

Harbourside

Extended Construction Hours Construction Noise and Vibration Management Plan

SSD-49295711 Mod-6

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Attention To	Mirvac Retail Sub SPV Pty Limited

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1 INTRODUCTION

This Plan has been developed in support of the proposed Mod-4 to SSD-49295711 consent relating to the detailed design, construction and operation of the Harbourside Tower and Podium Redevelopment. The modification proposal seeks permission to extend the approved construction hours within the consent for certain works, which have been identified and assessed within this assessment.

This Management Plan has been prepared to assess the noise and vibration impacts associated with the proposed changes to the consent, and provides mitigation advice where necessary to limit the impacts of these changes as much as feasible.

2 SITE DESCRIPTION

The Harbourside redevelopment site is located within the Darling Harbour Precinct inside the City of Sydney Local Government Area (LGA). The Darling Harbour Precinct remains Sydney's premier tourist and entertainment destination and accommodates varied recreation, tourism, entertainment, retail, residential apartments, and business land uses.

Specifically, the Harbourside redevelopment site occupies an area of approximately 2.05 hectares within the north western portion of Darling Harbour, in between Cockle Bay and the Pyrmont Peninsula. It is irregularly shaped and existing site improvements include the 2-3 storey Harbourside Shopping Centre.

The boundaries of the overall Harbourside redevelopment site are shown in Figure 1 below.



Figure 1: Harbourside Shopping Centre redevelopment site

3 NEAREST SENSITIVE RECEIVERS

The site is located at 2-10 Darling Drive, Darling Harbour. The site is bound to the north by Pyrmont Bridge, to the south by the Sofitel Sydney and the International Convention Centre (ICC), to the east by Darling Harbour and associated boardwalk/wharf and to the west by Darling Drive.

Figure 5 presents an aerial site map with figure 6 illustrating an eastern elevation of the proposed Harbourside development.

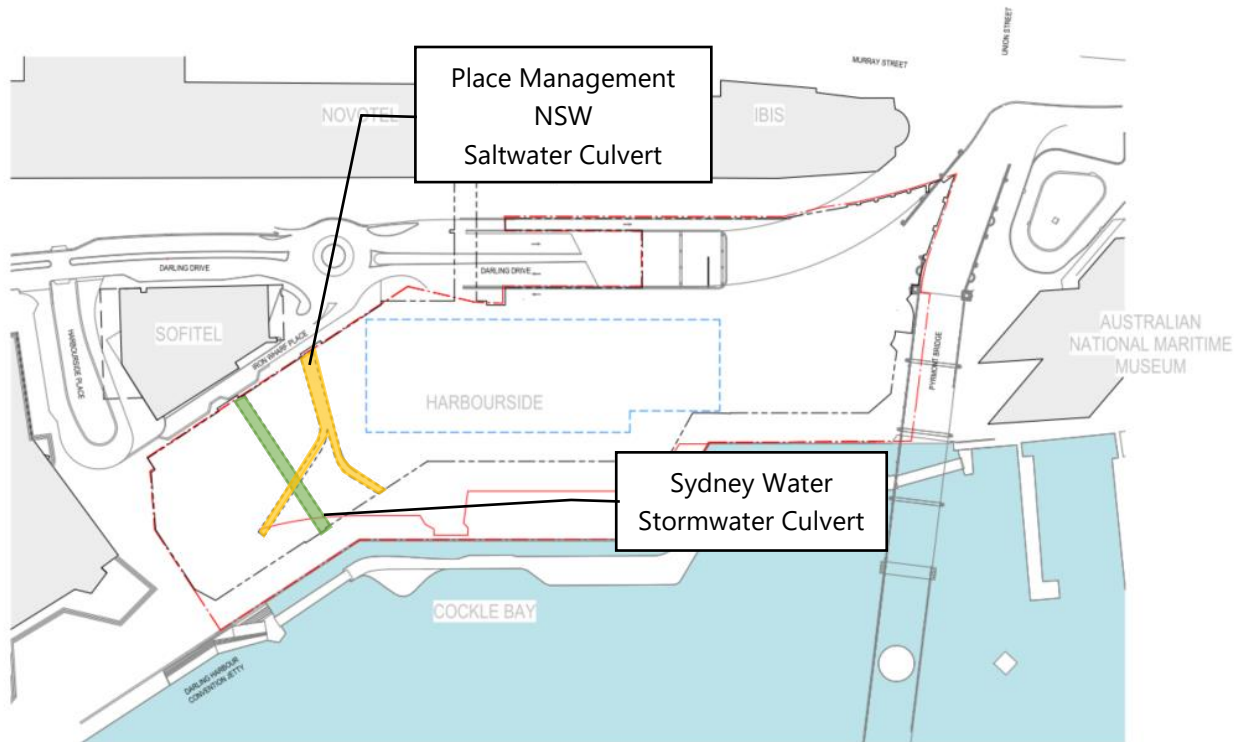


Figure 2: Aerial site map of the Harbourside project site

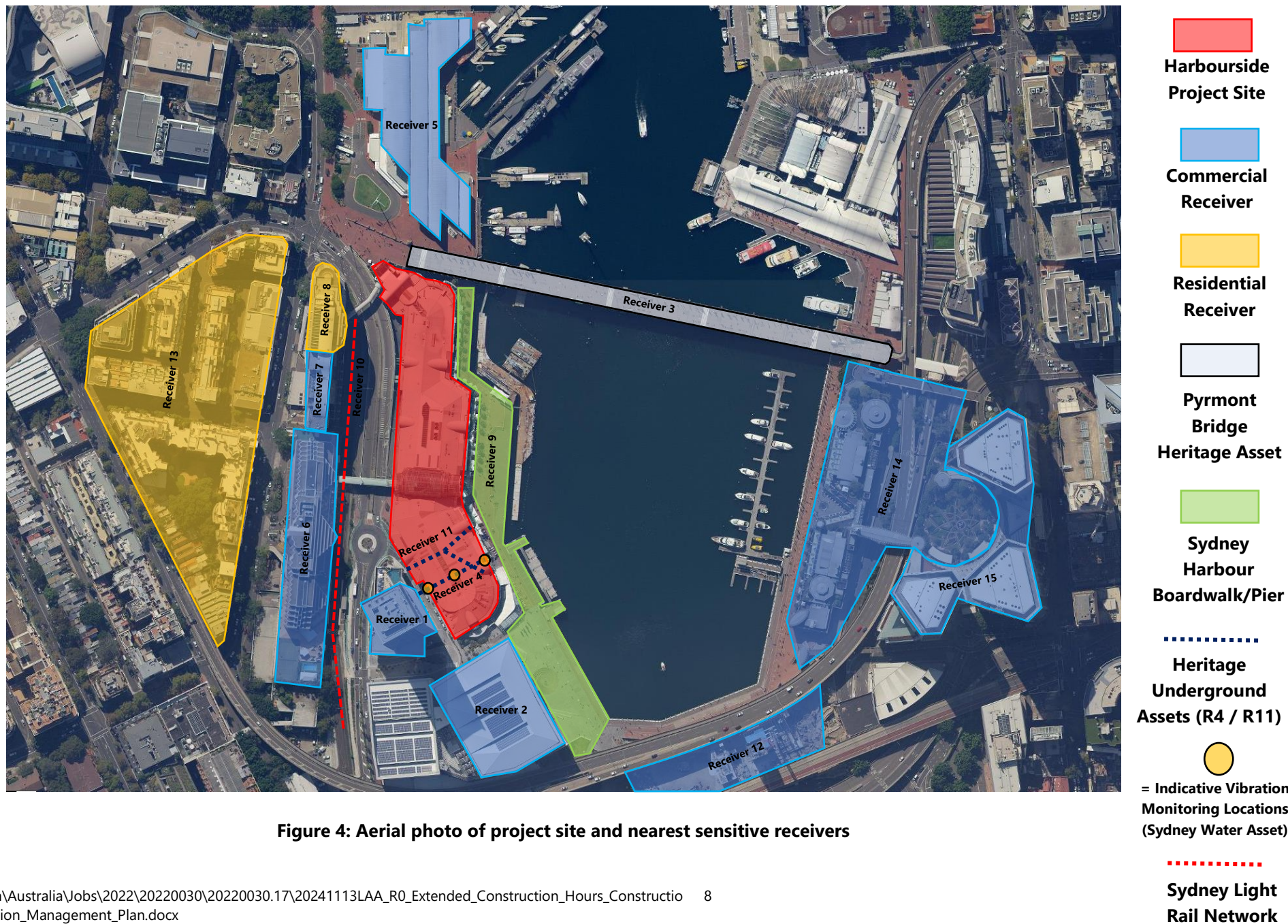


Figure 3: Eastern elevation of the proposed 'Harbourside' project site

The nearest potentially affected noise and vibration sensitive receivers immediate to the Harbourside redevelopment project site are:

