RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

AUSTRALIAN TECHNOLOGY PARK

Noise and Vibration Assessment

16 December 2015

Mirvac Projects Pty Ltd

TH615-02F03 (r6) DA NV report

30 1982 2012 ACOUSTIC EXCELLENCE
Sydney Melbourne Brisbane Kuwait
Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 861
Level 1/418A Elizabeth St SURRY HILLS NSW 2010 | PO Box 877 STRAWBERRY HILLS NSW 2012
P (02) 8218 0500 F (02) 8218 0501 sydney@renzotonin.com.au www.renzotonin.com.au

Document details

Detail	Reference
Doc reference:	TH615-02F03 (r6) DA NV report
Prepared for:	Mirvac Projects Pty Ltd
Address:	Level 26, 60 Margaret Street Sydney NSW 2000
Attention:	Joseph Scuderi

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Authorised
13.11.2015	Issued draft	0	1	GW	-	GW
02.12.2015	Second draft		2	GW	-	GW
08.12.2015	Final		3	GW	-	GW
09.12.2015	Revised for comment		4	GW	-	GW
10.12.2015	For TOA		5	GW	-	GW
16.12.2015			6	GW	-	GW

Contents

List of tables

List of figures

1 Introduction

This report supports a State Significant Development Application (SSDA) submitted to the Department of Planning and Environment pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

Mirvac Projects Pty Ltd (Mirvac) is seeking to secure approval for the urban regeneration of the Australian Technology Park (ATP), including the redevelopment of three car parking lots within ATP for the purposes of commercial, retail and community purposes, along with an extensive upgrade to the existing public domain within ATP. Building heights of 4, 7 and 9 storeys are proposed across the 3 development lots.

Australian Technology Park (ATP) has been continuously developed since its establishment in 1996, but has been underutilised as a technology and business precinct for quite some time. UrbanGrowth NSW Development Corporation (UGDC) has actively encouraged new development and employment opportunities at the Park for the past 15 years, and Mirvac intends to continue upon this and deliver upon the precinct's full potential, with the development of circa 107,400sqm for employment uses, which will facilitate the employment homes of an extra 10,000 staff everyday within ATP by development completion.

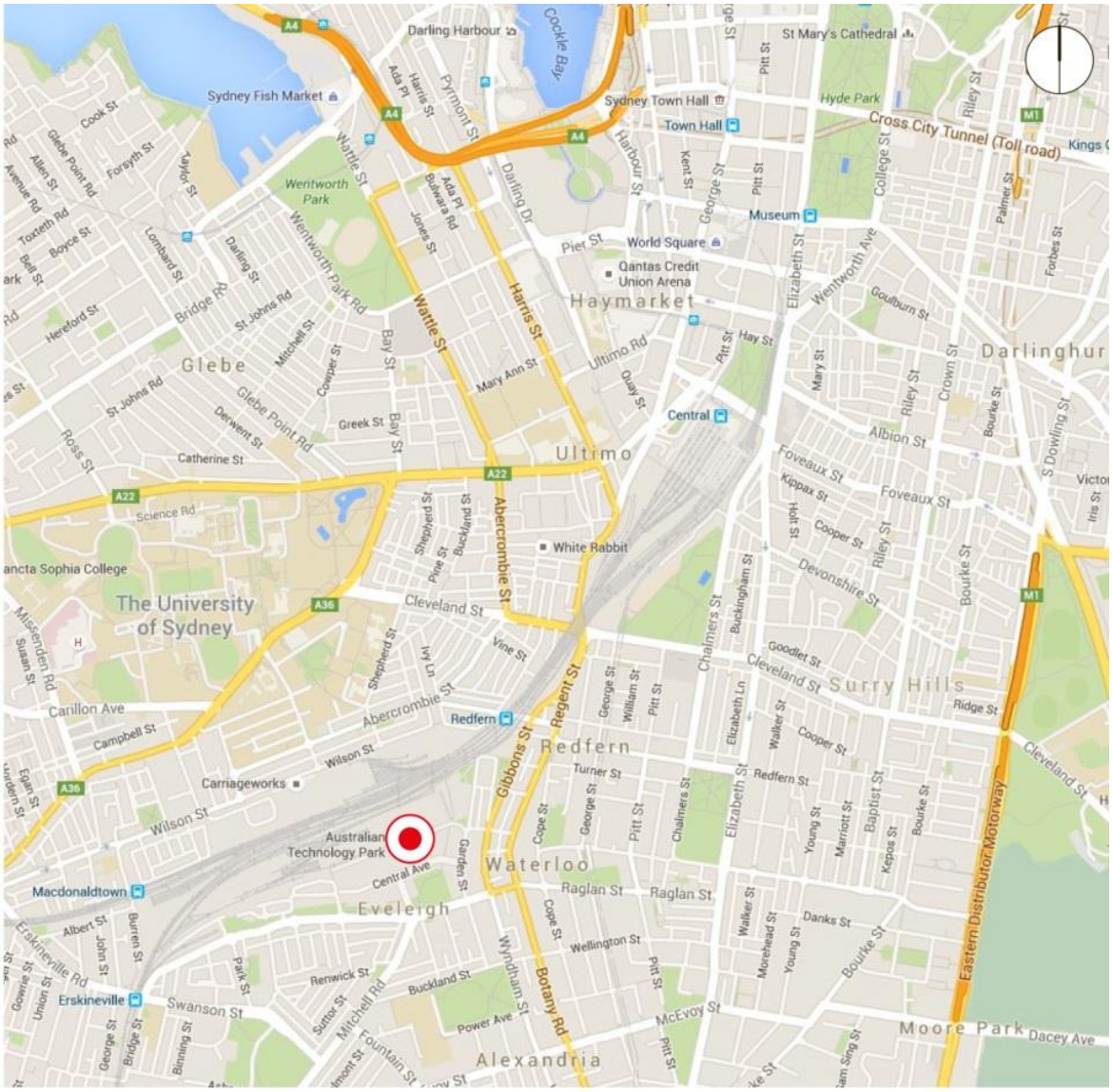
1.1 Background

Mirvac has been announced by UrbanGrowth NSW as the successful party in securing ownership and redevelopment rights for the ATP precinct, following an Expression of Interest (EOI) and an Invitation to Tender (ITT) process which commenced in 2014. Mirvac has also secured the Commonwealth Bank of Australia (CBA) as an anchor tenant for the development and intends to immediately commence the urban regeneration of this precinct through the lodgement of this SSDA. CBA's commitment to the precinct is in the form of one of the largest commercial leasing pre-commitments in Australian history, occupying circa 95,000 square metres of commercial, retail, community and childcare NLA, which will house circa 10,000 technology focused staff by 2019 and 2020. Mirvac's redevelopment goes well beyond the development on the 3 development lots, as it includes the regeneration of the public domain within ATP, the addition of retail to activate the precinct and also the provision of community facilities such as a community centre, a gym and 2 x 90 child childcare facilities.

1.2 Site description

The ATP site is strategically located approximately 5km south of the Sydney CBD, 8km north of Sydney airport and within 200m of Redfern Railway Station. The site, with an overall area of some 13.2 hectares, is located within the City of Sydney local government area (LGA). Refer to Figure 1 below for a graphic representation of the site location and context.

Figure 1: Site location and context



Three key sites remain undeveloped within the ATP site and are presently used for at-grade worker and special event car parking. These sites are:

- Lot 8 in DP 1136859 – site area circa 1,937m^2;
- Lot 9 in DP 1136859 – site area circa 8,299m^2; and
- Lot 12 in DP 1136859 – site area circa 11,850m^2.

Figure 2 provides an aerial image of the ATP site along with identifying the three development sites.

The SSDA works boundary excludes the Locomotive Workshop. Future development associated with the adaptive re-use of the Locomotive Workshop will be the subject of separate future applications.

Figure 2: Aerial site map

1.3 Overview of proposed development

The development application seeks approval for the following components of the development:

- Site preparation works, including demolition and clearance of the existing car parking areas/ancillary facilities and excavation;
- Construction and use of a 9 storey building within Lot 9 (Building 1), comprising of parking, retail, commercial and childcare uses;
- Construction and use of a 7 storey building within Lot 12 (Building 2) comprising of parking, retail and commercial uses;

- Construction and use of a 4 storey community building within Lot 8 (Community Building) comprising of gym, retail, community, commercial and childcare uses;
- Extensive landscaping and public domain improvements throughout the precinct for the benefit of the local community; and
- Extension and augmentation of physical infrastructure/utilities as required.

