



# **ABERGELDIE**

COMPLEX INFRASTRUCTURE

Abergeldie Contractors Pty Ltd  
ABN: 47 004 533 519 Abergeldie Contractors  
Pty Ltd ABN: 47 004 533 519

5 George Young St,  
Regents Park NSW 2143  
(P) 02 8717 7777  
(F) 02 8717 7778

**TfNSW**

## **T4291 SMWSA – ENABLING WORKS AT BADGERYS CREEK ROAD AREA AND AEROTROPOLIS**

**CONTRACT NUMBER: 21.0000139278.1275**

---

# **ELIZABETH DRIVE**

**Detailed Noise and Vibration Impact Statement**

**13 May 2022**


**Revision No: 2.0**

## TABLE OF CONTENTS

<b>1</b>	<b>DOCUMENT CONTROL</b> .....	<b>3</b>
1.1	APPROVAL .....	3
1.2	DOCUMENT REVISION STATUS.....	3
1.3	DISTRIBUTION (CONTROLLED COPIES) .....	3
1.4	GLOSSARY OF TERMS .....	3
<b>2</b>	<b>INTRODUCTION</b> .....	<b>8</b>
2.1	PURPOSE OF THIS PLAN .....	8
<b>3</b>	<b>PROJECT OVERVIEW</b> .....	<b>8</b>
3.1	PROJECT DESCRIPTION.....	8
3.2	RELEVANT CONDITION OF APPROVAL .....	9
3.3	WORK ACTIVITIES AND SCENARIOS .....	12
<b>4</b>	<b>EXISTING ENVIRONMENT</b> .....	<b>13</b>
4.1	LANDUSE SURVEY .....	13
4.2	NOISE CATCHMENT AREA .....	15
4.2.1	BACKGROUND NOISE LEVELS .....	16
<b>5</b>	<b>NOISE AND VIBRATION CRITERIA FOR NSW</b> .....	<b>16</b>
5.1	PROJECT WORKING HOURS.....	16
5.2	CONSTRUCTION NOISE AND ASSESSMENT OBJECTIVES.....	17
5.3	QUANTITATIVE NOISE ASSESSMENT CRITERIA.....	17
5.4	OTHER LAND USES .....	18
5.5	TRAFFIC NOISE ASSESSMENT GOALS .....	19
5.6	SLEEP DISTURBANCE .....	19
5.7	VIBRATION CRITERIA.....	19
<b>6</b>	<b>NOISE AND VIBRATION IMPACTS</b> .....	<b>21</b>
6.1	CONSTRUCTION NOISE ASSESSMENT .....	21
6.2	VIBRATION ASSESSMENT .....	23
6.3	OUT OF HOURS WORKS (E41, E42) .....	25
6.4	HIGHLY NOISE INTENSIVE WORKS (E39).....	25
6.5	SLEEP DISTURBANCE ASSESSMENT .....	25
<b>7</b>	<b>MITIGATION MEASURES</b> .....	<b>25</b>
7.1	ADDITIONAL MITIGATION MEASURES.....	27
<b>8</b>	<b>SUMMARY OF FINDINGS</b> .....	<b>30</b>
<b>APPENDIX A</b>	<b>NOISE ASSESSMENT / CALCULATIONS</b> .....	<b>31</b>
<b>APPENDIX B</b>	<b>MAXIMUM ALLOWABLE SOUND POWER LEVELS FOR CONSTRUCTION EQUIPMENT</b> .....	<b>43</b>
<b>APPENDIX C</b>	<b>SM-WSA OUT OF HOURS APPLICATION</b> .....	<b>45</b>

## 1 DOCUMENT CONTROL

### 1.1 APPROVAL

FUNCTION	POSITION	NAME	SIGNATURE	DATE
Written by	Environment Manager	Ewan Watson		13/05/2022
Approval	Project Director	Brain McGuinness		

### 1.2 DOCUMENT REVISION STATUS

Each page of this document bears a document number and revision date. When revisions to the document are issued, the following table will be updated to show the most recent revision level. The revised document will be forwarded to the holders of controlled copies. Recipients are responsible for destroying or marking "superseded" on the previous revision.

REVISION DATE	AMENDMENT DESCRIPTION
22/03/2022	Final issued to TfNSW
28/04/2022	Corrected typos and minor errors
13/05/2022	Updated based on SM-WSA comments and TfNSW review

Any changes within this document that modify either the scope or intent of the original document are highlighted in the right margin by a vertical bar (|).

Where review and revision is deemed warranted, i.e. such as:

- comments received from the Client,
- where it is necessary to reflect changes in contractual / Project requirements,
- where it is necessary reflect changes in work processes, outcomes of incident investigations and / or corrective action, or as a result of Legislative change.

These revisions shall be reviewed by the Project Manager and approved by the Construction Manager.

### 1.3 DISTRIBUTION (CONTROLLED COPIES)

COPY #	ISSUED TO	COMPANY / POSITION	DATE

### 1.4 Glossary of Terms

Term	Definition
AA	Acoustic Advisor
AEW	Advance Enabling Works for Sydney Metro – Western Sydney Airport.
Absorption Coefficient $\alpha$	The absorption coefficient of a material, usually measured for each octave or third-octave band and ranging between zero and one. For example, a value of 0.85 for an octave band means that 85% of the sound energy within that octave band is absorbed on coming into contact with the material. Conversely, a low value below about 0.1 means the material is acoustically reflective.
Adverse weather	Weather effects that enhance noise (particularly wind and temperature inversions) occurring at a site for a significant period of time. In the NSW INP this occurs when wind occurs for more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of nights in winter.

Active recreation	Active recreation area, characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion, e.g. school playground, golf course
Air-borne noise	Noise which is fundamentally transmitted by way of the air and can be attenuated by the use of barriers and walls placed physically between the noise source and receiver.
Alternate Solution	An Alternative Solution is a design that complies with the relevant Performance Requirements of the National Construction Code other than by using Deemed-to-Satisfy Provisions.
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
AMM	Additional Management Measures
Amenity	A desirable or useful feature or facility of a building or place.
AS	Australian Standard
Assessment period	The time period in which an assessment is made. e.g. Day 7am-6pm, Evening 6pm-10pm, Night 10pm-7am.
Assessment Point	A location at which a noise or vibration measurement is taken or estimated.
Attenuation	The reduction in the level of sound or vibration.
Audible Range	The limits of frequency which are audible or heard as sound. The normal hearing in young adults detects ranges from 20 Hz to 20 kHz, although some people can detect sound with frequencies outside these limits.
A-weighting	A filter applied to the sound recording made by a microphone to approximate the response of the human ear.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the LA90 noise level if measured as an overall level or an L90 noise level when measured in octave or third-octave bands.
Barrier (Noise)	A natural or constructed physical barrier which impedes the propagation of sound and includes fences, walls, earth mounds or berms and buildings.
BS	British Standard
CEMF	Construction Environmental Management Framework
CEMP	Construction Environmental Management Plan
CNVMP	Construction Noise and Vibration Management Plan
CNVS	Construction Noise and Vibration Strategy
COA	Minister's Conditions of Approval
CSSI	Critical State Significant Infrastructure
Decibel [dB]	<p>The units of sound measurement. The following are examples of the decibel readings of everyday sounds:</p> <p><b>0dB</b> The faintest sound we can hear, defined as 20 micro Pascal</p> <p><b>30dB</b> A quiet library or in a quiet location in the country</p> <p><b>45dB</b> Typical office space. Ambience in the city at night</p> <p><b>60dB</b> CBD mall at lunchtime</p> <p><b>70dB</b> The sound of a car passing on the street</p> <p><b>80dB</b> Loud music played at home</p> <p><b>90dB</b> The sound of a truck passing on the street</p> <p><b>100dB</b> The sound of a rock band</p> <p><b>115dB</b> Limit of sound permitted in industry</p> <p><b>120dB</b> Deafening</p>

dB(A)	A-weighted decibel. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid- low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies. The dB(C) level is not widely used but has some applications.
DECC	NSW Department of Environment and Climate Change
DIN	German Standard
DPE	NSW Department of Planning and Environment
DPIE	NSW Department of Planning, Industry and Environment (legacy Department)
DNVIS	Detailed Noise and Vibration Impact Statement
EPA	NSW Environment Protection Authority
ER	Environmental Representative
Field Test	<p>A test of the sound insulation performance in-situ. See also 'Laboratory Test'</p> <p>The sound insulation performance between building spaces can be measured by conducting a field test, for example, early during the construction stage or on completion.</p> <p>A field test is conducted in a non-ideal acoustic environment. It is generally not possible to measure the performance of an individual building element accurately as the results can be affected by numerous field conditions.</p>
Fluctuating Noise	Noise that varies continuously to an appreciable extent over the period of observation.
Free-field	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Ground-borne noise	Vibration propagated through the ground and then radiated as noise by vibrating building elements such as wall and floor surfaces. This noise is more noticeable in rooms that are well insulated from other airborne noise. An example would be vibration transmitted from an underground rail line radiating as sound in a bedroom of a building located above.
Habitable Area	<p>Includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom.</p> <p>Excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.</p>
Heavy Vehicle	A truck, transporter or other vehicle with a gross weight above a specified level (for example: over 8 tonnes).
High Noise Impact Works	Grinding metal, concrete or masonry, rock drilling, line drilling, smooth drum vibratory rolling, bitumen milling and profiling, jackhammering, rock-hammering or rock breaking, impact piling and other work occurring on surfaces that generates noise with impulsive, intermittent, tonal or low frequency characteristics.
ICNG	Interim Construction Noise Guideline (Environment NSW)
Impact Noise	The noise in a room, caused by impact or collision of an object onto the walls or the floor. Typical sources of impact noise are footsteps on the floor above a tenancy and the slamming of doors on cupboards mounted on the common wall between tenancies.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
INP	NSW Industrial Noise Policy, EPA 2000

Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
Intrusive noise	Refers to noise that intrudes above the background level by more than 5 dB(A).
ISEPP	State Environmental Planning Policy (Infrastructure), NSW, 2007
ISEPP Guideline	Development Near Rail Corridors and Busy Roads - Interim Guideline, NSW Department of Planning, December 2008
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L10(1hr)	The L10 level measured over a 1 hour period.
L10(18hr)	The arithmetic average of the L10(1hr) levels for the 18 hour period between 6am and 12 midnight on a normal working day.
L90	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
LAeq or Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time, which would produce the same energy as a fluctuating sound level. When A-weighted, this is written as the LAeq.
LAeq(1hr)	The LAeq noise level for a one-hour period. In the context of the NSW EPA's Road Noise Policy it represents the highest tenth percentile hourly A-weighted Leq during the period 7am to 10pm, or 10pm to 7am (whichever is relevant).
LAeq(8hr)	The LAeq noise level for the period 10pm to 6am.
LAeq(9hr)	The LAeq noise level for the period 10pm to 7am.
LAeq(15hr)	The LAeq noise level for the period 7am to 10pm.
LAeq (24hr)	The LAeq noise level during a 24 hour period, usually from midnight to midnight.
Lmax	The maximum sound pressure level measured over a given period. When A-weighted, this is usually written as the L <sub>Amax</sub> .
Lmin	The minimum sound pressure level measured over a given period. When A-weighted, this is usually written as the L <sub>Amin</sub> .
Laboratory Test	The performance of a building element when measured in a laboratory. The sound insulation performance of a building element installed in a building however can differ from its laboratory performance for many reasons including the quality of workmanship, the size and shape of the space in which the measurement is conducted, flanking paths and the specific characteristics of the material used which may vary from batch to batch.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on. That is, the sound of 85 dB is four times or 400% the loudness of a sound of 65 dB.
Microphone	An electro-acoustic transducer which receives an acoustic signal and delivers a corresponding electric signal.
NCA	Noise Catchment Area. An area of study within which the noise environment is substantially constant.
Noise	Unwanted sound
Noise affected level	Definition as stated in the ICNG: "The noise affected level represents the point above which there may be some community reaction to noise." Listed as RBL + 10dB for Standard Hours and RBL + 5dB Outside Standard Work Hours.
NML	Noise Management Levels
NPfi	Noise Policy for Industry (EPA 2017)
NSR	Noise and Vibration Sensitive Receivers
OOHW	Out of Hours Work

Passive recreation	Area specifically reserved for passive recreation, characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion e.g. reading, meditation
PPV	Peak Particle Velocity (mm/s)
Reflection	Sound wave reflected from a solid object obscuring its path.
Reverberation Time	The time (in seconds) it takes for a noise signal within a confined space to decay by 60dB. The longer the reverberation time (usually denoted as RT60), the more echoic a room. Longer reverberation times generally result in higher noise levels within spaces.
RMS	Roads and Maritime Services (legacy department)
Rw	<p>Weighted Sound Reduction Index</p> <p>A measure of the sound insulation performance of a building element. It is measured in very controlled conditions in a laboratory.</p> <p>The term supersedes the value STC which was used in older versions of the Building Code of Australia. Rw is measured and calculated using the procedure in ISO 717-1. The related field measurement is the DnT,w</p> <p>he higher the value the better the acoustic performance of the building element.</p>
R'w	<p>Weighted Apparent Sound Reduction Index.</p> <p>As for Rw but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement. The higher the value the better the acoustic performance of the building element.</p>
RNP	Road Noise Policy, NSW, March 2011
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
SM-WSA	Sydney Metro Western Sydney Airport
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound Absorption	The ability of a material to absorb sound energy by conversion to thermal energy.
Sound Insulation	Sound insulation refers to the ability of a construction or building element to limit noise transmission through the building element. The sound insulation of a material can be described by the Rw and the sound insulation between two rooms can be described by the DnT,w.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 pico watt.
Sound Pressure Level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone referenced to 20 micro Pascal.
STC	<p>Sound Transmission Class</p> <p>A measure of the sound insulation performance of a building element. It is measured in controlled conditions in a laboratory.</p> <p>The term has been superseded by Rw.</p>



Structure-borne Noise	<p>Audible noise generated by vibration induced in the ground and/or a structure. Vibration can be generated by impact or by solid contact with a vibrating machine.</p> <p>Structure-borne noise cannot be attenuated by barriers or walls but requires the isolation of the vibration source itself. This can be achieved using a resilient element placed between the vibration source and its support such as rubber, neoprene or springs or by physical separation (using an air gap for example).</p> <p>Examples of structure-borne noise include the noise of trains in underground tunnels heard to a listener above the ground, the sound of footsteps on the floor above a listener and the sound of a lift car passing in a shaft. See also 'Impact Noise'.</p>
TfNSW	Transport for New South Wales
Transmission Loss	<p>The sound level difference between one room or area and another, usually of sound transmitted through an intervening partition or wall. Also the vibration level difference between one point and another.</p> <p>For example, if the sound level on one side of a wall is 100dB and 65dB on the other it is said that the transmission loss of the wall is 35dB. If the transmission loss is normalised or standardised, it then becomes the <math>R_w</math> or <math>R'w</math> or <math>DnT,w</math>.</p>
VDV	Vibration Dose Value

## 2 INTRODUCTION

### 2.1 PURPOSE OF THIS PLAN

The purpose of this noise and vibration assessment is to assess impacts and identify suitable controls for the works at Elizabeth Drive Badgerys Creek. The assessment supports the Construction Environment Management Plan for Elizabeth Drive for Sydney Metro Western Sydney Airport – Advanced and Enabling Works (AEW) - Roadworks as identified in the SW-WSA Staging Report.

Primarily, this document has been prepared to fulfil the requirements of the Critical State Significant Infrastructure (CSSI) (SSI-10051) Approval Condition E47 that requires a Detailed Noise and Vibration Impact Statement (DNVIS) to be prepared. This DNVIS forms part of the Construction Environmental Management Plan (CEMP), in accordance with the SM-WSA Construction Environmental Management Framework (CEMF). Section 4.3 of the SM-WSA Construction Noise and Vibration Standard included as part of the Submissions Report also requires a DNVIS to be prepared.

This DNVIS has been prepared and developed using the RMS Construction Noise Estimator Tool.

## 3 PROJECT OVERVIEW

### 3.1 PROJECT DESCRIPTION

The Elizabeth Drive Enabling Work is a Project undertaken by Abergeldie for Transport for New South Wales (TfNSW) on behalf of Sydney Metro – Western Sydney Airport. This package of work forms part of the Advance Enabling Works (AEW) for Sydney Metro – Western Sydney Airport.

The Sydney Metro – Western Sydney Airport involves a new metro railway line around 23 kilometres in length between St Marys in the north and the Aerotropolis Core precinct in the south (the area to be called Bradfield). This will include a section of the alignment which passes through and provides access to Western Sydney International (Nancy-Bird Walton) Airport (Western Sydney International), currently under construction.

Enabling works for the SM-WSA are required to establish key construction sites and facilitate construction activities. Activities within the AEW stage includes construction of enabling works such as site investigation, clearance, demolition and modifications to the existing transport network (such as roads, bus interchanges, lift shaft relocation).





Figure 1 Project site boundary

Both Elizabeth Drive and Badgerys Creek Road are State Roads and the works area is located within the Special Purpose Infrastructure land use zone. To the south of the works area is the construction area of Western Sydney Airport and to the north is predominantly rural land uses zoned Environment and Recreation, and Enterprise under the *State Environmental Planning Policy (Western Sydney Aerotropolis) 2020* (SEPP WSA).

### 3.2 RELEVANT CONDITION OF APPROVAL

The condition related to the preparation and implementation of this DNVIS are present in Table 1. This table also provide a comment how or where the condition is addressed or implemented.

Table 1 Relevant Approval Conditions

Reference	COA	Comment
E37	A detailed land use survey must be undertaken to confirm sensitive land use(s) (including critical working areas such as operating theatres and precision laboratories) potentially exposed to construction noise and vibration and construction ground-borne noise. The survey may be undertaken on a progressive basis but must be undertaken in any one area before the commencement of work which generates construction noise, vibration or ground-borne noise in that area. The results of the survey must be included in the Detailed Noise and Vibration Impact Statements required under Condition E47.	Section 4.1 LANDUSE SURVEY
E38	Work must only be undertaken during the following hours: (a) 7:00am to 6:00pm Mondays to Fridays, inclusive; (b) 8:00am to 1:00pm Saturdays; and (c) at no time on Sundays or public holidays.	Noted.

