NOISE MANAGEMENT PLAN FOR SYDNEY HARBOUR FEDERATION TRUST PUBLIC DOMAIN AND ACCESS IMPROVEMENTS; AND REFURBISHMENTS OF SELECTED BUILDINGS – PLATYPUS RENEWAL PROJECT, NORTH SYDNEY

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Report No: 171067-02_NMP_Rev4
July 2017
(Released: 18 July 2017)

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DOCUMENT REVISION RECORD

Revision	Date	Description	Checked	Approved
1	26-06-2017	Draft / Rev1	E Hansma	Richard T Benbow
2	13-07-2017	Draft / Rev2	E Hansma	Richard T Benbow
3	14-07-2017	Rev 3	E Hansma	Richard T Benbow
4	18-07-2017	Rev 4	E Hansma	Richard T Benbow

DOCUMENT DISTRIBUTION

Revision	Issue Date	Issued To	Issued By
1	26-06-2017	Sydney Harbour Federation Trust	Benbow Environmental
2	13-07-2017	Sydney Harbour Federation Trust	Benbow Environmental
3	14-07-2017	Sydney Harbour Federation Trust	Benbow Environmental
4	18-07-2017	Sydney Harbour Federation Trust	Benbow Environmental

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EXECUTIVE SUMMARY

In December 2016 the Harbour Trust adopted a statutory Management Plan for the Platypus site, located in North Sydney, along the foreshore of Neutral Bay. The Management Plan proposes to reactivate the site through the provision of public open space, and adaptation of buildings for a range of cultural, recreational, community and commercial uses. The Harbour Trust is now looking to commence implementing key elements of the Plan as funding becomes available. The focus of this document is to provide guidance for the works to be undertaken to improve the public domain, new connections to adjoining land, and base works to buildings to facilitate future occupation and public access.

The Platypus renewal project will result in the site being able to be opened for public access and partly for future occupation of buildings by suitable tenants, in accordance with the management plan. Specific future uses have not yet been selected and would be suspect to further assessment at a later step.

The renewal works will comprise of the following **construction** works:

Connection improvements
- Kesterton Park Pedestrian Link;
- Upper level car park;
- RANTME Factory interim car park;
- Lift, cliff walkway and new RANTME bridge; and
- Northern access stairway.

Public domain improvements
- Northern park;
- Wharf promenade;
- Arrival Square;
- Gateway Plaza;
- The cutting; and
- Laneway.

Refurbishment of selected buildings
- Gatehouse building;
- Building 2 (Submarine school); and
- Building 10 (FIMA workshop).

The renewal works will also comprise of the following **operational activities only**:

Public access to the site, including
- Kesterton Park Pedestrian Link;
- Upper level car park;
- Upper level car park for construction workers;
- RANTME Factory interim car park;
- Lift, cliff walkway and new RANTME bridge;
- Northern access stairway;
- Use of the northern park;
- Gateway Plaza;
- The cutting;

- Laneway;
- Northern Wharf;
- Wharf Promenade; and
- Arrival Square.

The works proposed within the renewal project will be assessed by the Harbour Trust under the Trust's planning framework. As part of the application documentation and in order to protect local amenity while the renewal works are under way, this Noise Management Plan (NMP) has been prepared on behalf of the Harbour Trust.

Part of the Platypus site may be able to be opened to public pedestrian access while construction continues elsewhere on site. Other areas would remain closed while works continue.

This document presents a noise management plan conducted by Benbow Environmental for the Sydney Harbour Federation Trust former HMAS Platypus site at North Sydney. The NMP covers noise impacts from the operational activities and noise and vibration impacts from construction activities during the renewal works.

This noise management plan identifies the key features of the site and nearby receivers surrounding the site. The applicable noise criteria is identified and taken from the Interim Construction Noise Guideline (DECC, 2009) and the NSW Industrial Noise Policy (EPA, 2000). Modelling of the construction and operational activities was conducted using the noise modelling software SoundPlan 7.3.

Construction activities are modelled for the construction scenarios. Noise levels were predicted to exceed the 'noise affected Rating Background Level (RBL) + 10 dB' criteria at nearby receivers throughout some stages of the construction works. Selected receivers are predicted to exceed the 'highly noise affected 75 dB(A)' level during certain construction scenarios. All reasonable and feasible control measures are therefore recommended for the proposed construction works, as detailed in Section 7. Vibration from construction works is not predicted to cause cosmetic damage or human response at the nearest receivers.

Recommended mitigation measures for construction activities include limiting the hours of work (Section 7.1), work processes (Section 7.2), community notification (Section 7.3), complaints procedure (Section 7.4) and noise monitoring (Section 7.5).

Operational noise levels are predicted to be within the framework of the appropriate guidelines, following adoption of recommended mitigation measures and management practices. Noise mitigation measures including limiting times of use and sound power levels of equipment have been recommended in Section 9.

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Attachment 1: Glossary of Noise Terminology

1. INTRODUCTION

Benbow Environmental (BE) was engaged by Sydney Harbour Federation Trust to prepare a Noise Management Plan (NMP) for the proposed renewal works at the Platypus site which is located in North Sydney, along the foreshore of Neutral Bay.

The renewal works involve the construction noise and vibration assessment of connection improvements, public domain improvements, access improvements and refurbishment of selected buildings. The renewal works also involve the operational noise assessment of connection improvements, public domain improvements and access improvements. More details are provided in Section 3.

This Noise Management Plan identifies relevant noise criteria, shows predicted noise levels for relevant construction and operational scenarios and provides advice to manage noise and vibration during construction and operational works.

1.1 BACKGROUND

Benbow Environmental has prepared a Noise Impact Assessment (NIA) ref: 161005_NIA_rev4, to inform the recently adopted Platypus Management Plan. This work included background monitoring for establishing noise criteria and modelling a range of possible uses with the potential to affect the noise amenity of the area. These uses include cafes, restaurants, functions, small maritime industries, gyms and educational facilities. The aim of the NIA was to provide guidance for the selection of possible uses of the various areas at the site and identify any acoustic treatment, noise control measures and restrictions in operating hours necessary to minimise the noise impacts on the surrounding residences.

This NMP builds upon the work conducted for the previous Noise Impact Assessment. The relevant information will be reproduced/included in this NMP.

1.2 SCOPE OF WORKS

The scope of this Noise Management Plan is as follows:

a) Brief description of the site and the activities to be undertaken;
b) Identification of operational and construction scenario specific noise levels;
c) Show predicted noise levels associated with the proposed operational activities;
d) Present the predicted noise and vibration impacts associated with the proposed construction activities;
e) Noise controls and noise management practices to be implemented so as to ensure the site activities do not cause offensive noise; and
f) A procedure addressing noise complaints and issues and methods that will be undertaken to resolve these issues.

2. SITE IDENTIFICATION

2.1 SITE LOCATION

The subject site is located at 118 High St, North Sydney 2060, Lot A DP 109583. The site location is shown in Figure 2-1.

The land is located within the municipality of North Sydney. It lies on the southern side of Neutral Bay on a small peninsula surrounded principally by residential premises.

An aerial view of the current site is shown in Figure 2-2 and a concept site plan presenting the potential proposed outcomes is shown in Figure 2-3.

As seen in the diagrams, the waterfront location lends itself to potential public use, however the potential noise impacts at residents across the bay must be considered in the assessment. The water provides a reflective surface in which noise may have the ability to travel easily, with fewer attenuating features in the transmission path to receivers over the bay.

The rear of the Platypus site features a steep cliff face. For many receivers at 1 Kiara Close, they may be located in an elevated position over the Platypus site with direct line of sight of noise generating activities. However, for receivers further west of the Kiara Close apartments, the cliff face may provide noise attenuation from potential noise impacts.

Figure 2-1: Site Location

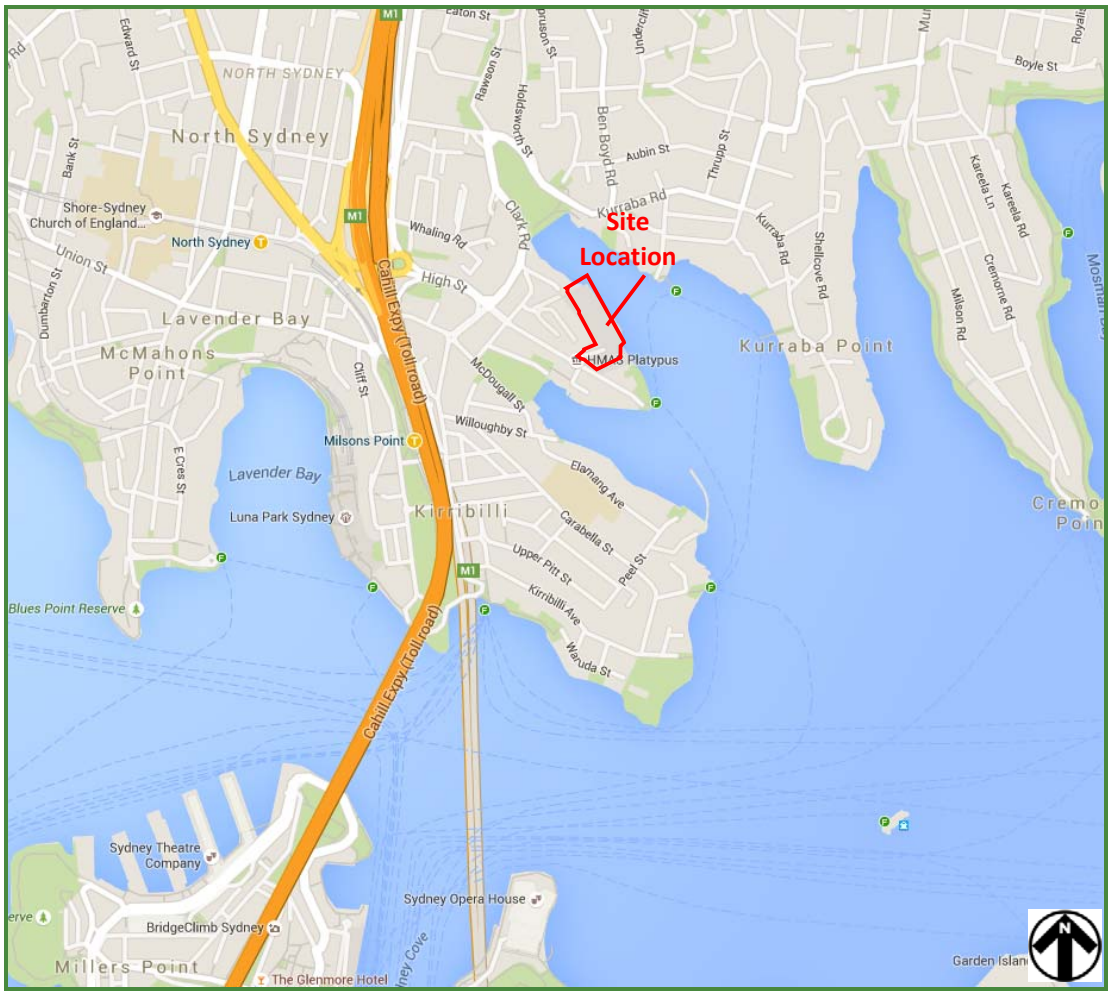


Image Source: Google Maps

Figure 2-2: Site Aerial

Image Source: The Sydney Harbour Federation Trust

Figure 2-3: Outcomes – Comprehensive Plan

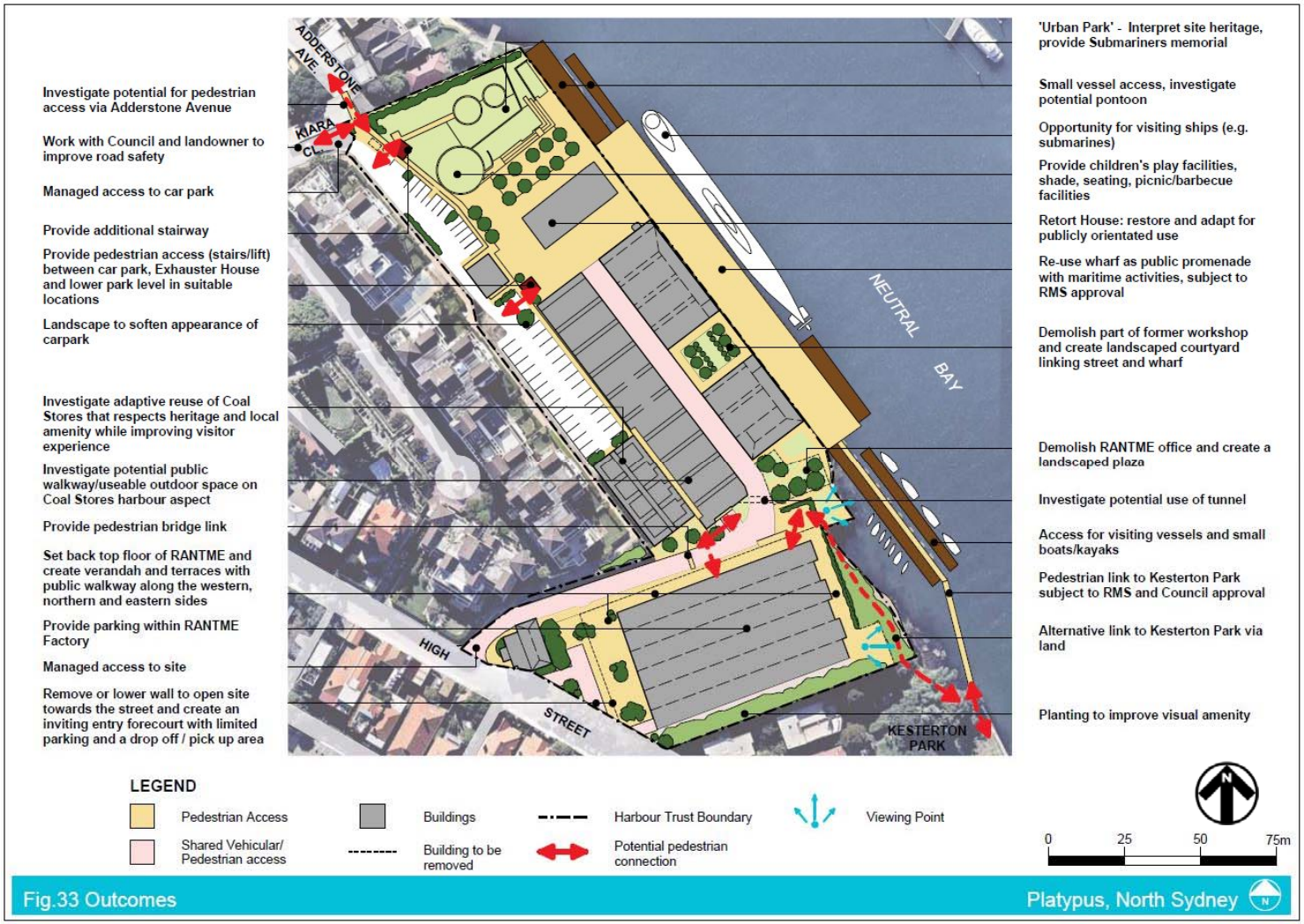


Image Source: The Sydney Harbour Federation Trust

2.2 NEAREST SENSITIVE RECEPTORS

The nearest sensitive receptors identified include principally residential premises and public parks. A small number of commercial premises are also present and the Customs Marine Depot is located in the opposite side of the bay. The aerial photographs of the sensitive receivers are shown in Figure 2-4. These receptors were selected based on their proximity and directional bearing from the subject site.