A more detailed and comprehensive description of the proposal is contained in the Environmental Impact Statement (EIS) prepared by JBA.

1.4 Planning framework

State Environmental Planning Policy (SEPP) Major Development 2005 is the principal environmental planning instrument applying to the ATP. Schedule 3, Part 5 of the Major Development SEPP sets out the zoning, land use and development controls that apply to development on the Site.

As the development has a capital investment value of more than $10 million it is identified as *State Significant Development* under the *State Environmental Planning Policy (State and Regional Development) 2011*, with the Minister for Planning the consent authority for the project.

1.5 Acoustic assessment requirements

Renzo Tonin & Associates has been engaged to prepare a construction and operational noise and vibration assessment for SSD 7317 application for the redevelopment of the Australian Technology Park ATP. The SEARs issued for application SSD 7317 do not set out any specific requirements with regard to the assessment of noise and vibration other than reference to the following policies:

- State Environmental Planning Policy – Infrastructure 2007 [1]
- Development Near Rail Corridors and Busy Road-Interim Guideline [2]

In addition, this report presents an assessment by reference to the following NSW noise guidelines:

- NSW Industrial Noise Policy [3]
- Interim Construction Noise Guideline [4]
- Assessing Vibration: A Technical Guideline [5]
- Road Noise Policy [6]

The above policies and guidelines have been addressed in this report as follows:

Policy or guideline	Assessment outline	Report section
NSW Industrial Noise Policy [3]	Operational noise from the development and its potential impact on surrounding development	Section 3

Policy or guideline	Assessment outline	Report section
Interim Construction Noise Guideline [4]	Assessment of noise during the construction phase of the development and its potential impact on surrounding development	Section 6
Assessing Vibration: A Technical Guideline [5]	The primary potential for vibration impact generated by the development is during construction phase. Also referenced in the State Environmental Planning Policy – Infrastructure 2007 with regard to rail vibration.	Section 6 Section 5
Road Noise Policy [6]	Assessment of road traffic generated by the development on the local road network and its potential impact on surrounding development.	Section 4
State Environmental Planning Policy – Infrastructure 2007 [1]	Assessment of noise onto the development from busy roads and rail corridors.	Section 5
Development Near Rail Corridors and Busy Road-Interim Guideline [2]	Supporting guideline for the State Environmental Planning Policy – Infrastructure 2007.	Section 5

1.6 Scope of assessment

The following outlines the scope of assessment with respect to the above policies and guidelines:

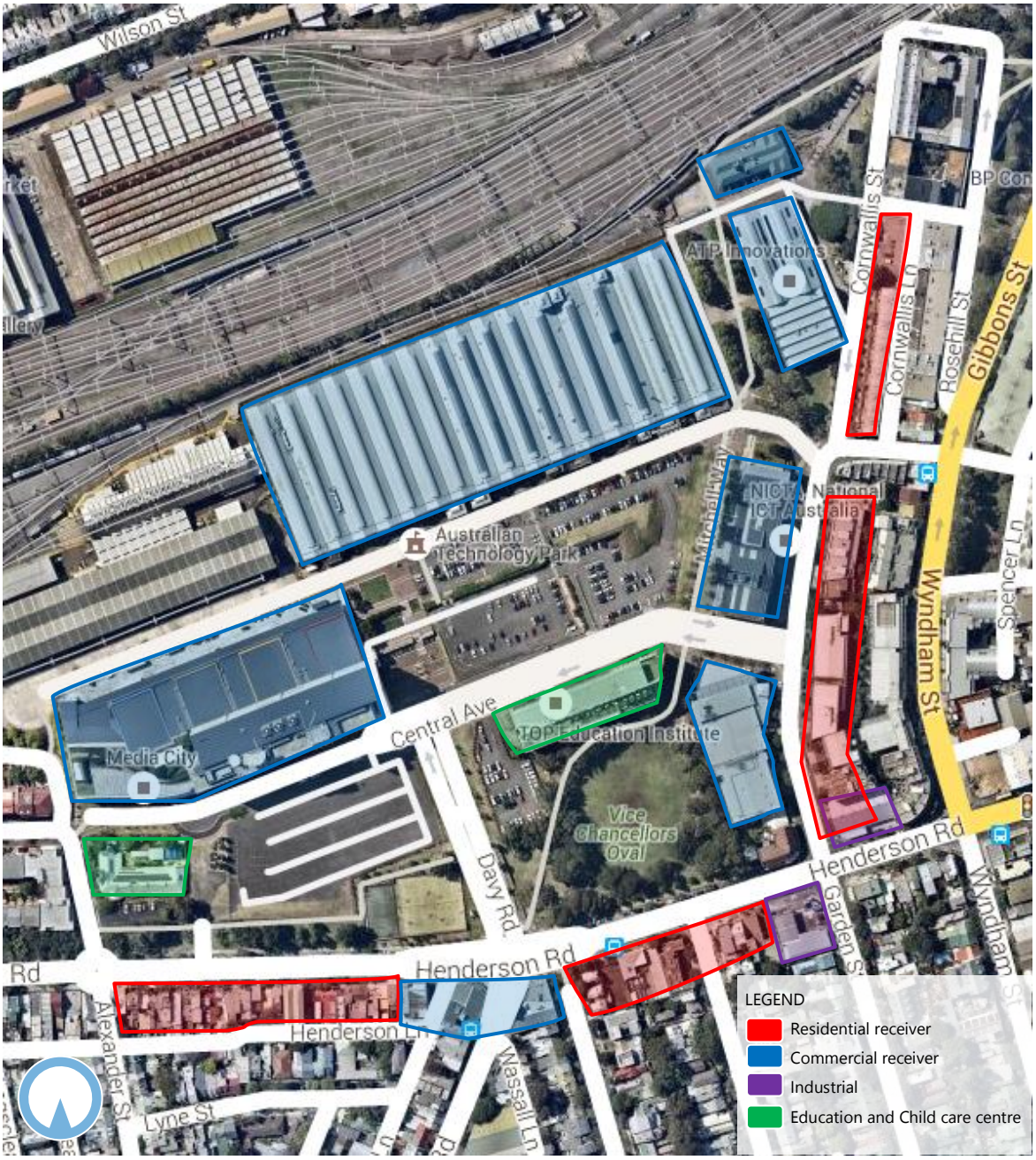
- Examine the proposed concept plan to identify acoustic aspects of the construction and operation of the developments.
- Identify the sensitive receiver locations surrounding the site, which are to be assessed with regard to construction and operational activities.
- Conduct noise level monitoring to establish the existing noise environment at the site and surrounding receiver locations for the purpose of setting noise targets for the project.
- Where appropriate data is available, carry out a quantitative acoustic assessment of potential impacts and compare against the relevant noise and vibration targets.
- Identify where further design development is required, and identify in-principle methods by which noise and vibration emission can be addressed in the design.
- Provide description of the assessment methodology to be adopted during the detailed design phase.

2 Surrounding uses and existing noise environment

2.1 Surrounding land uses

The nearest most potentially affected land uses surrounding the development have been identified in Figure 3.

Figure 3: Site and receiver locations



2.2 Existing noise environment

Criteria for the assessment of operational and construction noise are usually derived from the existing noise environment of an area, excluding noise from the subject development.

Appendix B of the NSW EPA *Industrial Noise Policy* (INP) [3] outlines two methods for determining the background noise level of an area, being 'B1 – Long-term background noise method' and 'B2 – Short-term background noise method'. This assessment has relied upon short-term noise monitoring due to constraints accessing appropriate locations for long-term noise unattended monitoring.

While the short-term monitoring provides adequate data for the preliminary assessment of the project, it is recommended that long-term unattended noise monitoring be carried out to confirm noise targets for the operational stages of the development.