Reference	COA	Comment
E39	<p>Except as permitted by an EPL or approved in accordance with the Out-of-Hours Works Protocol required by Condition E42, highly noise intensive work that result in an exceedance of the applicable NML at the same receiver must only be undertaken:</p> <p>(a) between the hours of 8:00 am to 6:00 pm Monday to Friday;</p> <p>(b) between the hours of 8:00 am to 1:00 pm Saturday; and</p> <p>(c) if continuously, then not exceeding three (3) hours, with a minimum cessation of work of not less than one (1) hour.</p> <p>For the purposes of this condition, 'continuously' includes any period during which there is less than one (1) hour between ceasing and recommencing any of the work.</p>	<p>Highly intensive work has not been predicted during standard hours. Noise levels are below NML.</p> <p>Proposed out of hours works will be approved in accordance with the Out-of-hours Work Protocol.</p>
E41	<p>Notwithstanding Conditions E38 and E39 work may be undertaken outside the hours specified in the following circumstances:</p> <p>(a) Safety and Emergencies, including:</p> <p>(i) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or</p> <p>(ii) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm; or</p> <p>(b) Low impact, including:</p> <p>(i) construction that causes LAeq(15 minute) noise levels:</p> <ul style="list-style-type: none"> <li>• no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, and</li> <li>• no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); and</li> </ul> <p>(ii) construction that causes:</p> <ul style="list-style-type: none"> <li>• continuous or impulsive vibration values, measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), or</li> <li>• intermittent vibration values measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006); or</li> </ul> <p>(c) By Approval, including:</p> <p>(i) where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or</p> <p>(ii) works which are not subject to an EPL that are approved under an Out-of-Hours Work Protocol as required by Condition E42; or</p> <p>(iii) negotiated agreements with directly affected residents and sensitive land user(s); or</p> <p>(d) By Prescribed Activity, including:</p> <p>(i) tunnelling and ancillary support activities (excluding cut and cover tunnelling and surface works not directly supporting tunnelling) are permitted 24 hours a day, seven days a week; or</p> <p>(ii) grout batching at the Orchard Hills construction site is permitted 24 hours per day, seven days per week; or</p> <p>(iii) delivery of material that is required to be delivered outside of standard construction hours in Condition E38 to directly support tunnelling activities, except between the hours 10:00 pm and 7:00 am to / from the Orchard Hills ancillary facility; or</p> <p>(iv) haulage of spoil generated through tunnelling is permitted 24 hours per day, seven days per week except between the hours of 10:00 pm and 7:00 am to / from the Orchard Hills construction site; or</p> <p>(v) works within an acoustic enclosure are permitted 24 hours a day, seven days a week where there is no exceedance of noise levels or intermittent vibration levels under Low impact circumstances identified in Condition E41(b), unless otherwise agreed with the Planning Secretary; or</p> <p>(vi) tunnel and underground station box fit out works are permitted 24 hours per day, seven days per week.</p> <p>On becoming aware of the need for emergency work in accordance with (a)(ii) above, the ER, the Planning Secretary and the EPA must be notified of the reasons for such work. The Proponent must use best endeavours to notify as soon as practicable all noise and/or vibration affected sensitive land user(s) of the likely impact and duration of those work.</p> <p>Notes:</p> <p>1. Tunnelling does not include station box excavation.</p>	<p>Proposed out of hours works are to be via E41 (c) (ii)</p> <p>This DNIVIS supports the approval via the Out of Hours Work Protocol.</p>

Reference	COA	Comment
	2. Tunnelling ancillary support activities includes logistics support and material handling and delivery	
E42	<p>An Out-of-Hours Work Protocol must be prepared to identify a process for the consideration, management and approval of work (not subject to an EPL) that is outside the hours defined in Conditions E38 and E39. The Protocol must be approved by the Planning Secretary before commencement of the out-of-hours work. The Protocol must be prepared in consultation with the ER. The Protocol must provide:</p> <p>(a) justification for why out-of-hours work need to occur;</p> <p>(b) identification of low and high-risk activities and an approval process that considers the risk of activities, proposed mitigation, management, and coordination, including where:</p> <p>(i) the ER reviews all proposed out-of-hours activities and confirms their risk levels;</p> <p>(ii) low risk activities that can be approved by the ER; and</p> <p>(iii) high risk activities that are approved by the Planning Secretary;</p> <p>(c) a process for the consideration of out-of-hours work against the relevant NML and vibration criteria;</p> <p>(d) a process for selecting and implementing mitigation measures for residual impacts in consultation with the community at each affected location, including respite periods consistent with the requirements of Condition E56. The measures must take into account the predicted noise levels and the likely frequency and duration of the out-of-hours works that sensitive land user(s) would be exposed to, including the number of noise awakening events;</p> <p>(e) procedures to facilitate the coordination of out-of-hours work including those approved by an EPL or undertaken by a third party, to ensure appropriate respite is provided; and</p> <p>(f) notification arrangements for affected receivers for all approved out-of-hours works and notification to the Planning Secretary of approved low risk out-of-hours works.</p> <p>This condition does not apply if the requirements of Condition E41 are met.          Note: Out-of-hours work is any work that occurs outside the construction hours identified in Condition E38 and E39.</p>	<p>The Out of Hours Work Protocol has been Approved.</p> <p>The Proposed out of hours work will be approved through application process outlined in the Out of Hours Work</p>
E43	<p>Mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration criteria:</p> <p>(a) construction 'Noise affected' noise management levels established using the Interim Construction Noise Guideline (DECC, 2009);</p> <p>(b) preferred vibration criteria established using the Assessing vibration: a technical guideline (DEC, 2006) (for human exposure);</p> <p>(c) Australian Standard AS 2187.2 - 2006 "Explosives - Storage and Use - Use of Explosives" (for human exposure);</p> <p>(d) BS 7385 Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2" as they are "applicable to Australian conditions"; and</p> <p>(e) the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures (for structural damage).</p> <p>Any work identified as exceeding the noise management levels and / or vibration criteria must be managed in accordance with the Noise and Vibration CEMP Sub-plan.</p>	As per the Staging Report mitigation measures have been included in the CEMP.
E44	<p>All reasonable and feasible mitigation measures must be applied when the following residential ground-borne noise levels are exceeded:</p> <p>(a) evening (6:00 pm to 10:00 pm) — internal LAeq(15 minute): 40 dB(A); and</p> <p>(b) night (10:00 pm to 7:00 am) — internal LAeq(15 minute): 35 dB(A).</p> <p>The mitigation measures must be outlined in the Noise and Vibration CEMP Sub-plan, including in any Out-of-Hours Work Protocol, required by Condition E42.</p>	As per the Staging Report mitigation measures have been included in the CEMP.
E47	<p>Detailed Noise and Vibration Impact Statements (DNVIS) must be prepared for any work that may exceed the NMLs, vibration criteria and / or ground-borne noise levels specified in Conditions E43 and E44 at any residence outside construction hours identified in Condition E38, or where receivers will be highly noise affected or subject to vibration levels above those otherwise determined as appropriate by a suitably qualified structural engineer under Condition E87. The DNVIS must include specific mitigation measures identified through consultation with affected sensitive land user(s) and the mitigation measures must be implemented for the duration of the works. A copy of the DNVIS must be provided to the ER before the commencement of the associated works. The Planning Secretary and the EPA may request a copy (ies) of the DNVIS.</p>	This document.

Reference	COA	Comment
E57	<p>In order to undertake out-of-hours work outside the work hours specified under Condition E38, appropriate respite periods for the out-of-hours work must be identified in consultation with the community at each affected location on a regular basis. This consultation must include (but not be limited to) providing the community with:</p> <p>(a) a progressive schedule for periods no less than three (3) months, of likely out-of-hours work;</p> <p>(b) a description of the potential work, location and duration of the out-of-hours work;</p> <p>(c) the noise characteristics and likely noise levels of the work; and</p> <p>(d) likely mitigation and management measures which aim to achieve the relevant NMLs under Condition E43 (including the circumstances of when respite or relocation offers will be available and details about how the affected community can access these offers).</p> <p>The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out-of-hour work must be provided to the ER, EPA and the Planning Secretary prior to the out-of- hours work commencing.</p> <p>Note: Respite periods can be any combination of days or hours where out-of-hours work would not be more than 5 dB(A) above the RBL at any residence.</p>	<p>Respite has not been triggered by the works assessed in this DNVIS.</p>

### 3.3 WORK ACTIVITIES AND SCENARIOS

The works include the following:

- Construction of a 4th leg of the Elizabeth Drive and Badgerys Creek Road roundabout to the north with 2 travel lanes 3.5m wide, with a 1m shoulder and 3m verge on either side. This will be established as a 'stub road' which extends for approximately 32 metres from the road reserve.
- A new raised median at the entry to the new road access.
- Construction of stormwater drainage – adjustment/modification of 2 drainage pits, installation of 1 new stormwater pit, new open channel and pipe beneath new road access.
- Installation of a chain wire fence 1.8m in height and a 9m wide gate across new access to Transport for NSW standard specification.
- Installation of new road signage.
- Temporary exclusion fencing and signage will be established around the project boundary.