- **Receiver 1:** The Sofitel Sydney Darling Harbour located at 12 Darling Drive, Darling Harbour. The commercial receiver is located to the south of the project site.
- **Receiver 2:** The International Convention Centre (ICC) located at 14 Darling Drive, Darling Harbour. The commercial receiver is located to the south of the project site.
- **Receiver 3:** The Pyrmont Bridge heritage asset located to the north of the project site.
- **Receiver 4(a):** The Sydney Water stormwater culvert (Upstream) located directly beneath the project site at 2-10 Darling Drive, Darling Harbour.
- **Receiver 4(b):** The Sydney Water stormwater culvert (Downstream) located directly beneath the project site at 2-10 Darling Drive, Darling Harbour.
- **Receiver 4(c):** The Sydney Water stormwater culvert (centre) located directly beneath the project site at 2-10 Darling Drive, Darling Harbour
- **Receiver 5:** The Australian National Maritime Museum located at 2 Murray Street, Darling Harbour. The museum is located to the north of the project site.
- **Receiver 6:** The Novotel Sydney on Darling Harbour located at 100 Murray Street, Pyrmont. The commercial receiver is located to the west of the project site.
- **Receiver 7:** The Ibis Sydney Darling Harbour located at 70 Murray Street, Pyrmont. The commercial receiver is located to the west of the project site.
- **Receiver 8:** The One Darling Harbour located at 50 Murray Street, Sydney. The residential receiver is located to the west of the project site.
- **Receiver 9:** The Darling Harbour boardwalk and associated wharf/pier located to the east of the project site.
- **Receiver 10:** Sydney light rail network and associated light rail station 'Convention' located to the west of the project site.
- **Receiver 11:** Heritage item Water Cooling System and Manifold (saltwater intake and discharge culvert), Place Management NSW asset.
- **Receiver 12:** "W Sydney," a hotel development located at 31 Wheat Road, Sydney, to the south-east of the project site.
- **Receiver 13:** A collection of residential receivers maintained to the west of the project site, across Murray Street.
- **Receiver 14:** "Cockle Bay Park," a proposed commercial development, including a 42-storey commercial and retail tower, maintained east of the project site, across Darling Harbour.
- **Receiver 15:** "Darling Park," three multi-storey commercial buildings to the east of the project site, across Darling Harbour.

An aerial photo is presented in figure 7 detailing the sensitive receiver locations.



4 PROPOSED AMENDMENTS TO SSD-49295711

Proposed amendments to SSD-49295711 have been outlined within the Section 4.55(1A) modification Application for, prepared by Ethos Urban, and have been reciprocated below for reference. The proposed amendments to the consent conditions E3, E4, E5 and E9 are provided below, noting that the proposed words to be deleted within the existing conditions are highlighted by ~~bold-strikethrough~~, whilst the additional wording is provided as **bold italics**.

HOURS OF CONSTRUCTION

E3. Construction, including the delivery of materials to and from the site, may only be carried out between the following hours:

(a) between 7am and 7pm, Mondays to Fridays inclusive;

(b) between 7am and 5pm, Saturdays; and

~~***(c) between 5pm and 6pm, Saturdays (internal works only).***~~

No work may be carried out on Sundays or public holidays.

E4. Construction activities may be undertaken outside of the hours in Condition E3 if required:

(a) by the Police or a public authority for the delivery of vehicles, plant or materials; or

(b) in an emergency to avoid the loss of life, damage to property or to prevent environmental harm.

~~***E5. Notification of such construction activities as referenced in Condition E4 this condition***~~ must be given to affected residents before undertaking the activities or, in the event of an emergency, as soon as is practical afterwards.

E5. Construction activities may also be undertaken outside of the hours in Condition E3 as follows:

(a) if a relevant utility service operator has advised the Applicant in writing that carrying out the works and activities would result in a high risk to the operation and integrity of the utility network.

(b) concrete pours or finishing works may finish after 6pm and no later than 10pm Monday to Friday on a maximum of two occasions per calendar month.

(c) hoist and crane climbing or dismantling between 8am and 5pm on Sunday for a maximum of two Sundays over the duration of the project where it can be demonstrated that the work cannot be undertaken during the standard construction hours in Condition E3.

(d) internal fit-out and services installations/commissioning up to 24 hours a day (excluding Sunday and public holidays) behind a closed façade.

Activities permitted in this condition are subject to the following:

(e) Should noise complaint(s) be received and the complaint(s) be confirmed as connected with this condition after being substantiated by the Department's Compliance Team, the construction work occurring during extended construction hours in Condition D5 above must cease and may not recommence until:-

i. compliance with the conditions of consent has been established

ii. compliance with the relevant noise management and mitigation measures identified in the Construction Noise and Vibration Management Sub-Plan (CNVMP) prepared under Condition D29 has been established; and

iii. it can be satisfactorily demonstrated to the Planning Secretary that any additional management and mitigation measures, as recommended by a qualified acoustic consultant, have been fully implemented.

(f) The Planning Secretary may suspend the works within the extended hours under this condition if substantiated complaints are received and are not resolved to the satisfaction of the Planning Secretary.

CONSTRUCTION NOISE MITIGATION

E9. The Applicant must ensure all construction vehicles (including concrete agitator trucks) do not arrive at the site or surrounding residential precincts outside of the construction hours of work outlined under Condition E3, except when permitted under Condition E5(b).

5 CONSTRUCTION ACTIVITIES

Proposed amendments to SSD-49295711 have been outlined within the Section 4.55(1A) modification Application for, prepared by Ethos Urban, and have been reciprocated below for reference. Specifically, the changes pertain to the provision of additional approved construction hours for the categories of works outlined within the following table:

Table 1 – Works Proposed to be Subject to Extended Construction Hours

Types of Work	Extended Hours Proposed
Works and activities where a relevant utility service operator has advised in writing that would result in a high risk to the operation of the utility network.	May now occur at any time as needed, when required to minimise potential risks and safety implications.
Concrete pours / finishing works.	May now occur between 6pm – 10pm on weekdays on no more than two occasions per calendar month.
Hoist and crane climbing / dismantling.	May now occur between 8am and 5pm on Sunday for a maximum of two Sundays over the duration of the project.
Internal fit-out and services installation / commissioning works.	May now occur 24 hours a day, excluding Sunday and public holidays, where the works occur behind a closed façade.

Refer to figure 5 for the proposed vehicle travel path and figure 6 for the proposed crane location plan.