2.2.1 Noise measurement locations

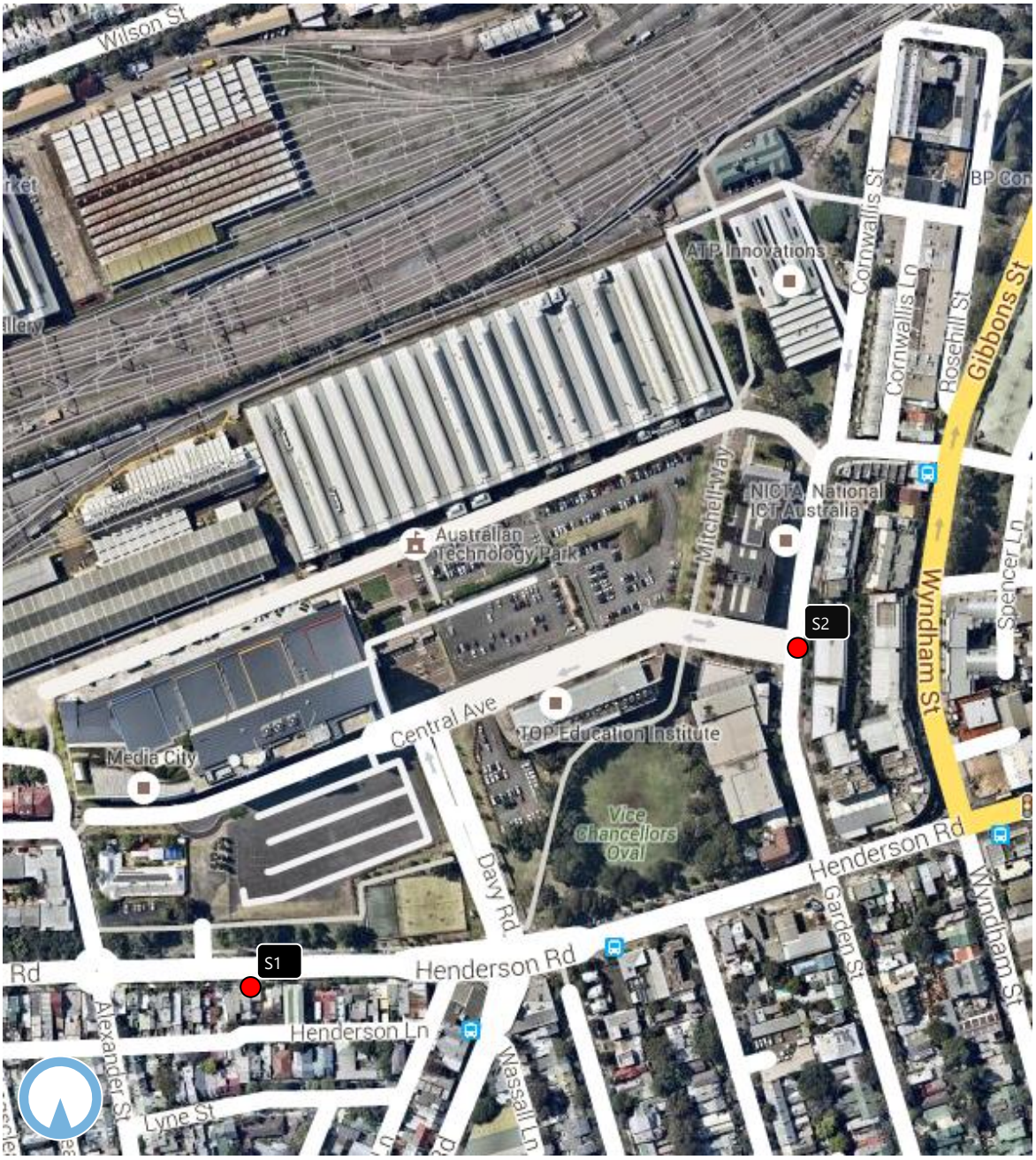
Noise measurements are ideally carried out at the nearest or most potentially affected locations surrounding a development. An alternative, representative location should be established in the case of access restrictions or a safe and secure location cannot be identified. Furthermore, representative locations may be established in the case of multiple receivers as it is usually impractical to carry out measurements at all locations surrounding a site.

The short-term measurement locations are outlined in Table 1 and shown in Figure 4.

Table 1: Noise monitoring locations

ID	Address	Description
Short-term noise monitoring		
S1	114 Henderson Road, Alexandria	The monitor was located on the footpath outside the terrace in a free-field position. The monitor was positioned at a distance of 1m from the kerb, at a height of 1.5m from the ground.
S2	Unit 17, 30-44 Garden Street, Alexandria	The monitor was located on the footpath outside the apartment complex in a Free-field position. The monitor was positioned at a distance of 1m from the kerb, at a height of 1.5m from the ground. It was positioned in-line with the driveway for vehicles entering/exiting the Australian Technology Park.

Figure 4: Site and noise monitoring locations



2.3 Short-term noise measurement results

As the construction and operation of the site will generally be limited to the day time period (7am - 6pm) short-term measurements were carried out outside of the typical peak traffic periods in order to establish representative background noise levels. Measurements were undertaken during the morning of Friday, 6 November 2015 and afternoon of Wednesday, 11 November 2015.

A summary of the short-term measurement results is presented in Table 2.

Table 2: Short-term noise monitoring results

Location	Date / Time	Measured noise level, dB(A)		Comments on measured noise levels
		L_{Aeq}	L_{A90}	
S1 – 114 Henderson Road, Alexandria	6/11/2015 10:32-10:47	63	48	The background L_{A90} was determined by distant traffic noise at the Henderson Road/Mitchell Road intersection. The ambient L_{Aeq} noise level was determined by local/through traffic on Henderson Road.
	6/11/2015 10:48-11:03	63	49	
	11/11/2015 14:54-15:07	64	46	
	11/11/2015 15:10-15:25	64	47	
S2 – Unit 17, 30-44 Garden Street, Alexandria	6/11/2015 10:32-10:47	62	50	The background L_{A90} was determined by distant traffic noise on Henderson Road. The ambient L_{Aeq} noise level was determined by local/through traffic on Garden Street, and cars moving in and out of the ATP via Central Avenue.
	6/11/2015 10:48-11:03	63	51	
	11/11/2-15 15:00-15:15	63	50	
	11/11/2015 15:15-15:30	65	49	

Notes: The equipment used for noise measurements was a Brüel & Kjær Type 2250 precision sound level analyser which is a Class 1 instrument having accuracy suitable for field and laboratory use. The instrument was calibrated prior and subsequent to measurements using a Bruel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed. All instrumentation complies with IEC 61672 (parts 1-3) 'Electroacoustics - Sound Level Meters' and IEC 60942 'Electroacoustics - Sound calibrators' and carries current NATA certification (or if less than 2 years old, manufacturers certification).

3 Operational noise

3.1 Overview

The primary operational noise sources with the potential to impact upon surrounding noise sensitive uses include:

- Child care centres at Lower Ground level of Building 1 and Level 1 of Community Building,
- Gymnasium at ground level of the Community Building
- Retail uses:
  - Building 1 - Lower Ground eastern side
  - Building 2 - Upper Ground north west and north east and Lower Ground south west
  - Community Building - Ground level north and south
- Mechanical plant and equipment serving the three buildings.

3.2 Criteria

In the absence of specific noise criteria stipulated by the consent authority, reference is made to the NSW *Industrial Noise Policy* (INP) [3].

The assessment procedure in terms of the INP has two components:

- Controlling intrusive noise impacts in the short-term for residences; and
- Maintaining noise level amenity for particular land uses for residences and other land uses.

3.2.1 Intrusive noise criteria

According to the INP, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor) does not exceed the background noise level measured in the absence of the source by more than 5dB(A). The intrusiveness criterion is summarised as follows:

- $L_{Aeq,15minute} \leq$ rating background level plus 5dB(A)

3.2.2 Amenity noise criteria

The INP amenity criteria are designed to maintain noise level amenity for particular land uses, including residential and other land uses. The INP recommends base acceptable noise levels for various receivers, including residential, commercial, industrial receivers and other sensitive receivers in Table 2.1 of the INP. Noise from new sources need to be designed such that the cumulative effect does not produce levels that would significantly exceed the criterion.

Table 3: INP Amenity Criteria - Recommended L_{Aeq} noise levels from industrial noise sources [NSW INP Table 2.1]

Type of receiver	Indicative noise amenity area	Time of day	Recommended $L_{Aeq(Period)}$ noise level	
			Acceptable	Recommended maximum
Residence	Urban	Day	60	65
		Evening	50	55
		Night	45	50
School classrooms - internal	All	Noisiest 1 hour period when in use	35	40
Active recreation area (e.g. school playground, golf course)	All	When in use	55	60
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Note: Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am

On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.

