>
R04	<b>48</b>	<b>42</b>	<b>42</b>	<b>40</b>
R05	<b>56</b>	<b>48</b>	<b>48</b>	<b>47</b>
R06	<b>60</b>	<b>48</b>	<b>48</b>	<b>47</b>
R07	<b>59</b>	<b>58</b>	<b>58</b>	<b>58</b>
R08	<b>42</b>	39	<b>39</b>	<b>38</b>
R09	<b>46</b>	38	<b>38</b>	<b>37</b>
Criteria	40 dB(A)	40 dB(A)	35 dB(A)	35 dB(A)

<sup>1</sup> Predicted exceedances are shown in **bold**.

## Site layout option 2

**Table 5-5 Predicted noise impacts for layout option 2**

Receiver	Predicted noise level, $L_{Aeq(15min)}$ dB(A) <sup>1</sup>			
	Worst case	Typical scenario		
		Day	Day	Evening
R01	<b>47</b>	<b>43</b>	<b>43</b>	<b>42</b>
R02	<b>47</b>	<b>46</b>	<b>46</b>	<b>45</b>
R03	<b>44</b>	<b>42</b>	<b>42</b>	<b>42</b>
R04	<b>44</b>	<b>43</b>	<b>43</b>	<b>42</b>
R05	<b>59</b>	<b>59</b>	<b>59</b>	<b>59</b>
R06	<b>54</b>	<b>54</b>	<b>54</b>	<b>54</b>
R07	<b>44</b>	<b>42</b>	<b>42</b>	<b>39</b>
R08	<b>70</b>	<b>45</b>	<b>45</b>	<b>45</b>
R09	<b>58</b>	<b>41</b>	<b>41</b>	<b>41</b>
Criteria	40 dB(A)	40 dB(A)	35 dB(A)	35 dB(A)

<sup>1</sup> Predicted exceedances are shown in **bold**.

Based on the noise model results, the operational noise is predicted to exceed the established project noise trigger levels. Site layout option 1 will have an overall lower noise impact than site layout option 2, however both options will have exceedances at most/all receivers.

The predicted exceedances are based on the concept design, with minimal noise mitigation measures implemented. Subsequent design phases should consider design decisions that mitigate noise impacts.

Section 6.3 provides some general mitigation measures that should be implemented to reduce the noise impact from the site.

### 5.1.4 Discussion

One of the main drivers for the site's exceedance of the noise criteria are the various pumps around the site. The predicted noise impacts from the outdoor equipment (e.g. water treatment equipment) can be seen as conservative as they are based on the high level concept design. The design currently does not include possible noise mitigation elements such as noise attenuation enclosures/barriers or lower noise generating equipment selection. In general:

- The implementation noise attenuation barriers near the source or sensitive receiver boundary, the noise transmitted to a sensitive receiver can typically be reduced by up to 10 dB.
- The housing of plant/equipment within an acoustically enclosed structure, the noise transmitted to a sensitive receiver can typically be reduced by 15 – 20 dB.
- The selection of quieter equipment can typically reduce the noise generated by around 5 dB.

With the incorporation of a combination of the above mitigation measures, the site can potentially meet the established criteria. Where reasonable and feasible mitigation measures have been implemented and the predicted noise impacts at sensitive receivers are above the established noise criteria, at premise noise treatments may be required to deal with the residual noise.

### **Site specific recommendations**

Based on the predicted noise contribution to nearby sensitive receivers, the following items are recommended to be included into subsequent phases of the site design.

- Placement of kitchen mechanical plant (e.g. exhaust fan) in a manner that it does not have line of sight to sensitive receivers.
- Housing of the water treatment equipment in an acoustic structure. If airflow is required for the equipment, acoustic louvres should be implemented in the structure to minimise noise egress.
- Housing of the mechanical plant in an acoustic structure. If airflow is required for the equipment, acoustic louvres should be implemented in the structure to minimise noise egress.

## **5.2 Sleep disturbance impacts**

Based on the results in Section 5.1.3, the predicted noise levels at all residential receivers are above the screening criteria of  $L_{Aeq(15\text{ min})}$  40 dB(A). This indicates that there is potential for sleep disturbance to occur and a detailed sleep disturbance assessment is recommended.

It is understood that the site layout, plant equipment selection and location may change in subsequent design phases to reduce the noise impact on nearby sensitive receivers. Should later design changes alter the night time noise impacts below the screening criteria ( $L_{Aeq(15\text{ min})}$  40 dB(A)), then a detailed sleep disturbance assessment may not be necessary.

