Noise and Vibration Impact Assessment

Proposed Bioresources Facility Development
University of Newcastle, Callaghan, NSW.

Prepared for: de Witt Consulting Pty Ltd
March 2018

MAC
Muller Acoustic Consulting

Document Information

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by de Witt Consulting Pty Ltd (DWC) to prepare a Noise and Vibration Impact Assessment for the proposed Bioresources Facility Development (the 'project'), situated at Lot 1, DP 1188100, 130 University Drive, Callaghan, NSW.

This assessment has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the project and will accompany the Environmental Impact Statement (EIS) being prepared for the project by DWC.

The SEARs are summarised below:

Noise and Vibration

Identify and provide a quantitative assessment of the main noise and vibration generating sources during construction and operation and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.

Relevant Policies and Guidelines:

- Noise Policy for Industry 2017 (EPA)
- Interim Construction Noise Guideline (DECC)
- Assessing Vibration: A Technical Guideline 2006
- Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning 2008)

The assessment quantifies noise and vibration emissions from the project during standard construction hours to surrounding educational receivers. Secondly, this assessment provides a quantitative assessment of operational noise from mechanical plant once the construction is completed. Finally, the assessment quantifies the road traffic intrusion from the Newcastle Inner City Bypass (NICB) to the project.

The key objective of the EIS is to ensure appropriate environmental controls and management procedures are implemented to protect the environment and community from adverse noise and vibration impacts arising from the project.

The assessment has been undertaken in accordance with the following documents:

- Environment Protection Authority (EPA), NSW Noise Policy for Industry (NPI) 2017;
- Department of Environment and Climate Change (DECC), Interim Construction Noise Guideline (ICNG) 2009;
- Standards Australia AS 2107-2016 Acoustics – Recommended design sound levels and reverberations times for building interiors;
- Standards Australia AS 2436-2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites;
- Standards Australia AS 1055.1:1997 - Acoustics - Description and measurement of environmental noise - General Procedures;
- Department of Environment and Conservation 2006, Assessing Vibration: A Technical Guideline;
- German Standard DIN4150; and
- British Standard BS7385: Part 2–1993.

A glossary of terms, definitions and abbreviations used in this report is provided in Appendix A. A copy of the SEARs is provided in Appendix B.

1.1 Background

The project proposes the construction of Bioresources Facility at Lot 1, DP1188100, 130 University Drive, Callaghan, NSW, which is located within the University of Newcastle Campus (UON). The site is currently occupied by several glass houses, which are to be demolished as part a separate approved project currently being undertaken by UON. The project proposes the construction of a three-storey facility comprising of two storeys of research facility with a mechanical plant enclosure servicing the facility located on the third storey rooftop. The site is bounded on the north, east and south by existing educational buildings which house the medical, life, biological and general sciences departments of the university and the Newcastle Inner City Bypass is located approximately 60m to the west of the site.

1.2 Receiver Review

Receivers surrounding the project site are all educational and are summarised in Table 1. Figure 1 provides a locality plan identifying the position of each of the educational receivers in relation to the project site.

Table 1 Sensitive Receivers and Relevant Noise Catchments

Receiver ID	Building Use	Coordinates		Distance to Project Boundary[1]
		Easting	Northing	
BS 1	Biological Science Location 1	378174	6359889	50
BS 2	Biological Science Location 2	378152	6359890	25
BS 3	Biological Science Location 3	378150	6359869	32
BS 4	Biological Science Location 4	378163	6359865	43
BT 1	Basden Theatre	378154	6359850	44
CH 1	Chemistry Location 1	378153	6359835	48
CH 2	Chemistry Location 2	378141	6359835	41
LS 1	Life Science Location 3	378184	6359907	57
LS 2	Life Science Location 4	378183	6359896	51
MS 1	Medical Science Location 1	378132	6359913	23
MS 2	Medical Science Location 2	378147	6359912	27
MS 3	Medical Science Location 3	378162	6359910	38
MSW 1	Medical Science West Location 1	378083	6359910	12
MSW 2	Medical Science West Location 2	378097	6359909	13
MSW 3	Medical Science West Location 3	378109	6359908	13
SC 1	Science Location 1	378125	6359836	35
SC 2	Science Location 2	378108	6359837	31
SC 3	Science Location 3	378097	6359837	32
SC 4	Science Location 4	378095	6359819	53

Note 1: Approximate distance to nearest project site boundary.

FIGURE 1

LOCALITY PLAN

REF: MAC170588

0 20m

KEY

R1 RECEIVER LOCATION

SITE LOCATION

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*Imagery Source : nearmaps

2 Policy and Criteria

2.1 Construction Noise and Vibration

The ICNG sets out procedures to identify and address the impacts of construction noise on residences and other sensitive land uses. This section provides a summary of noise objectives that are applicable to the assessment. The ICNG provides two methodologies for the assessment of construction noise emissions:

- Quantitative, which is suited to major construction projects with typical durations of more than three weeks; and
- Qualitative, which is suited to short term infrastructure maintenance (<three weeks).

The methodology for a quantitative assessment requires a more complex approach, involving noise predictions from construction activities to the nearest relevant assessment locations.

The qualitative assessment methodology is a more simplified approach that relies on noise management strategies. This study has adopted a quantitative assessment approach. Steps of the quantitative approach are summarised in Figure 2.

The quantitative approach includes identification of potentially affected receivers, description of activities involved in the proposal, derivation of the construction noise management levels, quantification of potential noise impact at receivers and, provides management and mitigation recommendations.

Figure 2 – Quantitative Assessment Processes for Assessing and Managing Construction Noise.

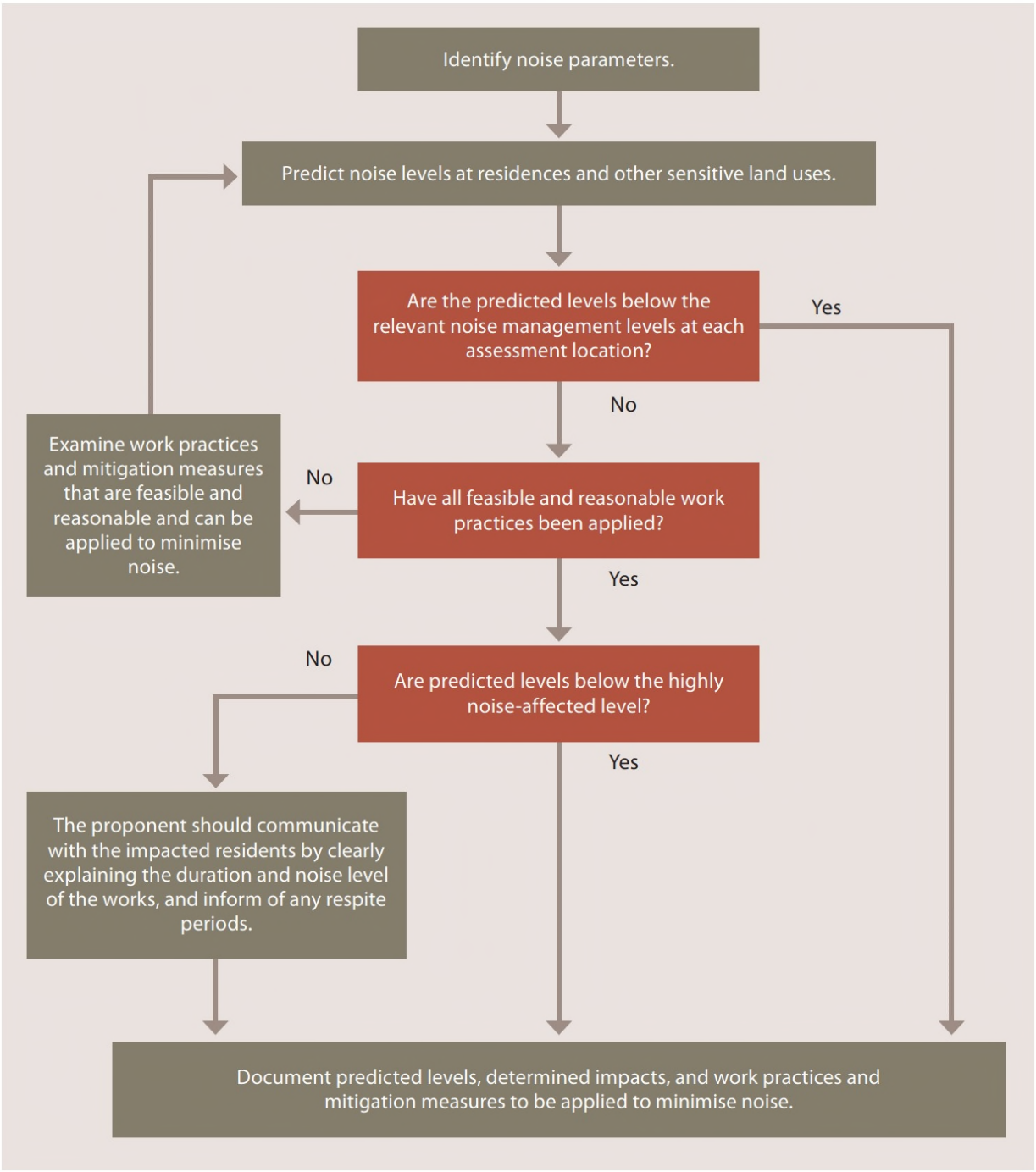


Table 2 summaries the recommended standard and out of hours periods for construction. Note, although are not mandatory, strong justification is required to work outside of normal construction hours. Notwithstanding, construction works during non-standard hours may be required for this project to minimise impact on surrounding educational receivers.