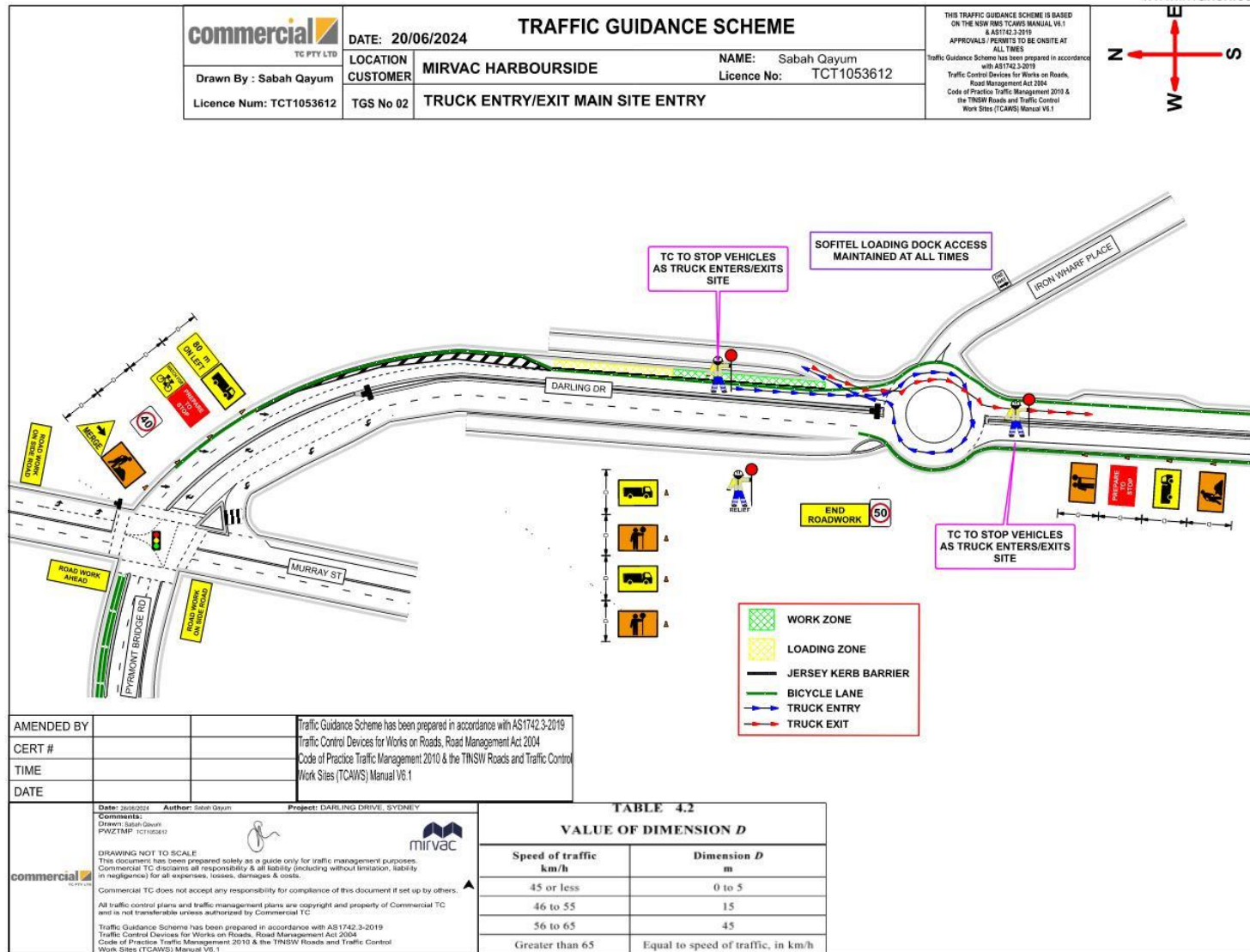
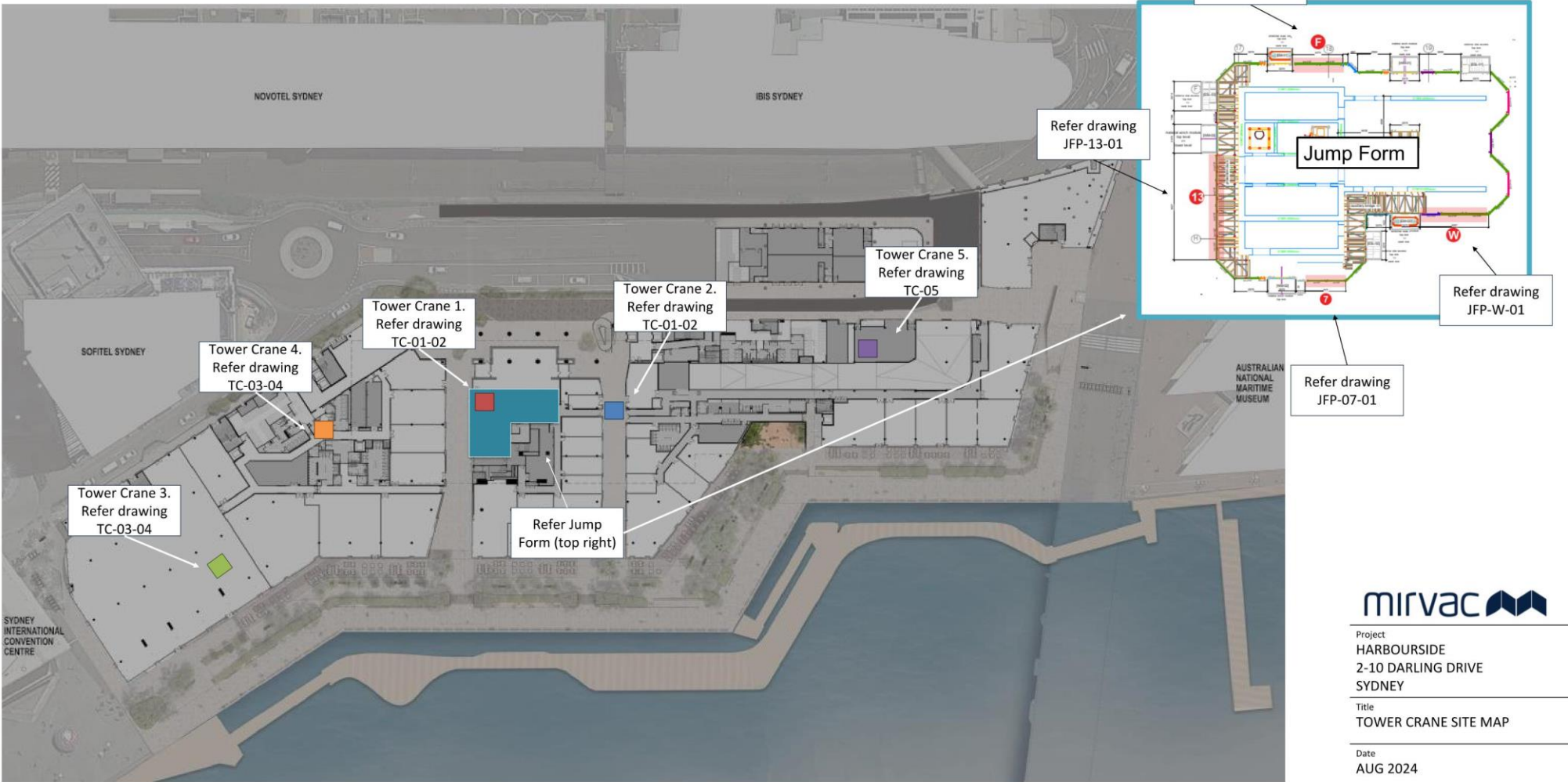


Figure 5: Proposed Vehicle Travel Path

HARBOURSIDE TOWER CRANE SIGNAGE



Project
HARBOURSIDE
2-10 DARLING DRIVE
SYDNEY

Title
TOWER CRANE SITE MAP

Date
AUG 2024

Drawing Number TCSM-01	Revision 1.0
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Figure 6: Proposed Tower Crane Layout

6 EXISTING BACKGROUND NOISE LEVELS

Information pertaining background noise monitoring and measurements have been summarised with relevant DA acoustic documentation submitted and approved for SSD-49295711. Background noise levels relevant to the assessment provided within this management plan have been provided below for reference.

Table 6-1 – Measured Rating Background Noise Levels

Monitor Location	Rating Background Noise Level dB(A) _{L90(Period)}		
	Day (7am – 6pm)	Evening (6pm – 10pm)	Night (10pm – 7am)
U204, 50 Murray Street, Pyrmont	53	54 (53)**	48
U1302, 50 Murray Street, Pyrmont	59	59	52
Western façade of the Novotel, Level 2, 100 Murray Street, Pyrmont	57	57	52
Cockle Bay – North-Eastern Corner Level 2 (2021)*	68	60	52
Cockle Bay – South-Eastern Corner Level 2 (2021)*	63	57	48

*Monitoring conducted for previous development (Cockle Bay Park).

**In line with the requirements of EPA document, "Noise Policy for Industry 2017," evening monitoring data has been corrected to be equal to the noise levels observed during the day at the monitoring location.

7 CONSTRUCTION NOISE CRITERIA

Construction noise criteria will be developed with reference to:

- City of Sydney Council – Code of Practice for Construction Hours/Noise within the Central Business District 1992, and
- Australian Standard AS2436:2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites

The relevant requirements of the above documents are summarised in the following sections.

7.1 CITY OF SYDNEY COUNCIL – CODE OF PRACTICE FOR CONSTRUCTION HOURS/NOISE WITHIN THE CENTRAL BUSINESS DISTRICT 1992

The Council of The City of Sydney code of practice establishes various categories for construction works based on the time of day they are undertaken, as detailed below. Time periods relevant to the contents of this management plan have been highlighted within the below table, noting that time periods maintained within the approved consent hours have been omitted.

Table 7-1 – Categories of Working Hours and Noise Levels

Day	Time Zone	Category	Noise Limit dB(A) $L_{Av, Max(15min)}$
Monday to Friday	00.00 – 07.00	4	Background + 0 dB(A)
	07.00 – 08.00	1	Background + 5dB(A)
	08.00 – 19.00	1	Background + 5dB(A) + 5 dB(A) (to be determined on a site basis)
	19.00 – 23.00	2	Background + 3 dB(A)
	23.00 – 24.00	4	Background + 0dB(A)
Saturday	00.00 – 07.00	4	Background + 0dB(A)
	07.00 – 08.00	1	Background + 5dB(A)
	08.00 – 17.00	1	Background + 5dB(A) + 5 dB(A) (to be determined on a site basis)
	17.00 – 23.00	2	Background + 3 dB(A)
	23.00 – 24.00	4	Background + 0dB(A)
Sundays and Public Holidays	00.00 – 07.00	4	Background + 0dB(A)
	07.00 – 17.00	3	Background + 3 dB(A)
	17.00 – 24.00	4	Background + 0dB(A)

7.1.1 Australian Standard AS2436:2010 "Guide to Noise Control on Construction, Maintenance and Demolition Sites"

Australian Standard AS2436 states that where all reasonable and available measures have been taken to reduce construction noise, mitigation strategies may be put in place to reduce levels noise levels to within a reasonable and acceptable level.

For the control and regulation of noise from construction sites, AS2436 nominates the following:

- a. That reasonable suitable noise criterion is established,*
- b. That all practicable measures be taken on the building site to regulate noise emissions, including the siting of noisy static processes to locations of the site where they can be shielded, selecting less noisy processes, and if required regulating construction hours, and*
- c. The undertaking of noise monitoring where non-compliance occurs to assist in the management and control of noise emission from the construction site.*

The guideline reflects on feasible and reasonable mitigation strategies, management controls and public liaising in the effort to reach realistic compromises between construction sites and potential noise affected receivers.