## **5.3 Annoying characteristics**

Any annoying characteristics (such as tonality, low frequency, impulsiveness, etc.) generated by the site will need to have correction factors applied, as per the NPI. This will need to be assessed as part of the detailed design stage where specific operational equipment are selected.

## **5.4 Operational vibration**

The equipment on site is not expected to have vibrational impacts during operation.

# 6. Noise and vibration mitigation measures

## 6.1 In-principle noise and vibration control methods

In principle, there are three approaches to controlling construction noise and vibration:

- Control at the source
- Control on the source-to-receiver pathway
- Control at the receiver

### 6.1.1 Control at the source

Control at the source is considered to be the most cost-effective in the reduction of noise and vibration levels and as such should be given highest priority when considering mitigation options. The solutions available include:

- Substitution of equipment:
  - Substitution involves where reasonably practicable the use of less noisy or vibration-generating equipment. This should be considered at the beginning of the construction phase, prior to any work being carried out. Equipment should be selected to meet the needs of the project or process it is required for and not be excess.
- Modification of existing equipment:
  - Modification of equipment involves the addition of acoustic treatments to parts of the machinery. These include but are not limited to improved mufflers, stiffening of panels and surface coating of resonance dampening material. These options would often require discussion with the supplier and manufacturer of the equipment.
- Use and siting of equipment:
  - Plant should always be used in accordance with the manufacturer's instructions. Where possible the location of equipment should be away from noise sensitive areas. This includes taking into consideration the emission direction of equipment and directing this away from noise sensitive receivers. Plant used intermittently should be shut down during the intervening periods or throttled down to a minimum. Dropping of material from height should be limited where possible, particularly the loading and unloading of scaffolding.
- Regular and effective maintenance:
  - Maintenance should be carried out to ensure equipment is running at optimal conditions.

### 6.1.2 Control along the path

There are two ways of mitigating noise along the transmission path:

- Increasing the distance between the source and receiver.
- Where distance is limited, screening of noise may be considered. In some circumstances it may also be possible to enclose the equipment during the operation.

Table 6-1 provides typical noise attenuation provided by noise control methods.

**Table 6-1 Typical attenuations for source to receiver noise control methods**

Control by	Nominal noise reduction possible, in total A-weighted sound pressure level LpA dB
Distance	Approximately 6 for each doubling of distance
Screening	Normally 5 to 10, maximum of 15
Enclosure	Normally 15 to 25, maximum of 50

### 6.1.3 Control of noise at the receiver

Reasonable and feasible mitigation measures at the receivers for this Project are limited to effective community consultation.

## 6.2 Construction mitigation and management measures

The noise and vibration mitigation measures detailed in Section Table 6-2 are recommended where reasonable and feasible to reduce the impact on the surrounding receivers and sensitive land uses during construction.

**Table 6-2 Mitigation measures for construction noise and vibration**

Action required	Details
General controls	
Site inductions	All employees, contractors and subcontractors are to receive an environmental induction. The induction should include: <ul style="list-style-type: none"> <li>• All relevant project specific and standard noise and vibration mitigation measures</li> <li>• Relevant licence and approval conditions</li> <li>• Permissible hours of work</li> <li>• Location of nearest sensitive receivers</li> <li>• Construction employee parking areas</li> <li>• Designated loading/unloading areas and procedures</li> <li>• Site opening/closing times (including deliveries)</li> <li>• Environmental incident procedures</li> </ul>
Behavioural practices	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Implement community consultation measures	Contact will be established with the local residents and the construction program and progress communicated on a regular basis, particularly when noisy or vibration-generating activities are planned. Affected receivers will be notified of the intended work, its duration and times of occurrence. This may include a local community update letters for specific construction activities and a Project info line.