Table 2 Recommended Hours for Construction

Period	Preferred Construction Hours
Normal construction	Monday to Friday - 7am to 6pm Saturdays - 8am to 1pm Sundays or Public Holidays - No construction
Out of Hours Period 1	Monday to Friday - 6pm to 10pm Saturdays – 7am to 8am and 1pm to 10pm Sundays or Public Holidays - 8am to 6pm
Out of Hours Period 2	Monday to Friday – 10pm to 7am Saturdays – 10pm to 8am Sundays or Public Holidays – 6pm to 7am

These recommended hours do not apply in the event of direction from police, or other relevant authorities, for safety reasons or where required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.

2.1.1 Construction Noise Management Levels

Table 3 presents the standard construction period noise management levels (NMLs) for non-residential receivers in close proximity to the project in accordance with the ICNG. For educational receivers, it is more practical to assess against an external NML. Therefore, the NMLs for educational receivers have been adjusted to an external management level assuming 10dB attenuation for a partially open window.

Table 3 ICNG Noise Management Levels, $LA_{eq(15\text{-}min)}$

Receiver	Receiver Type	Noise Management Level $LA_{eq(15min)}$
All Receivers	Educational	45 (internal)/55 (external)

2.2 Vibration Assessment Guidelines

2.2.1 Structural Damage Criteria

For structural damage, British Standard BS 7385:Part 2-1993 “Evaluation and measurement for vibration in buildings Part 2”, gives guidance on the levels of vibration which building structures could be damaged. BS7385 also takes into consideration the frequency of the vibration which is critical when assessing the likelihood of building damage.

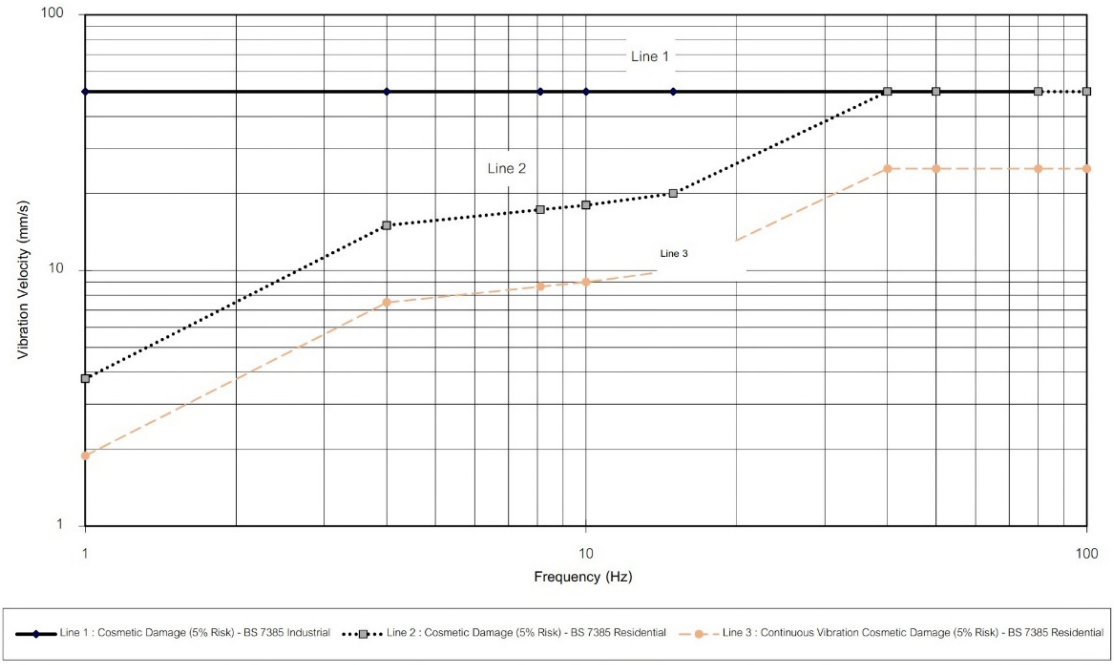
Guide values are set for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to result in a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and heavy commercial/industrial buildings are presented in Table 4, with a visual representation presented in Figure 3. Where sources of continuous vibration may give rise to dynamic magnification due to resonance, the values provided in Table 4 should be reduced by 50%, this is especially the case with respect to Peak Particle Velocity (PPV) at lower frequencies.

Table 4 Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage

Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Figure 3 – Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage



2.2.2 Human Comfort – Assessing Vibration a Technical Guideline

Humans are far more sensitive to vibration than is commonly realised and may detect vibration levels which are well below levels that may cause damage to buildings or structures. Assessing vibration: a technical guideline was published in February of 2006 by the DECC and is based on guidelines contained in BS 6472 – 1992, Evaluation of human exposure to vibration in buildings (1-80 Hz) and provides guidance on assessing vibration against human comfort.

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in Table 5.

Table 5 Examples of types of vibration (from Table 2.1 of the guideline)		
Continuous Vibration	Impulsive Vibration	Intermittent Vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery)	Infrequent: Activities that create up to three distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990)	Trains, intermittent nearby 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 these would be assessed against impulsive vibration criteria.

2.2.3 Continuous Vibration

Appendix C of the guideline outlines acceptable criteria for human exposure to continuous vibration (1-80Hz), the criteria are dependent on both the time of activity (usually daytime or night-time) and the occupied place being assessed. Table 6 reproduces the preferred and maximum criteria relating to measured peak velocity.

Table 6 Criteria for Exposure to Continuous Vibration			
Place	Time	Peak Velocity (mm/s)	
		Preferred	Maximum
Critical working Areas (e.g. hospital operating theatres, precision laboratories)	Day or Night	0.14	0.28
Residences	Day	0.28	0.56
	Night	0.20	0.40
Offices	Day or Night	0.56	1.1
Workshops	Day or Night	1.1	2.2

Note: rms velocity (mm/s) and vibration velocity value (dB re 10^{-9} mm/s) values given for most critical frequency >8Hz assuming sinusoidal motion.

Note: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

2.2.4 Impulsive Vibration

Appendix C of the guideline outlines acceptable criteria for human exposure to impulsive vibration (1-80Hz), these criteria are dependent on both the time of activity (usually daytime or night-time) and the occupied place being assessed. Impulsive vibration (as defined in Section 2.1 of the guideline) is generally associated with infrequent activities that create up to three (3) distinct vibration events in an assessment period e.g. occasional dropping of heavy equipment, occasional loading and unloading. Table 7 reproduces the preferred and maximum criteria relating to measured peak velocity.

Table 7 Criteria for exposure to Impulsive Vibration

Place	Time	Assessment Criteria	
		Peak Velocity (mm/s)	
		Preferred	Maximum
Critical working Areas (e.g. hospital operating theatres, precision laboratories)	Day or Night-time	0.14	0.28
Residences	Daytime	8.6	17.0
	Night-time	2.8	5.6
Offices	Day or Night-time	18.0	36.0
Workshops	Day or Night-time	18.0	36.0

Note: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

2.2.5 Intermittent Vibration

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Intermittent vibration is representative of activities such as impact hammering, rolling or general excavation work (such as an excavator tracking).