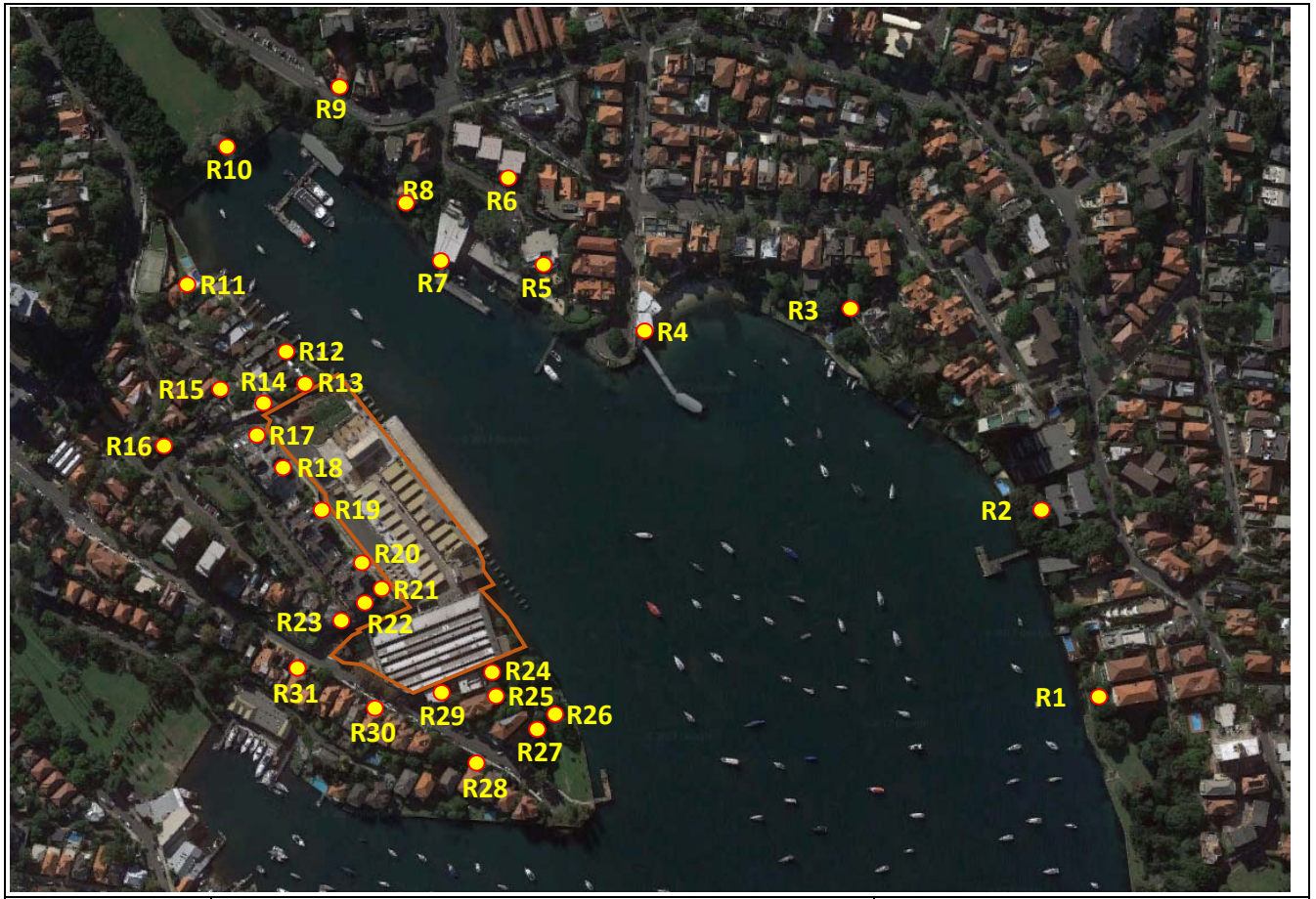
Table 2-1: Residential and Non-Residential Receivers

Receptor ID	Address	Lot & DP	Approx. Distance from Proposed Operations	Type of Receptor
R1	135 Kurraba Road, Kurraba Point	SP 9968	440 m E	Residential
R2	107 Kurraba Road, Kurraba Point	SP 2522	390 m E	Residential
R3	1 Wallaringa Avenue, Kurraba Point	SP 73259	330 m NE	Residential
R4	1 Hayes Street, Neutral Bay	Lot C DP 341833	200 m NE	Commercial
R5	2 Hayes Street, Neutral Bay	SP 46768	160 m NE	Residential
R6	1-5 Manns Avenue, Neutral Bay	SP 13571	200 m NE	Residential
R7	1 Ben Boyd Road, Neutral Bay	Lot 2 DP 800615	130 m NE	Commercial
R8	2 Ben Boyd Road, Neutral Bay	Lot 4 DP 333590	150 m NE	Residential
R9	66 Kurraba Road, Neutral Bay	SP 71206	230 m N	Residential
R10	Clark Road, Neutral Bay	Lot 3 DP 913708	200 m NW	Active Recreation
R11	4 Adderstone Avenue, North Sydney	Lot 2 DP 200214	135 m NW	Residential
R12	20 Adderstone Avenue, North Sydney	Lot 18 DP 14085	45 m NW	Residential
R13	24 Adderstone Avenue, North Sydney	Lot 15 DP 14085	10 m N	Residential
R14	9A Kiara Close, North Sydney	SP 57236	25 m W	Residential
R15	7 Adderstone Avenue, North Sydney	SP 11585	50 m NW	Residential
R16	15 Hipwood Street, North Sydney	Lot 7 DP 14085	140 m SW	Residential
R17	1 Kiara Close, North Sydney	SP 36253	15 m SW	Residential
R18	1 Kiara Close, North Sydney	SP 36253	25 m S	Residential

Table 2-1: Residential and Non-Residential Receivers

Receptor ID	Address	Lot & DP	Approx. Distance from Proposed Operations	Type of Receptor
R19	1 Kiara Close, North Sydney	SP 36253	70 m S	Residential
R20	1 Kiara Close, North Sydney	SP 36253	100 m W	Residential
R21	1 Kiara Close, North Sydney	SP 36253	90 m SW	Residential
R22	1 Kiara Close, North Sydney	SP 36253	110 m SW	Residential
R23	1 Kiara Close, North Sydney	SP 36253	130 m SW	Residential
R24	140 High Street (Rear), North Sydney	SP 17230	40 m SW	Residential
R25	142 High Street, North Sydney	Lot 2 DP 12302	40 m SW	Residential
R26	146 High Street, North Sydney	SP 14876	70 m S	Residential
R27	High Street, North Sydney	Lot 1 DP 12302	20 m SW	Active Recreation
R28	171-173 High Street, North Sydney	SP 9902	100 m SW	Residential
R29	140 High Street (Front), North Sydney	SP 17230	40 m SW	Residential
R30	147 High Street, North Sydney	Lot 9 DP 4416	40 m SW	Residential
R31	135 High Street, North Sydney	Lot 1 DP 935811	40 m SW	Residential

Figure 2-4: Nearest Receptors



↑N	LEGEND: Site Receptor	Benbow Environmental 13 Daking Street, North Parramatta NSW 2151

3. PROPOSED ACTIVITIES AND CONSTRUCTION WORKS

The primary purpose of the renewal works are to provide public domain improvements with greater connections to the local area and open as much of Platypus as possible for public access. A basic site plan showing the location of the proposed works is presented in Figure 3-1.

The locations of the proposed construction activities and/or operational activities are shown in section 3.1.

3.1 LOCATIONS OF PROPOSED ACTIVITIES

Kesterton Park Pedestrian Link (Construction works and operational activities)

The Kesterton Park Pedestrian Link will be an extension to the existing wharf such that it links up to the northern point of Kesterton Park. Kesterton Park contains North Sydney Ferry Wharf, allowing people to travel to Platypus by ferry from Circular Quay. The link will use the existing headstocks and install new piles and decking structure. The construction of an additional pontoon and kayak steps are also features of the Kesterton Park Pedestrian Link.

Operational activities include people coming to/from Kesterton Park or Platypus via the pedestrian link and the Kesterton Park Link pontoon. The kayak steps once built, will also generate operational activities; small vessel access with boat radios and operators.

Northern Park (Construction works and operational activities)

Minor additional landscaping improvement works are proposed for the northern park. This will involve installing a modest children's playground, some benches and tables, planting additional vegetation and constructing a new walkway and steps to the location of the proposed northern access stairway.

Operational activities in the northern park include general play, children on play equipment, or outdoor events such as weddings or small performances;

Northern Access Stairway (Construction works and operational activities)

Stairs will be constructed at the northern end of the site to link the upper level with the foreshore park. The northern access stairs will have a half turn stairs with landings structure, a concrete footing and steel frame. The frame is likely to be lowered via a crane from the upper level car park above.

Upper level car park (Construction works and operational activities)

The upper level car park already exists, and will generally be used to provide car parking for regular site users and special events use. During the construction works, the existing gate house pavilion to the upper level car park will be demolished. The northern sliding gate will be replaced, to enable a lockable after hours gate to be installed. Safety works and landscaping activities are also proposed, with road safety improvements to Kiara Close, new lighting, balustrades, car safety stops, hand rails and bitumen resurfacing.

Operational activities include parking for up to 55 spaces for regular staff and key clients, and access and occasional use of the upper level car park before 7am and after 10pm by pre-booked users;

RANTME factory car park (Construction works and operational activities)

Part of the RANTME factory to be used as a car park. Up to 30 spaces could be used for construction workers during the works, and casual public parking once the works are complete.

Lift, cliff walkway and new RANTME bridge (Construction works and operational activities)

The lift is to be constructed, connecting to the existing tunnel. Either an updated cliff walkway, or a shared pedestrian zone within the upper level carpark is to be constructed, as well as a new RANTME bridge.

The operational impacts of the use of the walkway, and the mechanical impact of the lift are to be examined.

Laneway (Construction works and operational activities)

The laneway works will include surface treatments, loading and unloading of materials and reverse beepers from trucks.

Operational activities will look at people moving through the laneway between buildings 2 and 10.

The Cutting (Construction works and operational activities)

Similar to the laneway, the cutting works will include surface treatments, loading and unloading of materials and reverse beepers from trucks.

Operational activities will involve people moving through the cutting alongside the RANTME building.

Wharf promenade (Construction works and operational activities)

The wharf promenade will include the installation of benches, shade cloths and planter boxes.

Operational activities on the wharf promenade include the use of the outdoor area for general outdoor use. The service of alcohol as part of outdoor dining activities is outside the scope of this report, and therefore has not been included in this scenario.

Arrival square (Construction works and operational activities)

The arrival square works include landscaping, benches, stairs to the cutting and surface treatments.

Operational activities at arrival square include people moving through the area.

Gateway plaza (Construction works and operational activities)

The gateway plaza works include benches, planter boxes and the removal of the wall facing High Street.

Operational activities at the gateway plaza include pedestrian access and general outdoor use.

Gatehouse building (Construction works only)

Improvements will be made to the gatehouse building façade and an internal refurbishment carried out for 2 x 2 bed apartments. The works for the gatehouse building at this stage are limited to refurbishment only, and this document will not look at specific uses at this time.

Building 2 (Construction works only)

Modifications are to be made for the external fabric of the building 2 submarine school. Penetrations will be made for new windows and doors, and a base building refurbishment carried out including services, toilets, bin store and basic lighting. The works for building 2 at this point are limited to refurbishment only, and this assessment will not look at specific uses.

Building 10 (Construction works only)

Partial demolition of building 10 is proposed. Modifications including new awnings, and penetrations for new windows and doors are to be made to the external building fabric of the building 10 FIMA workshop. Proposed base building refurbishment includes services, toilets, bin store and basic lighting. The works for building 10 at this stage are limited to refurbishment only, and this document will not look at specific uses.

Northern Wharf (Operational activities only)

Operational activities include small vessel access with boat radios and operators located at the northern wharf.

Upper level car park for construction workers (Operational activities)

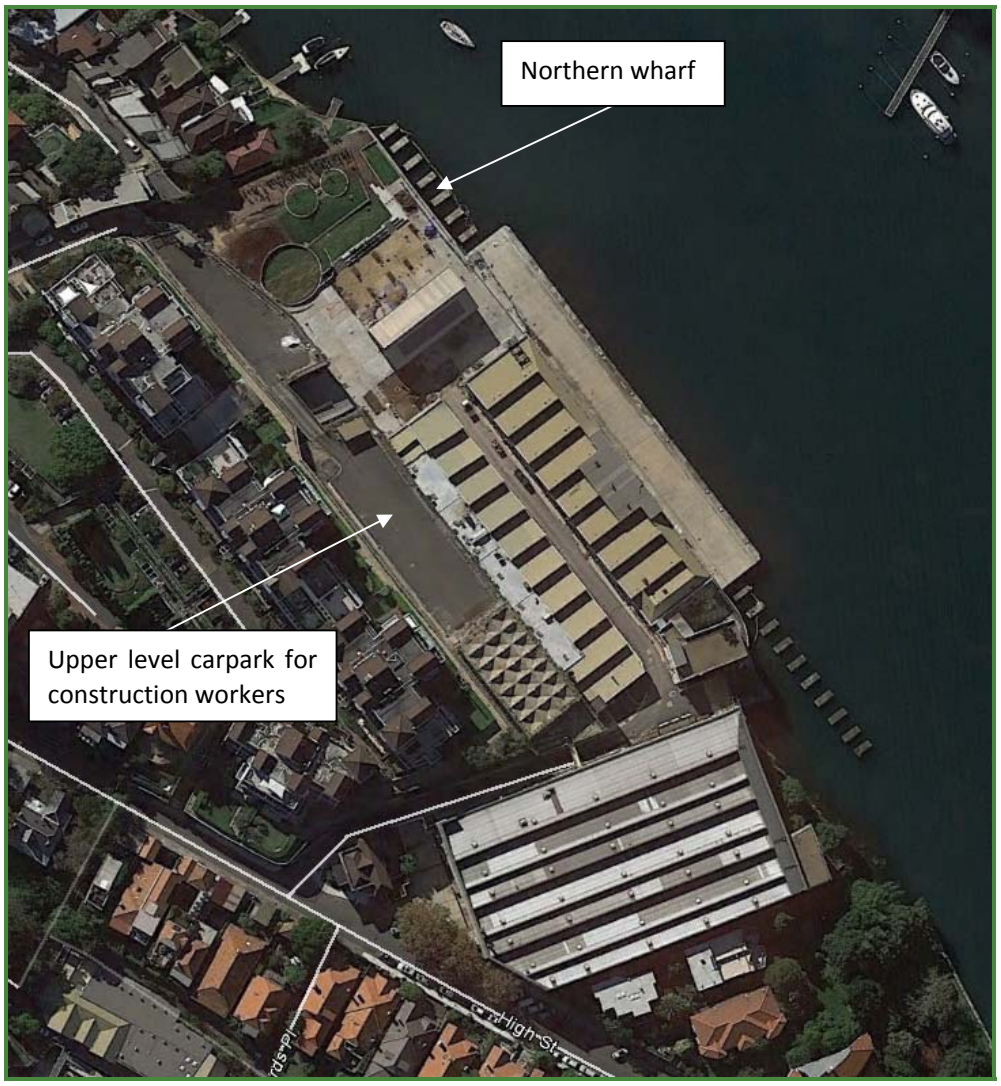
This scenario, also utilises the upper level carpark similar to a separate scenario, but is specifically examining the use of the carpark before 7am by construction workers.

In general, it is expected that the construction activities will occur mostly during the day, with the possibility of early morning piling. Operational activities are expected on initially take place during the day and evening mostly, with parts of the site eventually intended to be used 24 hours a day.

Figure 3-1: Proposed Renewal Construction and Operational Works

Figure 3-2: Proposed Renewal Construction Only Works

Figure 3-3: Proposed Renewal Operational only activities



3.2 HOURS OF OPERATIONS

The hours of operations for all **construction** works are as follows:

Monday to Friday:	7am to 5pm (with no hammering or saw-cutting to occur before 7.30am)
Saturday:	8am to 1pm (with no hammering or saw-cutting to occur before 8.30am)
Sunday and Public Holidays:	No works permitted

The proposed hours of construction fall within the recommended standard hours of work within the Interim Construction Noise Guideline (DECC, 2009) and day period of the Industrial Noise Policy (EPA, 2000). It is also possible that piling installation works may be needed on an emergency basis during the night time period, should the need for minimal harbour wash arise.

The hours that the Kesterton Park Pedestrian Link, northern wharf and northern park areas will be open to the public have not been conclusively decided by the Sydney Harbour Federation Trust. However, it is expected that initially the Pedestrian Link, northern wharf and northern park areas will be open during daytime hours. Restrictions in operational uses have been included in Section 9 based on noise impact.

The opening hours for all **operational** activities will be recommended on a case by case basis throughout the assessment. Generally however, it is expected that the bulk of operational activity occurs will occur initially during the day and evening periods, with the site envisaged for 24 hour use long term.

4. PROJECT CRITERIA

The operational noise criteria is presented in section 4.1 and the construction noise and vibration criteria is shown in section 4.2.

4.1 OPERATIONAL NOISE CRITERIA

Operational noise criteria is outlined in this section, using guidance from the NSW Industrial Noise Policy (INP) (EPA, 2000).

4.1.1 NSW EPA Industrial Noise Policy Noise Criteria

Operational noise limits for the site have been established in accordance with the principles and methodologies of the NSW INP, the measured background noise levels and the existing industrial operational noise levels of the area.

According to the NSW INP, it is recommended that the more stringent noise limits be applied to protect the existing acoustic amenity from deteriorating.

The selected On-Site Project Specific Noise Levels (PSNL) and the Sleep Disturbance Criteria associated with operational activities are presented in Table 4-1.