Action required	Details
Implement complaints management measures	<p>Complaints will be managed in accordance with the procedure outlined below. Signage at each site will clearly and visibly provide a contact number and name to receive complaints and enquiries about construction.</p> <p>Potential complaints specific to these works could include:</p> <ul style="list-style-type: none"> <li>• Vibration impacts from works that significantly affect structures or dwellings</li> <li>• A cluster of noise and/or vibration complaints</li> </ul> <p>In this instance the response would be to:</p> <ul style="list-style-type: none"> <li>• Verbally respond to complainant</li> <li>• Provide a written response within seven calendar days if the complaint cannot be resolved verbally</li> <li>• Log the complaint, and any actions taken with regards to the complaint within a complaints register</li> <li>• Undertake monitoring at the complainant's residence(s)</li> <li>• Investigate the nature and reasons of the impact</li> <li>• Investigate and implement further mitigation measures to minimise the impact</li> </ul>
Compliance vibration measurements	<p>Vibration monitoring will be undertaken where construction equipment operate within the safe working distances, outlined in Table 4-2, of a building or when a complaint is received. Vibration monitoring should be conducted during these activities at the most susceptible buildings close to the construction sites.</p> <p>Where exceedances of the relevant vibration criteria outlined in Section 3.1.2 are recorded, the situation should be reviewed in order to identify the measures that can be taken to minimise the impacts to sensitive equipment and prevent structural damage. The review may result in a requirement to modify work practices or use alternative, low-vibration methods and equipment.</p> <p>Any vibration measurement will be undertaken by a qualified professional and with consideration to the ICNG guidelines.</p>
<b>Source controls</b>	
Construction hours and scheduling	<p>Comply with the recommended standard construction hours outlined in Section 3.1.1, unless out of hours work has been approved.</p> <p>No truck movements before 7.00 am or after 6.00 pm.</p> <p>For any work that would take place outside of normal construction hours:</p> <ul style="list-style-type: none"> <li>• Undertake an assessment of the potential noise and vibration impacts associated with the proposed activities and outline specific mitigation measures.</li> <li>• Residents potentially affected by such activities will be notified at least five days before hand.</li> <li>• Minimise consecutive night activities in the same locality and provide periods of quiet if activities occur for extended periods during the night.</li> <li>• Conduct activities in a manner that eliminates or minimises the need for audible warning alarms.</li> </ul>

Action required	Details
Construction respite period	High noise and vibration generating activities may only be carried out in continuous blocks, not exceeding three hours each, with a minimum respite period of one hour between each block. High noise refers to construction noise impacts which exceed the highly affected noise management level of 75 dB(A) $L_{Aeq(15-min)}$ during standard construction hours.
Equipment selection	Use quieter and less vibration emitting construction methods where reasonable and feasible.
Use and siting of plant	Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided. The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers.
Plan worksites and activities to minimise noise and vibration	Plan traffic flow, parking and loading unloading areas to minimise reversing movements within the site.
Minimise disturbance arising from delivery of goods to construction sites	Loading and unloading of materials/deliveries is to occur during standard construction hours. Contractors are to avoid dropping materials from height where practicable, during loading and unloading. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.
<b>Path controls</b>	
Use of safe distances	The safe working distances outlined in Table 4-2 will be observed when reasonable and feasible to minimise adverse vibration impacts.

### 6.3 Operational mitigation and management measures

Based on the noise modelling predictions, detailed in Section 5.1.3, exceedances are expected at nearly all sensitive receivers during all periods.

It is recommended that during subsequent design phases that plant/equipment selection and placement should consider acoustic impacts. Design decisions should be made to mitigate the potential noise impacts. Recommended operational mitigation and management measures are listed below.

- Develop an operational environmental management plan that covers noise. The document will detail noise management procedures, including complaints handling procedures.
- All equipment will be selected to minimise noise emissions and regularly maintained to avoid any unnecessary noise caused by lack of maintenance. Equipment should be fitted with appropriate silencers and be in good working order.
- All equipment will be contained within acoustic enclosures or buildings to mitigate direct noise transmissions.
- Shielding in the form of noise barriers should be considered for receivers near the site.

# 7. Conclusions

This noise and vibration assessment has led to the following conclusions, which are subject to the limitations outlined in the document.

- For construction activities associated to the Project:
  - Based on indicative construction equipment and distances involved between the construction areas and the nearest sensitive receivers, noise and vibration impacts are expected during construction of the Project.
  - It is recommended, where reasonable and feasible, that the mitigation measures outlined in Section 6.2 be used to minimise noise impacts due to construction activities.
  - It is recommended that a construction noise management plan is developed for the works. The plan will cover more detailed construction activities, their impacts and the mitigation measures to be implemented.
- For operational activities associated to the Project:
  - The noise levels due to operation of the Project are expected to exceed the adopted noise criteria at all assessed sensitive receivers.
  - The operation of the MPS is not expected to have any vibrational impacts.
  - The predicted noise exceedances are based on the concept design, with minimal noise mitigation measures implemented. Subsequent design phases should consider design decisions that mitigate noise impacts.
  - It is recommended that the mitigation measures outlined in Section 6.3 be used to minimise noise impacts from site operations.