Section 2.4 of the Guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted rms (root mean square) acceleration levels over the frequency range 1-80 Hz. To calculate VDV the following formula (refer section 2.4.1 of the guideline) was used:

$$VDV = \left[\int_0^T a^4(t)dt \right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, a (t) is the frequency-weighted rms of acceleration in m/s^2 and T is the total period of the day (in seconds) during which vibration may occur.

The Acceptable Vibration Dose Values (VDV) for Intermittent Vibration is reproduced in Table 8.

Table 8 Acceptable Vibration Dose Values (VDV) for Intermittent Vibration

Location	Daytime		Night-time	
	Preferred Value, $m/s^{1.75}$	Maximum Value, $m/s^{1.75}$	Preferred Value, $m/s^{1.75}$	Maximum Value, $m/s^{1.75}$
Critical Areas	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

Note: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

Note: These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

2.3 Operational Noise

Operational noise refers to noise emissions from the project once established and operational. and is assessed in accordance with the Noise Policy for Industry (NPI) (EPA, 2017). The NPI provides a process for establishing noise criteria for consents and licenses enabling the EPA to regulate noise emissions from scheduled premises under the Protection of the Environment Operations Act 1997.

The objectives of the NPI are to:

- provide the noise criteria that are used to assess both change in noise level and long-term noise levels;
- provide a clear and consistent framework for assessing environmental noise impacts from industrial premises and industrial development proposals;
- promote the use of best-practice noise mitigation measures that are feasible and reasonable where potential impacts have been identified; and
- support a process to guide the determination of achievable noise limits for planning approvals and/or licences, taking into account the matters that must be considered under the relevant legislation (such as the economic and social benefits and impacts of industrial development).

The policy sets out a process for industrial noise management involving the following key steps:

1. Determine the project noise trigger levels for a development. These are the levels (criteria), above which noise management measures are required to be considered. They are derived by considering two factors: shorter-term intrusiveness due to changes in the noise environment and require the measurement of existing background levels; and maintaining the noise amenity of an area.
2. Predict or measure the noise levels produced by the development with regard to the presence of annoying characteristics and meteorological effects such as temperature inversions and wind.
3. Compare the predicted or measured level with the project noise trigger level, and assessing impacts and the need for noise mitigation and management measures.
4. Consider residual noise impacts - that is, where noise levels exceed the Project Noise Trigger Levels (PNTL) after the application of feasible and reasonable noise mitigation measures. This may involve balancing economic, social and environmental costs and benefits from the proposed development against the noise impacts, including consultation with the affected community where impacts are expected to be significant.
5. Set statutory compliance levels that reflect the best achievable and agreed noise limits for the development.
6. Monitor and report environmental noise levels from the development.

2.3.1 Project Noise Trigger Levels

The policy sets out the procedure to determine the Project Noise Trigger Level (PNTL) (i.e. criteria) relevant to a particular industrial development. The PNTL applies to existing noise-sensitive receivers, however, it may also be used in strategic planning processes for proposed land uses.

The PNTL is the lower (that is, the more stringent) value of the Project Intrusiveness Noise Level (PINL) and Project Amenity Noise Level (PANL) determined in accordance with Sections 2.3 and 2.4 of the NPI. The PINL aims to protect receivers against significant changes in noise levels, whilst the PANL seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses. As the receivers surrounding the project are educational receivers, the PNTL's are based on the PANL.

2.3.2 Assessing Amenity

Amenity noise levels are relevant to a specific land use or locality. To limit continuing increases in intrusiveness levels, the ambient noise level within an area from all combined industrial sources should remain below the recommended amenity noise levels specified in Table 2.2 (of the NPI). The NPI defines two categories of amenity noise levels:

- Amenity Noise Levels (ANL) – are determined considering all current and future industrial noise within a receiver area.
- Project Amenity Noise Levels (PANL) – is the recommended levels for a receiver area, specifically focusing the project under investigation.

As per Section 2.4 of the NPI, ANL and PANLs consider:

- areas with high traffic noise levels;
- proposed developments in major industrial clusters;
- existing industrial noise; and
- greenfield sites.

The recommended amenity noise levels as per Table 2.2 of the NPI reproduced in Table 9.

Table 9 Amenity Criteria			
Receiver Type	Noise Amenity Area	Time of day	Recommended amenity noise level L_{Aeq} dBA
School classroom – internal	All	Noisiest 1 hour period when in use	35 (45 external)

Notes: The recommended amenity noise levels refer only to noise from industrial noise sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

Time of day is defined as follows: (These periods may be varied where appropriate, for example, see A3 in Fact Sheet A.)

- day – the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays
- evening – the period from 6pm to 10pm
- night – the remaining periods.

2.4 Road Traffic Noise Intrusion

AS/NZS 2107:2016 recommends design criteria for conditions affecting the acoustic environment within building interiors to ensure human comfort and productivity. Table 1 of the standard prescribes the background sound level for different areas of occupancy of a variety of building types including residential, educational, medical and industrial. The prescribed noise levels are to be considered during the design stage of construction projects, to ensure the internal amenity of the occupied spaces is maintained through the application of adequate attenuation to the building facades.

The project is classed as a working laboratory within an educational building. The applicable noise levels for the internal spaces within the facility are referenced from Table 1 of AS/NZS 2107:2016 and reproduced in Table 10.

Table 10 Design Levels for Different Areas of Occupancy	
Type of Occupancy/ Activity	Design Sound Level ($L_{Aeq,t}$) range
Educational Building	
Working Laboratory	40 to 50

2.5 Road Noise Policy

The EPA's RNP (EPA, 2011) has been reviewed and is designed to quantify the noise intrusion from the road network on existing receptors. As this project is related to the construction of a new building, the RNP is not applicable to this assessment.

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3 Noise Assessment Methodology

3.1 Noise Modelling Methodology

Brüel and Kjær Predictor Type 7810 (Version 11.10) noise modelling software was used to assess potential noise impacts associated with the project. A three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process.

The model calculation method used to predict construction noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation'.

The model incorporated three-dimensional digitised ground contours, the proposed buildings as derived from proposed site plans provided by de Witt Consulting Pty Ltd (2018) (see Appendix C), existing buildings and the surrounding land base topography. Where relevant, modifying factors in accordance with Section 4 of the NPI have been applied to calculations.

3.2 Construction Noise Assessment Methodology

Construction methodology for the project is currently unavailable, however construction works associated with the project are expected to be divided into several activities. These assumed activities and anticipated plant to be used are summarised in Table 11.

Table 11 Construction Activities		
Activity	Construction Fleet/Plant	Fleet Sound Power
Activity 1: Earthworks		
Stripping and Excavation of site to proposed building level.	Excavator, bobcat, trucks, whacker and concrete agitator.	114dBA
Activity 2: Concrete pouring		
Pouring of concrete foundation and reinforced sections	Excavator, concrete pump, concrete agitator, trucks and hand tools.	116dBA
Activity 3: Building Construction		
Construction of new 2 storey facility	Excavator, backhoe, front end loader, bobcat, trucks, concrete trucks and pumps,	112dBA
Activity 4: Plant Installation		
Installation of roof top plant and equipment	Front end loader, bobcat, trucks, hand tools and crane.	110dBA
Activity 5: Building Fit out		
Internal installation and fit out of building	Trucks (delivery) and hand tools.	102dBA

Generally, construction fleet sound power levels (SWLs) range from 102dBA for fit out works to 116dBA which is representative of the combined noise level for concrete pouring activities. It should be noted that some items may be interchanged within each fleet and would have no influence on the overall noise level of each fleet or predicted noise levels.

3.3 Operational Noise Assessment Methodology

Noise modelling was undertaken to assess potential noise impacts from the project rooftop plant. Plant and equipment were modelled at various locations as per the plans for the proposed building (de Witt Consulting Pty Ltd, 2018). The model calculation method used to predict noise levels was in accordance with ISO 9613-1 ‘Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere’ and ISO 9613-2 ‘Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation’.

3.3.1 Mechanical Plant Sound Power Levels

Table 12 presents the sound power level for each item of plant modelled in this assessment. It is noted that sound power levels were sourced from manufacturer's specifications or from in-field measurements at similar project sites. The sound power levels have been adjusted to account for duration over a fifteen-minute period.