The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

3.3 Project noise goals

Table 4 summarises the single Rating Background Levels (RBL) and relevant INP intrusiveness, amenity targets for the project. With regard to the noise amenity criteria, it is noted that no existing industrial noise contribution was identified at the nearest most potentially affected receiver locations and therefore no modification to the amenity targets as per Table 2.2 of the INP were required.

Table 4: Operational noise targets, dB(A)

Location	Representative noise monitor	Period	RBL, dB(A)*	INP criteria	
				$L_{Aeq(15min)}$ intrusive	$L_{Aeq(period)}$ amenity
Residential receivers					
R1 - Henderson Rd - west of Mitchell Rd	S1	Day	46	51	60
R2 - Henderson Rd - east of Mitchell Rd	S2	Day	49	54	60
R3 - Garden St and Cornwallis St	S2	Day	49	54	60
Other noise sensitive receiver locations					
Child care	School classroom	When in use	-	-	40 (internal)
	Active Recreation	When in use	-	-	55
TOP Education Institute	School classroom	When in use	-	-	40 (internal)
All commercial	-	When in use	-	-	65
Industrial sites	-	When in use	-	-	70

Notes: * RBL based on lowest measured background noise level at the representative monitoring location.

3.4 Source noise levels

The source noise levels for children playing and other activities in the centre have been based on previous measurements conducted by Renzo Tonin and Associates. The sound power levels recommended in the Association of Australian Acoustical Consultants (AAAC) *Guideline for Child Care Centre Acoustic Assessment* were used in the calculations for the outdoor areas.

The sound power levels obtained from the guideline are adjusted to take into consideration the number of children for the age group. With each child care centre having 90 children, 30 of each age group are assumed. The source noise levels are based on the outdoor areas being used for active play (e.g. children free play). Noise levels will be lower when the outdoor play areas are used for passive type activities (e.g. learning activities such as story reading).

Table 5: Operational noise sources

Area	Applicable noise source	Overall dB(A)	Octave band centre frequency - Hz (dBZ)								
			31.5	63	125	250	500	1k	2k	4k	8k
Childcare	30 x 0 - 2 year olds - Lw	85	-	-	-	-	76	80	80	76	70
	30 x 2 - 3 year olds - Lw	92					83	87	87	83	77
	30 x 3 - 5 year olds - Lw	95					86	90	90	86	80
Café/Food and Beverage	Patrons (Internal spatial L_p L_{eq})	74	69	71	73	70	72	71	66	61	53
	Patrons - external (Raised male) - Lp @ 1m per person	65	-	-	54	59	64	58	54	49	43
Gym	Weights and cardio area - Lp	81	78	80	79	75	75	76	73	72	66

3.5 Noise predictions

For the child care centre, a worst case assessment has been carried out assuming all 90 children from each centre are in the outdoor play area. For this scenario, the following noise mitigation measures have been included in the assessment:

- Building 1 - 1.8m high solid barrier around the perimeter of the outdoor play area
- Community - 1.5m high solid barrier around the southern perimeter of the outdoor play area

For the retail uses, the following is assumed:

- Building 1 - approximately 40 seats externally along the northern and eastern frontages combined. Internal noise will be readily mitigated by the façade.
- Building 2 - approximately 50 seats each for the retail areas and 200 people in the plaza area on the western side. Internal noise will be readily mitigated by the façade.
- Community building - approximately 35 seats externally in the northern plaza area and 25 seats to the southern end. Internal noise will be readily mitigated by the façade.

Table 6 summarises the noise predictions carried out to the nearest most potentially affected receiver surrounding the site, identified as residential premises on Henderson Road, west of Mitchell Road. The residential premises are in the closest proximity to the various retail uses and Child care centres, as well as having the lowest background noise levels. Noise predictions have been carried in accordance with ISO9613-2 algorithms. The noise model assesses acoustic losses due to distance, shielding by intervening structures and reflections off surrounding buildings.

Table 6: External noise prediction summary

Assessment location	Noise source	Predicted noise level, dB(A)	Project noise goal, dB(A)
R1 - Henderson Rd - West of Mitchell Rd (second storey)	Child care B1 (90 children outside)	47	
	Child care Community (90 children outside)	40	
	B1 - Retail external patrons	31	
	B2 - Retail external patrons	37	
	Community - North external patrons	29	
	Community - South external patrons	34	
	Community – Gymnasium*	16	
	TOTAL	**48**	**51**

Notes: * Low frequency content assessed, but correction not required due to low overall contribution at receiver.

The predicted noise levels indicate that compliance can be achieved while also providing allowance for additional noise from mechanical services plant and equipment.

It is noted that the cumulative assessment outlined in Table 6 is made against the daytime noise goals given that the majority of uses will be restricted to this period. It is noted however that the gymnasium in the Community building and supermarket located in Building 2 could operate 24 hrs. With regard to the gymnasium, the predicted noise levels would readily satisfy the minimum applicable noise criteria of $L_{Aeq\ 15minute}$ 35dB(A). For the supermarket, noise generated by the use would be limited to mechanical equipment and traffic generated by the development. Mechanical equipment will be subject to detailed design while traffic impacts are discussed in Section 4. Noise from deliveries and loading dock activities would be sufficiently removed from nearby noise sensitive receivers, however deliveries could potentially be restricted to occur between 7am and 10pm only as a conservative measure.

3.6 Recommendations

3.6.1 Child care centre

While the assessment presented herein indicates that compliance could be achieved, a detailed review of the child care centre design and operational plan should be carried out during the design development stage in order to confirm appropriate noise mitigation measures have been incorporated into the development and that the use is capable of complying with the relevant noise criteria imposed on the development.

3.6.2 Retail uses

While the assessment presented herein indicates that compliance could be achieved, a detailed review of the retail uses should be carried out during the design development stage in order to confirm appropriate noise mitigation measures have been incorporated into the development. Additional measures such as acoustically absorptive treatment to soffits or external covered areas and internal spaces may be considered to improve the acoustic amenity of the areas and increase noise mitigation.

With regard to the proposed 24 hour supermarket, operational noise would be limited to mechanical equipment which would be subject to detailed design.

3.6.3 Gymnasium

The noise mitigation and management measures required for the gymnasium are likely to be determined by the need to control impacts upon the future uses within the ATP site rather than onto surrounding land uses. The predicted noise levels indicate that the use could be operated 24 hours.

3.6.4 Mechanical plant

Mechanical plant associated with the development has the potential to impact on nearby noise sensitive properties if not appropriately assessed and acoustically designed. However, in order to carry out a quantitative assessment of mechanical equipment, a complete specification of equipment is required. At this stage of the development appropriate detail for mechanical plant is not available and therefore a qualitative assessment has been carried out and in-principle noise mitigation and management measures outlined:

- Acoustic assessment of mechanical services equipment should be undertaken during the detail design phase of the development to ensure that the cumulative noise of all equipment does not exceed the applicable noise criteria. Development consent conditions typically require detailed assessment of mechanical plant and equipment prior to construction.
- Noise control treatment can affect the operation of the mechanical services system. An acoustic engineer should be consulted during the initial design phase of mechanical services system to reduce potential redesign of the mechanical system.
- Mechanical plant noise emission can be controlled by appropriate mechanical system design and implementation of common engineering methods, which may include:
  - procurement of 'quiet' plant
  - strategic positioning of plant away from sensitive neighbouring premises to maximise intervening acoustic shielding between the plant and sensitive neighbouring premises
  - commercially available acoustic attenuators for air discharge and air intakes of plant
  - acoustically lined and lagged ductwork
  - acoustic barriers between plant and sensitive neighbouring premises

- partial or complete acoustic enclosures over plant

- The specification and location of mechanical plant should be confirmed prior to installation on site, and

- Fans shall be mounted on vibration isolators and balanced in accordance with Australian Standard 2625 '*Rotating and Reciprocating Machinery – Mechanical Vibration*'.

4 Road traffic generated by development

4.1 Noise criteria

Noise impact as a result of increased traffic generated on the surrounding road network is assessed in accordance with The NSW *Road Noise Policy* (RNP) [6]. Table 3 of the RNP sets out the assessment criteria for residences to be applied to particular types of project, road category and land use. These criteria are for assessment against façade corrected noise levels when measured in front of a building façade. In Table 3, freeways, arterial roads and sub-arterial roads are grouped together and attract the same criteria. The roads surrounding ATP are classified sub-arterial roads under the RNP.