Scenarios have been created to enable modelling of the noise impacts. Each scenario is related to an activity in the construction program. and identifies the noise period when the work will be undertaken. Some constructions activities with the Elizabeth Drive road corridor have already been undertaken through the Low Impact Work Approval Process. These activities have not been included in the DNVIS.



**Table 2 Construction Scenarios**

Scenario	Equipment	Duration	Noise Period
Clearing	Brushcutter, Chainsaw, mulcher	2 days	Standard hours
Grubbing	Grader, excavator, truck and dog,	3 days	Standard hours
Earthworks	Excavator, roller, water cart	4 days	Standard hours
Drainage and utilities	demo saw, excavator, truck and dog, compactor/upright rammer	3 days	Standard hours
Paving	Milling machine, paver, rollers, bobcat, Truck and dogs	8 days, 7 nights	Standard hours
			Day (OOHW)
			OOHW Period 1
			OOHW Period 2
Concreting Works	Concrete Agitator, Vibrator, kerb machines	4 days 2 nights	Standard hours
			Day (OOHW)
			OOHW Period 1
			OOHW Period 2
Removal of Traffic Barriers	Truck, franna, generator	2 nights	Standard hours
			Day (OOHW)
			OOHW Period 1
			OOHW Period 2
Road Furniture	Tool truck , Small hand tools	1 DAY	Standard hours
			Day (OOHW)
			OOHW Period 1
			OOHW Period 2
Vegetation & landscaping	1.7 t excavator, tool truck	3 days	Standard hours
			Day (OOHW)

## 4 EXISTING ENVIRONMENT

### 4.1 LANDUSE SURVEY

The land surrounding the project area has recently been rezoned as part of the *State Environmental Planning Policy (Western Sydney Aerotropolis) 2020*. The planning zones are shown in Figure 2 Planning Zones below.

The Project site is located within the land adjacent to the north of the new roundabout at Badgerys Creek Road and Elizabeth Drive. The surrounding area consists of single dwelling residential land use, vacant land and farmland. The closest residential building to the site is 460m north-east of the site. A land use survey has been undertaken of the land surrounding the project area, using desktop top online mapping and physical drive-by inspection. The list of receivers and distance of each receiver to the project is detail in Table 3 Land use survey.

The individual residential receivers are shown in Figure 3. No sensitive receivers of critical working area such as operating theatres or precision equipment was identified.

**Table 3 Land use survey**

Receiver	Receiver Address / Location	Distance to Receivers
Residential		
Elizabeth Drive	1789 Elizabeth Drive, Badgerys Creek NSW 2555	460m
	1745 Elizabeth Dr, Badgerys Creek NSW 2555	800m
Lawson St	5 to 87 Lawson St Kemp's Creek NSW 2178 (10 properties)	740 to 1050m

Elizabeth Drive (Mixed use)	1970 Elizabeth Drive Kemps Creek NSW 2178	1010m
	1990 Elizabeth Drive, Kemps Creek NSW 2178	1010m
<b>Industrial</b>		
Western Sydney Airport	Western Sydney Airport	Adjacent
Cleanaway Kemps Creek Resource Recovery Park	1725 Elizabeth Dr, Kemps Creek NSW 2178	710m
Elizabeth Drive (Mixed use)	1970 Elizabeth Drive Kemps Creek NSW 2178	1010m
	1990 Elizabeth Drive, Kemps Creek NSW 2178	1010m
<b>Heritage</b>		
McGarvie Smith Farm	No Address (North-west of Site)	Closest Building is 780m



**Figure 2 Planning Zones**

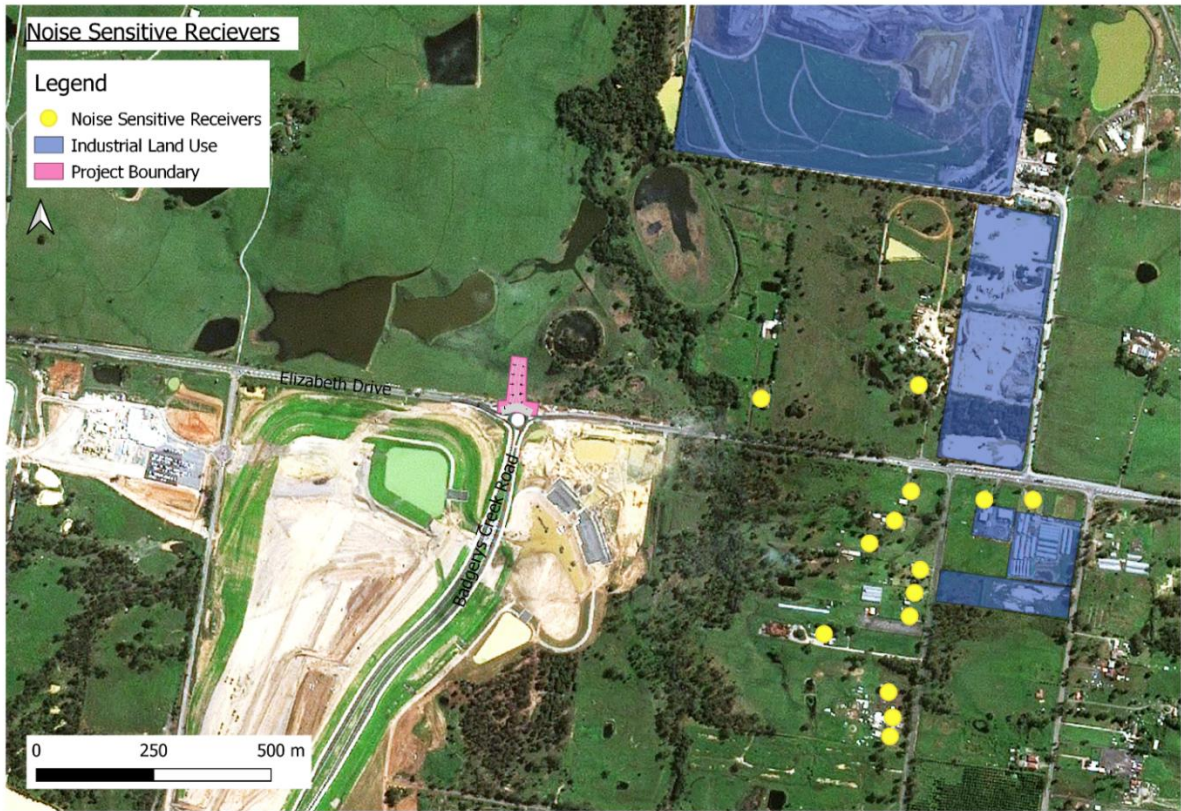


Figure 3 Noise sensitive receivers near the proposal area

## 4.2 NOISE CATCHMENT AREA

Noise Catchment Areas (NCA) have been identified in the SM-WSA EIS. The project will impact on the NCA10 and NCA11. The locations of each catchment are identified in Figure 4.

The EIS provides a description of the NCA as:

NCA10 - Open farmland with low density single storey and multi-storey residential dwellings within the Twin Creeks area east of the project and scattered residential dwellings along Luddenham Road.

NCA11 - Predominantly Western Sydney International (on-airport) land. Low density residential dwellings along Lawson Road and Martin Road to the east of the project. Medium density residential dwellings at Luddenham to the west of the project.