Table 4-1: Site Project Specific Noise Levels for Operational Activities, dB(A)

Receiver Location	Period	Intrusive Criterion $L_{Aeq(15\ minute)}$	Amenity Criterion $L_{Aeq(period)}$	Site PSNL $L_{Aeq(15\ minute)}$	Site Sleep Disturbance L_{Amax}
R1-R9	Day	45	60	**45**	-
	Evening	45*	50	**45**	-
	Night	41	45	**41**	**55**
R10-R13	Day	52	60	**52**	-
	Evening	52	50	**52**	-
	Night	44	45	**44**	**55**
R14-R23	Day	51	60	**51**	-
	Evening	50	50	**50**	-
	Night	40	45	**40**	**55**
R24-R31	Day	49	60	**49**	-
	Evening	49*	50	**49**	-
	Night	43	45	**43**	**55**

Note: - indicates not applicable
*When the background for evening time is greater than daytime the criteria for evening time is set to be equal to daytime in accordance with the INP.

4.2 CONSTRUCTION NOISE AND VIBRATION CRITERIA

Criteria for construction noise has been obtained from the NSW Interim Construction Noise Guideline (DECC, 2009). Guidance for construction vibration has been taken from British Standard BS7385-Part 2: 1993 'Evaluation and measurement for vibration in buildings' and other standards.

4.2.1 NSW Interim Construction Noise Guideline

Residential Criteria

Table 2 of the Interim Construction Noise Guideline (DECC, 2009), sets out construction noise management levels for noise at residences and how they are to be applied. The management noise levels from the Interim Construction Noise Guideline are reproduced in full in Table 4-2 below.

Construction activities that are below the 'Noise Affected Rating Background Level (RBL) + 10 dB' level, comply with the noise criteria in the Interim Construction Noise Guideline. As seen in Table 4-2, construction noise generation that is above the 'Noise Affected RBL + 10 dB level' may cause some community reaction, and all feasible and reasonable work practices should be applied to minimise potential impacts. Where construction noise impacts are predicted to be above the 'highly noise affected 75 dB(A) level', there may be strong community reaction to the activities, and restrictions to the hours of work may apply.

Table 4-2: Management Levels at Residences Using Quantitative Assessment

Time of Day	Management Level $L_{Aeq(15\ minute)}$	How to Apply
Recommended standard hours: Monday to Friday 7am – 6pm Saturday 8am – 1pm No work on Sundays or Public Holidays	Noise Affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15\ minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practises to meet the noise affected level. • The proponent should also inform all potentially affected residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly Noise Affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: ▸ times identified by the community when they are less sensitive to noise (such as before and after school, or mid-morning or mid-afternoon for works near residents. ▸ if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise Affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2 (RNP)

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

Other Land Uses

Table 4-3 sets out management levels for construction noise at other land uses applicable to the surrounding area.

Table 4-3: Management Levels at Other Land Uses

Land use	Management Level $L_{Aeq(15\ minute)}$ (applies when properties are being used)
Active Recreation Areas	External Noise Level 65 dB(A)
Offices, Retail Outlets	External Noise Level 70 dB(A)
Industrial Premises	External Noise Level 75 dB(A)

Aside from residential receivers and the non-residential receivers outlined in Table 4-3, there are no other sensitive land uses in the area surrounding the site.

The noise criterion for construction noise is presented in Table 4-4.

Table 4-4: Construction Noise Criterion dB(A)

Receiver	Period	RBL L_{A90}	Management Level $L_{Aeq(15\ minute)}$
R1-R9	Day	40	50
R10-R13	Day	47	57
R14-R23	Day	46	56
R24-R31	Day	44	54

4.2.2 Vibration Criteria

Vibration criteria from construction works is outlined in this section, including guidelines to avoid cosmetic damage, structural damage or human discomfort. There is no specific vibration standard in NSW to assess cosmetic or structural damage to buildings. Usually the British Standard BS7385-Part 2: 1993 'Evaluation and measurement for vibration in buildings' or the German standard DIN4150-Part 3: 1999 'Structural Vibration Part 3 – effects of vibration on structures' is referenced. The *Assessing Vibration – A Technical Guideline* (DEC, 2006) provides guidance on preferred levels for human exposure.

4.2.3 BS 7385–2: 1993

The British Standard BS 7385-Part 2: 1993 'Evaluation and measurement for vibration in buildings' provides vibration limits to avoid cosmetic damage on surrounding structures. Limits are set at the lowest limits where cosmetic damage has previously been shown.

Table 4-5: Vibration criteria for cosmetic damage (BS 7385:2 1993)

Type of building	Peak component particle velocity in frequency range of predominant pulse [1]		
	4 to 15 Hz	15 Hz to 40 Hz	40 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above		
Unreinforced or light framed structures. Residential or light commercial type buildings	15 to 20 mm/s [2]	20 to 50 mm/s	50 mm/s

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

4.2.4 DIN 4150-3: 1999

The German standard DIN 4150-Part 3: 1999 'Structural Vibration Part 3 – effects of vibration on structures' has also been considered. The German standard is considered more onerous than the British standard, and specifically includes more stringent limits to avoid structural damage to surrounding heritage buildings.

Table 4-6: Structural damage criteria heritage structures (DIN4150-3 1999)

Type of building	Peak component particle velocity (PPV) mm/s [2]			
	Vibration at the foundation at a frequency of:			Vibration of horizontal plane of highest floor at all frequencies
	1 to 10 Hz	10 to 50 Hz	50 to 100 Hz [1]	
Buildings used for commercial purposes, industrial buildings or buildings of similar design	20	20 to 40	40 to 50	40
Residential dwellings and similar	5	5 to 15	15 to 20	15
Structures that, because of their particular sensitivity to vibration, cannot be classified as the two categories above, and are of intrinsic value (for example heritage listed buildings).	3	3 to 8	8 to 10	8

Note 1: For frequencies above 100 Hz, the maximum values specified in this column shall be applied
Note 2: Values referred to are at the base of the building

4.2.5 Human Exposure

The guideline *Assessing Vibration – A Technical Guideline* (DEC, 2006) describes preferred criteria for human exposure. The limits describe values where occupants of buildings would be impacted by construction work.

Table 4-7: Preferred and maximum weighted rms z-axis values, 1-80 Hz

Location	Daytime		Night-time	
	Preferred	Maximum	Preferred	Maximum
Continuous Vibration (weighted root mean square (rms) vibration levels for continuous acceleration (m/s^2) in the vertical direction)				
Residences	0.01	0.02	0.007	0.014
Offices, schools, educational institutions and places of worship	0.02	0.04	0.02	0.04
Workshops	0.04	0.08	0.04	0.08
Impulsive Vibration (weighted root mean square (rms) vibration levels for impulsive acceleration (m/s^2) in the vertical direction)				
Residences	0.3	0.6	0.1	0.2
Offices, schools, educational institutions and places of worship	0.64	1.28	0.64	1.28
Workshops	0.64	1.28	0.64	1.28
Intermittent Vibration (m/s)				
Residences	0.2	0.4	0.13	0.26
Offices, schools, educational institutions and places of worship	0.4	0.8	0.4	0.8
Workshops	0.8	1.6	0.8	1.6

5. CONSTRUCTION NOISE ASSESSMENT

Predictive Noise Modelling was carried out in SoundPLAN v7.3 using the ISO 9613 algorithm. This model has been extensively utilised by Benbow Environmental, and is recognised by regulatory authorities throughout Australia. The model allows for the prediction of noise from a site, at the specified receptor, by calculating the contribution of each noise source.

The primary noise sources associated with the noise model include:

- Pile Driver;
- Concrete mixer truck ;
- Concrete pump;
- Concrete cutter;
- Welding;
- Drilling;
- Concrete core drill;
- Angle grinding;
- Circular saw;
- Hammering;
- Truck;
- Excavator;
- Jackhammer;
- Cement mixer;
- Paving machine; and
- Franna crane.

5.1 MODELLING METHODOLOGY

5.1.1 Assumptions Made for Noise Modelling

It should be noted that the relevant assessment period for construction and operational noise activities have been considered to be 15 minutes. Therefore noise source durations detailed in the following assumptions should be considered per 15 minute period in view of potential noise impacts under worst-case scenarios. Each assessment-specific assumption has been detailed below:

- Off-site topographical information has been obtained from NSW Land and Property Information LIDAR terrain data at 1 m resolution.

- On-site topography has been obtained from the site survey plans provided by the client. The topography of the northern park was obtained by on-site measurement.

- Off-site structures such as warehouses, buildings and solid fences surrounding the project site have been included in the model.

- All ground areas surrounding the subject site and the nearest nominated occupancies have been modelled with degrees of sound absorption represented by factors ranging from 0 to 1. Zero indicates a fully reflective ground and 1 soft ground. A ground factor of 0 has been used for water and concrete areas. A ground factor of 0.5 was used for residential areas. A ground factor of 0.75 was used for public parks.

- All residential receivers were modelled at 1.5 m above ground level, at the most noise-affected point within 30 m of the residence and also at the residence façade. Receptors located in multi-storey buildings were modelled at 2.8 m intervals on each floor level.

- All noise sources associated with the construction works have been modelled as point sources.

- Unless stated otherwise, all construction noise sources are assumed to operate for 100% of the 15 minute period as a worst case scenario.

5.1.2 Noise Sources

A-weighted octave band centre frequency sound power levels are presented in Table 8-1 below. The sound power levels for the relevant noise sources have been calculated from measurements of sound pressure levels undertaken by an acoustic engineer from Benbow Environmental at similar sites and sourced from Benbow Environmental's extensive noise source database, as well as taken from AS 2436: 2010 and the UK Department for Environmental Food and Rural Affairs (DEFRA) database, *Update of noise database for prediction of noise on construction and open sites*.

Table 5-1: A-weighted Sound Power Levels Associated with Construction Activities, dB(A)

Noise Source	Overall	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Pile Driver	**137**	121	119	119	124	134	132	122	113
Concrete Mixer Truck	**108**	85	86	85	94	98	107	89	82
Concrete Pump	**105**	77	92	97	99	100	95	95	89
Concrete Cutter	**116**	113	102	100	98	100	104	110	105
Welder	**108**	83	90	93	99	105	102	98	93
Drilling	**92**	58	61	69	75	80	86	89	84
Concrete core drill	**114**	103	102	103	100	102	103	108	108
Angle grinder	**108**	85	79	80	88	98	105	101	101
Circular saw	**105**	51	65	82	91	93	101	101	94
Hand Tools/hammer	**100**	71	81	91	96	94	90	87	81
Truck	**102**	67	79	80	100	95	89	89	91
Excavator (5T)	**108**	101	99	98	99	100	100	95	88
Jackhammer	**117**	84	94	101	114	111	107	104	97
Cement mixer	**105**	77	92	97	99	100	95	95	89
Paving machine	**109**	100	105	102	100	99	98	95	88
Franna crane	**104**	88	93	97	98	98	96	88	78

5.1.3 Construction Noise Scenarios

Construction scenarios 1-14 associated with the renewal works are considered in the noise model.

- Construction scenario 1 considers a construction scenario in which the Kesterton Park Pedestrian Link including the pontoon and kayak steps is built. Activities include pile driving, concreting and decking construction activities.
- Construction scenario 2 considers a construction scenario for landscaping improvement works of the northern park, including additional park benches and staircases.
- Construction scenario 3 assesses the demolition of the gate house and the upper level carpark works for construction workers.
- Construction scenario 4 considers the construction works at the wharf promenade.
- Construction scenario 5 looks at the construction activities associated with arrival square.
- Construction scenario 6 considers the construction activities at gateway plaza.
- Construction scenario 7 covers the construction of a lift and new RANTME bridge.
- Construction scenario 8 looks at the car park construction inside the RANTME building.
- Construction scenario 9 assesses the construction of the northern access stairway and footing.
- Construction scenario 10 considers the construction works at the waterfront laneway.
- Construction scenarios 11, 12 and 13 consider the penetration works and refurbishment works at the gatehouse building, Building 2 and Building 10 respectively.
- Construction scenario 14 looks at the works taking place at the cutting.

The noise source list for construction scenarios 1-14 is detailed in Table 5-2, with equipment locations shown in Figure 5-1 to Figure 5-19.

Table 5-2: Construction Noise Scenarios

Construction Scenarios	Noise Sources for Worst 15-minute Period
Scenario 1a – Construction: Kesterton Park Pedestrian Link – Pile Driving	• Pile Driver[1]
Scenario 1b – Construction: Kesterton Park Pedestrian Link – Concreting	• Concrete truck • Concrete truck pump • Concrete cutter[1]
Scenario 1c – Construction: Kesterton Park Pedestrian Link – Decking, pontoon and kayak steps	• Welding • Drilling • Concrete core drill[1] • Angle grinding[1] • Circular saw[1] • Hammering (Nail guns) • Truck
Scenario 2 – Construction: Northern Park, Landscaping improvement works	• Small 5T excavator • Drilling • Small portable cement mixer • Hammering • Truck
Scenario 3 – Construction: Upper level car park – Demolition of gate house	• Small 5T excavator • Jackhammer[1] • Hand tools • Truck
Scenario 4 – Construction: Wharf promenade	• Drilling • Small portable cement mixer • Hammering • Truck
Scenario 5 – Construction: Arrival Square	• Small 5T excavator • Drilling • Small portable cement mixer • Hammering • Truck • Paving machine
Scenario 6 – Construction: Gateway Plaza	• Drilling • Small portable cement mixer • Hammering • Truck • Circular saw[1]
Scenario 7 – Construction: Lift, cliff walkway and new RANTME bridge	• Franna Crane • Drilling • Hammering • Welder • Truck
Scenario 8 – Construction: RANTME factory car park	• Circular saw[1] • Hammering • Truck

Table 5-2: Construction Noise Scenarios

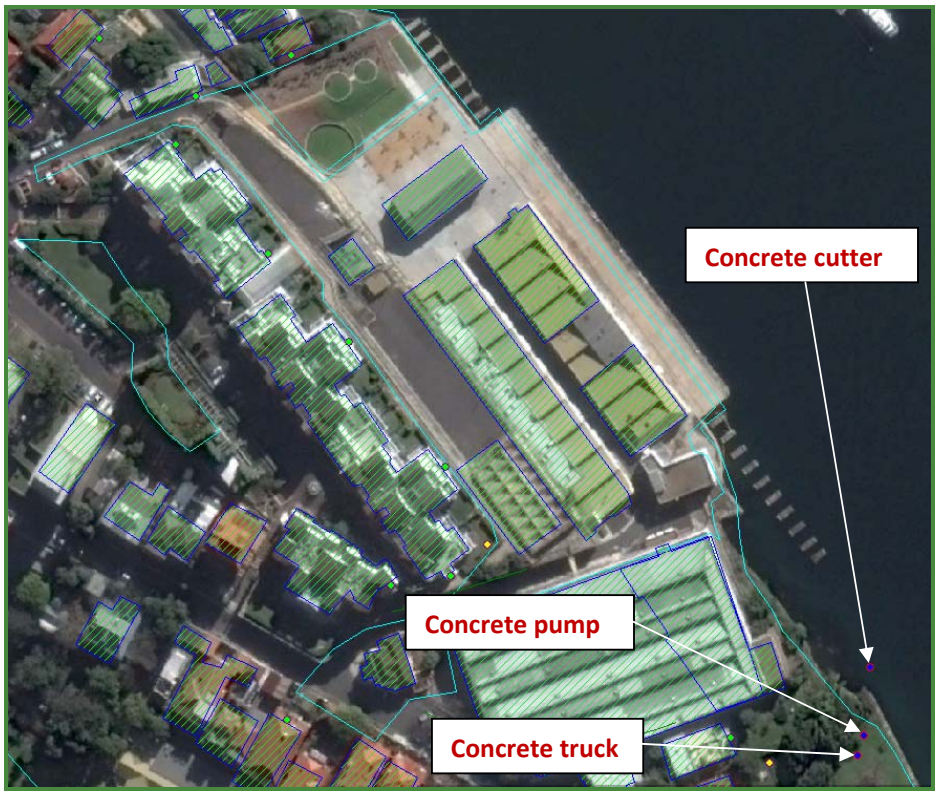
Construction Scenarios	Noise Sources for Worst 15-minute Period
Scenario 9a – Construction: Northern Access Stairway – Footing	• Small 5T excavator • Welding • Drilling • Angle grinding[1] • Concrete truck • Concrete truck pump • Concrete cutter[1]
Scenario 9b – Construction: Northern Access Stairway – Frame	• Franna 15T-20T crane located at upper level car park • Welding • Drilling • Angle grinding[1] • Truck
Scenario 10 – Construction: Laneway	• Drilling • Small portable cement mixer • Hammering • Truck • Paving machine
Scenario 11a – Construction: Gatehouse Building, penetration works	• Concrete cutter[1] • Hammering • Angle Grinder[1]
Scenario 11b – Construction: Gatehouse Building, refurbishment works	• Hammering • Drilling • Truck
Scenario 12a – Construction: Building 2, penetration works	• Concrete cutter[1] • Hammering • Angle Grinder[1]
Scenario 12b – Construction: Building 2, refurbishment works	• Hammering • Drilling • Truck
Scenario 13a – Construction: Building 10, penetration works	• Concrete cutter[1] • Hammering • Excavator 1.8T • Angle Grinder[1]
Scenario 13b – Construction: Building 10, refurbishment works	• Hammering • Drilling • Truck
Scenario 14 – Construction: The Cutting	• Drilling • Small portable cement mixer • Hammering • Truck • Paving machine

Note 1: As per section 4.5 of the Interim Construction Noise Guideline (DECC, 2009), a number of activities have proven to be particularly annoying to residents and have therefore had 5 dB added to their predicted levels.