Based on these criteria the following procedure will be used to assess noise emissions:

- Predict noise levels produced by typical construction activities at the sensitive receivers.
- Adopt management conditions as per AS2436 in the event of a non-compliance.

7.2 SUMMARY OF RELEVANT CONSTRUCTION NOISE LEVELS

A summary is presented in table 3 of the adopted construction noise management levels.

Table 7-2 – Summarised Construction Noise Requirements During Proposed Hours

Receiver	Period/Time	Measured Background Noise Level dB(A)L ₉₀	Construction Noise Management Levels dB(A)L _{10(15min)}
R1, R2, R6, R7, R13	Monday – Friday 7pm – 10pm	57	60
	Saturday 6pm – 10pm		
	Monday – Saturday 10pm – 11pm	52	55
	Monday – Saturday 11pm – 7am		52
	Sunday 8am – 5pm	56	59
R5, R8	Monday – Friday 7pm – 10pm	53	56
	Saturday 6pm – 10pm	55	58
	Monday – Saturday 10pm – 11pm	48	51
	Monday – Saturday 11pm – 7am	48	48
	Sunday 8am – 5pm	53	56
R12, R14, R15	Monday – Friday 7pm – 10pm	57	60
	Saturday 6pm – 10pm		
	Monday – Saturday 10pm – 11pm	48	51
	Monday – Saturday 11pm – 7am		48
	Sunday 8am – 5pm	62	65

7.3 VIBRATION

Vibrations caused by any proposed activities on site, at the façade or incident on the structure of any surrounding sensitive receivers including infrastructure and heritage items, will be assessed against the following provisions:

For buildings

- For structural damage to heritage buildings, German Standard DIN 4150-3 *Structural Vibration: Effects of Vibration on Structures*.
- For structural damage to buildings (excluding heritage buildings), British Standard BS 7385 Part 2-1993 *Evaluation and Measurement for Vibration in Buildings. Part 2. Guide to damage levels from groundborne vibration*

For Human Response to Vibration

- For human exposure to vibration, the evaluation criteria presented in NSW Environmental Protection Authority (EPA) "Assessing Vibration: A Technical Guideline".

For below Ground Assets (Culverts)

- For structural damage to heritage buildings, German Standard DIN 4150-3 *Structural Vibration: Effects of Vibration on Structures*.
- Requirements of Sydney Water 'Sydney Water Specialist Engineering Assessment

For the Light Rail Corridor

- British Standard BS 7385 Part 2-1993 *Evaluation and Measurement for Vibration in Buildings. Part 2. Guide to damage levels from groundborne vibration*
- Transport for NSW Standard "Development Near Rail Tunnels" (Ref: T HR CI 12051 ST); and

The criteria and the application of these guidelines are discussed in separate sections below. Note that this SSDA relates to the main works only, all excavation works to be undertaken via SSDA 1 where vibration has been addressed as part of the reports submitted in support of that application.

7.3.1 German Standard DIN 4150-3 (1990)

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in Table 4.

It is noted that the peak velocity is the absolute value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 7-3 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

TYPE OF STRUCTURE		PEAK PARTICLE VELOCITY (mms ⁻¹)			
		At Foundation at a Frequency of			Plane of Floor of Uppermost Storey
		< 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used in 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 Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

- = Receiver 8 & 13
- = Receivers 3, 4a, 4b, 4c, 9 & 11
- = Receivers 1, 2, 5, 6, 7, 12, 14 & 15

7.3.2 British Standard BS 7385 Part 2-1993

British Standard BS 7385 Part 2-1993 *Evaluation and Measurement for Vibration in Buildings. Part 2. Guide to damage levels from groundborne vibration* presents vibration guide values to determine the effect of ground movement on structures. The values in BS7385-2 are directly reproduced in Australian Standard AS2187.2.

The guidelines are presented in the table below:

Table 7-4 BS 7385-2 - Guideline for Building Vibration

Line	Type of Building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz – 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 structure. Residential or light commercial type buildings	15 mm/s at 4 Hz and above increasing to 20mm/s at 15 Hz	20 mm/s at 4 Hz and above increasing to 50mm/s at 40 Hz and above

Notes:

1. Values referred to are at the base of the building
2. For line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 mm ZTP (zero to peak) should not be exceeded.

7.3.3 NSW EPA Assessing Vibration: A Technical Guideline

The NSW Environment Protection Authority's (EPA) publication "Assessing Vibration: A Technical Guideline" (Feb 2006), outlines vibration criteria to assess the effects on human exposure to vibration from industry, transportation and machinery. This will ensure the amenity of tenants within surrounding residential properties is not adversely impacted.

This document classifies vibrations in buildings into continuous (with magnitudes varying or remaining constant with time), impulsive (such as shocks) or intermittent (with the magnitude of each event being either constant or varying with time). Criteria stipulated in this publication is based on the type of vibrations generated by the source.

Criteria relevant to the proposed construction activities on site are detailed below.

Table 7-5 – EPA Recommended Human Comfort Vibration Criteria

		RMS acceleration (m/s ²)		RMS velocity (mm/s)		Peak velocity (mm/s)	
Place	Time	Preferred	Maximum	Preferred	Maximum	Preferred	Maximum
Continuous Vibration							
Residences	Daytime	0.01	0.02	0.2	0.4	0.28	0.56
Offices		0.02	0.04	0.4	0.8	0.56	1.1
Workshops		0.04	0.08	0.8	1.6	1.1	2.2
Impulsive Vibration							
Residences	Daytime	0.3	0.6	6.0	12.0	8.6	17.0
Offices		0.64	1.28	13.0	26.0	18.0	36.0
Workshops		0.64	1.28	13.0	26.0	18.0	36.0

7.3.4 Requirements of Sydney Water ‘Sydney Water Specialist Engineering Assessment’

The vibration limits presented in Table 7 are detailed within the ‘*Sydney Water Specialist Engineering Assessment*’ document for threshold vibration limits of pipe assets. It has been identified to this office that there is an existing Sydney Water stormwater culvert and associated pipework located directly beneath the Harbourside project site.

Table 7-6 – Threshold Vibration Limits

Asset Type	Threshold values for velocity (PPV) measured on the asset in mm/s
Brittle Pipe assets – RC, VC/EW, CICL	Maximum PPV for intermittent vibrations 10mm/s Maximum PPV for continuous vibrations 5mm/s
Ductile Pipe assets – SCL, DI, PVC, PE, PP, GRP	Maximum PPV for intermittent vibrations 20mm/s Maximum PPV for continuous vibrations 10mm/s
Masonry	3mm/s
Unreinforced Concrete	3mm/s

Note: The table above is applicable for buried assets, in sound condition, and laid in a typical soil trench in stable ground. Alternative criteria shall be development for other asset types, above ground assets, concrete encased pipes, pipes on piled/special supports and pipes in tunnels or of other unusual construction or ground conditions.

Given the above vibration limits as outlined in the ‘*Sydney Water Specialist Engineering Assessment*’ and the information provided in the ‘*Stormwater Culvert beneath Harbourside Pre-Construction Dilapidation and Condition Assessment Report*’ (Ref: 8824.20.01 Pre-Construction Dilapidation and Condition Assessment Report) dated 25/02/2022, the following vibration limits are applicable to the stormwater culvert:

- Stormwater Culvert (Receiver 4):
 - Maximum PPV for intermittent vibrations: 10mm/s PPV.
 - Maximum PPV for continuous vibrations: 5mm/s PPV.
- Associated pipework:
 - Assumed to be unreinforced concrete: Maximum PPV for continuous vibrations: 3mm/s PPV.

Sydney Water sewer & water supply pipework is also contained adjacent the development to the west, with sewer pipework running along Darling Drive. Supply pipework is adjacent to sewer mains, however also wraps around the building at the northern and southern extents. Review of potential impacts to these assets has been undertaken by Douglas Partners (CN197993) in consultation with Sydney Water. Their review concluded that impacts on these assets was negligible, and therefore specific monitoring would not be required.

The heritage item saltwater culvert on the southern end of the Harbourside development (Receiver 11) is addressed in the *Heritage Impact Statement and Archaeological Impact Statement* prepared by Curio Projects (April 2022). The item is noted as having structural integrity, and when last used (c1990) was noted to be in good condition and substantially intact. Notwithstanding, and given the heritage significance of the culvert, the lowest vibration level identified in the Sydney Water assessment will be adopted. We also note that this is in line with the lower range of the DIN 4150-3 recommended levels for heritage structures.

- Water Cooling System and Manifold
 - Maximum PPV for continuous vibrations: 3mm/s PPV.