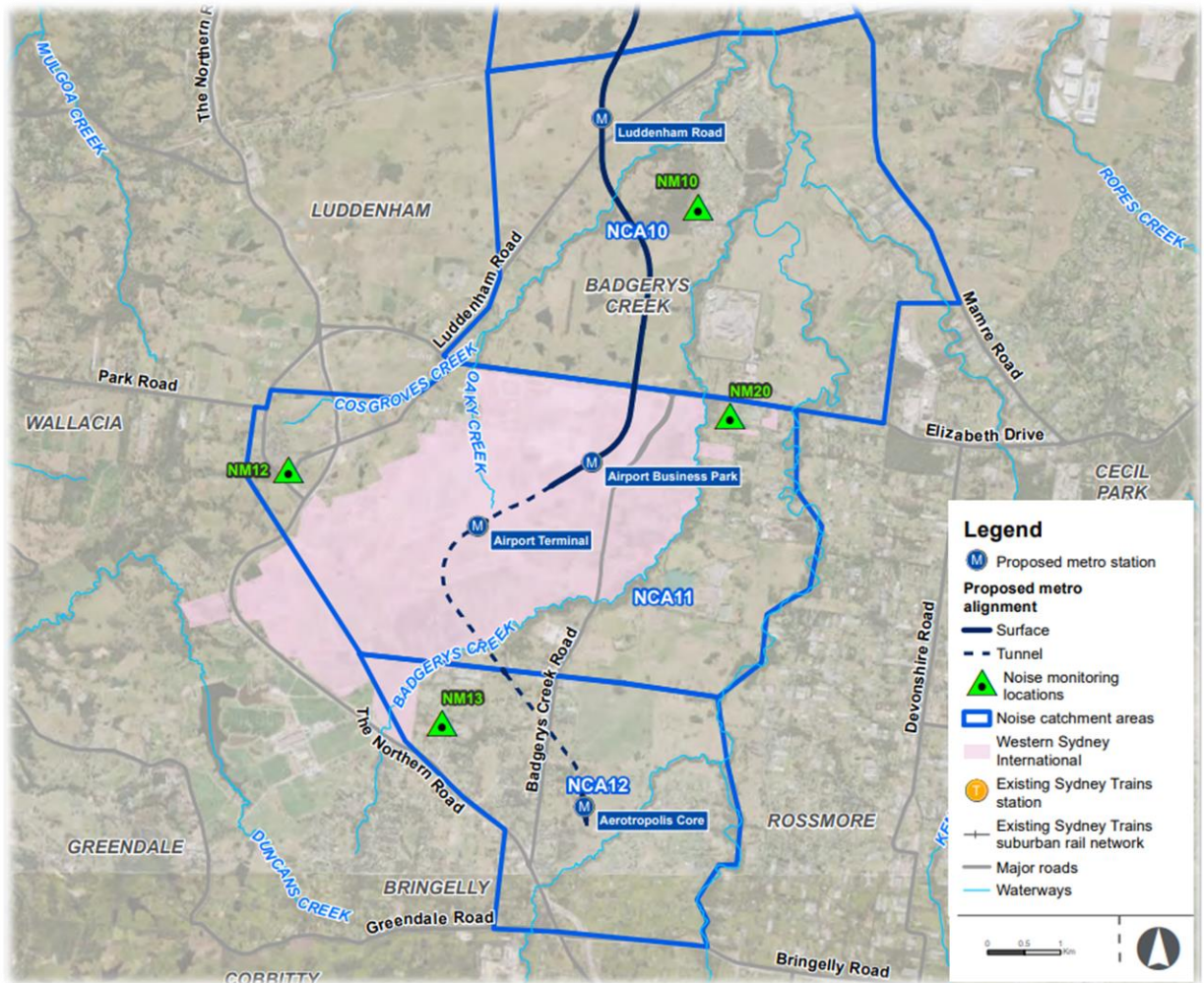


Figure 4 Noise catchment areas and background noise monitoring locations (Extracted from Sydney Metro - Western Sydney Airport EIS Technical Paper 2: Noise and Vibration)

### 4.2.1 BACKGROUND NOISE LEVELS

Table 4 Measured background noise levels SM-WSA EIS

Noise Area Category		SM-WSA NCA10	SM-WSA NCA11
RBL or L <sub>A90</sub> Background Level dB(A)	Day	35	38
	Evening	30	35
	Night	30	34

## 5 NOISE AND VIBRATION CRITERIA FOR NSW

### 5.1 PROJECT WORKING HOURS

The conditional of approval E38 stipulates the standard hours of construction as:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sundays and public holidays: no works.

In addition to E38, Condition of Approval 39 also stipulates that: except as permitted by an EPL or approved in accordance with the Out of Hours Works Protocol required by Condition E42, highly noise intensive work that result in an exceedance of the applicable NML at the same receiver must only be undertaken:

- (a) between the hours of 8:00 am to 6:00 pm Monday to Friday;
- (b) between the hours of 8:00 am to 1:00 pm Saturday; and
- (c) if continuously, then not exceeding three (3) hours, with a minimum cessation of work of not less than one (1) hour.

For the purposes of this condition, 'continuously' includes any period during which there is less than one (1) hour between ceasing and recommencing any of the work.

## 5.2 CONSTRUCTION NOISE AND ASSESSMENT OBJECTIVES

The ICNG provides guidelines for the assessment and management of construction noise. The ICNG focuses on applying a range of work practices to minimise construction noise impacts rather than focusing on achieving numeric noise levels.

The main objectives of the ICNG are to:

- Identify and minimise noise from construction works
- Focus on applying all 'feasible' and 'reasonable' work practices to minimise construction noise impacts
- Encourage construction during the recommended standard hours only, unless approval is given for works that cannot be undertaken during these hours
- Reduce time spent dealing with complaints at the project implementation stage
- Provide flexibility in selecting site-specific feasible and reasonable work practices to minimise noise impacts.

## 5.3 QUANTITATIVE NOISE ASSESSMENT CRITERIA

The CNVS identifies the ICNG as the reference document for the determination of construction noise management levels. The CNVS supplements the ICNG to address the unique requirements of the project. The ICNG has been developed to provide a framework for identifying and understanding the impact of airborne construction noise on sensitive land uses.

As outlined in the ICNG, a quantitative assessment requires the development of Noise Management Levels (NML) and a comparison of predicted construction noise levels with the developed NMLs.

Table 5 sets out management levels for noise at residences and how they are to be applied. The rating background level (RBL) is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy (EPA 2000).

As a guide, the difference between the internal noise level and the external noise level is typically 10dB with windows open for adequate ventilation.

**Table 5 Noise at residents using quantitative assessment (DECC 2009)**

Time of day	Management Level $L_{Aeq}$ (15min)*	How to apply
Recommended standard hours:  Monday to Friday 7 am to 6 pm, Saturday 8 am to 1pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. <ul style="list-style-type: none"> <li>• Where the predicted or measured <math>L_{Aeq}</math> (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.</li> </ul>

Time of day	Management Level $L_{Aeq}$ (15min)	How to apply
No work on Sundays or public holidays		<ul style="list-style-type: none"> <li>The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.</li> </ul>
	Highly noise affected 75 dB(A)	<p>The highly noise affected level represents the point above which there may be strong community reaction to noise.</p> <ul style="list-style-type: none"> <li>Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:               <ul style="list-style-type: none"> <li>times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences)</li> <li>if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.</li> </ul> </li> </ul>
Outside recommended standard hours	Noise affected RBL + 5 dB	<ul style="list-style-type: none"> <li>A strong justification would typically be required for works outside the recommended standard hours.</li> <li>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</li> <li>Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community</li> </ul>

\* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Noise Management Levels for residential receivers are presented in the table below. These have been developed from the background levels present in section 4.2.1 and the criteria described above. These Noise Management Levels are also detailed in section 4.1.1 in the EIS Technical Paper 2 Noise and Vibration. Since this DNVIS is using a simplified assessment method of the RMS Construction Noise Estimator all assessments have been undertaken using the most conservative background levels from NCA10.

**Table 6 NML for Residential Receivers from SM-WSA EIS**

	Noise Area Category	SM-WSA NCA10	SM-WSA NCA11
<b>Noise Management Level for Residential Receivers</b>	Day	45	49
	Day (OOHW)	40	44
	Evening	35	42
	Night	35	35
<b>dB(A) <math>L_{Aeq}</math> (15minute)</b>			

## 5.4 OTHER LAND USES

Other sensitive land uses, such as schools, typically find noise from construction to be disruptive when the properties are being used (such as during school times). The only sensitive receiver type other than residential in the land surrounding the project is industrial. Table 7 presents the noise management level (NML) for industrial premises likely to be affected by the Project.

**Table 7 Noise at industrial premises using quantitative assessment (DECC, 2009).**

Land use	Management level, $L_{Aeq}$ (15 min) (applies when properties are being used)	Present in the land surrounding the project
Industrial premises	External noise level 75 dB(A)	Yes

## 5.5 TRAFFIC NOISE ASSESSMENT GOALS

When trucks and other vehicles are operating within the boundaries of the various construction sites, road vehicle noise contributions are included in the overall predicted  $L_{Aeq(15\text{minute})}$  construction site noise emissions. When construction related traffic moves onto the public road network a different noise assessment methodology is appropriate, as vehicle movements would be regarded as 'additional road traffic' rather than as part of the construction site.

The ICNG does not provide specific guidance in relation to acceptable noise levels associated with construction traffic. For assessment purposes, guidance is taken from the NSW Road Noise Policy (RNP).

One of the objectives of the RNP is to apply relevant permissible noise increase criteria to protect sensitive receivers against excessive decreases in amenity as the result of a proposal. In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

On this basis, construction traffic NMLs set at 2 dB above the existing road traffic noise levels during the daytime and night-time periods are considered appropriate to identify the onset of potential noise impacts. Where the road traffic noise levels are predicted to increase by more than 2 dB as a result of construction traffic, consideration would be given to applying feasible and reasonable noise mitigation measures to reduce the potential noise impacts and preserve acoustic amenity.

In considering feasible and reasonable mitigation measures where the relevant noise increase is greater than 2 dB, consideration would also be given to the actual noise levels associated with construction traffic and whether or not these levels comply with the following road traffic noise criteria in the RNP:

- 60 dB  $L_{Aeq(15\text{hour})}$  day and 55 dB  $L_{Aeq(9\text{hour})}$  night for existing freeway/ arterial/ sub-arterial roads.
- 55 dB  $L_{Aeq(1\text{hour})}$  day and 50 dB  $L_{Aeq(1\text{hour})}$  night for existing local roads.

## 5.6 SLEEP DISTURBANCE

The ICNG recommends that where construction works are planned to extend over two or more consecutive nights, the assessment should consider maximum noise levels and the extent and frequency of maximum noise level events exceeding the RBL.

The most current method for assessing sleep disturbance from NSW transport infrastructure projects is contained in the EPA's Noise Policy for Industry (NPfI). Although the NPfI sleep disturbance criteria relate to industrial noise, they are considered relevant for reviewing potential impacts from construction noise.