Table 12 Acoustically Significant Sources - Sound Power Levels (re 10-12 Watts)

Item and number modelled per 15 minutes	Individual Sound Power Level, $LA_{eq(15min)}$ dBA	Total Source Sound Power Level, $LA_{eq(15min)}$ dBA
Operation		
Exhaust Fan (x 8)	76	86
Chiller Plant (x 2)	80	83
Chilled/Hot Water System pumps (x 2)	81	84
HHF/ Steam Systems (x 4)	73	79

3.3.2 Noise Attenuation Assumptions

The operational noise model adopted the following noise controls:

- Enclosure and roof surrounding the mechanical plant comprises of a metal façade with infill and extends to a height of 5m above the plant floor. The barrier has been assumed not to contain any gaps and consist of materials with a surface density of at least 10kg/m2; and
- The ventilated façade of the gas fired plant room will be fitted with acoustic louvres to attenuate noise from within the interior of the plant room. The louvres will have a minimum overall acoustic reduction of 35dBA to attenuate noise from the plant.

3.4 Traffic Noise Intrusion Assessment Methodology

A theoretical assessment of road traffic noise was carried out to predict levels at each façade of the proposed dwellings using the Calculation of Road Traffic Noise (CORTN) algorithm, as developed by the UK Department of Transport. This method incorporates consideration of traffic flow volume, average speed, percentage of heavy vehicles, and road gradient and includes attenuation via spherical spreading (or cylindrical in the case of a line source such as a road), soft ground, atmospheric absorption and screening from buildings or barriers. Noise Modelling was undertaken to assess potential noise intrusion impacts from the Newcastle Inner City Bypass (NICB) to the facades of the project.

Traffic volumes for NICB (also known as State Highway 23) were sourced from the Newcastle Inner City Bypass Rankin Park to Jesmond Submissions Report (RTA, 2008). The report identifies an Annual Average Daily Traffic (AADT) of up to 16,966 vehicles for 2004 which is considered consistent with flows along NICB. It is estimated that current (2018) NICB traffic would be in the order of 27,623 AADT assuming a 3.5% traffic growth since 2004. This data was found to be consistent with alternative studies conducted in the area (see University of Newcastle Strategic Transport Management Plan, Better Transport Futures, 2012).

4 Results

4.1 Construction Noise Results

Noise modelling included the assessment of construction equipment operating at representative locations for each of adopted construction activities. Results of the modelling for standard and out of hours construction hours periods are presented in Table 13 for the worst-case receiver height for assessed educational receivers.

Table 13 Predicted Construction Noise Levels, dBA $LA_{eq(15min)}$

Receiver ID	Construction Activities Maximum Predicted Noise Levels $LA_{eq(15min)}$, dBA					CNML[1]
	1	2	3	4	5	
BS 1	60	62	59	57	44	55
BS 2	71	72	69	67	56	55
BS 3	70	72	69	67	56	55
BS 4	66	67	64	62	50	55
BT 1	68	70	67	65	53	55
CH 1	67	68	65	63	51	55
CH 2	68	69	66	64	53	55
LS 1	67	68	65	63	51	55
LS 2	64	64	62	60	47	55
MS 1	71	73	69	67	56	55
MS 2	70	71	68	66	55	55
MS 3	69	70	67	65	53	55
MSW 1	74	74	72	70	60	55
MSW 2	74	74	72	70	60	55
MSW 3	74	75	72	70	60	55
SC 1	70	70	68	66	54	55
SC 2	71	72	69	67	56	55
SC 3	71	72	70	68	57	55
SC 4	66	65	64	62	51	55

Note 1: External CNML and relevant for all assessment periods (ie standard and out of hours periods).

4.2 Vibration Assessment Results

The major potential sources of construction vibration includes vibrating rollers (such as compactors that may be required for earthworks). Equipment and plant have the potential to operate at a minimum offset distance of 20m from the nearest receivers when work occurs at the project site.

Generally, rolling would take place at the project site during excavation ground works. Peak levels of vibration from rolling typically occurs as the roller stops to change direction and a resonance is created as the roller (and vibrator) is stationary.

Table 14 provides the minimum working distances for the use of various vibration intensive sources to nearby receivers.

Table 14 Minimum Working Distances or Vibratory Plant (m)

Plant item	Rating / Description	Minimum working distance	
		Cosmetic damage (BS 7385)	Human response (OH&E Vibration guideline)
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5m	15m to 20m
	< 100 kN (Typically 2-4 tonnes)	6m	20m
	< 200 kN (Typically 4-6 tonnes)	12m	40m
	< 300 kN (Typically 7-13 tonnes)	15m	100m
	> 300 kN (Typically 13-18 tonnes)	20m	100m
	> 300 kN (> 18 tonnes)	25m	100m
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	2m	7m
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7m	23m
Large Hydraulic Hammer	(1600 kg – 18 to 34t excavator)	22m	73m
Vibratory Pile Driver	Sheet piles	2m to 20m	20m
Pile Boring	≤ 800 mm	2m (nominal)	4m
Jackhammer	Hand held	1m (nominal)	2m

Note: Source, CNVG (Roads and Maritime, 2016)

4.3 Feasible and Reasonable Mitigation Measures - Vibration

A minimum offset distance to receptors of at least 25m or greater is required to satisfy the minimum offset criteria specified in the CNVG and BS7385. Therefore, once the final vibratory plant has been selected a review minimum offset distances should be completed. Where minimum working distances are exceeded, vibration monitoring should be undertaken at the nearest effected receiver. This is to ensure vibration levels satisfy relevant structural criteria at all sensitive receivers. Notwithstanding, to minimise vibration impact during rolling activities, it is recommended that large vibratory rollers be substituted with smaller units or replaced with alternative compaction techniques (ie wacker packers), where feasible.

4.4 Operational Noise Results

A noise modelling assessment of the rooftop mechanical plant noise has been completed. The model assumed that plant is situated within the plant area on the rooftop of the facility building and incorporates acoustic screens and louvres. Results of the modelling are presented in Table 15 for both external and internal receiver locations (assuming 10dB loss for a partially opened window).

Table 15 Predicted Operational Noise Levels, dBA $LA_{eq(15min)}$				
Receiver ID	Maximum Predicted External Noise Levels $LA_{eq(15min)}$, dBA	Maximum Predicted Internal Noise Levels $LA_{eq(15min)}$, dBA	PNTL $LA_{eq(15min)}$, dBA	Compliant
BS 1	29	19	35 (internal)	✓
BS 2	35	25	35 (internal)	✓
BS 3	31	21	35 (internal)	✓
BS 4	29	19	35 (internal)	✓
BT 1	30	20	35 (internal)	✓
CH 1	31	21	35 (internal)	✓
CH 2	29	19	35 (internal)	✓
LS 1	34	24	35 (internal)	✓
LS 2	33	23	35 (internal)	✓
MS 1	38	28	35 (internal)	✓
MS 2	37	27	35 (internal)	✓
MS 3	36	26	35 (internal)	✓
MSW 1	40	30	35 (internal)	✓
MSW 2	42	32	35 (internal)	✓
MSW 3	43	33	35 (internal)	✓
SC 1	31	21	35 (internal)	✓
SC 2	37	27	35 (internal)	✓
SC 3	38	28	35 (internal)	✓
SC 4	38	28	35 (internal)	✓

Results of the noise assessment demonstrate that noise emissions associated with the mechanical plant operating within the plant enclosure would comply with the internal noise criteria for all educational receivers surrounding the project.

4.5 Road Noise Intrusion Results

A review of plans (de Witt Consulting Pty Ltd, 2018) (Appendix C) for the project have been completed as part of the assessment. The exposed facades of the north, west and south of the facility have been assessed for noise from the nearby NICB for both day and night periods taking into account the transmission loss of the building. A light frame building with single 3mm glazing would be expected to provide a reduction of approximately 20dBA from external noise sources to interior spaces taking into account closed windows. As the Bioresources Facility will comprise of double glazing or spandrel cladding in galvanised metal planks, the transmission loss is expected to be greater than 20dB. Therefore, an attenuation loss of 30dB has been adopted for this assessment.

Table 16 presents a comparison of predicted road traffic noise against the respective day and night internal criteria.

Table 16 Traffic Noise Intrusion Prediction Results

Facade	Receptor Room Category[1]	Predicted level, L_{Aeq}, dBA[2] (internal)		Internal Criteria L_{Aeq}, dBA	
		Day	Night	Day	Night
North	Ground Floor	37	37	40	50
North	Level 1	37	37	40	50
South	Ground Floor	35	35	40	50
South	Level 1	36	36	40	50
West	Ground Floor	39	39	40	50
West	Level 1	39	39	40	50

Note 1: Determined from proposed site drawing plans (de Witt, 2018).