## **Appendices**

## **Appendix A** – Calibration certificates

# CERTIFICATE OF CALIBRATION

CERTIFICATE No: 26710

**EQUIPMENT TESTED:** Sound Level Calibrator

**Manufacturer:** Casella CEL  
**Type No:** CEL-110/2      **Serial No:** 097197  
**Owner:** GHD Pty Ltd  
Level 8, 180 Lonsdale Street  
Melbourne VIC 3000

**Tests Performed:** Measured output pressure level was found to be:

Parameter	Pre-Adj	Adj Y/N	Output: (db re 20 µPa)	Frequency: (Hz)	THD&N (%)
Level 1:	NA	N	113.84	1000.09	0.50
Level 2:	NA	N	N	NA	NA
<b>Uncertainty:</b>			±0.11 dB	±0.05%	±0.20 %
Uncertainty (at 95% c.i.) k=2					

**CONDITION OF TEST:**

**Ambient Pressure:** 1006 hPa ±1.5 hPa    **Relative Humidity:** 50% ±5%

**Temperature:** 25 °C ±2° C

**Date of Calibration:** 15/04/2020      **Issue Date:** 15/04/2020

**Acu-Vib Test Procedure:** AVP02 (Calibrators)

**Test Method:** AS IEC 60942 - 2017

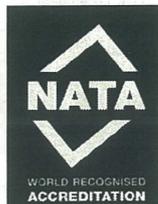
**CHECKED BY:** *IKB* **AUTHORISED SIGNATURE:** .....

*Hein Soe*

Accredited for compliance with ISO/IEC 17025 - Calibration

The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.



Accredited Lab. 9262  
Acoustic and Vibration  
Measurements



**HEAD OFFICE**  
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154  
Tel: (02) 96808133 Fax: (02)96808233  
Mobile: 0413 809806  
Web site: www.acu-vib.com.au

# CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: **SLM 24491 & FILT 5122**

**Equipment Description:** Sound & Vibration Analyser

**Manufacturer:** Svantek

**Model No:** Svan-977      **Serial No:** 36821

**Microphone Type:** 7052E      **Serial No:** 52114

**Preamplifier Type:** SV12L      **Serial No:** 30276

**Filter Type:** 1/3 Octave      **Serial No:** 36821

**Comments:** All tests passed for class 1.  
(See over for details)

**Owner:** GHD Pty Ltd  
Level 3, 24 Honeysuckle Drive  
Newcastle, NSW 2300

**Ambient Pressure:** 1009 hPa  $\pm$ 1.5 hPa

**Temperature:** 23 °C  $\pm$ 2° C      **Relative Humidity:** 54%  $\pm$ 5%

**Date of Calibration:** 15/04/2019      **Issue Date:** 16/04/2019

**Acu-Vib Test Procedure:** AVP10 (SLM) & AVP06 (Filters)

**CHECKED BY:** 

**AUTHORISED SIGNATURE:** 

*Jack Kieft*

Accredited for compliance with ISO/IEC 17025 - Calibration  
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.



**ACU-VIB**  
ELECTRONICS

HEAD OFFICE

Unit 14, 22 Hudson Ave. Castle Hill NSW 2154

Tel: (02) 96808133 Fax: (02) 96808233

Mobile: 0413 809806

web site: www.acu-vib.com.au

Accredited Lab. No. 9262  
Acoustic and Vibration  
Measurements

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AVCERT10 Rev. 1.3 15.05.18

**CERTIFICATE NO.: SLM 24491 & FILT 5122**

The performance characteristics listed below were tested. The tests are based on the relevant clauses of IEC 61672-3:2013

<b>Tests Performed:</b>	<i>Clause</i>	<i>Result</i>
<i>Absolute Calibration</i>	10	Pass
<i>Acoustical Frequency Weighting</i>	12	Pass
<i>Self Generated Noise</i>	11.1	Entered
<i>Electrical Noise</i>	11.2	Entered
<i>Long Term Stability</i>	15	Pass
<i>Electrical Frequency Weightings</i>	13	Pass
<i>Frequency and Time Weightings</i>	14	Pass
<i>Reference Level Linearity</i>	16	Pass
<i>Range Level Linearity</i>	17	Pass
<i>Toneburst</i>	18	Pass
<i>Peak C Sound Level</i>	19	Pass
<i>Overload Indicator</i>	20	Pass
<i>High Level Stability</i>	21	Pass

**Statement of Compliance:** The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC61672-1:2013.  
A full technical report is available if required.