The NPfI defined sleep disturbance criteria is:

- $L_{Aeq,15\text{min}}$  40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or the
- 52 dBA  $L_{AF\text{max}}$  or the prevailing background level plus 15 dB, whichever is the greater.

## 5.7 VIBRATION CRITERIA

The effects of vibration from construction works can be divided into three categories:

- Those in which the occupants of buildings are disturbed (human comfort). People can sometimes perceive vibration impacts when vibration generating construction works are located close to occupied buildings. Vibration from construction works tends to be intermittent in nature and the EPA's Assessing Vibration: a technical guideline (2006) provides criteria for intermittent vibration based on the Vibration Dose Value (VDV) shown in Table 8.



- Those where building contents may be affected (building contents). People perceive vibration at levels well below those likely to cause damage to building contents. For most receivers, the human comfort vibration criteria are the most stringent and it is generally not necessary to set separate criteria for vibration effects on typical building contents.
- Those where the integrity of the building/structure may be compromised (structural or cosmetic damage). If vibration from construction works is sufficiently high it can cause cosmetic damage to elements of affected buildings. Industry standard cosmetic damage vibration limits are specified in Australian Standard AS 2187-2, British Standard BS 7385 and German Standard DIN 4150, which are referenced in the Sydney Metro CNVS. The limits are shown in Table 9.

**Table 8 Human Comfort Vibration Dose Values for Intermittent Vibration**

Building Type	Assessment Period	Vibration Dose Value1 (m/s <sup>1.75</sup> )	
		Preferred	Maximum
Critical Working Areas (e.g. operating theatres or laboratories)	Day or night-time	0.10	0.20
Residential	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

Note: The VDV accumulates vibration energy over the daytime and night-time assessment periods and is dependent on the level of vibration as well as the duration.

**Table 9 Vibration Limits for Cosmetic Damage DIN 4150**

Type of Structure	Vibration Thresholds for structural damage, PPV (mm/s)				
	Short Term			Long Term	
	At Foundation			Uppermost Floor	Uppermost Floor
	0 to 10 Hz	10 to 50 Hz	50 to 100 Hz	All Frequencies	All Frequencies
Commercial / Industrial	20	20 to 40	40 to 50	40	10
Residential	5	5 to 15	15 to 20	15	5
Sensitive / Historic	3	3 to 8	8 to 10	8	2.5

## 6 NOISE AND VIBRATION IMPACTS

### 6.1 CONSTRUCTION NOISE ASSESSMENT

The Construction Noise Assessment has been undertaken using the RMS Construction Noise Estimator. This assessment method is deemed to be acceptable for the scope of the proposed works and the limited number of sensitive receivers located in the surrounding area likely to be impacted. This simplified approach uses the most conservative background and noise management levels from NCA10 in the assessment.

All reasonable mitigation measures have been considered for the implementation of the proposed construction activities. The installation of noise barriers will be implemented and has been included in the assessment of the Activities: Paving, Concrete works, Removal of Traffic Barriers where the NML is exceeded. The inclusion of the noise barriers at the source is estimated in the RMS Construction Noise Estimator by selecting “No – (behind solid barrier)” for the option “Is there line of site”. Where plant is mobile and may not be behind the barrier at all times during operation is has been selected as Yes, i.e. no barrier.

To identify all sensitive receivers impacted by the works and to not omit impacted receivers, the worst case scenario was used in the RMS Construction Noise Estimator and the distance at which the NML is not exceeded was identified. This scenario of the RMS Construction Noise Estimator has been included in APPENDIX A. The distance at which the NML are not exceeded is 890m, which is the worst case scenario (ie paving works) being completed at night time. Two residential properties are within 890m of these works. The closest is located about 460m from the closest works point.

Generally, most construction activities are either below or close to the NMLs at levels that are unlikely to be noticeable to the closest sensitive receiver. The assessment identifies that the noisiest works activity is the paving works, which must be completed at night (out of standard hours) due to traffic restrictions on two arterial roads (Elizabeth Drive and Badgerys Creek). The noise calculator identifies that the worst-case noise levels for these works at the closest receiver is about 13dBA above NMLs without any mitigation measures (as shown in Appendix A). For these works (an concreting and traffic barrier works) noise will be mitigated through the use of noise barriers (eg noise curtains) to be installed close to the noise source, which conservatively should provide about 4-5dBA noise attenuation for the works. As part of the summary of noise impacts as outlined in Table 10, this noise attenuation has been included in the expected noise levels and the commitment to installing these barriers is included. Therefore the expected worst-case is 9dBA above NMLs at the single closest sensitive receiver. This activity is only expected to occur for 4-5 night shifts total. Therefore in accordance with Sydney Metro’s CNVS respite is not required given the predicted noise levels at the closest sensitive receiver for the short duration of the expected works.

**Table 10 Construction Noise Assessment**

Activity	Plant (plant included in modelled Scenario examples)	Period	NML	Estimated Noise Level	Level above NML NCA10	Exceeds Sleep Disturbance Criteria	Additional Mitigation Measures	Specific mitigation included in the assessment.
Clearing	Brushcutter, chainsaw, mulcher	Standard hours	45	48	3	-	-	
Grubbing	Grader, excavator, truck and dog,	Standard hours	45	42	-3	-	-	
Earthworks	Excavator, roller, water cart	Standard hours	45	43	-2	-	-	
Drainage and utilities	Demo saw, excavator, truck and dog, compactor/upright rammer	Standard hours	45	47	2	-	-	
Paving	Milling machine, paver, rollers, bobcat, truck and dogs	Standard hours	45	44	-1	-	-	Noise barriers at source
		Day (OOHW)	40	44	4	-	LB	Noise barriers at source
		OOHW Period 1	35	44	9	-	LB	Noise barriers at source
		OOHW Period 2	35	44	9	YES	LB	Noise barriers at source
Concreting Works	Concrete agitator, vibrator, kerb machines	Standard hours	45	40	-10	-	-	
		Day (OOHW)	40	40	0	-	LB	Noise barriers at source
		OOHW Period 1	35	35	0	-	LB	Noise barriers at source
		OOHW Period 2	35	35	0	NO	LB	Noise barriers at source
Removal of Traffic Barriers	Truck, ranna, generator	Standard hours	45	39	-6	-	-	
		Day (OOHW)	40	39	-1	-	-	
		OOHW Period 1	35	34	-1	-	-	Noise barriers at source
		OOHW Period 2	35	34	-1	-	-	Noise barriers at source
Road Furniture	Tool truck, small hand tools	Standard hours	45	33	-12	-	-	
		Day (OOHW)	40	33	-7	-	-	
		OOHW Period 1	35	33	-2	-	-	
		OOHW Period 2	35	33	-2	NO	-	
Vegetation & landscaping	1.7 t excavator, tool truck	Standard hours	45	38	-7	-	-	
		Day (OOHW)	40	38	-2	NO	-	



## 6.2 VIBRATION ASSESSMENT

Vibration during construction would not have impacts on nearby buildings or sensitive receivers where the separation distances for vibration intensive plant are complied with. The closest sensitive receiver is located about 460 metres from the works area and given the type of works required it is unlikely that there would be any construction activities within the cosmetic damage range. In addition, none of the larger equipment would be required for these works would be within the human response distance criteria.

A simple vibration prediction has been undertaken for high vibration risk plant proposed to be used, excavator and vibratory roller. The prediction for each piece of machinery was calculated using, the reference distance of and PPV reference values. The PPV reference values were obtained from a VicRoads vibration manual and Department of Transport South Australia manual. Note that RMS and TfNSW vibratory guidance does not provided reference PPV values for typical construction plant. Peak Particle Velocity (PPV-mm/s), which is defined as the vector sum of the maximum velocity components of vibration and is a measure of the damage potential of vibration. For amenity the PPV values were converted to VDV (vibration dose values). The following assumptions were made during the conversion process which can lead to conservative VDV estimates.

- Percentage use time as 60% (i.e. 0.6)
- Crest factor of 4
- Amplification of 2
- Frequency of 31.5 Hz
- Weighting of 0.4905

The predictions demonstrate that the risk of exceeding vibration criteria occur at 15m from the source of the vibration for structural values of PPV of 3mm/s. This is the most conservative trigger value for heritage buildings for a vibration frequency of 0 to 10 Hz. Vibration Dose Values predicted are shown in the following Figure 5 and Figure 6.