Table 7: Road traffic noise criteria for surrounding residential receivers

Road category	Type of project/land use	Assessment criteria – dB(A)	
		Day (7:00am-10:00pm)	Night (10:00pm-7:00am)
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeways / arterial / sub-arterial roads generated by land use developments	$L_{Aeq,(15\ hour)}$ 60 (external)	$L_{Aeq,(9\ hour)}$ 55 (external)

Where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria. A secondary objective is to protect against excessive decreases in amenity as the result of a project by applying the relative increase criteria.

For existing residences and other sensitive land uses affected by *additional traffic on existing roads generated by land use developments*, any increase in the total traffic noise level should be limited to 2dB above that of the corresponding 'no build option'.

4.2 Assessment

The operational traffic assessment prepared by GTA consultants has been referenced for the noise assessment [7]. Noise assessment in accordance with the NSW RNP is based on the average traffic generated over the 15-hour day and 9-hour night period, however the traffic studies forecast only peak hour generation from the ATP site. Assessment has conservatively been based on the AM and PM peak hour generations.

As the existing road traffic noise levels measured along Henderson Road and Garden Street exceed the base criteria of the RNP, the 2dB(A) allowance is used as the basis of assessment.

Table 8 presents the summary of the noise assessment. The results reveal compliance for all locations.

Table 8: Peak hour traffic noise assessment

Road	Section	AM			PM			AM + PM	dB increase
		N/E	S/W	TOTAL	N/E	S/W	TOTAL		
Existing (2015)									
Garden St	Nth of Central Ave	310	127	437	262	84	346	783	
	Sth of Central Ave	351	85	436	149	103	252	688	
Henderson Rd	btw Garden St and Mitchell Rd	926	602	1528	685	881	1566	3094	
	btw Alexander St and Mitchell Rd	400	234	634	251	361	612	1246	
Mitchell Rd	Sth of Henderson Rd	690	325	1015	470	648	1118	2133	
Post Development									
Garden St	Nth of Central Ave	343	183	526	356	90	446	972	0.9
	Sth of Central Ave	362	155	517	151	200	351	868	1.0
Henderson	btw Garden St and Mitchell Rd	931	779	1710	696	963	1659	3369	0.4
	btw Alexander St and Mitchell Rd	449	248	697	266	399	665	1362	0.4
Mitchell Rd	Sth of Henderson Rd	740	329	1069	486	691	1177	2246	0.2

In addition to the peak hour assessment, consideration was also given to potential impacts from the proposed 24hr supermarket, to be located within Building 2. It is however expected that the approximate 500m^2 supermarket would generate negligible traffic outside of the daytime period particularly as no specific parking provision is provided for the retail use. The supermarket is expected to generate the majority of its custom from walk-in pedestrians working and living in the surrounding areas. Furthermore, based on the location of the proposed supermarket, the limited customers that may access the site by private vehicle are expected to utilise Davy Rd, and the additional traffic on Henderson Road would be inconsequential in regard to noise.

5 Noise and vibration impact upon development

5.1 Criteria

5.1.1 NSW State Environmental Planning Policy (Infrastructure) 2007

The NSW State Environmental Planning Policy (Infrastructure) 2007 (known as 'ISEPP') came into force in NSW on 1 January 2008 to facilitate the effective delivery of infrastructure across the State. The aim of the policy includes identifying the environmental assessment category into which different types of infrastructure and services development fall and identifying matters to be considered in the assessment of development adjacent to particular types of infrastructure.

For the proposed redevelopment of ATP, the pertinent aspects of the ISEPP to the noise and vibration assessment are limited to impacts upon the proposed childcare centres. Furthermore, as the roads surrounding the development have Annual Average Daily Traffic (AADT) volumes of less than 40,000, the assessment is limited to rail noise and vibration:

87 Impact of rail noise or vibration on non-rail development

1. This clause applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration:

a. a building for residential use,

b. a place of public worship,

c. a hospital,

d. an educational establishment or child care centre.

2. Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.

3. If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:

a. in any bedroom in the building - 35 dB(A) at any time between 10 pm and 7am,

b. anywhere else in the building (other than a garage, kitchen, bathroom or hallway) - 40 dB(A) at any time.

5.1.2 Department of Planning publication 'Development near rail corridors and busy roads – Interim guideline'

To support the Infrastructure SEPP, the NSW Department of Planning released the *Development in Rail Corridors and Busy Roads – Interim Guideline* [2]. The Guideline assists in the planning, design and assessment of developments in, or adjacent to, major transport corridors in terms of noise, vibration and air quality.

5.2 Assessment

The proposed child care centres are to be located within ground floor of Building 1 and Level 1 of the Community building. Both the Building 1 and Community building child care centre are at least 250m from the operating rail lines and will be acoustically shielded by intervening buildings. The proposed uses are therefore sufficiently removed from rail operations both in terms of potential noise and vibration impacts and do not warranted any further quantitative assessment.

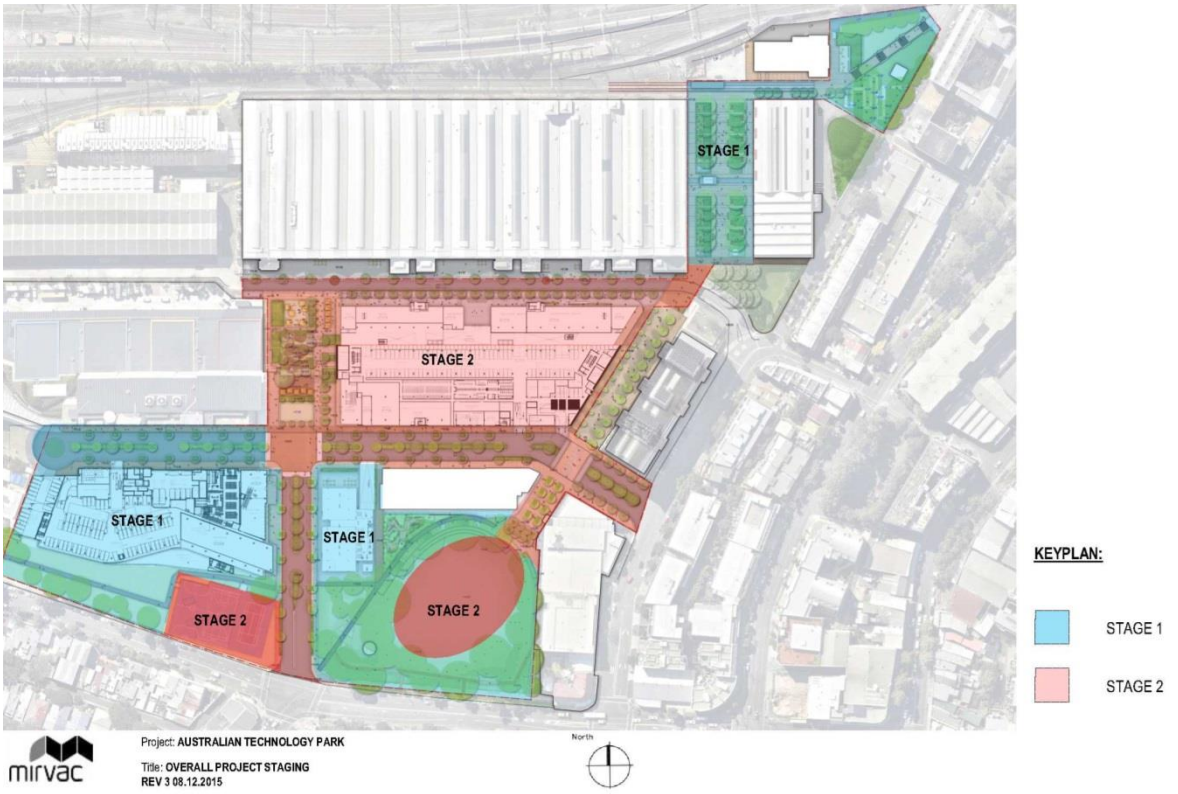
6 Construction

A Construction and Environment Management Plan (CEMP) has been prepared by Mirvac for the ATP redevelopment. This assessment supplements the CEMP and has been used to inform the proposed work practices and management measures contained in the CEMP. The CEMP will be further development as the construction methodologies and processes are confirmed during the design development process.