7.3.5 Vibration Impacts to Light Rail Assets

7.3.5.1 Transport for NSW Development Near Rail Tunnels (T HR CI 12051 ST)

NSW Government Transport Asset Standards Authority Standard *Development Near Rail Tunnels* dated 15 November 2018 states:

Any development that occurs within a distance of 25 m horizontally from first reserve shall assess the vibration on the rail tunnels. The assessment criteria shall be a maximum peak particle velocity (PPV) of 15 mm/s at the tunnel lining for brick or mass concrete in good condition or a maximum PPV of 20 mm/s at the tunnel lining for cast iron, steel or concrete segment lining

7.3.5.2 Summary of Light Rail Vibration Criteria

Considering the relevant guidelines for impact to light rail, we note:

- BS7385-2 provides reference for the point at which vibration is likely to cause structural damage. Considering the disruption structural damage to the light rail infrastructure would provide, vibration should be below this level at all times.
- The TfNSW guideline relating to train tunnels provides further guidance on an appropriate maximum level of vibration that is acceptable to buried rail assets (as opposed to on grade lines). This level is nominated as a maximum of 20mm/s PPV, which is consistent with the upper limits of BS7385-2.
- Based on the above, a maximum/stop work PPV vibration level of 15mm/s is considered acceptable to protect the light rail infrastructure.

7.3.6 Summary of Recommended Vibration Limits

The recommended vibration limit at the nearest vibration sensitive receivers are summarised in table 8.

Table 7-7 – Recommended Vibration Limit Criteria

Receiver Location	Vibration Limit Criteria (mm/s PPV)
Receiver 1	≤20
Receiver 2	≤20
Receiver 3	≤3
Receiver 4	≤3
Receiver 5	≤20
Receiver 6	≤20
Receiver 7	≤20
Receiver 8	≤5
Receiver 9	≤3
Receiver 10	≤15
Receiver 11	≤3
Receiver 12	≤20
Receiver 13	≤5
Receiver 14	≤20
Receiver 15	≤20

8 ACTIVITIES TO BE CONDUCTED AND THE ASSOCIATED NOISE SOURCES

Noise impacts will be determined from primary processes and equipment. The sound power levels of these activities are presented below.

Table 8-1 - Sound Power Levels of the Proposed Equipment

Stage	Equipment/Process	Sound Power Level dB(A)
Concrete Pouring / Finishing	Concrete Tower Boom Pump	108
	Concrete Pumps	108
	Concrete Truck Movements	105
	Concrete Truck Idle	105
	Helicopter Trowel	100
Crane Removal	Diesel Crane	105
	Mini Crane	95
	Mobile Crane	105
Utilities Servicing	General Hand Tools	95
	Angle Grinder	105
	Cherry Picker	95
Internal fit-out and Services Works / Commissioning*	General Hand Tools	95
	Drill	95
	Angle Grinder	105

**Works in stage pertaining only to internal works behind a closed façade.*

The noise levels presented in the above table are derived from the following sources, namely:

- Table A1 of Australian Standard 2436-2010.
- Data held by this office from other similar studies.

9 NOISE EMISSION ASSESSMENT

9.1 PREDICTED NOISE EMISSIONS

An assessment of the principal sources of noise emissions has been undertaken to identify the activities that may produce noise and/or vibration impacts so that appropriate ameliorative measures can be formulated. In addition, SoundPLAN noise modelling has been conducted based on information provided to this office of construction methodology and activities likely to be undertaken and presents the cumulative predicted external noise levels to the nearest surrounding receivers.

Noise levels from construction works have been predicted at the nearby development and assessed with reference to the City of Sydney - Code of Practice for Construction Hours/Noise Within the Central Business District 1992.

With regard to the noise level generated at the nearest receivers, noise levels will vary depending where on the construction site the work is undertaken. To address this, a range of predicted noise levels is provided. Predicted noise levels are presented below.

The predicted noise levels are based on the assumption that the recommendations in section 9 have been implemented/observed.

9.2 SOUNDPLAN MODELLING

Noise levels have been predicted at the receiver locations using SoundPLAN™ 8.0 modelling software implementing the ISO 9613-2:1996 "Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation" noise propagation standard.

Noise enhancing meteorological effects have been adopted as recommended by the NPfI, noting that the ISO 9613 modelling approach assumes that all receivers are 'downwind' (i.e., that noise enhancing wind conditions are in effect at all times).

Ground absorption was conservatively calculated with a ground factor of 0 for all areas except for localised lawns and greenery with a ground factor of 0.6 as recommended in *Engineering Noise Control* (Bies & Hanson).

In line with Factsheet C of the NPfI, penalties for annoying noise characteristics should be applied at the receiver, where applicable. Based on the predicted noise levels, no penalty should be applied (either for tonality, intermittency, or otherwise).

The following figures present the results of the SoundPLAN Noise modelling, and results are summarised in Table 9-1.