Figure 5-1: Construction scenario 1a

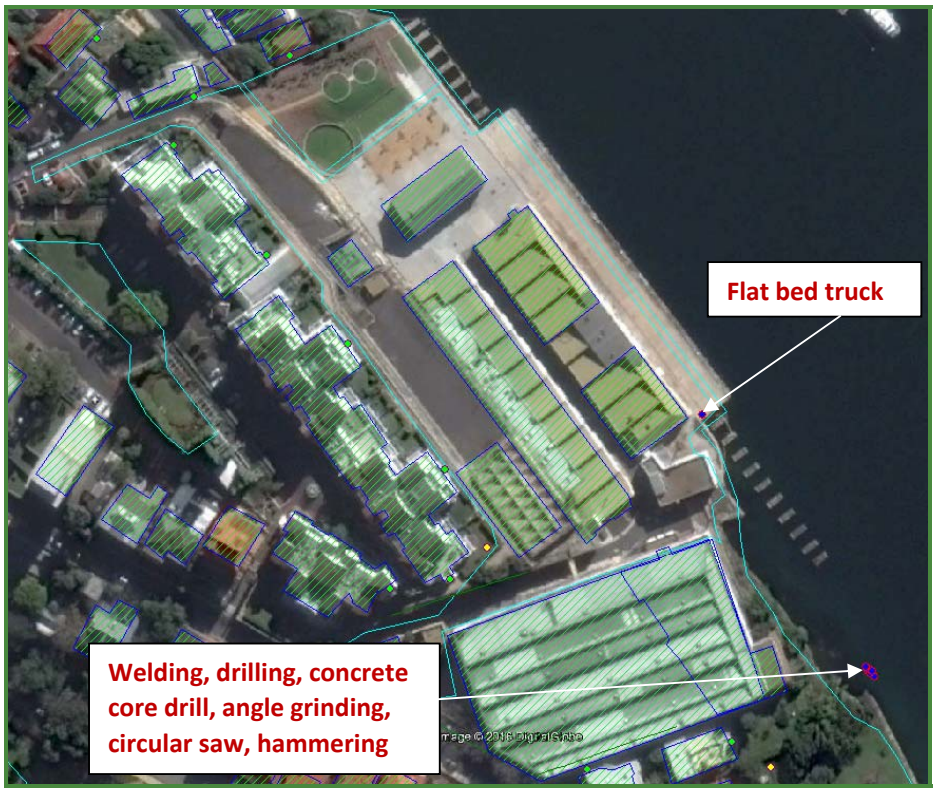
Buildings Receptors Noise sources

Figure 5-2: Construction scenario 1b



Buildings Receptors Noise sources

Figure 5-3: Construction scenario 1c

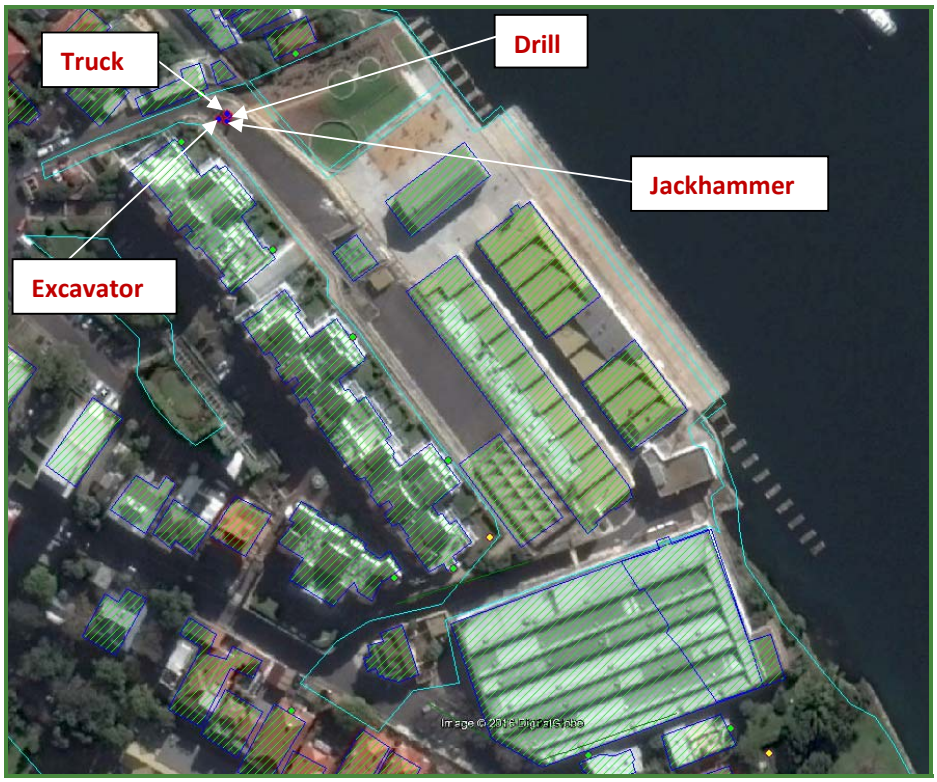


Buildings Receptors Noise sources

Figure 5-4: Construction scenario 2

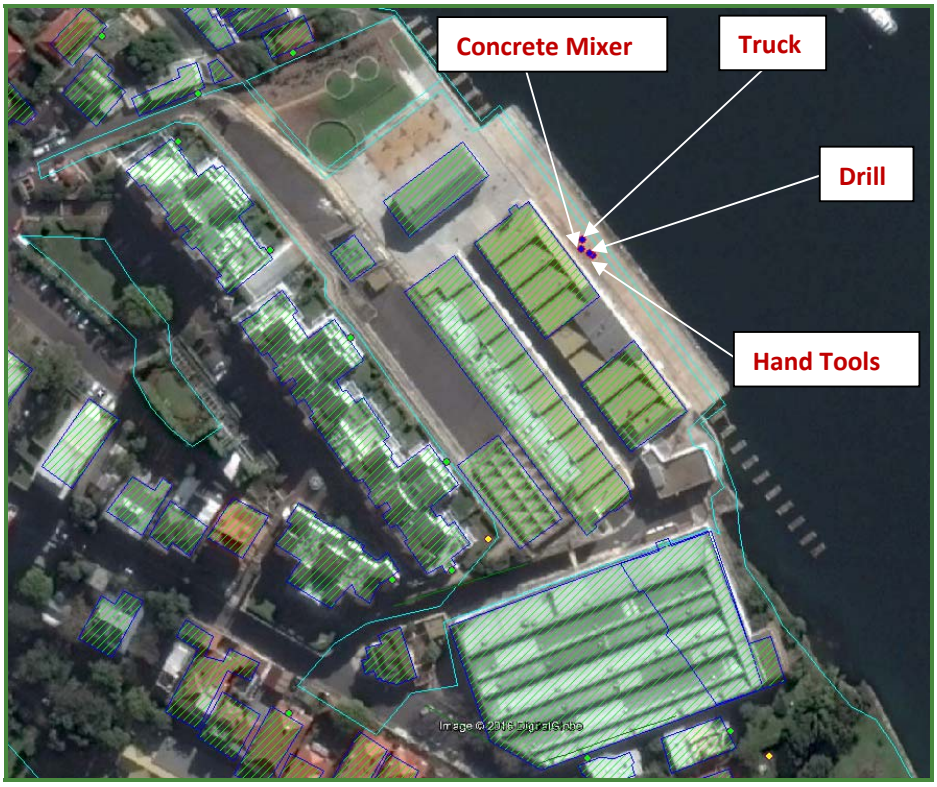
Buildings Receptors Noise sources

Figure 5-5: Construction scenario 3



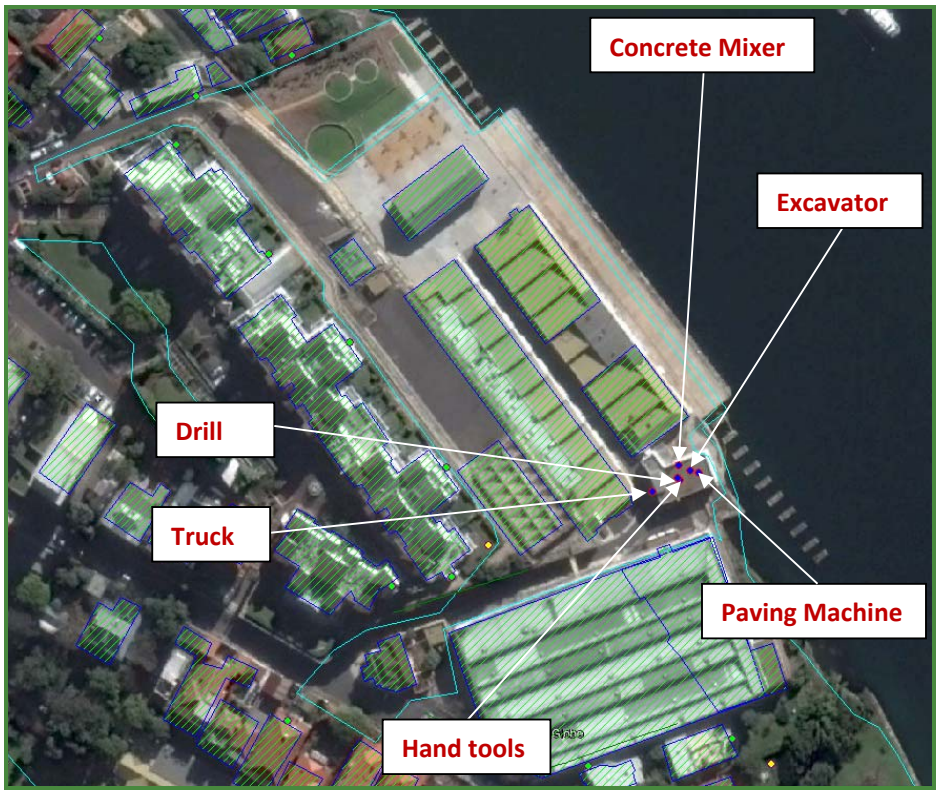
Buildings Receptors Noise sources

Figure 5-6: Construction scenario 4



Buildings Receptors Noise sources

Figure 5-7: Construction scenario 5



Buildings Receptors Noise sources

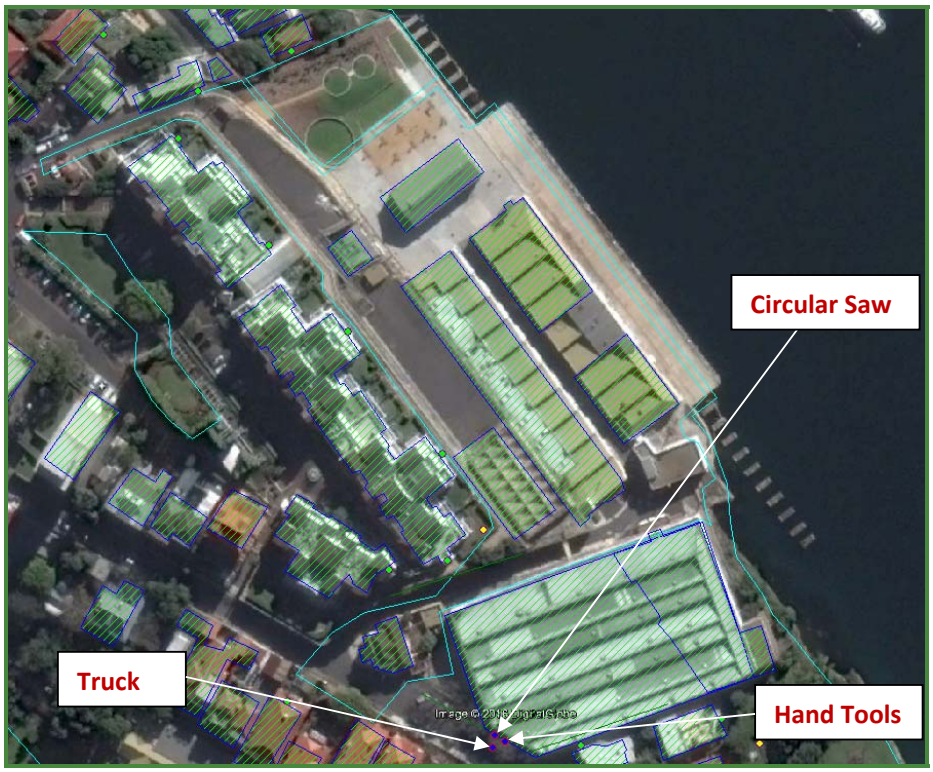
Figure 5-8: Construction scenario 6

Buildings Receptors Noise sources

Figure 5-9: Construction scenario 7

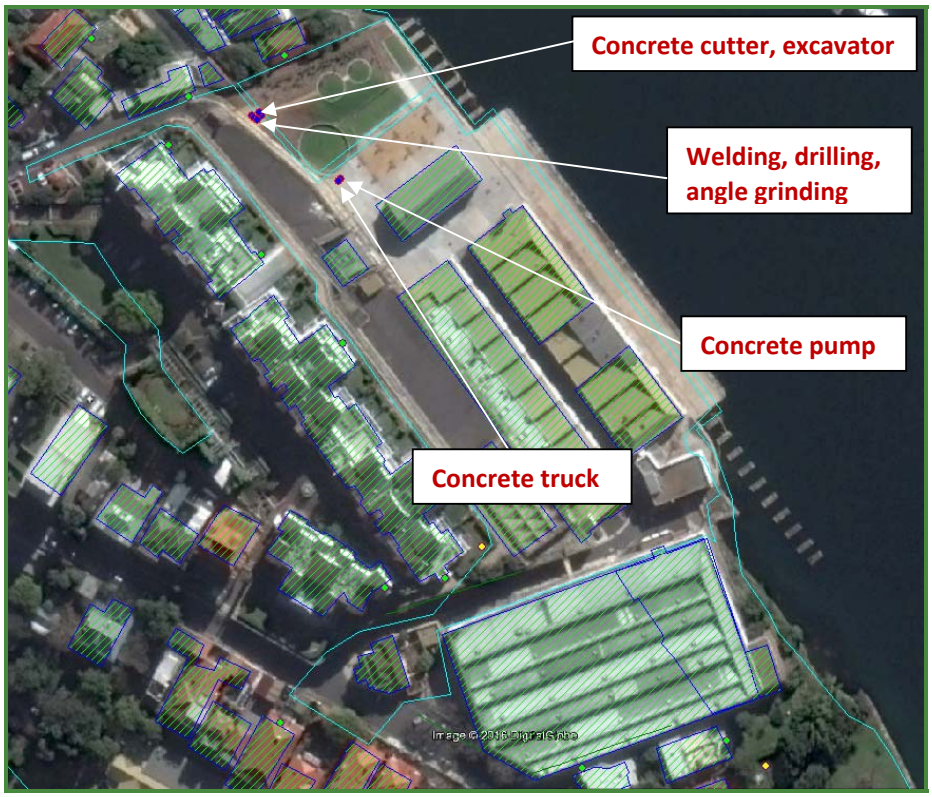
Buildings Receptors Noise sources

Figure 5-10: Construction scenario 8



Buildings Receptors Noise sources

Figure 5-11: Construction scenario 9a

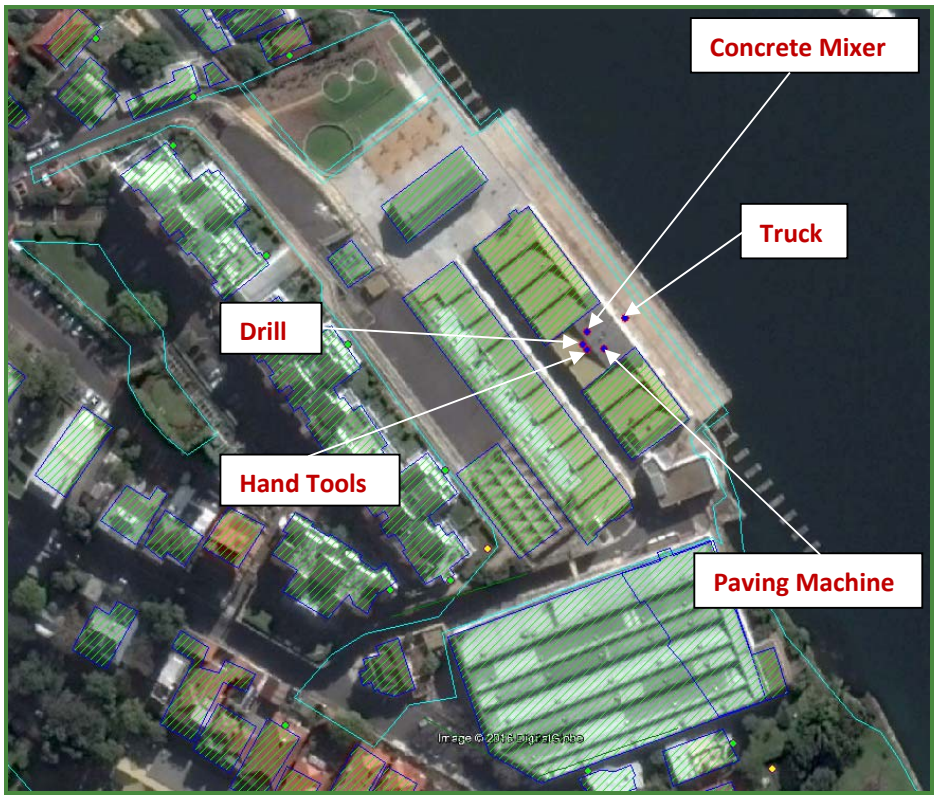


Buildings Receptors Noise sources

Figure 5-12: Construction scenario 9b

Buildings Receptors Noise sources

Figure 5-13: Construction scenario 10



Buildings Receptors Noise sources

Figure 5-14: Construction scenario 11a

Buildings Receptors Noise sources

Figure 5-15: Construction scenario 11b

Buildings Receptors Noise sources

Figure 5-16: Construction scenario 12a

Buildings Receptors Noise sources

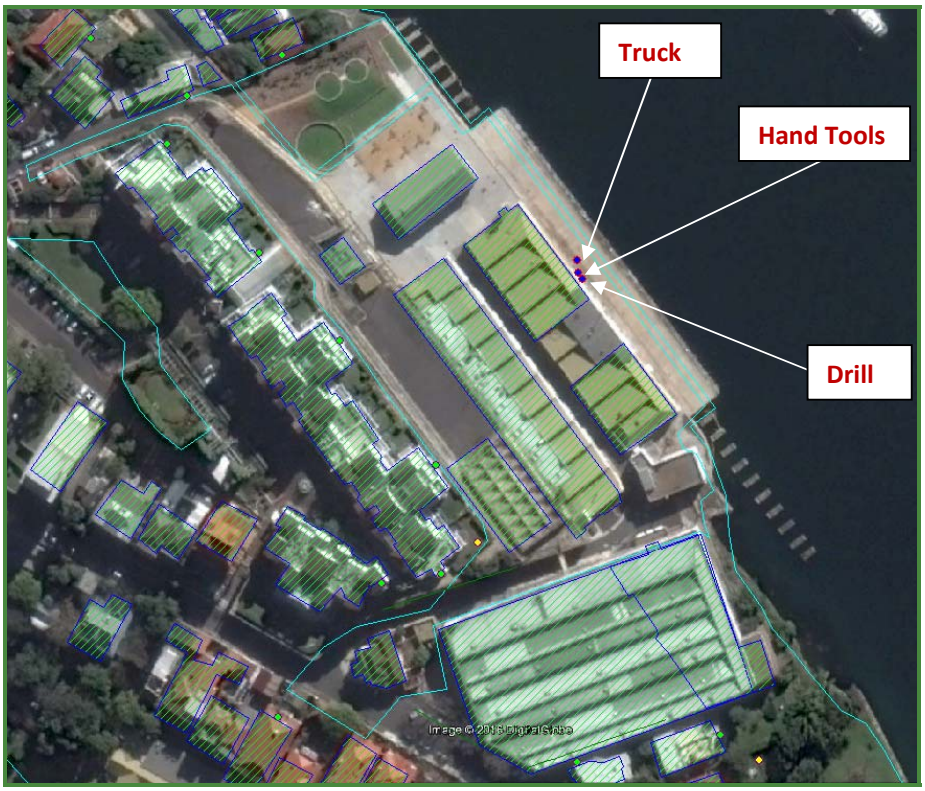
Figure 5-17: Construction scenario 12b

Buildings Receptors Noise sources

Figure 5-18: Construction scenario 13a

Buildings Receptors Noise sources

Figure 5-19: Construction scenario 13b



Buildings Receptors Noise sources

Figure 5-20: Construction scenario 14

Buildings Receptors Noise sources

5.2 PREDICTED NOISE LEVELS

Results of the predictive noise modelling of the construction scenarios have been displayed in Table 5-3. Modelling scenarios for the modification assessment have been carried out using the L_{Aeq} descriptor.

Results reflect the worst case scenario, in which the construction works take place for relatively short periods of time in order to enable public access to the site. All construction scenarios are limited to the day period only.

5.2.1 Noise levels predicted below the 'Noise affected RBL + 10dB' criteria

During all activities (Construction scenarios 1-14), the majority of receivers are predicted to comply with the 'Noise affected RBL + 10 dB' criteria as outlined in Table 4-2 and shown in the Interim Construction Noise Guideline. It can be seen from Table 5-3, that the majority of individual receiver/activity combinations are below the 'Noise affected RBL + 10 dB' criteria (the boxes are unshaded). One scenario is predicted to have no exceedances of the 'Noise affected RBL + 10 dB' limit at any receiver (building 2 refurbishment works, construction scenario 12b). The noise impacts from the construction activities at these levels are predicted to be minimal at these 'unshaded' receivers, and no additional mitigation measures are recommended.

5.2.2 Noise levels predicted above the 'Noise affected RBL + 10dB' criteria

Construction activities are predicted to exceed the 'noise affected RBL + 10 dB' level at a number of receivers during the following scenarios (boxes in Table 5-3 are shaded yellow). The twelve construction scenarios that are predicted to feature worst case noise impacts above 'noise affected RBL + 10 dB' level are:

- Kesterton Park pedestrian link – concreting (Construction scenario 1b);
- Kesterton Park pedestrian link – decking, pontoon and kayak steps (Construction scenario 1c);
- Northern park – landscaping improvement works (Construction scenario 2);
- Wharf promenade (Construction scenario 4);
- Arrival square (Construction scenario 5);
- Lift, cliff walkway and new RANTME bridge (Construction scenario 7);
- Laneway (Construction scenario 10);
- Gatehouse building – refurbishment works (Construction scenario 11b);
- Building 2, penetration works (Construction scenario 12a);
- Building 10, penetration works (Construction scenario 13a);
- Building 10, refurbishment works (Construction scenario 13b); and
- The cutting (Construction scenario 14).

Scenario 1
During the Kesterton Park pedestrian link works, scenarios 1b (concreting) and 1c (decking pontoon and kayak steps), noise levels are predicted to comply with the 'noise affected RBL + 10 dB' levels at 18 of 31 surrounding representative receivers. A maximum exceedance is predicted of 20 dB(A) at R25 (142 High Street).

Scenario 2
During the northern park landscaping works in construction scenario 2, noise levels are predicted to comply with the 'noise affected RBL + 10 dB' levels at 26 of 31 surrounding representative receivers. A maximum exceedance is predicted of 9 dB(A) at R14 (9A Kiara Close).

Scenario 4
For the wharf promenade works in construction scenario 4, noise levels are predicted to comply with 'noise affected RBL + 10 dB' level at 28 of 31 surrounding representative receivers. A maximum exceedance is predicted of 6 dB(A) at R5 (2 Hayes Street).

Scenario 5
During the arrival square construction (scenario 5), noise levels are predicted to comply with the 'noise affected RBL + 10 dB' levels at 25 of 31 surrounding representative receivers. A maximum exceedance is predicted of 7 dB(A) at R19 (1 Kiara Close).

Scenario 7
For the lift, cliff walkway and RANTME bridge construction in scenario 7, the maximum exceedance of 10 dB is predicted at 1 Kiara Close (R21). Noise levels are predicted to comply with 'noise affected RBL + 10 dB' level at 26 of 31 surrounding representative receivers.

Scenario 10
During the laneway construction works in scenario 10, the maximum exceedance of 6 dB is predicted at 1 Kiara Close (R19). Noise levels are predicted to comply with 'noise affected RBL + 10 dB' level at 27 of 31 surrounding representative receivers.

Scenario 11
During the gatehouse building refurbishment works in construction scenario 11b, noise levels are predicted to comply with the 'noise affected RBL + 10 dB' levels at 28 of 31 surrounding representative receivers. A maximum exceedance is predicted of 10 dB(A) at R23 (1 Kiara Close).

Scenario 12
For the Building 2 penetration works (construction scenario 12a), noise levels are predicted to comply with the 'noise affected RBL + 10 dB' levels at 24 of 31 surrounding receivers. The largest exceedance of 8 dB is predicted at R17 (1 Kiara Close).

Scenario 13
During the Building 10 works, construction scenarios 13a (penetration) and 13b (refurbishment), noise levels are predicted to comply with the 'noise affected RBL + 10 dB' levels at 24 of 31 receivers, with a maximum exceedance of 13 dB(A) at R5 (2 Hayes Street) during the building penetration activities.

Scenario 14
For the cutting construction activities (scenario 14), noise levels are predicted to comply with the 'noise affected RBL + 10 dB' levels at 28 of 31 surrounding representative receivers. A maximum exceedance is predicted of 13 dB(A) at R21 (1 Kiara Close).