6.1 Construction stages

Works are to be carried out in two primary stages with work overlapping across each.

Figure 5: Construction staging



6.2 Projected program and schedule

Element	Description	Duration
1. Site Establishment	Set up hoardings and site amenities	1 month
2. Earthworks	Building 1: Foundation Piling, bulk excavation and detailed excavation	4 months
	Building 2: Perimeter soldier pile wall construction, bulk excavation, foundation piling and detailed excavation	10 months
	Community centre	2 months
3. Construction	Building 1: Construction of multi storey building including integrated fitout works	20 months

Element	Description	Duration
	Building 2: Construction of multi storey building including integrated fitout works	25 months
	Community centre	14 months
4. Public Domain Works	Stage 1	14 months
	Stage 2	15 months

6.3 Construction hours

The construction hours are proposed to be based on the standard construction hours outlined in the City of Sydney Councils CBD Construction noise policy which are consistent with other major projects approved by the Department of Planning within the City of Sydney Council LGA.

In order to best manage potential impacts without unnecessarily prolonging the construction phase of the development, extended hours on Saturday would enable these works to be carried out when commercial uses are typically unoccupied. The hours are also consistent with other State Significant Developments recently approved in the City of Sydney LGA. It is noted that such works would generally be removed from the surrounding residential receivers.

The proposed construction hours for the ATP redevelopment are presented in Table 9.

Table 9: Proposed work hours

	Monday to Friday	Saturday	Sunday/ Public holiday
Work Hours	7:00am to 6:00pm	7:00am to 5:00pm	No work Potential out of hours work subject to Council approval.

6.4 Construction noise guideline

The NSW *Interim Construction Noise Guideline* (ICNG, 2009) provides guidelines for assessing noise generated during the construction phase of developments.

The key components of the guideline that are incorporated into this assessment include:

- Use of L_{Aeq} as the descriptor for measuring and assessing construction noise.

  NSW noise policies, including the INP, RNP and RING have moved to the primary use of L_{Aeq} over any other descriptor. As an energy average, L_{Aeq} provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the L_{A10} descriptor.

- Application of reasonable and feasible noise mitigation measures
- As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice, and is practical to build given the project constraints.

- Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

The ICNG provides two methods for assessment of construction noise, being either a quantitative or a qualitative assessment. A quantitative assessment is recommended for major construction projects of significant duration, and involves the measurement and prediction of noise levels, and assessment against set criteria. A qualitative assessment is recommended for small projects with a duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification.

Given the scale of the construction works proposed, a quantitative assessment is carried out herein, consistent with the ICNG requirements.

Table 10, reproduced from the ICNG, sets out the noise management levels and how they are to be applied for residential receivers.

Table 10: Noise management levels at residential receivers

Time of day	Management level $L_{Aeq\ (15\ min)}$ *	How to apply
Proposed construction hours: Monday to Friday 7 am to 6 pm Saturday 7 am to 5pm No work on Sundays or public holidays unless required and subject to Council approval.	Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured LAeq (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. • 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.
	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • 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: 1. 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 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2 *[of the ICNG.*

Time of day	Management level $L_{Aeq\ (15\ min)}$ *	How to apply

* 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.

Table 11 presents the construction noise management levels established for the nearest noise sensitive residential receivers based upon the noise monitoring outlined in Section 2.

Table 11: Construction noise management levels at residential receivers

ID	Location description	L_{A90} rating background level (RBL) - Day	Noise management level $L_{Aeq(15min)}$[1]	
			Noise affected	Highly noise affected
R1	Henderson Road - West of Mitchell Rd	46	56	75
R2	Henderson Rd - East of Mitchell Rd	49	59	75
R3	Garden St	49	59	75
R4	Cornwallis St	49	59	75

Notes: 1. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Table 12 sets out the ICNG noise management levels for other noise sensitive receiver locations. As identified for residential receivers, a 'highly affected' noise objective of $L_{Aeq(15min)}$ 75dB(A) is adopted for all noise sensitive receivers, with exceedances addressed as described in Table 10.

With regard to commercial offices, it is noted that the external target may be readily exceeded particularly for buildings within the ATP site. As commercial building typically have fixed glazing, the resultant internal noise level is more relevant for the assessment of construction noise impacts. In this regard, an indicative noise target is established for inside office areas of commercial buildings.

Table 12: Noise management levels at other noise sensitive land uses

Land use	Where objective applies	Management level $L_{Aeq\ (15\ min)}$
Child care	Internal noise level	45 dB(A)
	External noise level - Active recreation areas	65 dB(A)
TOP Education - internal	Internal noise level	45 dB(A)
Commercial premises	External noise level	70 dB(A)
	Internal noise level - offices*	50 dB(A)*
	Internal noise level - Ch7 studios*	To be determined with consultation

Notes: * - not outlined in the ICNG

6.5 Construction vibration guidelines

6.5.1 Disturbance to buildings occupants

Assessment of potential disturbance from vibration on human occupants of buildings is made in accordance with the DECC '*Assessing Vibration; a technical guideline*' [5]. In accordance with the guideline, assessment against the human exposure criteria is typically reserved for long-term vibration impacts such as that associated with operational phases of development rather than construction works. Notwithstanding, the relevant criteria are presented for reference.

The guideline provides criteria which are based on the British Standard BS 6472-1992 '*Evaluation of human exposure to vibration in buildings (1-80Hz)*' [8]. Sources of vibration are defined as either 'Continuous', 'Impulsive' or 'Intermittent'. Table 13 provides definitions and examples of each type of vibration.

Table 13: Types of vibration [5]

Type of vibration	Definition	Examples
Continuous vibration	Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time)	Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).
Impulsive vibration	A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.
Intermittent vibration	Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer, this would be assessed against impulsive vibration criteria.

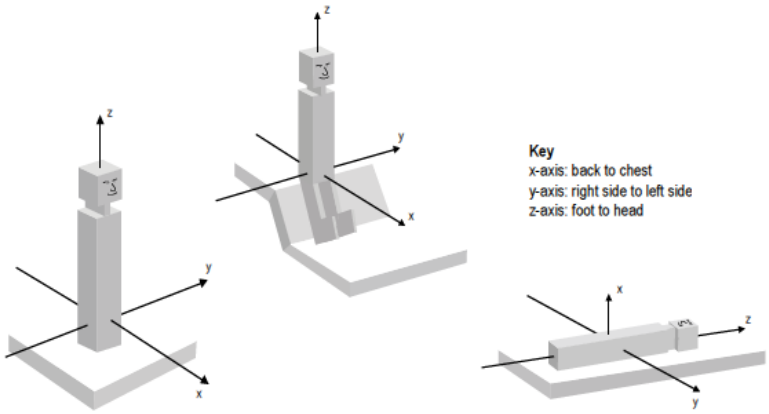
The vibration criteria are defined as a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Section 2.3 of the guideline states:

> *'Evidence from research suggests that there are summation effects for vibrations at different frequencies. Therefore, for evaluation of vibration in relation to annoyance and comfort, overall weighted rms acceleration values of the vibration in each orthogonal axis are preferred (BS 6472).'*

When applying the criteria, it is important to note that the three directional axes are referenced to the human body, i.e. x-axis (back to chest), y-axis (right side to left side) or z-axis (foot to head). Vibration may enter the body along different orthogonal axes and affect it in different ways. Therefore, application of the criteria requires consideration of the position of the people being assessed, as illustrated in Figure 6. For example, vibration measured in the horizontal plane is compared with x- and y-axis criteria if the

concern is for people in an upright position, or with the y- and z- axis criteria if the concern is for people in the lateral position.

Figure 6: Orthogonal axes for human exposure to vibration



The preferred and maximum values for continuous and impulsive vibration are defined in Table 2.2 of the guideline and are reproduced in Table 14.