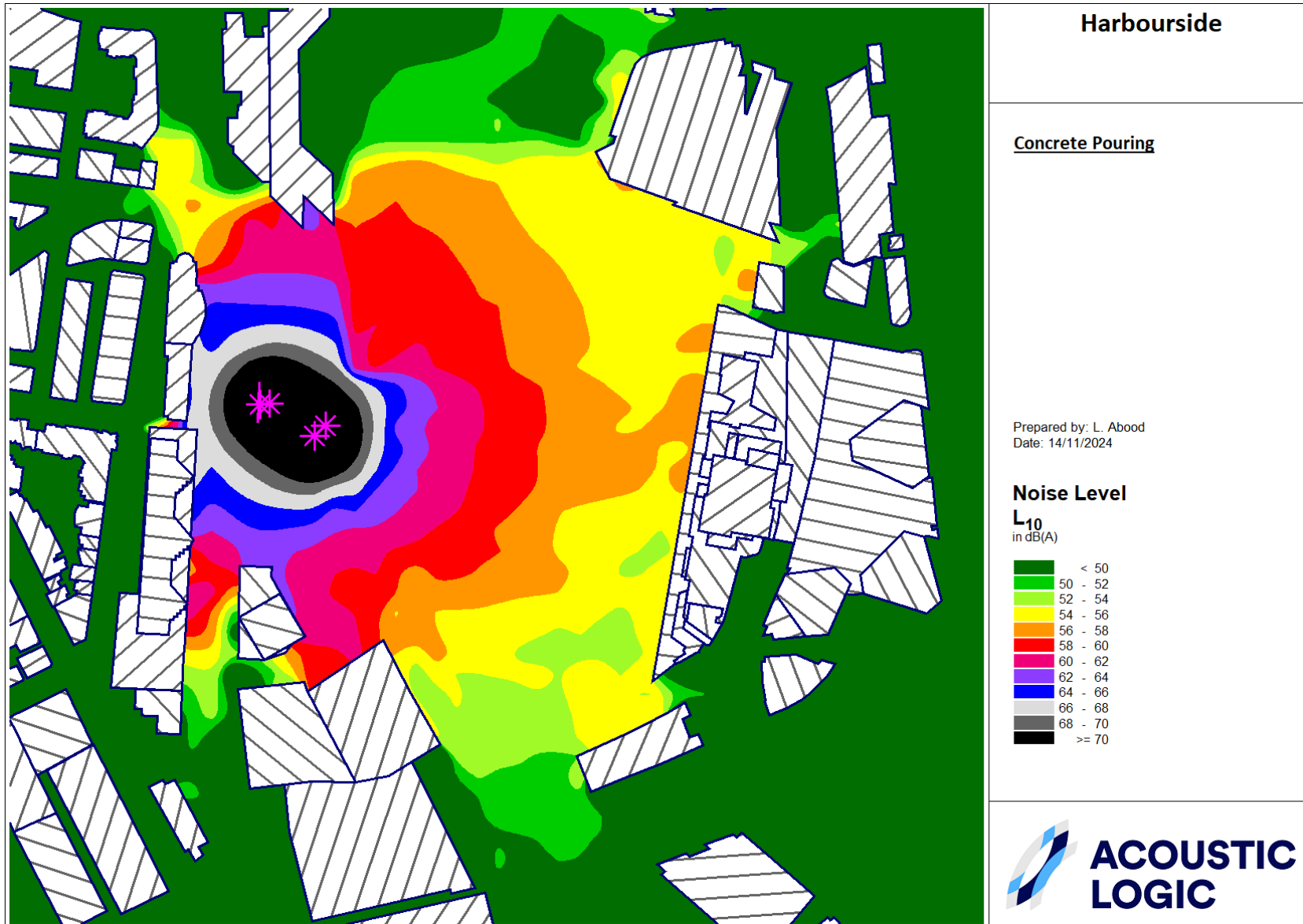


Figure 7: Concrete Pouring and Finishing Works

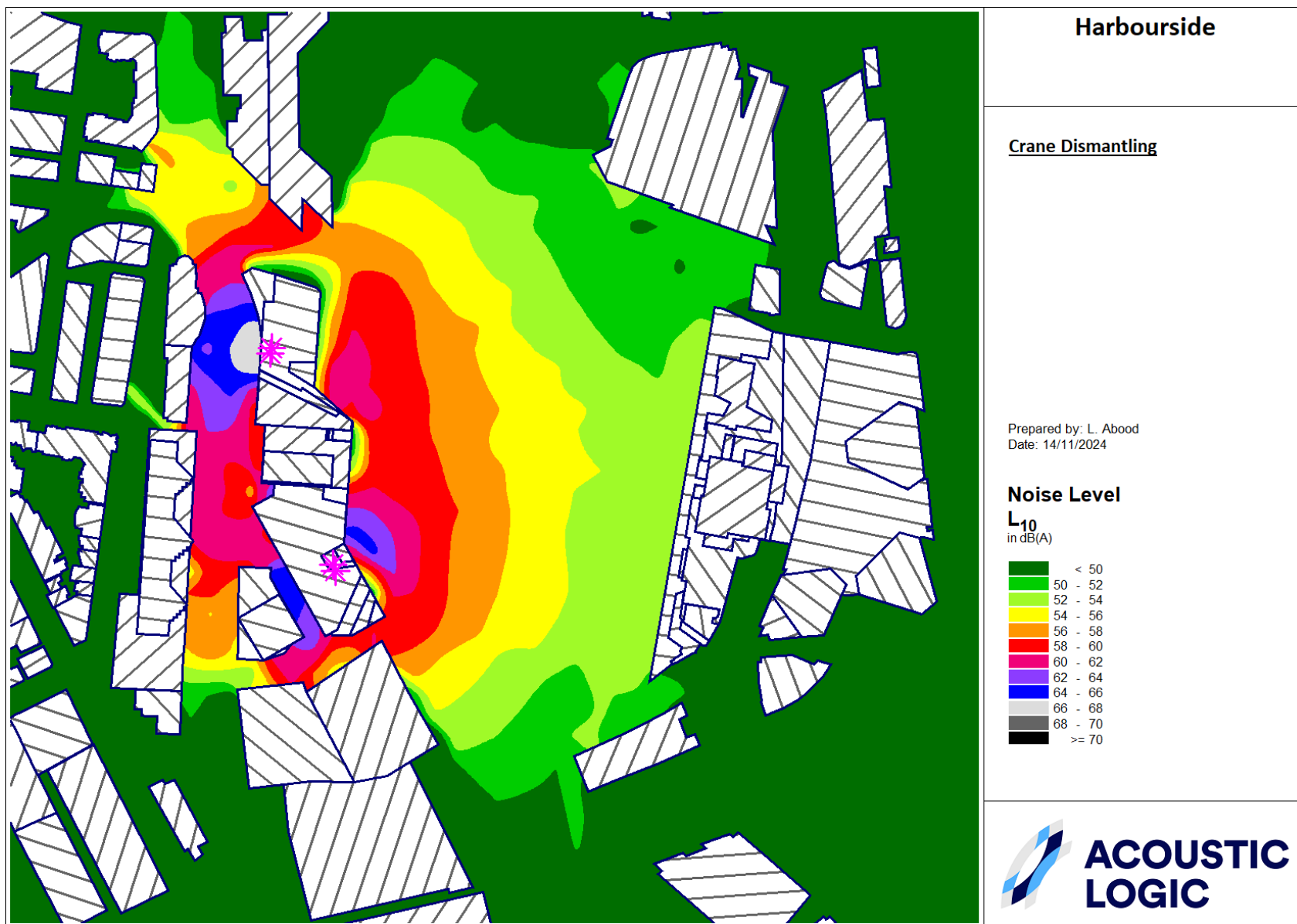


Figure 8: Crane Dismantling Works

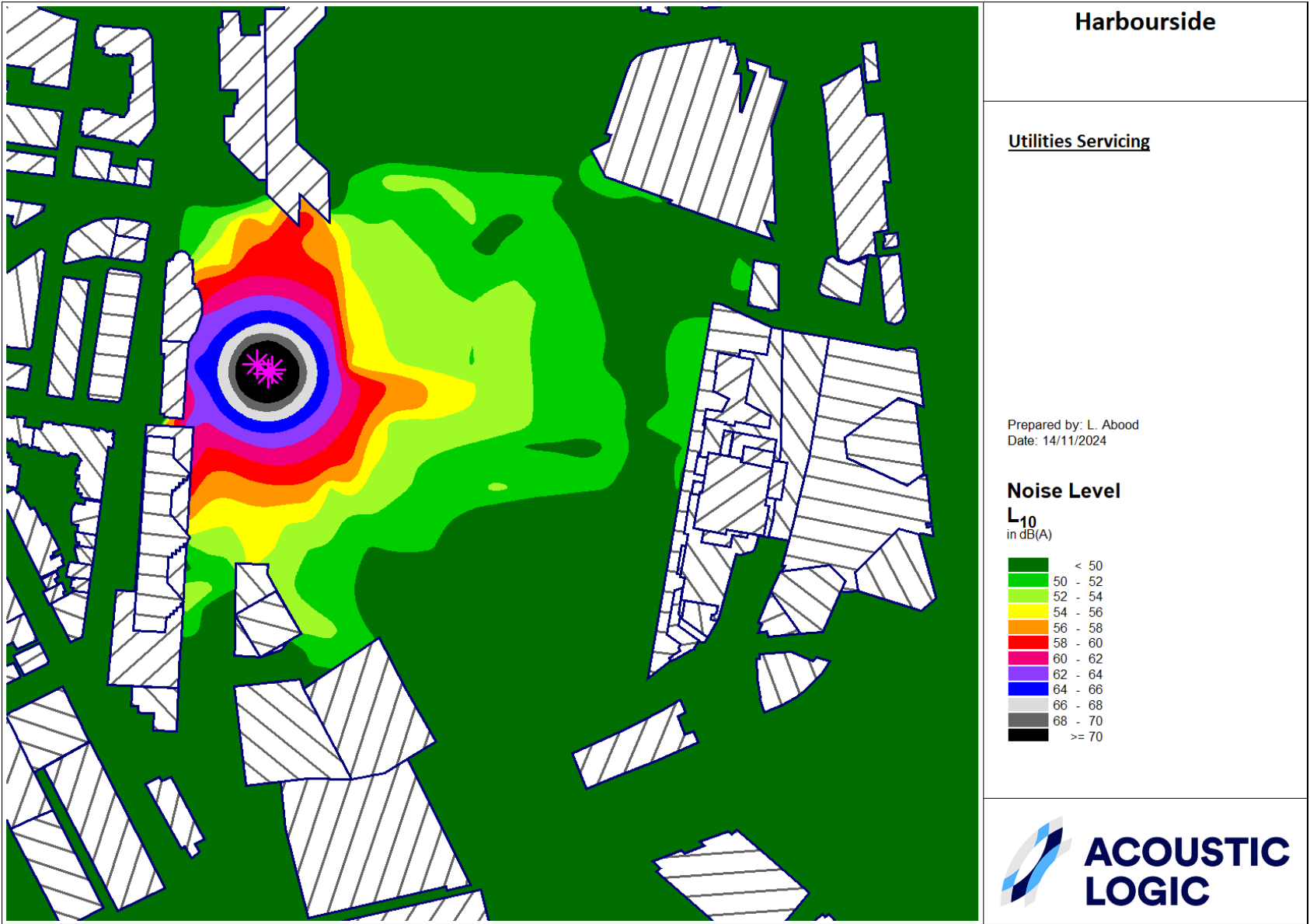


Figure 9: Utilities Services Works

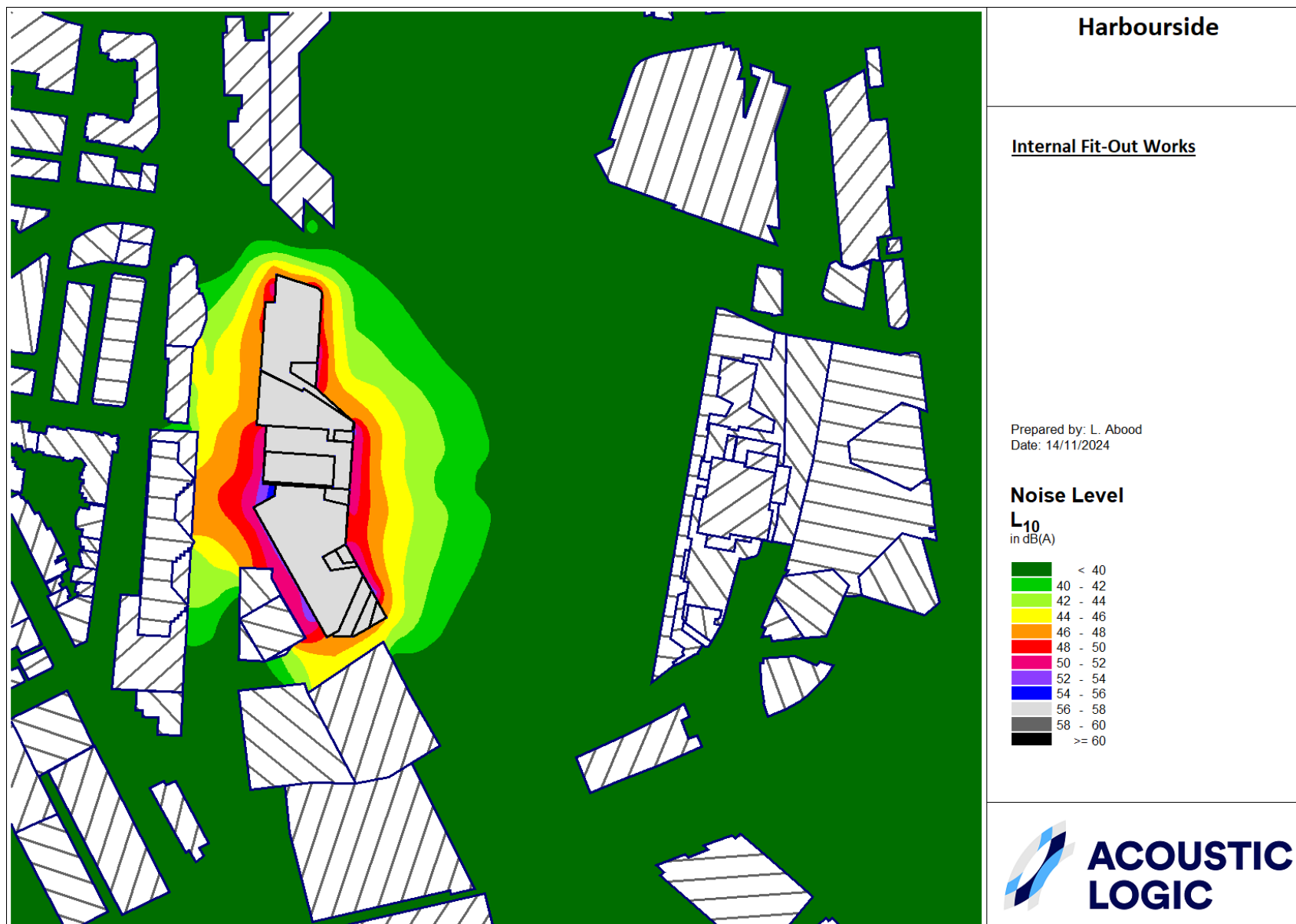


Figure 10: Internal Fit-Out, Services and Commissioning Works

Table 9-1 - Predicted External Noise Levels at Nearest Sensitive Receivers

Receiver	Concrete Pouring / Finishing		Crane Removal		Utilities Servicing		Internal Fit-Out, Services and Commissioning		Comments
	Predicted External Noise Levels	Noise Management Level	Predicted External Noise Levels	Noise Management Level	Predicted External Noise Levels	Noise Management Level	Predicted External Noise Levels	Noise Management Level	
	dB(A) L ₁₀ (15 min)								
R1	<40-63	≤ 60	≤ 62	≤ 59	≤ 55	≤ 52	≤ 45	≤ 52	Potential for noise levels to be above NMLs during concrete pouring, crane removal and utilities for some receivers; See following sections for ameliorative treatments. Noise levels meet the NMLs during Internal Works.
R2	<40-60		≤ 50		≤ 52		≤ 40		
R5	<40-61	≤ 56	≤ 60	≤ 56	≤ 59	≤ 48	≤ 41	≤ 48	
R6	<40-66	≤ 60	≤ 61	≤ 59	≤ 62	≤ 52	≤ 47	≤ 52	
R7	<40-65		≤ 64		≤ 63		≤ 45		
R8	<40-64	≤ 56	≤ 65	≤ 56	≤ 64	≤ 48	≤ 48	≤ 48	
R12	<40-52	≤ 60	≤ 52	≤ 65	≤ 50		≤ 40		
R13	<40-60		≤ 54	≤ 59	≤ 50	≤ 52			
R14	<40-54		≤ 65	≤ 52	≤ 48	≤ 48			
R15	<40-50			≤ 50				≤ 50	

9.3 NOISE IMPACTS DISCUSSION

Resultant external noise levels are predicted to potentially be above the NMLs for the following scenarios and following receivers:

- Concrete Pouring and Finishing Works; R1, R5 (Note works are outside of the operational hours of the Maritime Museum,) R6, R7 and R8.
- Crane Dismantling Works; R1, R5, R6, R7 and R8.
- Utilities Servicing Works; R1, R5 (Note works are outside of the operational hours of the Maritime Museum,) R6, R7, R8, R12 and R14.

With respect to the impacts of these works, we note the following:

- Modelling scenarios present an absolute worst case load scenario for the works and assume that there is no built form or trenching providing barrier attenuation to surrounding sensitive receivers. It is anticipated that the resultant noise levels at receiving locations will be lower in practice than those predicted and summarised above.
- Further, all internal works are not anticipated to result in noise levels above NMLs at any time at any surrounding noise sensitive receivers. Hence, as the project's built form develops, it is expected that the barrier attenuation impacting the noise emission generation from the works will increase, and hence the airborne noise impacts of the works will decrease.
- Noise levels are generally only marginally above NMLs for the receivers listed above at worst-case receiver locations, and only above NMLs along façades facing towards the project site. Predicted external noise levels for the majority of area within the receivers listed above are below the NMLs applicable to the receiver generally.
- Works are scheduled for limited time periods only, noting that concrete pouring works are to be limited to two nights per month, crane dismantling works are limited to only two Sundays across the life of the project, and Utilities servicing will only occur where required for safety purposes.
- Based on these items, AL conclude that the noise impacts associated with the Modification proposal are anticipated to be reasonable.
- Additional attenuation measures are recommended in proceeding sections to further control the impacts of the works on surrounding noise sensitive receivers.

10 AMELIORATIVE MEASURES

The following section presents specific and generalised ameliorative treatments that may be incorporated to control the amenity impacts of construction activity on surrounding noise-sensitive receivers.

10.1 SITE SPECIFIC RECOMMENDATIONS