In general, the above noise generating construction scenarios in section 5.2.2 comply with the 'noise affected RBL + 10 dB' level at the vast majority of receivers (unshaded boxes in Table 5-3).

Where construction impacts are predicted to be above the 'noise affected RBL + 10 dB' level, the proponent is recommended to apply all feasible and reasonable work practices to reduce the noise impacts. Noise control measures and management practices for these predicted exceedances are presented in Section 9.

5.2.3 Noise levels predicted above the 'Highly affected 75 dB(A)' criteria

The following construction scenarios are predicted to have at least one receiver which experiences, 'highly noise affected 75 dB(A)' levels (boxes in Table 5-3 are shaded orange). The seven construction scenarios that are predicted to feature worst case noise impacts above the 'highly noise affected 75 dB(A)' level are:

- Kesterton park pedestrian link – pile driving (Construction scenario 1a);
- Upper level car park – demolition of the gatehouse (Construction scenario 3);
- Gateway plaza (Construction scenario 6);
- RANTME factory car park (Construction scenario 8);
- Northern access stairway – footing (Construction scenario 9a);
- Northern access stairway – frame (Construction scenario 9b); and
- Gatehouse building - penetration works (Construction scenario 11a).

Scenario 1
During the Kesterton Park pedestrian link pile driving works (construction scenario 1a), noise levels are predicted to exceed the 'highly affected 75 dB(A)' criteria at 12 of 31 surrounding representative receivers. A maximum noise level of 97 dB(A) is predicted at R25 (142 High Street). It is understood that the piling works involves a small amount of piles and where possible they will be screwed into place to reduce noise levels below the predicted results.

Scenario 3
During the gatehouse demolition in the upper car park (construction scenario 3), noise levels are predicted to exceed the 'highly affected 75 dB(A)' criteria at 4 of 31 surrounding representative receivers. A maximum noise level of 89 dB(A) is predicted at R14 (9A Kiara Close).

Scenario 6
For the gateway plaza construction activities (construction scenario 6), noise levels are predicted to exceed the 'highly affected 75 dB(A)' criteria at 2 of 31 surrounding representative receivers. A maximum noise level of 79 dB(A) is predicted at R21 (1 Kiara Close).

Scenario 8
During the RANTME factory car park works, construction scenario 8, noise levels are predicted to exceed the 'highly affected 75 dB(A)' criteria at 1 of 31 surrounding representative receivers. The only receiver predicted to be above 75 dB(A) is R30 (147 High Street), with a maximum noise level of 78 dB(A).

Scenario 9
For the northern access stairway works, construction scenarios 9a (footing) and 9b (frame), noise levels are predicted to exceed the 'highly affected 75 dB(A)' criteria at 1 of 31 surrounding representative receivers. The only receiver predicted to be above 75 dB(A) is R14 (9A Kiara Close), with a maximum noise level of 80 dB(A).

Scenario 11

During the gatehouse building penetration works (construction scenario 11a), noise levels are predicted to exceed the 'highly affected 75 dB(A)' criteria at 2 of 31 surrounding representative receivers. A maximum noise level of 80 dB(A) is predicted at R23 (1 Kiara Close).

In general, the above noise generating construction scenarios in section 5.2.3 exceed the 'highly affected 75 dB(A)' criteria at only a small minority of receivers (shaded orange boxes in Table 5-3).

Where construction impacts are predicted to be above the 'highly affected 75 dB(A)' level, the proponent may require respite periods, or restricting activities to certain periods. Noise control measures and management practices for these predicted exceedances are presented in Section 7.

Table 5-3: Noise Modelling Results Associated with Construction Activities, L_{eq}, dB(A)

Receiver	Construction Criterion ($L_{eq,15\ minute}$ dB(A))	Predicted Noise Levels (L_{eq}, dB(A))																			
		1a[1]	1b[1]	1c[1]	2	3[1]	4	5	6[1]	7	8	9a[1]	9b[1]	10	11a[1]	11b	12a[1]	12b	13a[1]	13b	14
R1	50	79	53	54	33	56	45	48	32	24	18	44	45	44	26	16	46	37	52	42	22
R2	50	79	53	55	41	57	47	48	35	44	30	47	47	47	28	20	49	40	54	43	30
R3	50	80	54	56	41	58	49	51	44	52	26	52	50	49	33	26	53	43	57	45	48
R4	70	82	57	59	46	60	53	52	41	53	25	57	52	52	32	21	57	45	62	49	42
R5	50	82	57	59	51	63	56	52	38	47	25	61	56	54	33	21	58	46	63	51	34
R6	50	80	54	57	49	64	52	48	31	46	24	60	57	50	29	17	55	45	61	48	31
R7	70	77	52	55	49	65	54	46	33	41	26	62	59	50	32	21	56	43	64	49	32
R8	50	79	53	56	49	64	53	44	29	43	20	61	58	50	28	17	53	41	61	49	30
R9	50	77	51	54	47	61	50	42	27	42	18	56	54	47	27	15	43	40	58	46	29
R10	65	76	48	52	49	61	48	36	30	36	21	55	54	43	32	18	41	34	60	44	32
R11	57	71	46	48	32	45	31	30	29	29	20	43	44	31	31	17	33	24	36	25	25
R12	57	77	51	53	43	55	49	44	35	33	26	54	51	38	37	23	42	35	42	32	29
R13	57	67	40	45	54	78	43	43	36	40	27	71	70	43	39	25	50	38	52	40	35
R14	56	68	53	57	65	89	46	46	34	38	25	79	80	51	37	22	61	49	55	43	32
R15	56	64	39	44	44	65	43	42	32	31	23	55	57	47	35	21	53	41	52	40	28
R16	56	56	29	32	33	65	26	28	33	29	25	47	54	30	37	22	38	24	36	22	28
R17	56	71	43	48	62	78	42	51	38	44	31	73	70	57	45	30	64	49	48	36	35
R18	56	63	48	44	56	85	46	42	35	37	26	70	75	49	37	23	58	46	51	39	30
R19	56	70	44	54	55	69	43	63	47	57	35	63	62	62	47	33	56	46	51	38	47
R20	56	70	43	47	59	73	42	53	42	45	31	67	67	60	44	29	52	53	50	37	37
R21	56	70	44	56	32	45	32	62	79	66	45	41	39	53	70	60	45	31	42	28	69

Table 5-3: Noise Modelling Results Associated with Construction Activities, L_{eq}, dB(A)

Receiver	Construction Criterion ($L_{eq,15\ minute}$ dB(A))	Predicted Noise Levels (L_{eq}, dB(A))																		
		1a[1]	1b[1]	1c[1]	2	3[1]	4	5	6[1]	7	8	9a[1]	9b[1]	10	11a[1]	11b	12a[1]	12b	13a[1]	13b	14
R22	56	70	44	55	47	51	41	59	64	60	44	56	53	53	54	44	54	41	51	36	58
R23	56	68	44	45	30	43	31	58	77	62	55	41	39	35	80	66	43	29	41	27	64
R24	54	96	74	73	34	50	33	40	48	40	41	41	41	38	44	30	43	31	41	29	39
R25	54	97	74	74	33	39	33	39	44	40	39	40	36	38	42	28	44	31	41	28	35
R26	65	99	79	76	29	42	37	47	45	35	36	38	37	36	42	27	39	26	44	32	37
R27	54	94	73	71	29	38	32	43	40	34	33	35	32	34	37	24	37	27	39	28	32
R28	54	73	49	48	25	36	26	33	48	34	58	34	31	31	39	31	39	25	34	22	33
R29	54	92	68	70	35	41	30	40	55	43	54	39	35	40	45	32	45	32	38	25	43
R30	54	70	45	49	26	39	28	35	75	39	78	36	33	34	50	42	38	27	37	23	40
R31	54	63	38	39	27	40	28	35	64	41	66	39	36	32	80	64	41	27	37	24	44

Exceed the RBL +10 dB(A) (residential criteria) or management level criteria (non residential criteria)

Exceed the highly noise affected 75 dB(A) (residential criteria)

Note 1: As per section 4.5 of the Interim Construction Noise Guideline (DECC, 2009), a number of activities have proven to be particularly annoying to residents and have therefore had 5 dB added to their predicted levels.