Table 14: Preferred and maximum levels for human comfort

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration (weighted RMS acceleration, m/s^2, 1-80Hz)					
Critical areas[2]	Day- or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day- or night-time	0.020	0.014	0.040	0.028
Workshops	Day- or night-time	0.04	0.029	0.080	0.058
Impulsive vibration (weighted RMS acceleration, m/s^2, 1-80Hz)					
Critical areas[2]	Day- or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64	0.46	1.28	0.92
Workshops	Day- or night-time	0.64	0.46	1.28	0.92

Notes:
2. Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am
3. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above. Stipulation of such criteria is outside the scope of their policy and other guidance documents (e.g. relevant standards) should be referred to. Source: BS 6472-1992

The acceptable vibration dose values (VDV) for intermittent vibration are defined in Table 2.4 of the guideline and are reproduced in Table 15

Table 15: Acceptable vibration dose values for intermittent vibration (m/s$^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes: 1. Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am

2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous of impulsive criteria for critical areas.
Source: BS 6472-1992

6.5.2 Building damage

Potential structural damage of buildings as a result of vibration is typically managed by ensuring vibration induced into the structure does not exceed certain limits and standards, such as British Standard 7385 Part 2 [9] and German Standard DIN4150-3 [10]. Currently there is no existing Australian Standard for assessment of structural building damage caused by vibration energy.

Within British Standard 7385 Part 1: 1990, different levels of structural damage are defined:

- *Cosmetic - The formation of hairline cracks on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces; in addition the formation of hairline cracks in mortar joints of brick/concrete block construction.*
- *Minor - The formation of large cracks or loosening of plaster or drywall surfaces, or cracks through bricks/concrete blocks.*
- *Major - Damage to structural elements of the building, cracks in supporting columns, loosening of joints, splaying of masonry cracks, etc.*

The vibration limits in Table 1 of British Standard 7385 Part 2 [9] are for the protection against cosmetic damage, however guidance on limits for minor and major damage is provided in Section 7.4.2 of the Standard:

> *7.4.2 Guide values for transient vibration relating to cosmetic damage*
>
> *Limits for transient vibration, above which cosmetic damage could occur are given numerically in Table 1 and graphically in Figure 1. In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for the building types corresponding to line 2 are reduced. Below a frequency of 4 Hz, where a high displacement is associated with a relatively low peak component particle velocity value a maximum displacement of 0.6 mm (zero to peak) should be used.*

Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 1, and major damage to a building structure may occur at values greater than four times the tabulated values.

Within DIN4150-3 [10], damage is defined as "*any permanent effect of vibration that reduces the serviceability of a structure or one of its components*" (p.2). The Standard also outlines:

"that for structures as in lines 2 and 3 of Table 1, the serviceability is considered to have been reduced if

- *cracks form in plastered surfaces of walls;*
- *existing cracks in the building are enlarged;*
- *partitions become detached from loadbearing walls or floors.*

These effects are deemed 'minor damage. " (DIN4150.3, 1990, p.3)

While the DIN Standard defines the above damage as 'minor', based on the definitions provided in BS7385, the DIN standard is considered to deal with cosmetic issues rather than major structural failures.

6.5.2.1 British Standard

British Standard 7385: Part 2 '*Evaluation and measurement of vibration in buildings*', can be used as a guide to assess the likelihood of building damage from ground vibration. BS7385 suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur.

The cosmetic damage levels set by BS 7385 are considered 'safe limits' up to which no damage due to vibration effects has been observed for certain particular building types. Damage comprises minor non-structural effects such as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks and separation of partitions or intermediate walls from load bearing walls. 'Minor' damage is considered possible at vibration magnitudes which are twice those given and 'major' damage to a building structure may occur at levels greater than four times those values.

BS7385 is based on peak particle velocity and specifies damage criteria for frequencies within the range 4Hz to 250Hz, being the range usually encountered in buildings. At frequencies below 4Hz, a maximum displacement value is recommended. The values set in the Standard relate to transient vibrations and to low-rise buildings. Continuous vibration can give rise to dynamic magnifications due to resonances and may need to be reduced by up to 50%.Table 16 sets out the BS7385 criteria for cosmetic, minor and major damage.

Regarding heritage buildings such as the Locomotive Shed, British Standard 7385 Part 2 (1993) notes that "*a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive*" (p.5).

Where the Locomotive Shed is not considered structurally unsound, the management of potential effects of vibration could consider general criteria rather than Category 3 requirements under DIN 4150-3.

Table 16: BS 7385 structural damage criteria

Group	Type of structure	Damage level	Peak component particle velocity, mm/s		
			4Hz to 15Hz	15Hz to 40Hz	40Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	Cosmetic	50		
		Minor*	100		
		Major*	200		
2	Un-reinforced or light framed structures Residential or light commercial type buildings	Cosmetic	15 to 20	20 to 50	50
		Minor*	30 to 40	40 to 100	100
		Major*	60 to 80	80 to 200	200

Notes: Peak Component Particle Velocity is the maximum Peak particle velocity in any one direction (x, y, z) as measured by a tri-axial vibration transducer.

* Minor and major damage criteria established based on British Standard 7385 Part 2 (1993) Section 7.4.2

6.5.2.2 German Standard

German Standard DIN 4150 - Part 3 '*Structural vibration in buildings - Effects on Structure*' (DIN 4150-3), also provides recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are generally recognised to be conservative.

DIN 4150-3 presents the recommended maximum limits over a range of frequencies (Hz), measured in any direction, and at the foundation or in the plane of the uppermost floor of a building or structure. The vibration limits increase as the frequency content of the vibration increases. The criteria are presented in Table 17.

Table 17: DIN 4150-3 structural damage criteria

Group	Type of structure	Vibration velocity, mm/s			
		At foundation at frequency of			Plane of floor uppermost storey
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 or 2 and have intrinsic value (eg buildings under a preservation order)*	3	3 to 8	8 to 10	8

Notes: * - Refer also to British Standard 7385 Part 2 (1993)

6.6 Construction noise and vibration assessment

6.6.1 Equipment list and source noise levels

Noise generated from the site will vary depending on the level and specific type of activity carried out, as well the number of items of plant equipment operating at any one time. Table 18 provides the Sound Power Levels (LW) of plant likely to be used during the excavation and construction phases.

Table 18: Construction plant source levels

Equipment Type	Indicative Size	Indicative Equipment		Sound Power Level, dB(A) Lw re: 1pW
		Earthworks	Construction	L_{Aeq}
Air Compressor - Silenced	8 kW	-	Y	109
Cherry Picker	6 t	-	Y	106
Concrete Pump	6 t	Y	Y	103
Concrete Saw	9 kg	Y	-	119
Concrete Vibrator	2 kW	-	Y	97
Crane - Mobile	55t	-	Y	98
Crane - Diesel	22 t	-	Y	104
D10 Dozer	-	Y	-	110
Dump truck	30 t	Y	-	109
Excavator	40 t	Y	-	107
Excavator	32 t	Y	-	105
Excavator	12 t	Y	-	102
Generator - Diesel	100 kVA	-	Y	94
Hoist - Twin cage high speed Alimak	0.5 t	-	Y	96
Piling - Rotary bored cast in-situ	110 t	Y	Y	111
Pneumatic Hand Tools (general)		Y	Y	111
Pneumatic Jack Hammer	20 kg	Y	-	121
Power Generator	28 kg	Y	Y	102
Roller - Vibratory (pad foot)	20 t	Y	Y	108
Truck - Cement Mixer	26 t	-	Y	104
Water Cart	10-12t	Y	Y	107
Water jet fans	DSU T700	Y	-	108
Welders - welding & cutting steel piles	-	Y	Y	101

Note: Source:- Renzo Tonin & Associates Construction Noise Database (QTD-06 (rev 5))
LA1 only noted for equipment potentially used during the night period (as noted in the Construction Program in Appendix C)

6.6.2 Predicted Noise Levels

Noise emissions were determined by modelling the noise sources, receiver locations, and operating activities, based on the information currently available. Table 19 following presents a summary of the

predicted L_{Aeq} noise levels for each stage. Noise predictions have been conservatively assessed on the basis of the following:

- All plant and equipment for each stage operating concurrently for each phase/activity
- No acoustic shielding has been assumed for future structures on site. As the site works progress, acoustic shielding will be provided by the constructed structures to some locations. The modelling conservatively assumes a clear unobstructed site.
- A 25dB(A) reduction from outside to inside for offices and commercial buildings assuming closed windows, and a 60dB(A) reduction for the studios at 6-8 Central Avenue.
- No consideration of site hoardings or other forms of shielding have been considered in the modelling

While various stages and phases of work will overlap across the site, resulting in various combinations of activity, assessment has been based on the concurrent earthworks and construction phases that will occur on site.