- Notification - Prior to commencement of external works during the nighttime period (10pm-7am) as required by Utilities Services works, neighbouring residential receivers should be notified of the anticipated works and the potential noise and vibration generation from the activity. Anticipated timeframes should also be provided.
- Vehicle Noise – Where feasible, trucks should turn off their engines rather than idling to reduce impacts on nearby receivers (unless truck ignition needs to remain on during concrete pumping). Minimise truck reversing. Plant and equipment should be off when not in use.
- Where feasible, selection of construction equipment should consider the noise levels of plant and equipment, with the aim of selecting equipment with lower sound power levels.
- Where feasible and safe to do so, works during OOHW periods should be conducted within the building shell in order to allow the use of the existing building shell as noise shielding to nearby sensitive receivers. As built form develops, site workers should attempt to make conscientious efforts with respect to utilising the built form to control noise spill to surrounding receivers.
- Works should be completed away from the site boundaries as much as practical and feasible.
- Unnecessary shouting should be avoided on site, and appropriate signage should be installed to remind workers of their responsibility to reduce noise impacts where feasible. Loud music from radios and stereos is not permitted.
- Material handling procedures should be implemented to avoid careless dropping of construction waste or deliveries.
- Where allowable by site safety requirements, non-tonal reversing beepers can be implemented on construction equipment and mobile plant used regularly on site.

In the event of a complaint, noise management procedure identified in Section 13 of this report are to be followed. Notwithstanding above, general management techniques and acoustic treatments are included below which may be implemented on a case-by-case basis to reduce noise emissions to surrounding receivers.

10.2 GENERAL RECOMMENDATIONS

Other noise management practices which may be adopted are discussed below. In addition, notification, reporting and complaints handling procedures should be adopted as recommended in section in this report.

10.2.1 Silencing Devices

Where construction process or appliances are noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

10.2.2 Material Handling

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).

10.2.3 Treatment of Specific Equipment

In certain cases, it may be possible to specially treat a piece of equipment to reduce the sound levels emitted. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

10.2.4 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. This includes locating fixed plant items as far as possible from residents as well as rotating plant and equipment to provide respite to receivers.

Construction vehicles accessing the site should not queue in residential streets and should only use the designated construction vehicle routes. Loading of these vehicles should occur as far as possible from any sensitive receiver.

10.3 NOISE MONITORING

Noise monitoring may be undertaken to assess the airborne noise impacts associated with the proposed works.

10.3.1 Downloading of Noise Monitor Data

Downloading of the noise monitor data will be conducted on a regular basis. In the event of consistent high noise level periods, downloading of the noise monitor data will be conducted more frequently. Results obtained from the noise monitor will be presented in a graph format and will be forwarded to the client for review. It is proposed that reports are provided fortnightly, presenting the measured noise levels in reference to the noise management levels detailed in this report.