Predicted PPV at Distance of 15m

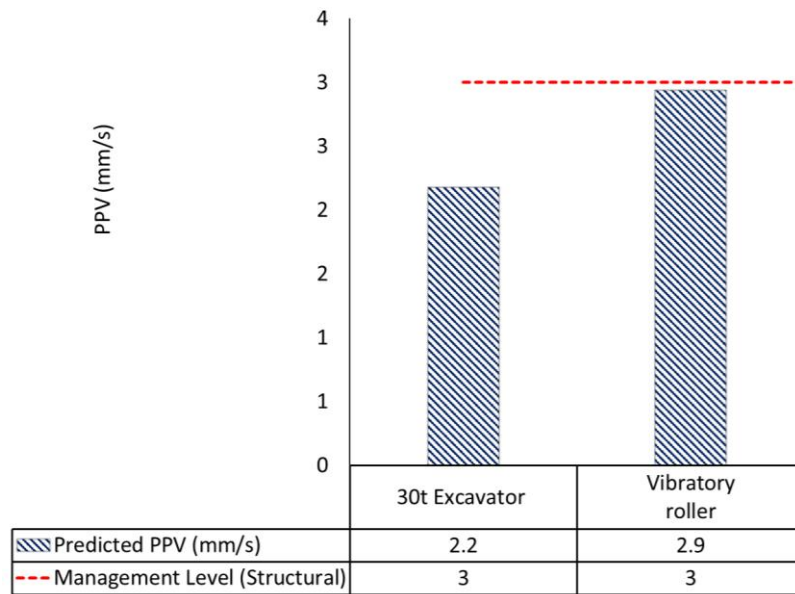


Figure 5 PPV Prediction at 15m

Predicted VDV at Distance of 15m

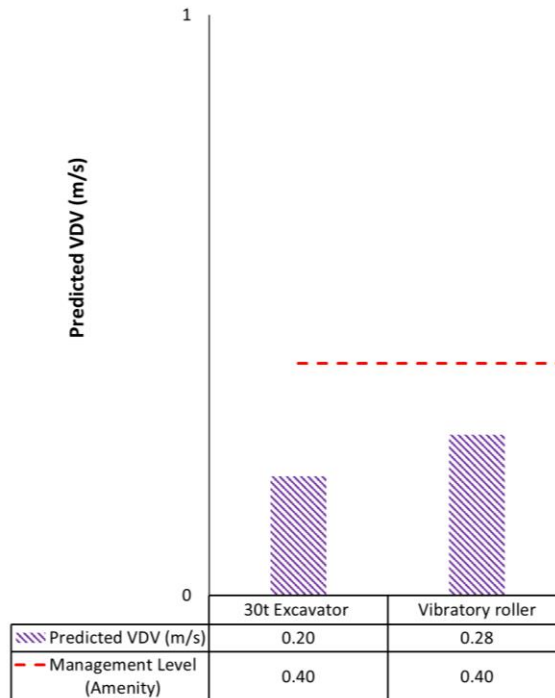


Figure 6 VDV Prediction at 15m

### 6.3 OUT OF HOURS WORKS (E41, E42)

The out of hours works proposed for the activities; Paving and Concreting works, will require approval under an Out of hours Protocol as per Condition E41 clause (c). This DNVIS will inform the Out of Hours Works Application under the SM-WSA Out of Hours Protocol which has been attached as Appendix A.

The out of hours works proposed for the activities; Removal of Traffic Barriers, and Road Furniture, do not exceed the NML for OOHW Period 1 or 2. Therefore these works are classified as Low Impact Works,

### 6.4 HIGHLY NOISE INTENSIVE WORKS (E39)

'Highly noise intensive works' have been identified in the by the assessment. Condition of approval E39 defines 'highly noise intensive works' as noise levels that exceed the NML's at the receivers. These activities must only be undertaken:

- (a) between the hours of 8:00 am to 6:00 pm Monday to Friday;
- (b) between the hours of 8:00 am to 1:00 pm Saturday; and
- (c) if continuously, then not exceeding three (3) hours, with a minimum cessation of work of not less than one (1) hour.

For the purposes of this condition, 'continuously' includes any period during which there is less than one (1) hour between ceasing and recommencing any of the work. The activities include:

- Clearing
- Drainage and utilities
- Paving
- Concreting Works

Of these activities, Paving and Concreting Works, are planned to be undertaken out of hour under the approval process describe in Section 6.3.

No Highly Noise Affect Residents defined in Condition of Approval E49 are not impacted by the works as the closest Highly Noise Affect Resident is in Orchard Hills, which is approximately 7km from the Project Area.

### 6.5 SLEEP DISTURBANCE ASSESSMENT

All activities have been assessed against the Sleep Disturbance detailed in Section 5.6. The Paving Activities exceeds the criteria at 44 dB(A) Leq, i.e. 4 dBA of the criteria of 40 dBA. Noise Barriers have already been included to mitigation sleep disturbance. Additional controls are included in Section 7. Consideration into reducing consecutive night works to 2 nights or less.

## 7 MITIGATION MEASURES

Standard mitigation measure for noise impacts will be implemented from the SM-WSA CNVS. These are listed in Table 11. Vibration impacts are non-existent as detailed in Section 6.2 due to the distance of receivers and therefore no mitigation measure have been identified as required.

**Table 11 Standard mitigation measures from Table 11 of the SM-WSA CNVS**

Action required	Applies to	Details	Implementation
Site inductions	Airborne noise	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: <ul style="list-style-type: none"> <li><input type="checkbox"/> All relevant project specific and standard noise and vibration mitigation measures</li> <li><input type="checkbox"/> Relevant licence and approval conditions</li> </ul>	All site personnel inducted

Action required	Applies to	Details	Implementation
		<input type="checkbox"/> Permissible hours of work <input type="checkbox"/> Any limitations on high noise generating activities <input type="checkbox"/> Location of nearest sensitive receivers <input type="checkbox"/> Construction employee parking areas <input type="checkbox"/> Designated loading/unloading areas and procedures <input type="checkbox"/> Site opening/closing times (including deliveries) <input type="checkbox"/> Environmental incident procedures	
Implement community consultation measures	Airborne noise	Periodic Notification (monthly letterbox drop) Website Project information and construction response telephone line Email distribution list Place Managers	Notification will be undertaken and will be ongoing
Register of Noise Sensitive Receivers	Airborne noise	A register of all noise and vibration sensitive receivers (NSRs) would be kept on site. The register would include the following details for each NSR: <input type="checkbox"/> Address of receiver <input type="checkbox"/> Category of receiver (e.g. Residential, Commercial etc.) <input type="checkbox"/> Contact name and phone number	Register maintained by Communications Team
Behavioural practices	Airborne noise	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. No excessive revving of plant and vehicle engines Controlled release of compressed air.	Standard control included in the project induction
Monitoring	Airborne noise	A noise monitoring program is to be carried out for the duration of the works in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions.	Noise Monitoring to be undertaken to confirm predicted noise levels are accurate.
Construction hours and scheduling	Airborne noise	Where feasible and reasonable, construction would be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels would be scheduled during less sensitive time periods.	Work scheduled during standard hours wherever possible
Construction respite period	Airborne noise	High noise and vibration generating activities may only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block.	Respite Period have been identified as required: <ul style="list-style-type: none"> <li>• Clearing</li> <li>• Drainage and utilities</li> <li>• Paving</li> <li>• Concreting Works</li> </ul>
Equipment selection	Airborne noise	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits.	Suitable sized plant will be used. Use of electric plant/equipment will be considered though development of Construction Methodologies.
Maximum noise levels	Airborne-noise	The noise levels of plant and equipment must have operating Sound Power Levels compliant with the criteria in Table 13 SM-WSA CNVS	Plant to be verified onsite with APPENDIX B MAXIMUM ALLOWABLE SOUND POWER LEVELS FOR CONSTRUCTION EQUIPMENT.

Action required	Applies to	Details	Implementation
Rental plant and equipment	Airborne-noise	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 13 SM-WSA CNVS	Plant to comply with APPENDIX B MAXIMUM ALLOWABLE SOUND POWER LEVELS FOR CONSTRUCTION EQUIPMENT.
Plan worksites and activities to minimise noise and vibration	Airborne noise	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.	Worksite planned to minimise reversing.
Non-tonal reversing alarms	Airborne noise	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.	Non-tonal to be used as per Mitigation Measures
Minimise disturbance arising from delivery of goods to construction sites	Airborne noise	Loading and unloading of materials/deliveries is to occur as far as possible from NSRs Select site access points and roads as far as possible away from NSRs Dedicated loading/unloading areas to be shielded if close to NSRs Delivery vehicles to be fitted with straps rather than chains for unloading, wherever feasible and reasonable	Delivery area will be designated to provide shielding as far as practicable considering site constraints.
Shield stationary noise sources such as pumps, compressors, fans etc	Airborne noise	Stationary noise sources would be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained. Appendix F of AS 2436: 1981 lists materials suitable for shielding.	Generators may be used for caravan and if use will be an enclosed unit.
Shield sensitive receivers from noisy activities	Airborne noise	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.	Site sheds will not be used. Caravan with amenities may be used. Due constraints to maintain access and small size and dynamic nature of the site. Shielding using noise barrier is not practicable.

## 7.1 ADDITIONAL MITIGATION MEASURES

Additional Management Measures (AMMs) are defined in the SM-WSA CNVS Table 15. All the Additional Management Measures have been considered and identified as applicable as per Table 12 (which is a copy of Table 16 in the SM-WSA CNVS) and shown in Table 13. Definition of relevant AMMs is provided in Table 14. AMMs will be applied conservatively to the residential receivers identified in Section 4.1. As detailed in Section 6.1 the distance to not exceed the NMLs for the worst case scenario 890m.