Note 2: Internally predicted to laboratory rooms. Adjustments made assuming attenuation (25dB) for the project structure with windows closed and includes +2.5dB façade correction.

Note: Exceedances of relevant internal criteria highlighted in bold font.

Note: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

Results of the noise assessment demonstrate that internal noise levels for the project would be within the design level range for working laboratories adopting the prescribed construction material if double glazing and spandrel panels or equivalent materials.

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5 Noise Mitigation of Construction Activities

The results of the Noise Assessment demonstrate that levels during construction periods may be above the relevant NMLs at several surrounding noise sensitive receivers. External exceedances range from 1dB to 20dB above relevant NMLs at receiver points in close proximity to the project works, assuming partially opened windows. It is noted that received internal noise levels would reduce by an additional 10dB (ie 20dB attenuation overall) if surrounding buildings windows remained closed.

Construction noise levels are predicted to satisfy the highly noise affected criteria of 75dBA $L_{Aeq(15min)}$ for all construction activities. It may be feasible to implement mobile noise screens (which can achieve noise reductions of up to 8dBA), optimise the positioning of plant and equipment to minimise line of site to receivers or substitute noisy equipment in order to reduce the noise impact at nearby receivers for these activities.

Where it is not feasible to implement noise controls, conducting particular construction activities during periods when neighbouring educational receivers are not occupied (ie university holidays or out of hours period) should be considered if justifiable.

Given the potential for the predicted noise exceedances, noise mitigation strategies should be implemented wherever feasible and practicable during standard works. Wherever possible, subject to feasibility and reasonability, the quietest plant and equipment should be utilised in combination with management measures in order to minimise noise impacts.

The primary objective of the noise and vibration management strategy is to minimise noise impacts on surrounding university faculty buildings. The project manager may adopt the following hierarchical strategy to achieve this objective:

- ensure that construction activities meet construction noise management levels within the allowable hours of operation as far as practicable;
- where noise levels are above relevant noise management levels, implement reasonable and feasible best practice noise controls to minimise noise emissions and/or exposure duration at affected receivers; and
- where the use of best practice noise controls does not adequately address exceedance of noise management levels, adopt alternative measures to minimise impacts on the community.

Australian Standard AS 2436-2010 "Guide to Noise Control on Construction, Maintenance and Demolition Sites" sets out numerous practical recommendations to assist in mitigating construction noise emissions. These recommendations include operational strategies, source noise control strategies, noise barrier control strategies, and community consultation. Employing these strategies could potentially result in noise level reductions ranging:

- up to 10dBA in instances where space requirements place limitations on the attenuation options available; or
- to potentially over 20dBA where equipment controls (enclosures, silencers, etc) can be combined with noise barriers and management techniques (eg avoidance of clustering).

Should compliance noise monitoring indicate exceedances of the noise criteria, a combination of comprehensive noise mitigation treatments (i.e. noise barriers, equipment enclosures, silencers, regular equipment maintenance, etc) and consultation with university representatives the local community will be considered to manage exceedances. Further descriptions of management measures and mitigation options are provided for specific construction activities and work areas in the following sections.

5.1 Noise Management Recommendations

During construction and any residual demolition activities, the following mitigation strategies to manage noise include:

- toolbox and induction of personnel prior to shift to discuss noise control measures that may be implemented to reduce noise emissions to surrounding receivers;
- training (of employees to conduct quieter work practices);
- equipment which is used intermittently is to be shut down when not in use;
- undertake noise intensive construction or demolition activities outside of university hours, or in university holiday periods;
- where work is undertaken outside of school hours, noise mitigation options should be thoroughly investigated by the contractor prior to these works and validated by attended noise monitoring;
- where possible, machinery will be located/orientated to direct noise away from the closest sensitive class rooms;
- undertake regular maintenance of machinery to minimise noise emissions. Maintenance will be confined to standard daytime construction hours and where possible, away from noise sensitive receivers;
- the quietest suitable machinery reasonably available will be selected for each work activity;

- the offset distance between noisy items of plant/machinery and nearby sensitive receivers and classrooms will be maximised;
- queuing of vehicles is not to occur adjacent to any occupied classroom;
- where queuing is required, for example due to safety reasons, engines are to be switched off to reduce their overall noise impacts on receivers;
- where practicable, ensure those noisy plant/machinery are not working simultaneously in close proximity to classrooms;
- where possible, all plant are to utilise a broad band reverse alarm in lieu of the traditional hi-frequency type reverse alarm;
- minimising the need for reversing or movement alarms; and
- conduct noise monitoring throughout the proposal work.

5.2 Vibration Management Recommendations

In general, to minimise vibration impacts during construction/demolition activities, it is recommended that vibrating plant selection takes into account relevant offset distances to receivers to achieve both the human comfort and structural damage criteria.

For particularly sensitive educational receivers, it is recommended that vibration monitoring should be considered so that vibration levels from the project can be quantified and proactively managed against relevant structural criteria.

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6 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise and Vibration Impact Assessment for the proposed Bioresources Facility Development at Lot 1, DP 1188100, 130 University Drive, Callaghan, NSW.

The assessment quantified construction noise and vibration emissions on surrounding university receiver buildings, operational emissions and offsite road noise intrusion.

The results of the assessment demonstrate that construction noise levels have the potential to be above the relevant NMLs at several surrounding university receivers during construction activities. Accordingly, prescriptive reasonable and feasible recommendations that can be implemented to reduce potential impacts are provided in Section 5 of this report. In particular, it is recommended that noise intensive activities be completed outside of university hours (ie university holidays or during out of hours periods if justifiable) where possible to minimise the disruption to students.

With respect to vibration, careful selection of the size of the vibratory sources should be made taking into consideration human comfort and vibration damage criteria at adjacent educational spaces.

Operational noise emissions from mechanical plant are expected to satisfy relevant operational noise criteria at surrounding university receivers provided the assumptions made in Section 3.3.2 are implemented.

Road noise intrusion from Newcastle Inner City Bypass is not expected to impact on the internal amenity of the Bioresources Facility based on the facade construction outline in the building plans.

In summary, it is recommended that during construction, noise control and management measures provided in this report are adopted to minimise impacts on the adjoining university educational spaces and the surrounding community.

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Appendix A - Glossary of Terms

A number of technical terms have been used in this report and are explained in the Table A1.

Table A1 Glossary of Terms

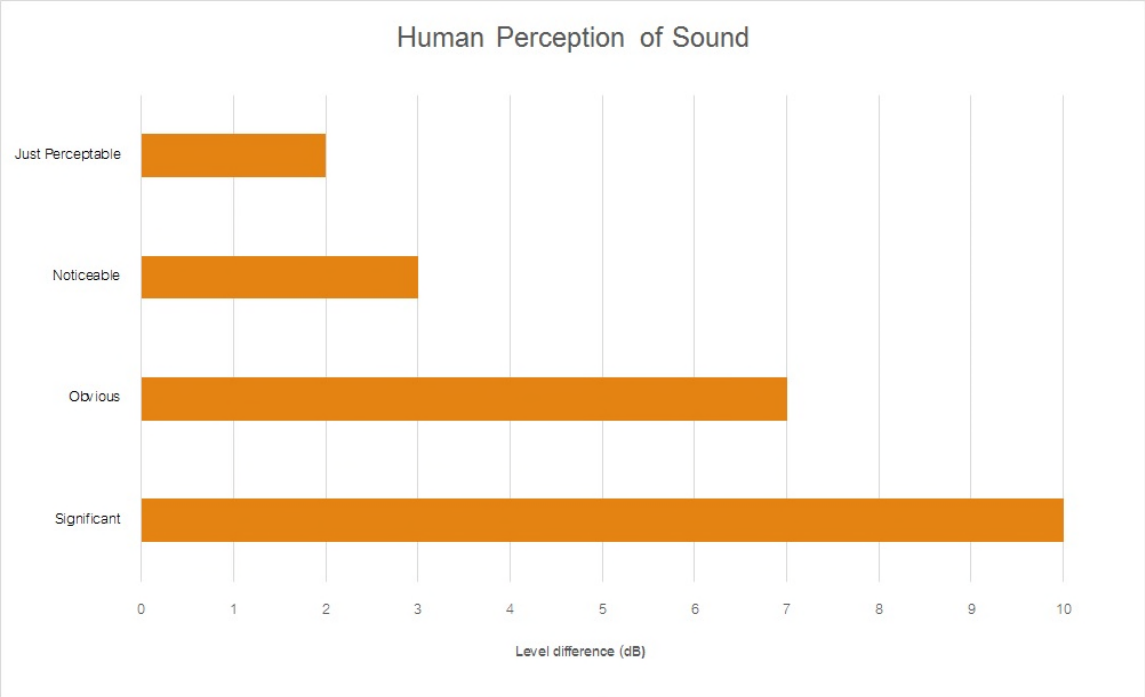
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmax	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : = 10.log10 (W/Wo) Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA

Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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Appendix B - Secretary's Environmental Assessment Requirements

Secretary's Environmental Assessment Requirements

Section 78A(8) of the *Environmental Planning and Assessment Act* Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

Application Number	SSD 8937
Proposal Name	Bioresources Facility Building
Location	The University of Newcastle, Callaghan Campus (Lot 1 DP 1188100)
Applicant	The University of Newcastle
Date of Issue	15 December 2017
General Requirements	The Environmental Impact Statement (EIS) must be prepared in accordance with, and meet the minimum requirements of clauses 6 and 7 of Schedule 2 the *Environmental Planning and Assessment Regulation 2000* (the Regulation). Notwithstanding the key issues specified below, the EIS must include an environmental risk assessment to identify the potential environmental impacts associated with the development. Where relevant, the assessment of the key issues below, and any other significant issues identified in the risk assessment, must include: • adequate baseline data; • consideration of potential cumulative impacts due to other development in the vicinity (completed, underway or proposed); and • measures to avoid, minimise and if necessary, offset the predicted impacts, including detailed contingency plans for managing any significant risks to the environment. The EIS must be accompanied by a report from a qualified quantity surveyor providing: • a detailed calculation of the capital investment value (CIV) (as defined in clause 3 of the Environmental Planning and Assessment Regulation 2000) of the proposal, including details of all assumptions and components from which the CIV calculation is derived; • an estimate of the jobs that will be created by the future development during the construction and operational phases of the development; and • certification that the information provided is accurate at the date of preparation.
Key Issues	The EIS must address the following specific matters: **1. Statutory and Strategic Context** – including: Address the statutory provisions contained in all relevant environmental planning instruments, including: • State Environmental Planning Policy (State & Regional Development) 2011; • State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017; • State Environmental Planning Policy No. 44 – Koala Habitat Protection; • State Environmental Planning Policy No. 55 – Remediation of Land; • State Environmental Planning Policy No. 64 – Advertising and Signage; • State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017; and • Newcastle Local Environmental Plan 2012.

	Permissibility Detail the nature and extent of any prohibitions that apply to the development. *Development Standards* Identify compliance with the development standards applying to the site and provide justification for any contravention of the development standards. **2. Policies** Address the relevant planning provisions, goals and strategic planning objectives in the following: • NSW State Priorities; • Hunter Regional Plan 2036; • Newcastle Development Control Plan 2012; • Draft Future Transport Strategy 2056 and supporting plans; • Crime Prevention Through Environmental Design (CPTED) Principles; • NSW Planning Guidelines for Walking and Cycling; • Healthy Urban Development Checklist, NSW Health; • Better Placed – An integrated design policy for the built environment of NSW 2017; • Draft Greater Newcastle Metropolitan Plan; and • Newcastle Development Control Plan 2012. **3. Built Form and Urban Design** • Address the height, density, bulk and scale, setbacks of the proposal in relation to the surrounding development, topography, streetscape and any public open spaces. • Address design quality, with specific consideration of the overall site layout, streetscape, open spaces, façade, rooftop, massing, setbacks, building articulation, heritage significance, materials, colours and Crime Prevention Through Environmental Design Principles. • Provide details of any digital signage boards, including size, location and finishes. • Detail how services, including but not limited to waste management, loading zones, and mechanical plant are integrated into the design of the development. **4. Environmental Amenity** • Detail amenity impacts including solar access, acoustic impacts, visual privacy, view loss, overshadowing, reflectivity from building facades and wind impacts. A high level of environmental amenity must be demonstrated. **5. Transport and Accessibility** Include a transport and accessibility impact assessment, which details, but not limited to the following: • accurate details of the current daily and peak hour vehicle, public transport, pedestrian and cycle movement and existing traffic and transport facilities provided on the road network located adjacent to the proposed development; • an assessment of the operation of existing and future transport networks including the bus network and their ability to accommodate the forecast number of trips to and from the development; • details of estimated total daily and peak hour trips generated by the proposal, including vehicle, public transport, pedestrian and bicycle trips; • the adequacy of public transport, pedestrian and bicycle networks and infrastructure to meet the likely future demand of the proposed development; • the impact of the proposed development on existing and future public transport infrastructure within the vicinity of the site in consultation with

	Roads and Maritime Services and Transport for NSW and identify measures to integrate the development with the transport network; • details of any upgrading or road improvement works required to accommodate the proposed development; • details of travel demand management measures to encourage sustainable travel choices and details of programs for implementation; • the impact of trips generated by the development on nearby intersections, with consideration of the cumulative impacts from other approved developments in the vicinity, and the need/associated funding for upgrading or road improvement works, if required (note: traffic modelling is to be undertaken with scope to be agreed by TfNSW and RMS in advance); • the proposed active transport access arrangements and connections to public transport services; • the proposed access arrangements, including car and bus pick-up/drop-off facilities, and measures to mitigate any associated traffic impacts and impacts on public transport, pedestrian and bicycle networks, including pedestrian crossings and refuges and speed control devices and zones; • measures to maintain road and personal safety in line with CPTED principles; • the proposed car and bicycle parking provision, including end-of-trip facilities, which must be taken into consideration of the availability of public transport and the requirements of Council's relevant parking codes and Australian Standards; • proposed bicycle parking facilities in secure, convenient, accessible areas close to main entries incorporating lighting and passive surveillance; • details of the proposed number of car parking spaces and compliance with appropriate parking codes and justify the level of car parking provided on-site; • details of emergency vehicle access arrangements; • an assessment of road and pedestrian safety adjacent to the proposed development and the details of required road safety measures; • service vehicle access, delivery and loading arrangements and estimated service vehicle movements (including vehicle type and the likely arrival and departure times); • in relation to construction traffic: o assessment of cumulative impacts associated with other construction activities; o an assessment of road safety at key intersection and locations subject to heavy vehicle construction traffic movements and high pedestrian activity; o details of construction program detailing the anticipated construction duration and highlighting significant and milestone stages and events during the construction process; o details of anticipated peak hour and daily construction vehicle movements to and from the site; o details of access arrangements of construction vehicles, construction workers to and from the site, emergency vehicles and service vehicle; o details of temporary cycling and pedestrian access during construction; o details of proposed construction vehicle access arrangements at all stages of construction; and o traffic and transport impacts during construction, including cumulative impacts associated with other construction activities, and how these impacts will be mitigated for any associated traffic, pedestrian, cyclists, parking and public transport, including the preparation of a draft Construction Traffic Management Plan to

	demonstrate the proposed management of the impact (which must include vehicle routes, number of trucks, hours of operation, access arrangements and traffic control measures for all demolition/construction activities). → Relevant Policies and Guidelines: • *Guide to Traffic Generating Developments (Roads and Maritime Services)* • *EIS Guidelines – Road and Related Facilities (DoPI)* • *Cycling Aspects of Austroads Guides* • *NSW Planning Guidelines for Walking and Cycling* • *Austroads Guide to Traffic Management Part 12: Traffic Impacts of Development* • *Standards Australia AS2890.3 (Bicycle Parking Facilities)* **6. Ecologically Sustainable Development (ESD)** • Detail how ESD principles (as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000) will be incorporated in the design and ongoing operation phases of the development. • Demonstrate that the development has been assessed against a suitably accredited rating scheme to meet industry best practice. • Include a description of the measures that would be implemented to minimise consumption of resources, water (including water sensitive urban design) and energy. **7. Biodiversity** Biodiversity impacts related to the proposed development are to be assessed in accordance with the requirements of Section 7.9 of the Biodiversity Conservation Act 2016, including the preparation of a Biodiversity Development Assessment Report where required. **8. Aboriginal Heritage** • Identify, describe and document the Aboriginal Cultural Heritage values that exist across the whole area that will be affected by the development, which may include the need for surface survey and test excavation. The identified of Aboriginal Cultural Heritage values should be guided by the *Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW (DECC, 2011).* • Where Aboriginal Cultural Heritage values are identified, consultation with Aboriginal people must be undertaken and documented in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010 (DECCW)*. The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the EIS. • The EIS must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the EIS must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented in the EIS. Please note the Due Diligence assessment process is not appropriate to address the requirements for Aboriginal Cultural Heritage assessment. **9. Noise and Vibration** Identify and provide a quantitative assessment of the main noise and vibration generating sources during construction and operation and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land. → Relevant Policies and Guidelines: • *Noise Policy for Industry 2017 (EPA)*