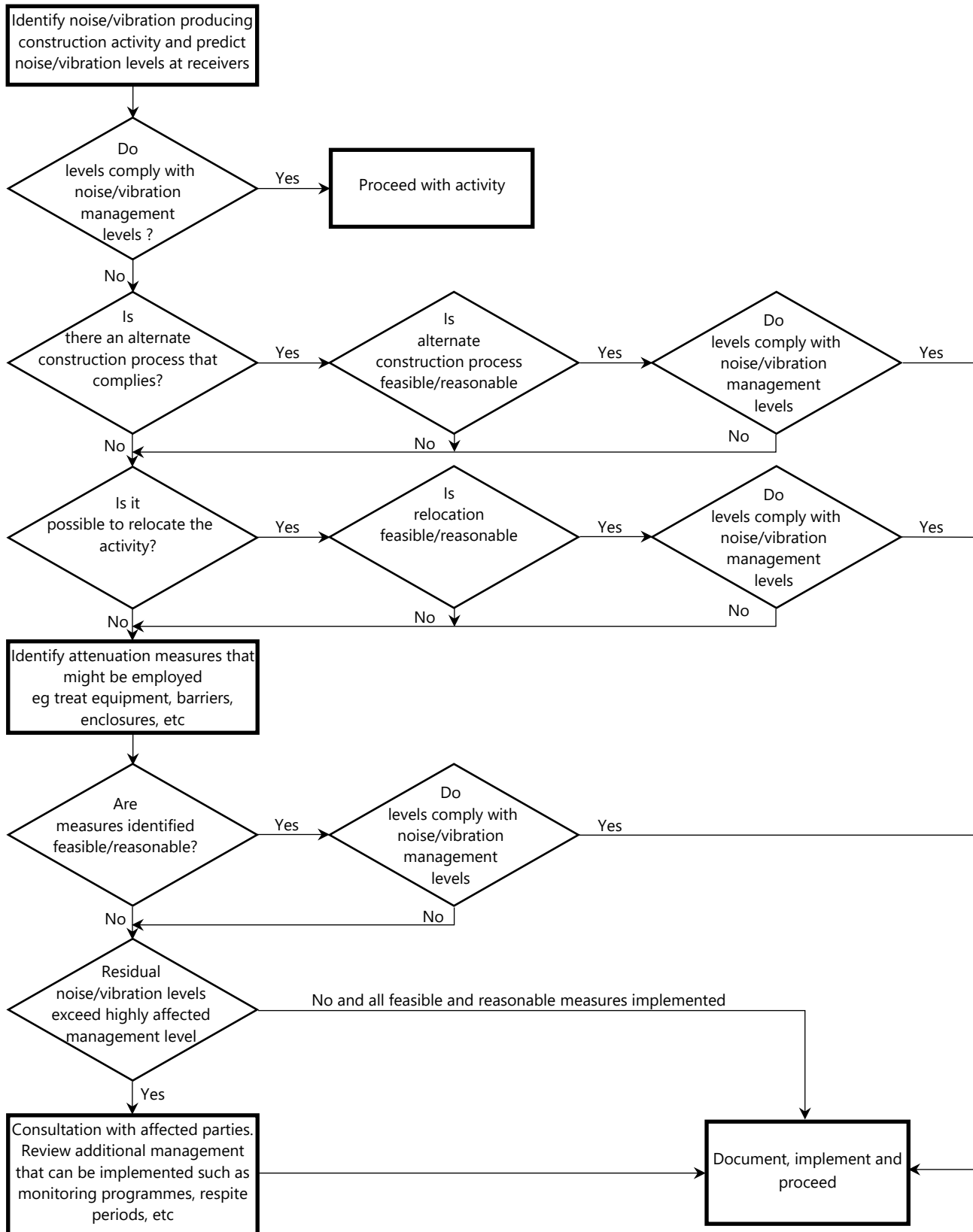
10.3.2 Presentation of Noise Monitor Results

A fortnightly report will be submitted to the client via email summarising the measured noise level events. Complete results of the continuous noise logging will be presented in fortnightly reports including graphs of the collected data.

11 ASSESSMENT METHODOLOGY AND MITIGATION METHODS

The flow chart that follows illustrates the process to be followed to minimise the impact associated with these activities.

Noise sources with the potential to exceed the criteria set out in section 6 have been identified and discussed in section 8.



12 ASSESSMENT OF VIBRATION

12.1 VIBRATION PRODUCING ACTIVITIES

It is not anticipated that any of the works proposed to be conducted for the purposes of this modification will generate significant ground borne noise or vibration. Notwithstanding, monitoring methodology has been outlined below, were this to be required throughout the proposed works.

12.2 VIBRATION MONITORING

12.2.1 Downloading of Vibration Monitor Data

Downloading of the vibration monitor data will be conducted on a regular basis. In the event of exceedance of the vibration criteria, downloading of the vibration monitor data will be conducted more frequently. Results obtained from the vibration monitor will be presented in a graph format and will be forwarded to the client for review. It is proposed that reports are provided fortnightly with any exceedances in the vibration criteria reported as detailed in this report.

12.2.2 Presentation of Vibration Monitor Results

A fortnightly report will be submitted to the client via email summarising the vibration events. The vibration exceedance of criteria is recorded, and the report shall be submitted within 24 hours. Complete results of the continuous vibration logging will be presented in fortnight reports including graphs of the collected data.

12.2.3 Vibration Monitoring Equipment

The vibration monitoring equipment recommended to be used for the monitoring of vibration emissions resulting from the demolition works shall be ETM vibration monitors or monitors of equal capability/performance with external geophones. The monitors are to be programmed with SMS messaging to alert of any vibration events exceeding the pre-defined warning level. The monitors are to be calibrated before being installed on the site.

13 COMMUNITY INTERACTION AND COMPLAINTS HANDLING

13.1 ESTABLISHMENT OF DIRECT COMMUNICATION WITH AFFECTED PARTIES

In order for any construction noise and vibration management programme to work effectively, continuous communication is required between; all parties which may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process which allows for the adjustment of control methods and criteria for the benefit of all parties.

The objective in undertaking a consultation process is to:

- Inform and educate the groups about the project and the noise controls being implemented.
- Increase understanding of all acoustic issues related to the project and options available.
- Identify group concerns generated by the project, so that they can be addressed.
- Ensure that concerned individuals or groups are aware of and have access to the Site Complaints Register which will be used to address any construction noise related problems should they arise.

To ensure that this process is effective, regular scheduled meetings may be required for a finite period, until all issues have been addressed and the evidence of successful implementation is embraced by all parties.

An additional step in this process is to produce a newsletter informing nearby residents of upcoming activities that are likely to generate higher noise/vibration levels.

13.2 DEALING WITH COMPLAINTS

Should ongoing complaints of excessive noise or vibration occur, immediate measures shall be undertaken to investigate the complaint, the cause of the exceedances and identify the required changes to work practices. In the case of exceedances of the vibration limits, all work potentially producing vibration shall cease until the exceedance is investigated. The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated.

If a noise complaint is received the complaint should be recorded on a Noise Complaint Form. The complaint form should list:

- The name and address of the complainant (if provided).
- The time and date the complaint was received.
- The nature of the complaint and the time and date the noise was heard.
- The name of the employee who received the complaint.
- Actions taken to investigate the complaint, and a summary of the results of the investigation.
- Required remedial action, if required.
- Validation of the remedial action.
- If necessary, setup vibration monitoring at the location representing the nearest affected vibration receiver, with alarm device which can inform the project manager on site if the vibration exceedance happened.
- Summary of feedback to the complainant.

A permanent register of complaints should be held.

All complaints received should be fully investigated and reported to management. The complainant should also be notified of the results and actions arising from the investigation.

The investigation of a complaint shall involve where applicable.

- noise measurements at the affected receiver.
- an investigation of the activities occurring at the time of the incident.
- inspection of the activity to determine whether any undue noise is being emitted by equipment; and
- Whether work practices were being carried out either within established guidelines or outside these guidelines.

Where an item of plant is found to be emitting excessive noise, the cause is to be rectified as soon as possible. Where work practices within established guidelines are found to result in excessive noise being generated then the guidelines should be modified so as to reduce noise emissions to acceptable levels. Where guidelines are not being followed, the additional training and counselling of employees should be carried out.

Measurement or other methods shall validate the results of any corrective actions arising from a complaint where applicable.

14 CONTINGENCY PLANS

Where non-compliances or noise complaints are raised the following methodology will be implemented.

1. Determine the offending plant/equipment/process.
2. Locate the plant/equipment/process further away from the affected receiver(s) if possible.
3. Implement additional acoustic treatment in the form of localised barriers, silencers etc where practical.
4. Selecting alternative equipment/processes where practical.
5. If necessary, setup noise and vibration monitoring devices at locations representing the nearest noise/vibration and dust affected receivers and provide data for each complain time period. Analysis is required to determine suitable mitigation measures.

Complaints associated with noise and vibration generated by site activities shall be recorded on a Complaint Form. The person(s) responsible for complaint handling and contact details for receiving of complaints shall be established on site prior to construction works commencing. A sign shall be displayed at the site indicating the Site Manager to the general public and their contact telephone number.

15 CONCLUSION

This report presents a Construction Noise and Vibration Management Plan for the works associated with the proposed changes to the Consent within Modification 4 of SSD-49295711.

Provided that the practices and recommendations in this report are implemented, the noise and vibration impacts during the extended hours works periods will be minimised.

We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,



Acoustic Logic Pty Ltd
Lachlan Abood