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6. CONSTRUCTION VIBRATION IMPACTS

The recommended safe working distances from vibration intensive equipment is shown below. The criteria of the British Standard has been adopted, in line with the TfNSW Construction Noise and Vibration Guideline. Although heritage buildings are present on site, no heritage buildings from neighbouring properties are in the immediate vicinity of the proposed construction activities, and therefore the criteria from the British Standard has been adopted.

The use of pile drivers, jackhammers, hydraulic hammers and pile boring machines has the potential to generate vibration. Human annoyance from vibration from construction equipment is considered more likely than structural damage to buildings.

Table 6-1: Recommended safe working distances for vibration intensive plant

Plant item	Rating/ description	Safe Working Distance	
		Cosmetic Damage[1]	Human Response[2]
Vibratory pile driver	Sheet piles	2 m to 20 m	20 m
Pile boring	<800 mm	2 m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure
Small hydraulic hammer	300 kg – 5 to 12 T excavator	2 m	7 m

Note 1: As per BS 7385
Note 2: As per OH&E Vibration Guideline

Pile driving and pile boring works are planned to take place beyond 25 m from any structure, and therefore it is considered unlikely that cosmetic damage or human response to vibration will occur. The piling works are to be kept to a minimum where possible, with screw methods used where feasible.

Jackhammers are planned to be used for the northern gatehouse and RANTME Building 3 internal demolition, with dwellings well beyond the nominal 1 m cosmetic damage criteria.

It is therefore considered unlikely that cosmetic damage or human response to vibration will occur as part of the proposed construction works.

7. CONSTRUCTION MANAGEMENT AND MITIGATION MEASURES

A number of management and mitigation measures are recommended to reduce the potential for noise impacts from the site. Proposed noise management procedures and mitigation measures include:

- Construction Hours of Work (Section 7.1);
- Mitigation Measures (Section 7.2);
- Community Notification (Section 7.3);
- Complaints Procedure (Section 7.4); and
- Noise Monitoring (Section 7.5).

7.1 CONSTRUCTION HOURS OF WORK

Due to the noise impacts predicted during construction works in Section 5, it is proposed that construction works take place during standard hours.

The proposed hours of operations for all **construction and delivery** works are as follows:

Monday to Friday:	7am to 5pm (with no hammering or saw-cutting to occur before 7.30am)
Saturday:	8am to 1pm (with no hammering or saw-cutting to occur before 8.30am)
Sunday and Public Holidays:	No works permitted

7.2 MITIGATION MEASURES

A number of general mitigation measures are recommended to be adopted where possible, including universal work practices (7.2.1), plant and equipment (7.2.2) and on-site measures (7.2.3).

7.2.1 Universal work practices

Universal work practices from section 6 of the *Industrial Construction Noise Guideline* are recommended to be adopted, including the following:

- Regularly train workers and contractors (such as at toolbox talks) to use equipment in ways to minimise noise.
- Ensure site managers periodically check the site and nearby residences and other sensitive land uses for noise problems so that solutions can be quickly applied.
- Include in tenders, employment contracts, subcontractor agreements and work method statements clauses that require minimisation of noise and compliance with directions from management to minimise noise.
- Avoid the use of radios or stereos outdoors where neighbours can be affected.
- Avoid the overuse of public address systems.
- Avoid shouting, and minimise talking loudly and slamming vehicle doors.

- Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes or compression braking, and no extended periods of engine idling).
- Develop a one-page summary of approval or consent conditions that relate to relevant work practices, and pin it to a noticeboard so that all site operators can quickly reference noise information.
- Workers may at times need to discuss or negotiate practices with their managers.

7.2.2 Plant and Equipment

As per section 6 of the *Industrial Construction Noise Guideline* controlling construction noise at the source is recommended to be done by the following means:

Use quieter methods

- Use alternatives to diesel and petrol engines and pneumatic units, such as hydraulic or electric controlled units where feasible and reasonable. Where there is no electricity supply, use an electrical generator located away from residences.

Use quieter equipment

- Examine different types of machines that perform the same function and compare the noise level data to select the least noisy machine.
- Pneumatic equipment is traditionally a problem – select silenced jackhammers and damped bits where possible.
- When renting, select quieter items of plant and equipment where feasible and reasonable.
- When purchasing, select, where feasible and reasonable, the most effective mufflers, enclosures and low-noise tool bits and blades. Always seek the manufacturer's advice before making modifications to plant to reduce noise.

Operate plant in a quiet and efficient manner

- Reduce throttle setting and turn off equipment when not being used.

Maintain equipment

- Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers.
- Equipment must not be operated until it is maintained or repaired, where maintenance or repair would address the annoying character of noise identified.
- Return any hired equipment that is causing noise that is not typical for the equipment – the increased noise may indicate the need for repair.
- Ensure air lines on pneumatic equipment do not leak.

7.2.3 On Site

On site location of plant should be considered where possible, as per section 6 of the *Industrial Construction Noise Guideline*:

Location of plant

- Place as much distance as possible between the plant or equipment and residences and other sensitive land uses.
- Restrict areas in which mobile plant can operate so that it is away from residences and other sensitive land uses at particular times.

- Locate site vehicle entrances away from residences and other sensitive land uses.
- Carry out noisy fabrication work at another site (for example, within enclosed factory premises) and then transport to site. Fabrication work that must take place on site is recommended to be carried out in an enclosed area, where possible.

Alternatives to reversing alarms

- Avoid use of reversing alarms by designing site layout to avoid reversing, such as by including drive through for parking and deliveries, and using spotters and traffic controllers.
- Install where feasible and reasonable less annoying alternatives to the typical 'beeper' alarms taking into account the requirements of the Occupational Health and Safety legislation; examples are smart alarms that adjust their volume depending on the ambient level of noise and multi frequency alarms that emit noise over a wide range of frequencies.
- In all circumstances, the requirements of the relevant Occupational Health and Safety legislation must be complied with. For information on replacing audible warning alarms on mobile plant with less annoying alternatives, see Appendix C of the Interim Construction Noise Guideline.

7.2.4 Other Specific Mitigation Measures

The following mitigation measures are recommended for selected construction scenarios:

Kesterton Park Pedestrian Link (Construction Scenario 1)

- If environmental conditions allow, screw piling is preferred over hydraulic piling.
- Piling works are recommended to take place during the daytime period on weekdays unless engineering advice states that no alternative is possible.
- Piling works are expected to take place during standard construction hours. However, piling works may need to take place at night on an emergency basis, should the need for minimal harbour wash arise. Should piling works be conducted at night, specific notification of surrounding receivers is to be done in accordance with section 7.3 of this report.
- Where possible, deck pieces should be constructed off site and brought into site with minimal fixing/noise generation required.
- Trucks are not recommended to lay idle during the works, the engine should run only when the truck is arriving or leaving site.
- Examine different types of saws that perform the same function and compare the noise level data to select the least noisy machine.

Northern Park Landscaping Improvement Works (Construction Scenario 2)

- Excavators with broadband reversing alarms are to be investigated, and fitted if possible.
- Trucks are not recommended to lay idle during the works, the engine should run only when the truck is arriving or leaving site.

Demolition of the Upper Level Carpark Gate House (Construction Scenario 3)

- Excavators with broadband reversing alarms are to be investigated, and fitted if possible.
- If jackhammers are used, investigate the use of silencers or damped bits, and incorporate if possible.
- Trucks are not recommended to lay idle during the works, the engine should run only when the truck is arriving or leaving site.

Wharf Promenade (Construction Scenario 4)

- Trucks are not recommended to lay idle during the works, the engine should run only when the truck is arriving or leaving site.

Arrival Square (Construction Scenario 5)

- Excavators with broadband reversing alarms are to be investigated, and fitted if possible.
- Trucks are not recommended to lay idle during the works, the engine should run only when the truck is arriving or leaving site.

Gateway Plaza (Construction Scenario 6)

- Trucks are not recommended to lay idle during the works, the engine should run only when the truck is arriving or leaving site.
- Examine different types of saws that perform the same function and compare the noise level data to select the least noisy machine.

Lift, Cliff Walkway and new RANTME Bridge (Construction Scenario 7)

- Trucks are not recommended to lay idle during the works, the engine should run only when the truck is arriving or leaving site.

RANTME Factory Car park (Construction Scenario 8)

- Trucks are not recommended to lay idle during the works, the engine should run only when the truck is arriving or leaving site.
- Examine different types of saws that perform the same function and compare the noise level data to select the least noisy machine.

Northern Access Stairway (Construction Scenario 9)

- Excavators with broadband reversing alarms are to be investigated, and fitted if possible.
- Trucks are not recommended to lay idle during the works, the engine should run only when the truck is arriving or leaving site.
- Examine different types of saws that perform the same function and compare the noise level data to select the least noisy machine.
- Examine different types of saws that perform the same function and compare the noise level data to select the least noisy machine.

Laneway (Construction Scenario 10)

- Trucks are not recommended to lay idle during the works, the engine should run only when the truck is arriving or leaving site.

Gatehouse Building (Construction Scenario 11)

- Trucks are not recommended to lay idle during the works, the engine should run only when the truck is arriving or leaving site.
- Examine different types of saws that perform the same function and compare the noise level data to select the least noisy machine.

Building 2 (Construction Scenario 12)

- Trucks are not recommended to lay idle during the works, the engine should run only when the truck is arriving or leaving site.
- Examine different types of saws that perform the same function and compare the noise level data to select the least noisy machine.

Building 10 (Construction Scenario 13)

- Excavators with broadband reversing alarms are to be investigated, and fitted if possible.
- Trucks are not recommended to lay idle during the works, the engine should run only when the truck is arriving or leaving site.
- Examine different types of saws that perform the same function and compare the noise level data to select the least noisy machine.

The Cutting (Construction Scenario 14)

- Planningre not recommended to lay idle during the works, the engine should run only when the truck is arriving or leaving site.

7.3 COMMUNITY NOTIFICATION

The community is more likely to be understanding and accepting of construction noise if frank information is provided, and commitments firmly adhered to. It is therefore recommended to undergo a community notification programme prior to construction works commencing.

Residents at potentially affected properties are to be notified of upcoming construction works by a newsletter letterbox drop. The newsletter is to contain, but not limited to the following:

- A brief outline of the proposed construction activities;
- Proposed times and dates of construction;
- Details of noise mitigation measures;
- Details of the noise complaints procedure; and
- Contact details of the community liaison officer.

A letter box notification is recommended for the renewal works, with a proposed area of letterbox drop is shown in Figure 7-1. Information is recommended to arrive at the residents' properties between 5 and 14 days before the renewal construction works commence. Additional notification is recommended should night-time piling works be required.

Figure 7-1: Proposed letterbox notifications

The SHFT website is also to contain information on the construction works, including the above newsletters and complaints procedure (Section 7.4).

7.4 COMPLAINTS PROCEDURE

A complaints procedure with a complaints hotline and a community liaison officer is recommended to manage and log all calls in a register. The liaison officer is to be a SHFT employee, a member of the construction company or on-site acoustician. The caller should be provided with relevant information including construction operations and finishing times when relevant.

In addition to the complaints hotline, a postal address, email address and details of the community liaison should also be included on the Sydney Harbour Federation Trust Platypus project website. The complaints register should record details of all complaints including but not limited to:

a) The date and time of the complaint/feedback;
b) The method by which the complaint was made (telephone, email, in writing, in person);
c) Any personal details of the complainant that were provided, or if no details were provided, a note to that effect;
d) The nature of the complaint;
e) Any action(s) taken by SHFT in relation to the complaint, including investigations and any follow up contact with the complainant; and
f) If no action was taken by SHFT, record the reason why no action was taken.

Any complaints should be acknowledged within 48 hours, with every effort made to resolve the issue within 10 days. All complaints and feedback are to be tabled for discussion at meetings with the Director responsible for operations.

7.5 NOISE MONITORING

The following construction scenarios are predicted to have the highest noise impacts at the surrounding receivers:

- Kesterton Park Pedestrian Link – pile driving (Construction scenario 1a);
- Upper level car park – demolition of gate house (Construction scenario 3); and
- Gatehouse building, refurbishment works (Construction scenario 11a).

During the piling works (construction scenario 1a), it is recommended to conduct on-site and offsite noise monitoring by a suitable qualified acoustic consultant during the construction period. Monitoring is recommended to take place during the period predicted to have the highest noise impact, i.e. the pile driving.

Should noise complaints be received during the other stages of the works, such as construction scenarios 3, 8a and 11, it is recommended that on-site and offsite noise monitoring be conducted by a suitable qualified acoustic consultant. All the noise complaints received to the hotline shall be recorded on a complaint register for reference.

On-site measurements shall be taken at a reference point from the noise generating activities. Offsite noise monitoring shall be undertaken at the most exposed residential receivers. An independent firm of suitably qualified noise consultants should undertake the noise monitoring programme.

Measurement of event noise levels employs a variety of time intervals to obtain a representative noise level in the relevant noise descriptor, i.e. L_{Aeq} and L_{Amax}.

The independent noise consultants should be in radio or mobile phone contact with Construction Manager. This should ensure that noise measurements in residential areas that exceed the predicted noise levels initiate a response at the noise source.

An alternative to in-person acoustic measurements is noise monitoring on a continual basis using a noise monitoring system.

8. OPERATIONAL NOISE ASSESSMENT

Predictive Noise Modelling was carried out in SoundPLAN v7.3 using the ISO 9613 algorithm. This model has been extensively utilised by Benbow Environmental, and is recognised by regulatory authorities throughout Australia. The model allows for the prediction of noise from a site, at the specified receptor, by calculating the contribution of each noise source.

The primary noise sources associated with the operational noise model include:

- On-site vehicles, manoeuvring;
- On-site vehicles, door close;
- On-site vehicles, ignitions;
- Gate open/close;
- Lift;
- Vessel at 15 km/h;
- PA Music;
- Amplified music; and
- People talking.

8.1 MODELLING METHODOLOGY

8.1.1 Assumptions Made for Noise Modelling

It should be noted that as per the Industrial Noise Policy (EPA, 2000), the relevant assessment period for operational noise activities has been considered to be 15 minutes. Therefore noise source durations detailed in the following assumptions should be considered per 15 minute period. Each noise generating scenario has been modelled to present potential noise impacts under worst-case scenarios. Each assessment-specific assumption has been detailed below:

- Off-site topographical information has been obtained from NSW Land and Property Information LIDAR terrain data at 1 m resolution.

- On-site topography has been obtained from the site survey plans provided by the client. The topography of the northern park was obtained by on-site measurements.

- Off-site structures such as warehouses, buildings and solid fences surrounding the project site have been included in the model.

- All ground areas surrounding the subject site and the nearest nominated occupancies have been modelled with degrees of sound absorption represented by factors ranging from 0 to 1. Zero indicates a fully reflective ground and 1 soft ground. A ground factor of 0 has been used for water and concrete areas. A ground factor of 0.5 was used for residential areas. A ground factor of 0.75 was used for public parks.

- All residential receivers were modelled at 1.5 m above ground level, at the most noise-affected point within 30 m of the residence and also at the residence façade. Receptors located in multi-storey buildings were modelled at 2.8 m intervals on each floor level.