Table 19: Summary of predicted L_{Aeq} levels

Receiver	Predicted L_{Aeq} noise levels, dB(A)		Noise management level, dB(A)	
	Stage 1 and 2 Earthworks (excavation)	Stage 1 and 2 Construction (structures)	Noise affected	Highly noise affected
R1 - Henderson Rd - West of Mitchell Rd	69	66	56	75
R2 - Henderson Rd - East of Mitchell Rd	66	63	59	75
R3 - Garden St	65	62	59	75
R4 - Cornwallis St	70	67	59	75
E1 - Child care centre - internal	49	46	45	-
E1 - Child care centre - external	69	66	65	75
E2 - TOP Education - internal	50	47	45	-
C2a - 6-8 Central Avenue - Eastern offices	48	45	50	-
C2b - 6-8 Central Avenue - Southern offices	50	47	50	-
C2c - 6-8 Central Avenue - Studios	12	9	TBC	-
C3 - 13 Garden St	49	46	50	-

Notes: 1 - NML applies to external areas
2 - NML applies to internal areas

Based on the predicted noise levels from construction activities, in accordance with the EPAs INCG, consideration will need to be given to all reasonable and feasible mitigation and management measures. General recommendations for the site wide management of noise and vibration are provided in the following section.

With regard to the Channel 7 studios located at 6-8 Central Ave, the noise intrusion from airborne noise is expected to be sufficiently reduced so as not to affect the use. However, on-site testing should be

carried out to confirm outcomes due to the sensitivity of the use. It is expected that structure borne noise generated by any vibration intensive works would be most critical with regard to impacts upon the studios and all endeavours should be made to reduce vibration intensive work in proximity to the studios, or in contact with the carpark structure below the plaza area.

6.7 Noise and vibration control measures

The following at-source control and management measures should be considered for the management of noise from construction works to reduce potential noise impacts. The management measures are focused on minimising unnecessary noise generation from the site and the extent and duration of peak noise levels.

Table 20: Construction noise management measures

Measure	Detail
Source controls	
Noise barriers	Where possible, stage development so that structures provide acoustic shielding to sensitive receiver locations. Construct any solid site hoarding as soon as practical. Where possible, stationary equipment or loading areas should be located to make most use of the solid hoarding. Barriers or enclosures around stationary plant should also be considered where it is required to be located in close proximity to sensitive receivers.
Location equipment	Loading/unloading zones and stationary plant such as generators should where practicable be located away from the most sensitive receivers.
Equipment selection	Use the quietest and least vibration emitting construction methods where feasible and reasonable.
Limit equipment in use	Only the equipment necessary for the construction works will be used at any time. Avoid any unnecessary noise when carrying out manual operations and when operating plant
Limit activity duration	Any equipment not in use for extended periods shall be switched off. For example, heavy vehicles should switch engines off whilst being unloaded.
Reversing alarms	Alternative reverse alarm, such as non-tonal 'quackers' should be installed where feasible and reasonable.
Management measures	
Implement community consultation measures	Inform community of construction activity and potential impacts
Develop good relations	Good relations with building occupants should be established at the beginning of the works and be maintained throughout the project, as this is of paramount importance. Keeping people informed of progress and taking complaints seriously and dealing with them expeditiously is critical. The person selected to liaise with the building occupants should be adequately trained and experienced in such matters.
Work staging	Where practical, stage works so that intrusive works are carried out at least noise sensitive periods.

Measure	Detail
Site inductions	All employees, contractors and subcontractors are to receive a Project induction. The environmental component may be covered in toolboxes and must include: • all relevant project specific and standard noise and vibration mitigation measures • relevant licence and approval conditions • permissible hours of work • any limitations on high noise generating activities • location of nearest sensitive receivers • construction employee parking areas • designated loading/unloading areas and procedures • site opening/closing times (including deliveries), and • environmental incident procedures
Complaints management procedure	A management procedure would need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits.
Noise monitoring	Noise and vibration monitoring should be carried out for any identified sensitive works, where monitoring could be used to proactively identify noisy works that may be otherwise managed and mitigated.

Regarding vibration, Table 21 below presents the recommended minimum working distances for high vibration generating plant.

Table 21: Recommended minimum working distances for vibration intensive plant

Plant item	Rating / description	Min. working distance, m	
		Cosmetic damage[2]	Human response[3]
Bobcat	Travelling	1 (nominal)	Avoid contact with structure
Jackhammer	Hand held	1 (nominal)	Avoid contact with structure
Excavator	<=30 Tonne (travelling/ digging)	5	15
Truck Movements[1]	Travelling loaded	5	10

Notes:
3. Renzo Tonin & Associates project files, databases & library
4. Based on DIN4150.3 Group 1 Buildings
5. For residential receivers

Site specific buffer distances shall be determined where vibration significant plant items, in particular jackhammers, operate within cosmetic damage minimum working distances detailed in Table 21 above. Where this occurs, minimum buffer distances to affected receivers shall be determined by site measurements prior to the commencement of the regular use of the vibration significant plant on site. The site specific minimum working distance shall be maintained in order to comply with relevant vibration limits.

The following vibration management measures are provided to minimise vibration impact from construction activities to the nearest affected receivers:

- At the commencement of operation for each plant or activity on site (once only, not every day), which has the potential to generate significant vibration levels, attended vibration

monitoring should be undertaken so to refine the recommended minimum working distances set out in Table 21 and provide a site-specific table of minimum working distances

- Where vibration is found to be excessive, management measures shall be implemented to ensure vibration compliance is achieved. Management measures may include modification of construction methods such as using smaller rock breakers, using alternative processes or establishment of larger minimum working distances.
- Carry out additional vibration monitoring when construction activities are at the nearest point to the nearby sensitive structures. This monitoring may signal to the contractor by way of a buzzer or flashing light, when levels approach/exceed the recommended limits.
- Before, during and after the demolition and construction stages we recommend preparation of a dilapidation report on the state of the existing buildings sharing the property boundary with the site.
- It is further recommended that a vibration complaints management system be established prior to the commencement of these works.

7 Conclusion

Renzo Tonin & Associates has completed an assessment of noise and vibration in regard to the operation and construction phases of proposed Australian Technology Park (ATP) redevelopment. While the Secretary's Environmental Assessment Requirements (SEARs) referred only to SEPP (Infrastructure) 2007, the assessment has been carried out in accordance with standard NSW policies and guidelines. Where relevant the report has presented recommended mitigation and management measures for the control of noise and vibration for both the construction and operational phases of the development. The report has also identified where additional detailed assessment may be required during the design development phase of the project.

References

[1] NSW Government, "State Environmental Planning Policy (Infrastructure)," Sydney, 2007.

[2] NSW Department of Planning, "Development in Rail Corridors and Busy Roads – Interim Guideline," NSW Department of Planning, Sydney, 2008.

[3] NSW EPA, NSW Industrial Noise Policy, Sydney: NSW EPA, 2000.

[4] Department of Environment and Climate Change NSW, "Interim Construction Noise Guideline," Department of Environment and Climate Change NSW, Sydney, 2009.

[5] Department of Environment and Conservation (NSW), "Assessing Vibration: A technical guideline," Department of Environment and Conservation (NSW), Sydney, 2006.

[6] NSW EPA, NSW Road Noise Policy, Sydney: NSW EPA, 2012.

[7] GTA Consultants, "Australian Technology Park, Eveleigh Redevelopment - Transport Impact Assessment 15S1478000 A-Dr2," GTA Consultants, Sydney, 2015.

[8] Bristish Standards Institution, "BS 6472-1992 Evaluation of human exposure to vibration in buildings (1-80Hz)," Bristish Standards Institution, London, 1992.

[9] Bristish Standard Institution, "BS 7385-2: 1993 Evaluation and measurement for vibration n buildings - Pt 2: Guide to damage levels from groundborne vibration," Bristish Standard Institution, London, 1993.

[10] DIN, "DIN 4150-3 (1999) Structural vibration - Effects of vibration on structures," DIN Deutsches Institut fur Normung, Berlin, 1999.

APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
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.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
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, when extraneous noise is removed. 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 L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. 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 switched on 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.
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.
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.
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.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.

L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	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).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
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.
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 through its conversion into thermal energy.
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 pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
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.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.