	• *Interim Construction Noise Guideline (DECC)* • *Assessing Vibration: A Technical Guideline 2006* • *Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning 2008)* **10. Sediment, Erosion and Dust Controls** Detail measures and procedures to minimise and manage the generation and off-site transmission of sediment, dust and fine particles. → *Relevant Policies and Guidelines:* • *Managing Urban Stormwater – Soils & Construction Volume 1 2004 (Landcom)* • *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA)* • *Guidelines for development adjoining land and water managed by DECCW (OEH, 2013)* **11. Contamination** Assess and quantify any soil and groundwater contamination and demonstrate that the site is suitable for the proposed use in accordance with SEPP 55. → Relevant Policies and Guidelines: • *Managing Land Contamination: Planning Guidelines - SEPP 55 Remediation of Land (DUAP)* **12. Utilities** • Prepare an Infrastructure Management Plan in consultation with relevant agencies, detailing information on the existing capacity and any augmentation and easement requirements of the development for the provision of utilities including staging of infrastructure. • Prepare an Integrated Water Management Plan detailing any proposed alternative water supplies, proposed end uses of potable and non-potable water, and water sensitive urban design. **13. Contributions** Address Council's Section 94 Contribution Plan and/or details of any Voluntary Planning Agreement, which may be required to be amended because of the proposed development. **14. Drainage** • Detail drainage associated with the proposal, including stormwater and drainage infrastructure. • Detail measures to minimise operational water quality impacts on surface waters and groundwater. → *Relevant Policies and Guidelines:* • *Guidelines for development adjoining land and water managed by DECCW (OEH, 2013)* **15. Flooding** Assess any flood risk on site (detailing the most recent flood studies for the project area) and consideration of any relevant provisions of the NSW Floodplain Development Manual (2005), including the potential effects of climate change, sea level rise and an increase in rainfall intensity. **16. Waste** Identify, quantify and classify the likely waste streams to be generated during construction and operation and describe the measures to be implemented to manage, reuse, recycle and safely dispose of this waste. Identify appropriate servicing arrangements (including but not limited to, waste management, loading zones, mechanical plant) for the site.

	17. Bushfire Address bushfire hazard and if required, prepare a report that addresses the requirements for Special Fire Protection Purpose Development as detailed in *Planning for Bush Fire Protection 2006* guidelines. **18. Construction Hours** Identify proposed construction hours and provide details of the instances where it is expected that works will be required to be carried out outside the standard construction hours.
Plans and Documents	The EIS must include all relevant plans, architectural drawings, diagrams and relevant documentation required under Schedule 1 of the Environmental Planning and Assessment Regulation 2000. Provide these as part of the EIS rather than as separate documents. In addition, the EIS must include the following: • Architectural drawings including but not limited to the following requirements: o dimensioned and including RLs; o plans, sections and elevations of the proposal at no less than 1:200 showing furniture layouts and program; o site and context plans that demonstrate active transport linkages with existing, proposed and potential footpaths and bicycle paths and public transport links; and o detailed annotated wall sections at 1:20 scale that demonstrate typical cladding, window and door details, including materials and general construction quality; • Site Survey Plan, showing existing levels, location and height of existing and adjacent structures / buildings and boundaries; • Site Analysis Plan; • Stormwater Concept Plan; • Sediment and Erosion Control Plan; • Shadow Diagrams; • View Analysis / Photomontages, including from public vantage points; • An integrated Landscape Plan/Strategy (including identification any trees to be removed and trees to be retained or transplanted); • Preliminary Construction Management Plan, inclusive of a Preliminary Construction Traffic Management Plan detailing vehicle routes, number of trucks, hours of operation, access arrangements and traffic control measures; • Geotechnical and Structural Report; • Accessibility Report; • Arborist Report; • Salinity Investigation Report (if required); • Acid Sulphate Soils Management Plan (if required); and • Schedule of materials and finishes.
Consultation	During the preparation of the EIS, you must consult with the relevant local, State or Commonwealth Government authorities, service providers, community groups, special interest groups including local Aboriginal land councils and registered Aboriginal stakeholders, and affected landowners. In particular, you must consult with: • The City of Newcastle; • Transport for NSW; and • Roads and Maritime Services. Consultation with TfNSW and RMS should commence as soon as practicable to agree the scope of investigation.

	The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.
Further consultation after 2 years	If you do not lodge a development application and EIS for the development within two years of the issue date of these SEARs, you must consult further with the Secretary in relation to the preparation of the EIS.
References	The assessment of the key issues listed above must consider relevant guidelines, policies, and plans as identified.