- All noise sources associated with the operational activities, excluding cars manoeuvring have been modelled as point sources.
- Car ignition has been modelled for 1 second per 15 minute period at 1 m above ground level.
- Car door closing has been modelled for 0.5 seconds per 15 minute period at 1 m above ground level.
- Cars manoeuvring has been modelled as a line source 1 m above ground level, representing vehicles travelling at 15 km/hr.
- Trucks have been modelled as a line source 1.5 m above ground level, moving at 10 km/hr, with one vehicle per 15 minute period.
- The boat vessel is coming into dock at less than 15 km/h
- Recorded music has been modelled playing 100% of the time at 3 m above ground level.
- The sound power level and octave band spectrum for the upper level car park gate has been taken from attended measurements during compliance monitoring in 2016.
- The northern park operational noise scenario 2 contains 4 music speakers at 70 dB(A) playing 100% of the time and a sound power level of 93 dB(A) from attendees.
- The upper level car park operational noise scenario 3 contains 8 car movements from a 55 space carpark during a 15 minute period as a worst-case scenario.
- The wharf promenade operational noise scenario 4 contains 1 music speaker at 70 dB(A) playing 100% of the time and a sound power level of 92 dB(A) from attendees.
- The arrival square operational noise scenario 5 contains 1 music speaker at 70 dB(A) playing 100% of the time and a sound power level of 92 dB(A) from attendees.
- The gateway plaza operational noise scenario 6 contains a sound power level of 88 dB(A) from attendees.
- The lift and RANTME building walkway contains 1 lift motor operating 100% of the time and a sound power level of 88 dB(A) from attendees.
- The RANTME factory car park operational noise scenario 8 contains 16 car movements from a 30 space carpark during a 15 minute period as a worst-case scenario. The southern wall of the RANTME building closest to 140 High Street is assumed to be maintained at this stage of the works.
- The laneway operational scenario 11 includes one vehicle such as a delivery truck or van arriving in a 15 minute scenario.
- The upper level car park for construction workers (operational noise scenario 13), contains 4 truck movements and 8 car movements from a 55 space carpark during a 15 minute period as a worst-case scenario.

The above noise generating scenarios reflect the worst-case scenarios per 15 minute period. An outline of the noise sources and noise modelling stages has been provided below.

8.1.2 Noise Sources

A-weighted octave band centre frequency sound power levels are presented in Table 8-1 below. The sound power levels for the relevant noise sources have been calculated from measurements of sound pressure levels undertaken by an acoustic engineer from Benbow Environmental at similar sites and sourced from Benbow Environmental's extensive noise source database.

Table 8-1: A-weighted Sound Power Levels Associated with Construction Activities, dB(A)

Noise Source	Overall	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
PA Music	**70**	42	51	55	68	64	57	55	53
4 People talking	**80**	48	58	72	78	71	69	65	58
Cars manoeuvring	**82**	58	69	74	80	77	66	60	58
Car door close	**95**	77	77	81	89	91	87	78	72
Car ignitions	**78**	47	51	57	66	70	75	71	68
Gate open/close	**72**	52	53	59	64	64	64	66	55
Lift Motor	**78**	64	67	69	72	72	71	66	58
Truck	**102**	67	79	80	100	95	89	89	91
Vessel at 15 km/h	**86**	58	68	75	81	79	80	75	73
Music	**60**	32	41	45	58	54	47	45	43

8.1.3 Operational Noise Scenarios

Nine operational scenarios were considered in the noise model as follows:

- Operational scenario 1 considers the operational scenario in which the Kesterton Park Pedestrian Link, including the pontoon and kayak steps, are being used by pedestrians and vessels.
- Operational scenario 2 looks at the operational use of the northern park, both for passive recreation and for functions such as weddings.
- Operational scenario 3 assesses the use of the upper level car park, both in daytime hours and after 10pm or before 7am for employees or long term users.
- Operational scenario 4 evaluates the operational activities at the wharf promenade including people and light music.
- Operational scenario 5 considers the arrival square operational activities including light music and pedestrians.
- Operational scenario 6 evaluates the operational activities at the gateway plaza including people and light music.
- Operational scenario 7 considers the operational scenario in which pedestrians utilise the walkway and new RANTME bridge and the lift is operational.
- Operational scenario 8 assesses the use of the RANTME factory as a car park.

- Operational scenario 9 evaluates the operational activities at the northern wharf including people, boats and light radios.
- Operational scenario 10 evaluates the operational activities of people using the northern stairs.
- Operational scenario 11 assesses the operational activities of people and vehicles using the laneway.
- Operational scenario 12 considers the operational activities of people and vehicles utilising the cutting.
- Operational scenario 13 contains the operational activities for the upper level car park specifically for construction workers.

The noise source list for operational scenarios 1-13 is detailed in Table 8-2, with noise source locations shown in Figure 8-1 to Figure 8-13.

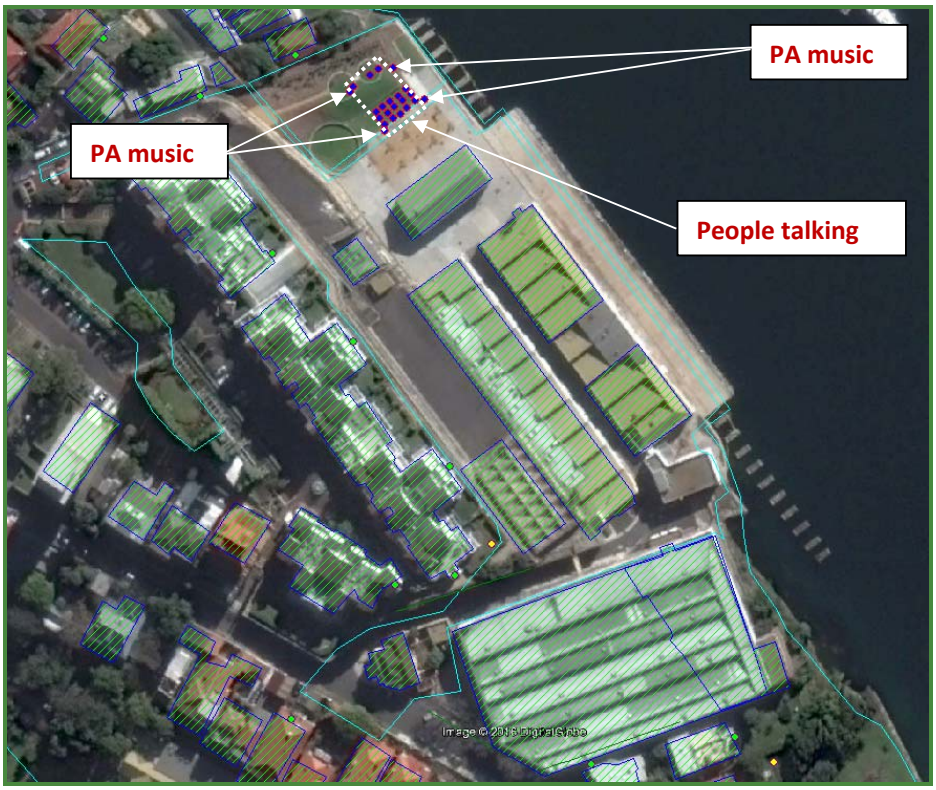
Table 8-2: Operation Noise Scenarios

Operational Scenarios	Noise Sources for Worst 15-minute Period
Scenario 1 – Operational: Kesterton Park Pedestrian Link, pontoon	• Vessels • Music • People talking
Scenario 2 – Operational: Northern park, music and people	• PA music • People talking
Scenario 3 – Operational: Upper level car park	• Cars manoeuvring • Doors close • Car ignitions • Gate opening/closing
Scenario 4 – Operational: Wharf promenade	• PA music • People talking
Scenario 5 – Operational: Arrival square	• PA music • People talking
Scenario 6 – Operational: Gateway Plaza	• People talking
Scenario 7 – Operational: Lift, cliff walkway and new RANTME bridge	• Lift • People talking
Scenario 8 – Operational: RANTME factory car park	• Cars manoeuvering • Doors close • Car ignitions
Scenario 9 – Operational: Northern Wharf	• Vessels • Music • People talking
Scenario 10 – Operational: Northern stairs	• People talking
Scenario 11 – Operational: Laneway	• People talking • Truck
Scenario 12 – Operational: The cutting	• People talking • Truck
Scenario 13 – Operational: Upper level car park for construction workers	• Cars manoeuvring • Doors close • Car ignitions • Gate opening/closing • Trucks

Figure 8-1: Operational scenario 1

Buildings Receptors Noise sources

Figure 8-2: Operational scenario 2



Buildings Receptors Noise sources

Figure 8-3: Operational scenario 3

Buildings Receptors Noise sources

Figure 8-4: Operational scenario 4

Buildings Receptors Noise sources

Figure 8-5: Operational scenario 5

Buildings Receptors Noise sources

Figure 8-6: Operational scenario 6

Buildings Receptors Noise sources

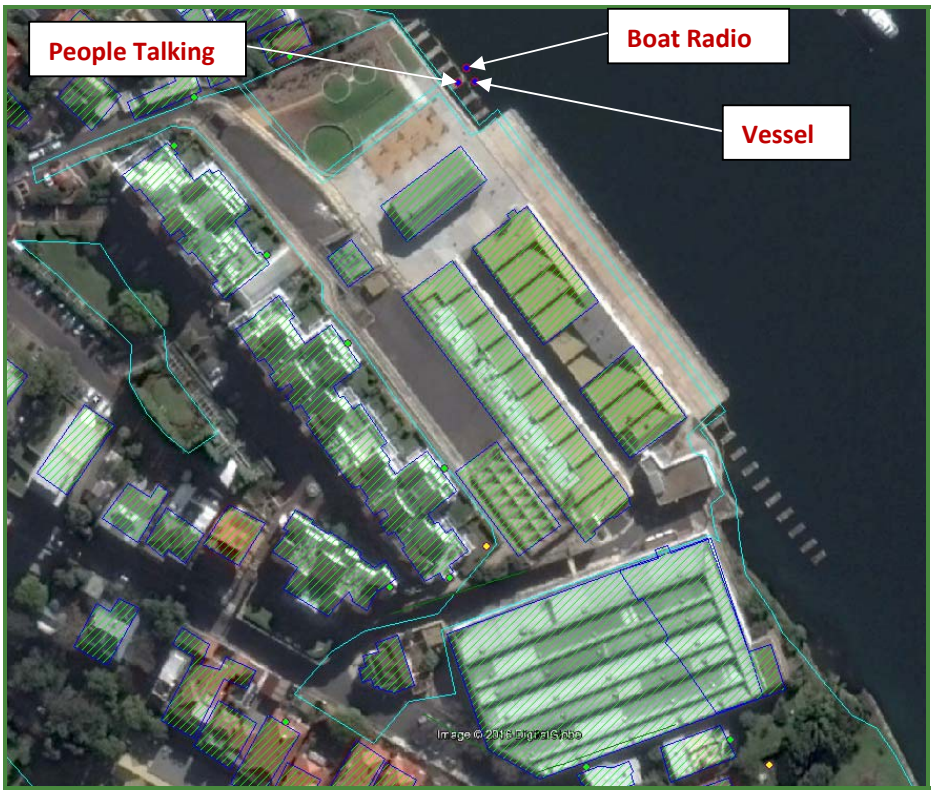
Figure 8-7: Operational scenario 7

Buildings Receptors Noise sources

Figure 8-8: Operational scenario 8

Buildings Receptors Noise sources

Figure 8-9: Operational scenario 9



Buildings Receptors Noise sources

Figure 8-10: Operational scenario 10

Buildings Receptors Noise sources

Figure 8-11: Operational scenario 11

Buildings Receptors Noise sources

Figure 8-12: Operational scenario 12

Buildings Receptors Noise sources

Figure 8-13: Operational scenario 13

8.2 PREDICTED NOISE LEVELS

The predicted results of the operational scenarios are shown in Table 8-3 for the NSW INP guidelines, Table 8-4 for the sleep disturbance criteria and **Error! Reference source not found.** to **Error! Reference source not found.** for octave band criteria.

Operational Scenarios 1, 4, 7, 8 and 9
The operational noise levels are predicted to comply with all noise criteria at all receivers during all periods for the Kesterton park pedestrian link and pontoon (operational scenario 1), wharf promenade (operational scenario 4), lift and walkway (operational scenario 7), RANTME building car park (operational scenario 8) and northern wharf (operational scenario 9).

Operational Scenario 2
During outdoor events at the northern park (operational scenario 2), noise levels are predicted to comply with the daytime and evening INP criteria at all surrounding receivers. Use of the park for events during the night INP period is predicted to result in exceedances of the noise criteria at the nearest receivers, with further mitigation measures recommended in section 9.

Operational Scenario 3
The predicted noise levels for the potential use of the upper level car park is shown in operational scenario 3. Compliance with the criteria is predicted during day and evening periods. A minor exceedance is predicted at R14 9A Kiara Close, exceeding the night time INP criteria of 40 dB(A) by 1 dB(A). The 1 dB amount is considered indistinguishable to the human ear. While use of the

upper level car park between 6am and 7am or 10pm and 11pm is predicted to comply with a night-time or shoulder period INP criteria, the modelled L_{Max} levels from site employees and long term users are predicted to exceed the sleep disturbance criteria of 55 dB(A) at five receivers by up to 6 dB in Table 8-4. Further mitigation measures are to be put into place for the upper level car park, as discussed in section 9.

Operational Scenario 5
For activities at arrival square (operational scenario 5), the modelled activities are predicted to comply with all criteria during the day and evening periods. Recommendations for outdoor use after 10pm are further discussed in section 9.

Operational Scenario 6
For activities at gateway plaza (operational scenario 6), noise levels are predicted to comply with the INP criteria at all receivers during the daytime and evening period. Recommendations for outdoor use after 10pm are further discussed in section 9.

Operational Scenario 10
For people using the northern stairs (operational scenario 10), the modelled activities are predicted to comply with all criteria during the day and evening periods. Recommendations for use after 10pm is further discussed in section 9.

Operational Scenario 11
For use of the laneway (operational scenario 11), the modelled activities are predicted to comply with all criteria during the day and evening periods. Use of delivery trucks in the laneway after 10pm are predicted to cause exceedances of the sleep disturbance criteria at four receivers. Further noise control recommendations are outlined in section 9.

Operational Scenario 12
For use of the cutting (operational scenario 12), the modelled activities are predicted to comply with all criteria during the day and evening periods. The presence of trucks in the cutting after 10pm are predicted to cause exceedances of the sleep disturbance criteria at one receiver. Further noise control recommendations are outlined in section 9.

Operational Scenario 13
The predicted noise levels for the potential use of the upper level car park by construction workers is shown in operational scenario 13. Compliance with the criteria is predicted during day and evening periods, with a minor exceedance predicted at R14 9A Kiara Close, exceeding the night time INP criteria of 40 dB(A) by 2 dB(A). While use of the upper level car park between 6am and 7am or 10pm and 11pm is predicted to be within the framework of a night-time or shoulder period INP criteria, the modelled L_{Max} levels from site workers and operators are predicted to exceed the sleep disturbance criteria of 55 dB(A) at five receivers by up to 8 dB in Table 8-4. It is expected that the use of the upper level car park during the shoulder periods for construction workers, would be personnel arrival on site just before 7am, and would rarely involve night time activities. Further mitigation measures are to be put into place for the upper level car park, as discussed in section 9.