**Table 12 Application of Additional Mitigation Measures – Airborne Construction Noise (Table 16 SM-WSA CNVS)**

Time Period		Mitigation Measures			
		Predicted LAeq (15minute) noise level Above NML			
		0 to 10 dB	10 to 20 dB	20 to 30 dB	> 30 dB
<b>Standard</b>	Mon-Fri (7.00 am - 6.00 pm)	-	LB	LB, M, SN	LB, M, SN
	Sat (8.00 am - 1.00 pm)				
	Sun/Pub Hol (Nil)				
<b>OOHW (Evening)</b>	Mon-Fri (6.00 pm - 10.00 pm)	LB	LB, M	LB, M, SN, RO	LB, M, SN, IB, PC, RO
	Sat (1.00 pm - 10.00 pm)				
	Sun/Pub Hol (8.00 am - 6.00 pm)				
<b>OOHW (Night)</b>	Mon-Fri (10.00 pm - 7.00 am)	LB	LB, M, SN, RO	LB, M, SN, IB, PC, RO, AA	LB, M, SN, IB, PC, RO, AA

Time Period		Mitigation Measures			
		Predicted LAeq (15minute) noise level Above NML			
	Sat (10.00 pm - 8.00 am)				
	Sun/Pub Hol (6.00 pm - 7.00 am)				

**Table 13 Additional Mitigation Measures**

Activity	Period	Additional Mitigation Measures
Clearing	Standard hours	-
Grubbing	Standard hours	-
Earthworks	Standard hours	-
Drainage and utilities	Standard hours	-
Paving	Standard hours	-
	Day (OOHW)	<i>LB</i>
	OOHW Period 1	<i>LB</i>
	OOHW Period 2	<i>LB</i>
Concreting Works	Standard hours	-
	Day (OOHW)	<i>LB</i>
	OOHW Period 1	<i>LB</i>
	OOHW Period 2	<i>LB</i>
Removal of Traffic Barriers	Standard hours	-
	Day (OOHW)	-
	OOHW Period 1	-
	OOHW Period 2	-
Road Furniture	Standard hours	-
	Day (OOHW)	-
	OOHW Period 1	-
	OOHW Period 2	-
Vegetation & landscaping	Standard hours	-
	Day (OOHW)	-

**Table 14 Applicable Additional Management Measures Definitions from Table 15 SM-WSA CNVS**

Measure	Description	Abbreviation
Letter box drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.	LB

Project specific mitigation measures that are implemented by Abergeldie are included in the Table 15. These mitigations measures are included as part of industry best practice and to address the requirements of Condition of Approval of E46.



**Table 15 Noise and vibration management and mitigation measures**

ID	Measure/Requirement	When to implement	Responsibility	Evidence
NVM1	Consider orientation of construction compound layout so that primary noise sources and noisy plant items (generators, pumps, fixed plant) to minimise impact to nearby noise sensitive receivers. Consider how structures (sheds and containers) can be placed between sensitive receivers and noise sources (and as close to the noise sources as is practical).	Pre-Construction / Construction	PM / Environment, Sustainability and Approvals Manager (ESAM)	Site establishment Plan / ECM
NVM2	Consider selecting site access points and roads as far as possible away from sensitive receptors.	Construction	PM / ESAM	Site establishment Plan / ECM
NVM3	Plant and equipment is to be maintained as per manufactures recommendation and be in good working order.	Construction	PM	ECM / Site inspections
NVM4	Where impacts to a sensitive receiver is expected to occur from fixed plant that is regularly operating an acoustic screen, such as shrouds, enclosures, must be considered.	Construction	Superintendent	ECM / Site inspections
NVM5	Selection of low-noise plant and equipment of appropriate size and power, including alternatives to diesel and petrol engines and pneumatic units such as hydraulic or electric-controlled units where feasible. Select compressors that are silenced, or sound-reduced models fitted with acoustic enclosures.	Construction	PM	ECM / Site inspections
NVM6	Minimise concurrent operation of dominant noise-generating plant to reduce noise impacts	Construction	Superintendent	ECM / Site inspections
NVM7	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.	Construction	PM / Superintendent	ECM / Site inspections
NVM8	Where reasonable and feasible arrange construction activities to restrict need for reversing of plant and use of reversing alarms.	Construction	PM / Superintendent	ECM / Site inspections
NVM9	No swearing or unnecessary shouting or loud stereos/radios on site	Construction	PM / Superintendent	ECM / Site inspections
NVM10	No dropping of materials from height, throwing of metal items and slamming of doors	Construction	PM / Superintendent	ECM / Site inspections
NVM11	No excessive revving of plant and vehicle engines	Construction	PM / Superintendent	ECM / Site inspections
NVM12	Plant and equipment is to be switched off when not being used rather than left idling for prolonged periods.	Construction	PM / Superintendent	ECM / Site inspections
NVM13	Controlled release of compressed air	Construction	PM / Superintendent	ECM / Site inspections
NVM14	Residents, businesses and other stakeholders within the vicinity of the proposed works would be notified of the scheduled works at least seven (7) calendar days prior to construction. This would include the provision of a contact person and phone number to enable complaints to be received and responded to, if required.	Construction	PM / Comms Manager	ECM / Site inspections / Notifications
NVM15	Verification measurements should be undertaken at the start of high noise generating activities and to assist in managing complaints. Predicted noise levels from the proposed works should be verified by measuring construction noise and background noise levels when high noise generating activities are undertaken or where complaints are received.	Construction	ESAM	ECM / OOHA / Monitoring Forms
NVM16	Noise Barriers are to be utilised when undertaking traffic control, site establishment during out of hours. Such barriers included noise blankets or other solid barrier that shields the noise from sensitive receivers.	Construction	PM / Superintendent	ECM / Site inspections



## 8 SUMMARY OF FINDINGS

The assessment shows that with the mitigation measures identified in Section 6 implemented the impact of local sensitive receivers will be less than 10 dBA above the Noise Management Levels.

Activity	Period	NML for SM-WSA NCA11	Additional Mitigation Measures
Installation of Traffic Barriers	Standard hours	-11	-
	Day (OOHW)	-6	-
	OOHW Period 1	-1	-
	OOHW Period 2	-1	-
Site Establishment	Standard hours	-11	-
	Day (OOHW)	-6	-
	OOHW Period 1	-1	-
	OOHW Period 2	-1	-
Clearing	Standard hours	3	-
Grubbing	Standard hours	-3	-
Earthworks	Standard hours	-2	-
Drainage and utilities	Standard hours	2	-
Paving	Standard hours	-1	-
	Day (OOHW)	4	LB
	OOHW Period 1	9	LB
	OOHW Period 2	9	LB
Concreting Works	Standard hours	-10	-
	Day (OOHW)	-5	-
	OOHW Period 1	0	LB
	OOHW Period 2	0	LB
Removal of Traffic Barriers	Standard hours	-11	-
	Day (OOHW)	-6	-
	OOHW Period 1	-1	-
	OOHW Period 2	-1	-
Road Furniture	Standard hours	-12	-
	Day (OOHW)	-7	-
	OOHW Period 1	-2	-
	OOHW Period 2	-2	-
Vegetation & landscaping	Standard hours	-7	-
	Day (OOHW)	-2	-































## APPENDIX B MAXIMUM ALLOWABLE SOUND POWER LEVELS FOR CONSTRUCTION EQUIPMENT

SM-WSA CNVS Table 13: Maximum Allowable Sound Power Levels for Construction Equipment

Equipment	Maximum Allowable Sound Power Level (dB) LAmax	Maximum Allowable Sound Pressure Level (dB) LAmax at 7 m
Excavator Hammer	118	93
Excavator (approx. 3 tonne)	90	65
Excavator (approx. 6 tonne)	95	70
Excavator (approx. 10 tonne)	100	75
Excavator (approx. 20 tonne)	105	80
Excavator (approx. 30 tonne)	110	85
Excavator (approx. 40 tonne)	115	90
Skidsteer Loaders (approx. 1/2 tonne)	107	82
Skidsteer Loaders (approx. 1 tonne)	110	85
Dozer (tracking) - equiv. CAT D8	118	93
Dozer (tracking) - equiv. CAT D9	120	95
Dozer (tracking) - equiv. CAT D10	121	96
Backhoe/FE Loader	111	86
Dump Truck (approx. 15 tonne)	108	83
Concrete Truck	112	87
Concrete Pump	109	84
Concrete Vibrator	105	80
Bored Piling Rig	110	85
Scraper	110	85
Grader	110	85
Vibratory Roller (approx. 10 tonne)	114	89
Vibratory Pile Driver	121	96
Impact Piling Rig	134	109
Compressor (approx. 600 CFM)	100	75
Compressor (approx. 1500 CFM)	105	80
Concrete Saw	118	93
Jackhammer	113	88
Generator	104	79
Lighting Tower	80	55
Flood Lights	90	65



SM-WSA CNVS Table 14: Generic Equipment or System Sound Power Level Limit1

Equipment	Maximum Allowable Sound Power Level (dB) L <sub>Amax</sub>	Maximum Allowable Sound Pressure Level (dB) L <sub>Amax</sub> at 7 m
Motorised (<25kW)	90	65
Motorised (<50kW)	95	70
Motorised (<100kW)	100	75
Motorised (<200kW)	105	80
Motorised (>200kW)	110	85
All other Auxiliary Equipment or Systems	90	65

Note 1: Sound Power Levels in dBA relative to 10 pW.

**APPENDIX C SM-WSA OUT OF HOURS APPLICATION**

---

To be added in final.