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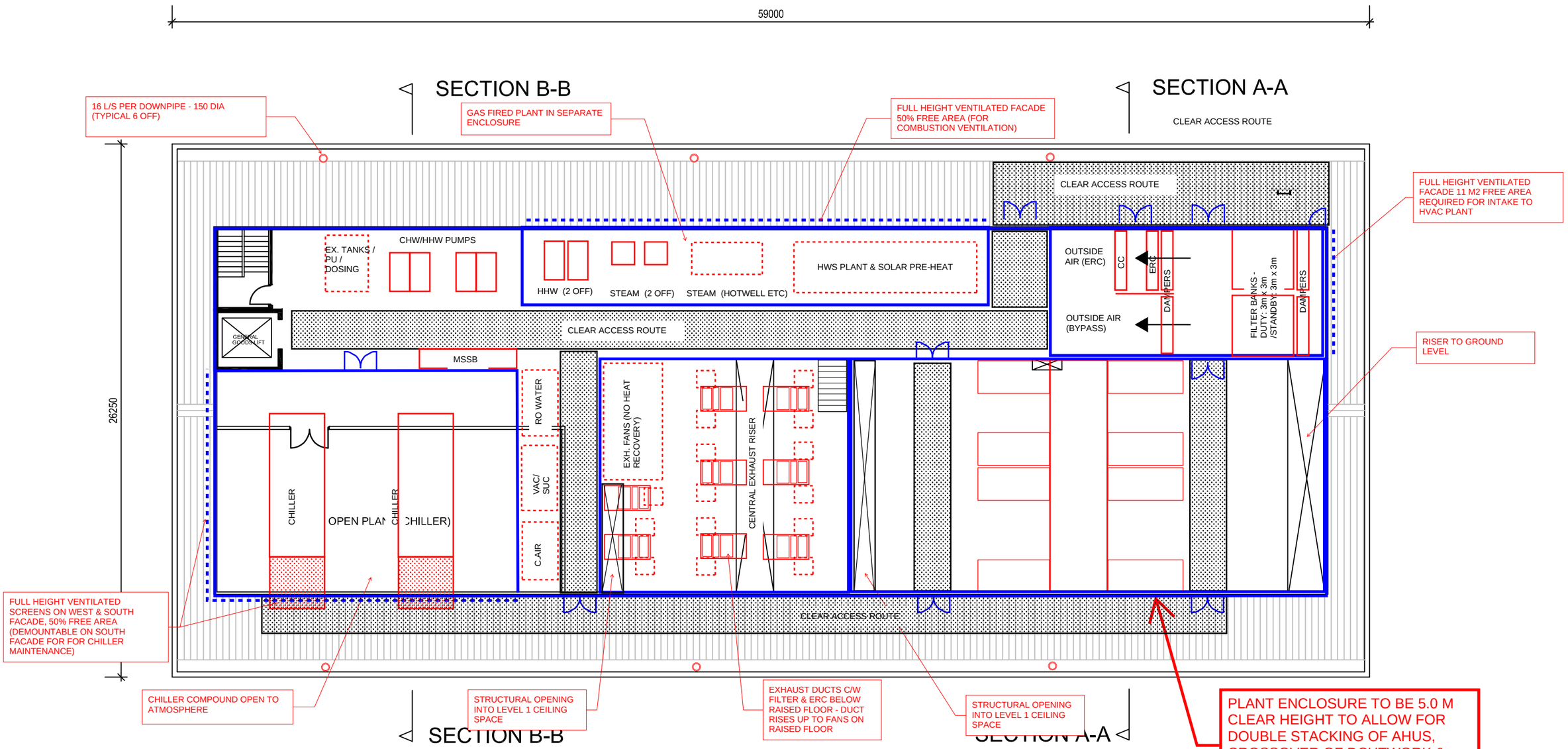
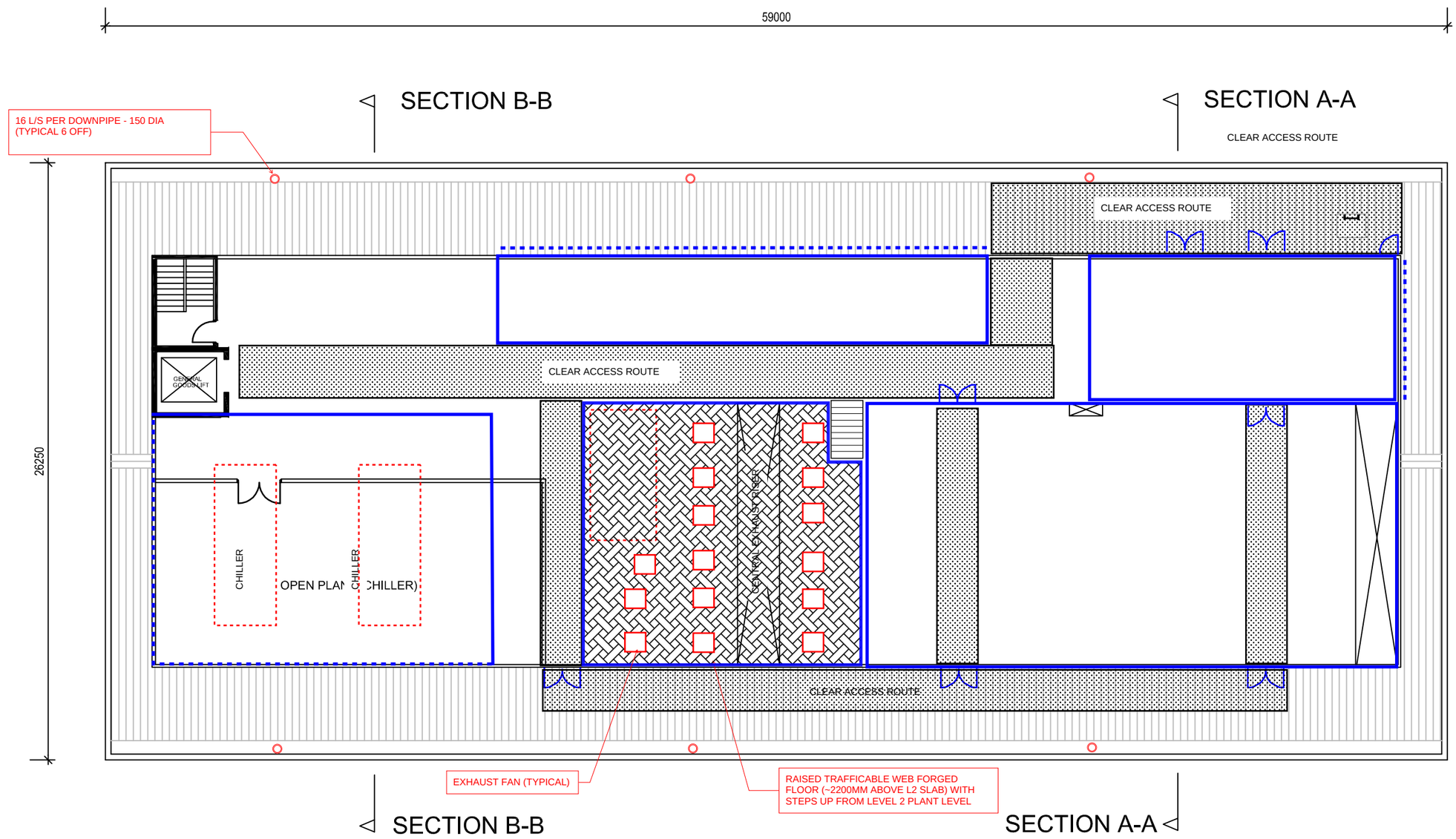
Appendix C – Site Plans



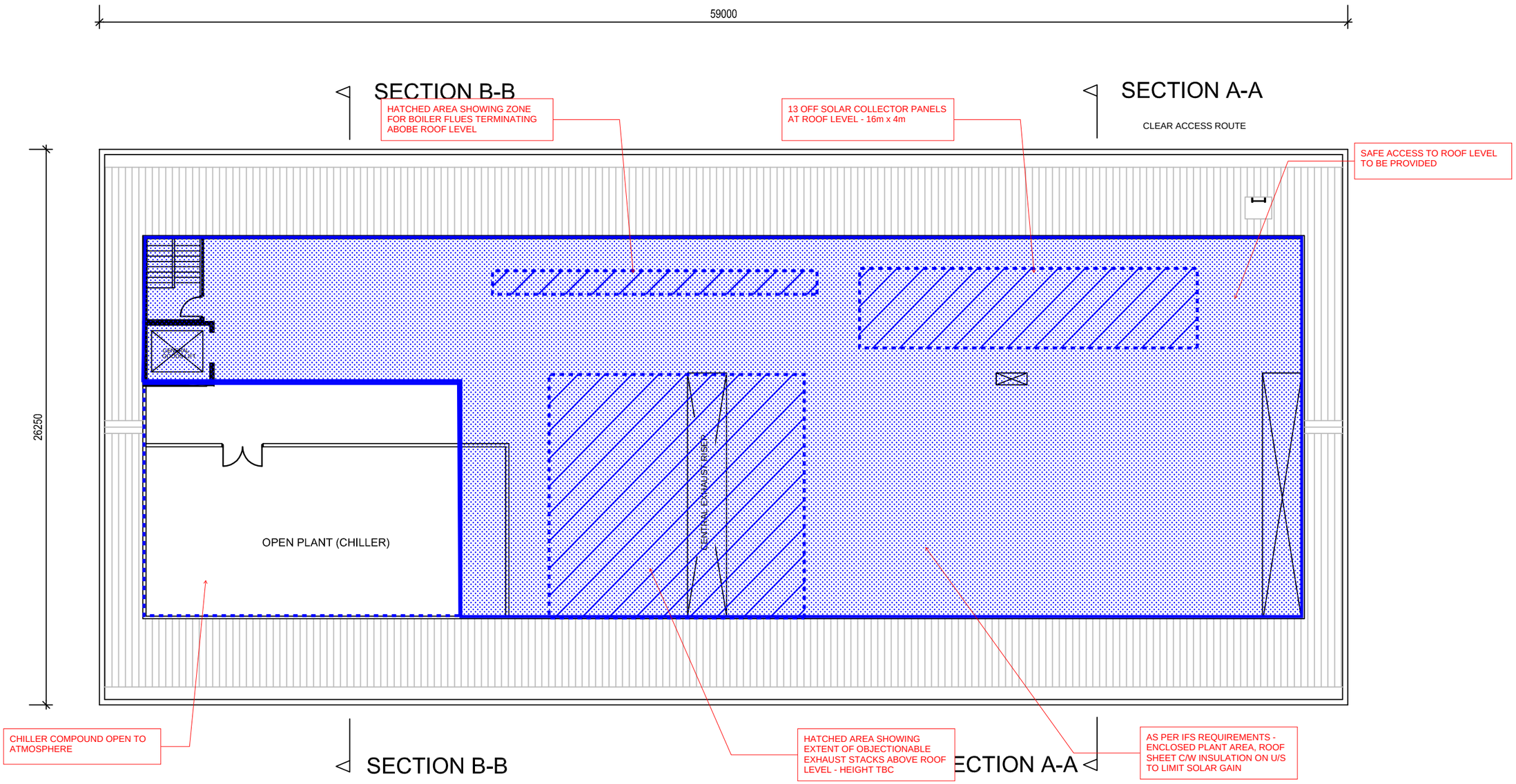
OPTION 2A

LEVEL 2 PLAN



OPTION 2A

LEVEL 2 PLAN



OPTION 2A

LEVEL 2 PLAN

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