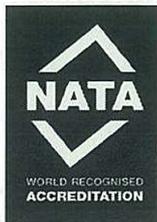
**This Sound Level Meter included an Octave Filter Set. Tests were based on IEC 1260: 1995 and AS/NZS 4476 - 1997 and were conducted to test the following performance characteristics:**

1. Relative attenuation clause 5.3

**Date of Calibration:** 15/04/2019      **Issue Date:** 16/04/2019

**Checked by:** *NB*

Accredited for compliance with ISO/IEC 17025 - Calibration  
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.



Accredited Lab. No. 9262  
Acoustic and Vibration  
Measurements



**HEAD OFFICE**  
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154  
Tel: (02) 96808133 Fax: (02)96808233  
Mobile: 0413 809806  
web site: www.acu-vib.com.au

# CERTIFICATE OF CALIBRATION

CERTIFICATE No.: **SLM 26830 & FILT 5857**

**Equipment Description:** Sound & Vibration Analyzer

**Manufacturer:** Svantek

**Model No:** Svan-977      **Serial No:** 92124

**Microphone Type:** 7052E      **Serial No:** 77132

**Preamplifier Type:** SV12L      **Serial No:** 33254

**Filter Type:** 1/3 Octave      **Serial No:** 95126

**Comments:** All tests passed for class 1.  
(See over for details)

**Owner:** GHD Pty Ltd  
Level 3, 24 Honeysuckle Drive  
Newcastle, NSW 2300

**Ambient Pressure:** 1016 hPa  $\pm$ 1.5 hPa

**Temperature:** 25 °C  $\pm$ 2° C      **Relative Humidity:** 42 %  $\pm$ 5%

**Date of Calibration:** 22/06/2020      **Issue Date:** 22/06/2020

**Acu-Vib Test Procedure:** AVP10 (SLM) & AVP06 (Filters)

**CHECKED BY:**       **AUTHORISED SIGNATURE:**   
*Jack Kielt*

Accredited for compliance with ISO/IEC 17025 - Calibration  
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**HEAD OFFICE**  
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154  
Tel: (02) 96808133      Fax: (02)96808233  
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The performance characteristics listed below were tested. The tests are based on the relevant clauses of IEC 61672-3:2013

<b>Tests Performed:</b>	<i>Clause</i>	<i>Result</i>
<i>Absolute Calibration</i>	10	Pass
<i>Acoustical Frequency Weighting</i>	12	Pass
<i>Self Generated Noise</i>	11.1	Observed
<i>Electrical Noise</i>	11.2	Observed
<i>Long Term Stability</i>	15	Pass
<i>Electrical Frequency Weightings</i>	13	Pass
<i>Frequency and Time Weightings</i>	14	Pass
<i>Reference Level Linearity</i>	16	Pass
<i>Range Level Linearity</i>	17	Pass
<i>Toneburst</i>	18	Pass
<i>Peak C Sound Level</i>	19	Pass
<i>Overload Indicator</i>	20	Pass
<i>High Level Stability</i>	21	Pass

**Statement of Compliance:** The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC61672-1:2013.

**This Sound Level Meter included an Octave Filter Set. Tests were based on IEC 1260: 1995 and AS/NZS 4476 - 1997 and were conducted to test the following performance characteristics:**

1. Relative attenuation clause 5.3

A full technical report is available if required.

**Date of Calibration: 22/06/2020 Issue Date: 22/06/2020**

Accredited for compliance with ISO/IEC 17025 - Calibration  
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GHD

Level 3 GHD Tower 24 Honeysuckle Drive Newcastle NSW 2300

PO BOX 5403 Hunter Region Mail Centre

Newcastle NSW 2300

T: 61 2 4979 9999 F: 61 2 9475 0725 E: ntlmail@ghd.com

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123/[https://projectsportal.ghd.com/sites/pp09\\_04/norfolkislandmpsdsc/ProjectDocs/12517635-REP-Norfolk Island MSP Noise and Vibration Assessment.docx](https://projectsportal.ghd.com/sites/pp09_04/norfolkislandmpsdsc/ProjectDocs/12517635-REP-Norfolk%20Island%20MSP%20Noise%20and%20Vibration%20Assessment.docx)

**Document Status**

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
DRAFT	A Cheung	J.Forrest		B.Murphy		24.11.2020

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