Table 8-3: Noise Modelling Results Associated with Operational Activities, L_{eq}, dB(A)

Receiver	PSNL ($L_{eq,15\ minute}$ dB(A))			Predicted Noise Levels (L_{eq}, dB(A))												
	Day	Eve	Night	1	2	3	4	5	6	7	8	9	10	11	12	13
R1	45	45	41	23	24	<15	28	29	<15	<15	<15	23	<15	18	23	<15
R2	45	45	41	24	26	16	30	29	<15	<15	<15	24	<15	20	26	17
R3	45	45	41	28	26	17	32	32	19	15	<15	23	<15	28	29	18
R4	70			29	31	20	36	33	<15	17	<15	29	15	27	31	21
R5	45	45	41	29	35	24	38	32	<15	21	<15	33	18	24	32	25
R6	45	45	41	27	32	21	35	29	<15	19	<15	30	19	22	29	22
R7	70			28	35	22	35	27	<15	20	<15	34	20	18	27	23
R8	45	45	41	26	33	21	35	26	<15	19	<15	32	20	20	28	22
R9	45	45	41	24	30	19	32	24	<15	17	<15	28	17	19	26	20
R10	65			27	34	21	30	21	<15	21	<15	32	<15	16	21	22
R11	52	52	44	20	19	<15	19	<15	<15	<15	<15	18	<15	<15	<15	<15
R12	52	52	44	24	41	17	32	22	<15	<15	<15	36	15	<15	21	18
R13	52	52	44	16	37	28	27	23	<15	26	<15	25	33	18	23	29
R14	51	50	40	24	43	41	32	27	<15	38	<15	36	43	24	31	42
R15	51	50	40	21	37	25	29	22	<15	23	<15	32	19	20	27	26
R16	51	50	40	<15	19	18	<15	<15	<15	16	<15	<15	<15	<15	<15	19
R17	51	50	40	29	41	37	34	36	<15	35	<15	36	34	28	35	38
R18	51	50	40	25	42	39	32	25	<15	36	<15	36	35	20	29	40
R19	51	50	40	34	37	37	38	43	17	34	<15	28	25	35	40	38
R20	51	50	40	32	42	39	37	35	<15	37	<15	36	30	27	36	40

Table 8-3: Noise Modelling Results Associated with Operational Activities, L_{eq}, dB(A)

Receiver	PSNL ($L_{eq,15\ minute}$ dB(A))			Predicted Noise Levels (L_{eq}, dB(A))												
	Day	Eve	Night	1	2	3	4	5	6	7	8	9	10	11	12	13
R21	51	50	40	36	<15	<15	34	42	47	9	20	<15	<15	47	46	<15
R22	51	50	40	31	31	29	36	40	35	29	<15	22	<15	37	37	30
R23	51	50	40	23	<15	<15	18	35	45	<15	19	<15	<15	45	45	<15
R24	49	49	43	31	16	<15	21	22	17	<15	18	<15	<15	18	19	<15
R25	49	49	43	32	16	<15	20	20	<15	<15	<15	<15	<15	15	18	<15
R26	49	49	43	36	<15	<15	32	32	<15	<15	<15	<15	<15	15	16	<15
R27	65			34	<15	<15	28	28	<15	<15	10	<15	<15	<15	<15	<15
R28	49	49	43	18	<15	<15	<15	<15	26	<15	<15	<15	<15	15	15	<15
R29	49	49	43	15	18	<15	20	23	26	<15	32	15	<15	22	23	<15
R30	49	49	43	<15	<15	<15	15	17	44	<15	29	<15	<15	34	34	<15
R31	49	49	43	<15	<15	<15	<15	16	39	<15	<15	<15	<15	40	40	<15

Note: Predicted to exceed the night-time Sleep Disturbance criteria

Table 8-4: Noise Modelling Results Associated with Operational Activities, L_{AMax}, dB(A)

Receiver	Max	Predicted Noise Levels (L_{Max}, dB(A))												
		1	2	3	4	5	6	7	8	9	10	11	12	13
R1	55	27	24	34	28	29	<15	<15	19	27	17	43	40	36
R2	55	28	26	36	30	29	<15	<15	19	27	18	45	44	38
R3	55	31	26	38	32	32	24	15	21	27	21	47	46	40
R4	NA	33	31	40	36	33	19	17	21	33	23	48	49	42
R5	55	33	35	44	38	32	<15	21	21	37	26	48	50	46
R6	55	30	32	42	35	29	<15	19	20	33	27	45	36	44
R7	NA	32	35	43	35	27	<15	20	20	38	28	40	35	45
R8	55	30	33	41	35	26	<15	19	21	36	28	43	44	43
R9	55	28	30	39	32	24	<15	17	25	31	25	42	42	41
R10	NA	31	34	43	30	21	<15	21	21	35	22	41	39	45
R11	55	24	19	26	19	<15	<15	<15	<15	26	<15	28	27	28
R12	55	27	41	40	32	22	<15	<15	17	39	23	41	34	42
R13	55	24	37	51	27	23	<15	26	22	30	41	41	36	53
R14	55	27	43	58	32	27	<15	38	27	41	51	49	48	60
R15	55	26	37	47	29	22	<15	23	15	36	27	46	44	49
R16	55	<15	19	30	<15	<15	<15	16	21	23	19	26	25	32
R17	55	33	41	58	34	36	15	35	34	40	42	52	53	60
R18	55	30	42	56	32	25	<15	36	16	40	43	46	47	58
R19	55	38	37	61	38	43	22	34	40	32	33	58	58	63
R20	55	35	42	60	37	35	17	37	36	40	38	50	54	62
R21	55	40	<15	35	34	42	52	33	46	<15	<15	65	35	37

Table 8-4: Noise Modelling Results Associated with Operational Activities, L_{AMax}, dB(A)

Receiver	Max	Predicted Noise Levels (L_{Max}, dB(A))												
		1	2	3	4	5	6	7	8	9	10	11	12	13
R22	55	35	31	53	36	40	40	34	38	26	<15	56	47	55
R23	55	28	<15	31	18	35	50	16	49	<15	<15	69	30	33
R24	55	35	16	29	21	22	22	<15	41	15	<15	35	33	31
R25	55	35	16	26	20	20	18	<15	34	15	<15	34	33	28
R26	55	39	<15	24	32	32	18	<15	29	17	<15	33	30	26
R27	NA	37	<15	24	28	28	15	<15	27	<15	<15	29	29	26
R28	55	21	<15	21	<15	<15	31	<15	34	<15	<15	43	25	23
R29	55	18	18	39	20	23	31	16	54	19	<15	42	36	41
R30	55	<15	<15	28	15	17	49	<15	53	<15	<15	61	29	30
R31	55	17	<15	24	<15	16	44	<15	43	<15	<15	67	26	26

Note: Predicted to exceed the night-time Sleep Disturbance criteria

9. OPERATIONAL MANAGEMENT AND MITIGATION MEASURES

The predicted noise levels from the operational Scenarios 1-13 were presented in section 8.
In general, most noise activity is expected during the day period. In order to further reduce the predicted noise levels, the following noise mitigation measures are proposed for each operational scenario

Kesterton Park Pedestrian Link (Operational Scenario 1)

- Incoming boats should be limited to a set speed to reduce noise.
- Signage is recommended close to the wharf to encourage incoming boats to reduce noise levels from radios and the craft.

Northern Park Events (Operational Scenario 2)

- The park is recommended to be predominately used during day light hours during the renewal works.
- The total sound power level from the attendees is recommended to be below 93 dB(A) (amount of attendees to be adjusted for a given activity).
- The speakers should be limited to a SWL of 70 dB(A) per speaker, with a maximum of four speakers allowed.
- Outdoor events with amplified speakers are recommended to be limited to daytime hours 7am – 6pm Monday to Saturday, or 8am – 6pm on Sundays.
- Events which continue into the evening period 6pm – 10pm, are recommended to have a total sound power level from attendees below 93 dB(A) and not use amplified speakers. Events are not recommended to continue past 10pm.
- Signs are recommended to be erected to encourage quiet behaviour in the northern park.

Northern Park Recreation (Operational Scenario 2)

- For recreation purposes, during the day and evening periods, the total sound power level from the attendees is recommended to be below 93 dB(A).
- Between 10pm and 7am, the northern park is recommended to have a total sound power level from attendees of less than 86 dB(A).
- Signs are recommended to be erected to encourage quiet behaviour in the northern park.

Upper level car park (Operational scenario 3)

- Kiara Close has a low speed limit; similarly, cars in the upper car park should be limited in speed to reduce noise levels.
- The gate beeping alarm should be disabled or replaced with an alarm that does not make offensive noise when the gate opens or closes (broadband alarm).
- The gate may be open when the car park is in use, and locked after hours, to reduce noise from the opening and closing.
- The upper level car park should not be regularly used before 7am or after 10pm due to potential exceedances in sleep disturbance.
- Car movements between 10pm and 7am should be minimised where possible, and it is understood that the carpark is not planned to be used often between 11pm and 4am. Use of the carpark between 6am and 7am and 10pm and 11pm should be minimised where possible, and the proponent may wish to consider additional mitigation measures such as signage to encourage quiet use of the carpark.

Wharf Promenade (Operational Scenario 4)

- The use of outdoor music should be limited to a total SWL of 70 dB(A) from the speakers.
- Outdoor use is not recommended during the night period (10pm – 7am).

Arrival Square (Operational Scenario 5)

- The use of outdoor music should be limited to a total SWL of 70 dB(A) from the speakers.
- Outdoor use is not recommended during the night period (10pm – 7am).

Gateway Plaza (Operational Scenario 6)

- The use of dining or extended outdoor use in the gateway plaza is recommended for the day and evening periods only.

Lift, cliff walkway and RANTME bridge (Operational Scenario 7)

- The lift motor and mechanical equipment should be selected and located to reduce noise levels at the Kiara Close apartments as much as possible.
- Signage is recommended close to the walkway/shared zone to encourage pedestrians to reduce noise levels for neighbouring residents.

RANTME factory car park (Operational Scenario 8)

- The car park is recommended to retain the southern wall facing 140 High Street North Sydney, or if this façade is demolished, include a 5 m high wall of a sound reduction index of at least R_w = 26 dB on the southern façade of the RANTME building (consistent with the recommendation of the 2016 report 161005_Advice_Rev4 Final).
- The car park is recommended to have a low speed limit, in order to reduce noise levels.
- The RANTME building car park may be used before 7am or after 10pm, should the 5 m high noise wall be installed. However, the proponents may wish to limit car movements where possible to further reduce noise impacts for the existing residents.

Northern Wharf (Operational Scenario 9)

- Incoming boats should be limited to a set speed to reduce noise.
- Signage is recommended close to the wharf to encourage incoming boats to reduce noise levels from radios and the craft.

Northern Stairs (Operational Scenario 10)

- Signage is recommended close to the walkway to encourage pedestrians to reduce noise levels at night for neighbouring residents.

Laneway (Operational Scenario 11)

- Trucks are recommended to be used during daytime and evening periods.
- Signage is recommended close to the walkway to encourage pedestrians to reduce noise levels at night for nearby residents.

The Cutting (Operational scenario 12)

- Trucks are recommended to be used during daytime and evening periods
- Signage is recommended close to the walkway to encourage pedestrians to reduce noise levels at night for neighbouring residents.

Upper level car park for construction workers (Operational scenario 13)

- Kiara Close has a low speed limit; similarly, vehicles in the upper car park should be limited in speed to reduce noise levels.

- The gate beeping alarm should be disabled or replaced with an alarm that does not make offensive noise when the gate opens or closes (broadband alarm).
- The gate may be open when the car park is in use, and locked after hours, to reduce noise from the opening and closing.
- The upper level car park should not be regularly used before 7am or after 10pm due to potential exceedances in sleep disturbance.
- Construction vehicle movements between 10pm and 7am should be minimised where possible. Where vehicle movements outside these hours occur, it is recommended that the movements be one-way, i.e. vehicles arrive in the carpark before 7am and do not again leave until after 7am.
- Truck movements into the carpark should be encouraged to occur after 7am and before 10pm.
- The proponent may wish to consider additional mitigation measures such as signage, and educating workers on the importance of reducing noise, to encourage quiet use of the carpark.

General controls

- A version of the complaints procedure outlined in Section 7.4 and complaints procedure in Section 7.3 should be considered for adoption during the operational phase of the project.
- Attended noise monitoring is recommended to take place during the commissioning phase of the operational activities.

10. CONCLUSIONS

A noise management plan has been prepared for the renewal project including construction and operational activities at the Platypus, North Sydney site.

This noise management plan identifies the key receivers surrounding the site, outlines the applicable noise criteria, and details the predicted construction and operational noise impacts at the nearby receivers.

Construction Activities
Construction noise levels were predicted to exceed the 'noise affected RBL + 10 dB' criteria at nearby receivers throughout the stages of the construction works. Selected receivers are predicted to exceed the 'highly noise affected 75 dB(A)' level during certain construction scenarios. All reasonable and feasible control measures are therefore recommended for the proposed construction works, as detailed in Section 7.
Recommended mitigation measures for the construction activities include:

- Limiting the construction work to standard construction hours (Section 7.1);
- Adopting universal work processes, quieter plant and equipment and locating plant away from receivers (Section 7.2);
- Community notification for the construction works by letterbox and website (Section 7.3);
- Complaints procedure for surrounding residents (Section 7.4); and
- Noise monitoring during construction works (Section 7.5).

Minimal vibration impacts are expected at the neighbouring receivers during the construction works, and no additional vibration mitigation measures are recommended.

Operational activities
Operational noise levels are predicted to be within the framework of the noise criteria, provided the recommended noise mitigation measures in Section 9 are adopted. The recommended noise management practices and noise mitigation measures include recommendations for times of use, sound power levels of equipment, and recommended numbers of people, amongst other measures.

This concludes the Noise Management Plan.

Peter Gangemi
Acoustical Engineer

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Principal Consultant

11. LIMITATIONS

Our services for this project are carried out in accordance with our current professional standards for site assessment investigations. No guarantees are either expressed or implied.

This report has been prepared solely for the use of Sydney Harbour Federation Trust, as per our agreement for providing environmental services. Only Sydney Harbour Federation Trust is entitled to rely upon the findings in the report within the scope of work described in this report. Otherwise, no responsibility is accepted for the use of any part of the report by another in any other context or for any other purpose.

Although all due care has been taken in the preparation of this study, no warranty is given, nor liability accepted (except that otherwise required by law) in relation to any of the information contained within this document. We accept no responsibility for the accuracy of any data or information provided to us by Sydney Harbour Federation Trust for the purposes of preparing this report.

Any opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal advice.

ATTACHMENTS

Attachment 1: Glossary of Noise Terminology

'A' FREQUENCY WEIGHTING

The 'A' frequency weighting roughly approximates to the Fletcher-Munson 40 phon equal loudness contour. The human loudness perception at various frequencies and sound pressure levels is equated to the level of 40 dB at 1 kHz. The human ear is less sensitive to low frequency sound and very high frequency sound than midrange frequency sound (i.e. 500 Hz to 6 kHz). Humans are most sensitive to midrange frequency sounds, such as a child's scream. Sound level meters have inbuilt frequency weighting networks that very roughly approximates the human loudness response at low sound levels. It should be noted that the human loudness response is not the same as the human annoyance response to sound. Here low frequency sounds can be more annoying than midrange frequency sounds even at very low loudness levels. The 'A' weighting is the most commonly used frequency weighting for occupational and environmental noise assessments. However, for environmental noise assessments, adjustments for the character of the sound will often be required.

AMBIENT NOISE

The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc. Usually assessed as an energy average over a set time period 'T' (L_{Aeq},T).

AUDIBLE

Audible refers to a sound that can be heard. There are a range of audibility grades, varying from "barely audible", "just audible" to "clearly audible" and "prominent".

BACKGROUND NOISE LEVEL

Total silence does not exist in the natural or built-environments, only varying degrees of noise. The Background Noise Level is the minimum repeatable level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc.. It is quantified by the noise level that is exceeded for 90 % of the measurement period 'T' (L_{A90}, T). Background Noise Levels are often determined for the day, evening and night time periods where relevant. This is done by statistically analysing the range of time period (typically 15 minute) measurements over multiple days (often 7 days). For a 15 minute measurement period the Background Noise Level is set at the quietest level that occurs at 1.5 minutes.

'C' FREQUENCY WEIGHTING

The 'C' frequency weighting approximates the 100 phon equal loudness contour. The human ear frequency response is more linear at high sound levels and the 100 phon equal loudness contour attempts to represent this at various frequencies at sound levels of approximately 100 dB.

DECIBEL

The decibel (dB) is a logarithmic scale that allows a wide range of values to be compressed into a more comprehensible range, typically 0 dB to 120 dB. The decibel is ten times the logarithm of the ratio of any two quantities that relate to the flow of energy (i.e. power). When used in acoustics it is the ratio of square of the sound pressure level to a reference sound pressure level, the ratio of the sound power level to a reference sound power level, or the ratio of the sound intensity level to a reference sound intensity level. See also Sound Pressure Level and Sound Power Level. Noise levels in decibels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dB, and another similar machine is placed beside it, the level will increase to 53 dB (from $10 \log_{10} (10^{(50/10)} + 10^{(50/10)})$ and not 100 dB. In theory, ten similar machines placed side by side will increase the sound level by 10 dB, and one hundred machines increase the sound level by 20 dB. The human ear has a vast sound-sensitivity range of over a thousand billion to one so the logarithmic decibel scale is useful for acoustical assessments.

dBA – See 'A' frequency weighting

dBC – See 'C' frequency weighting

EQUIVALENT CONTINUOUS SOUND LEVEL, LAeq

Many sounds, such as road traffic noise or construction noise, vary repeatedly in level over a period of time. More sophisticated sound level meters have an integrating/averaging electronic device inbuilt, which will display the energy time-average (equivalent continuous sound level - L_{Aeq}) of the 'A' frequency weighted sound pressure level. Because the decibel scale is a logarithmic ratio, the higher noise levels have far more sound energy, and therefore the LAeq level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.

'F'(FAST) TIME WEIGHTING

Sound level meter design-goal time constant which is 0.125 seconds.

FREQUENCY

The number of oscillations or cycles of a wave motion per unit time, the SI unit is the hertz (Hz). 1 Hz is equivalent to one cycle per second. 1000 Hz is 1 kHz.

LOUDNESS

The volume to which a sound is audible to a listener is a subjective term referred to as loudness. Humans generally perceive an approximate doubling of loudness when the sound level increases by about 10 dB and an approximate halving of loudness when the sound level decreases by about 10 dB.

MAXIMUM NOISE LEVEL, LAFmax

The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'F' (Fast) time weighting. Often used for noise assessments other than aircraft.

MAXIMUM NOISE LEVEL, LASmax

The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'S' (Slow) time weighting. Often used for aircraft noise assessments.

NOISE

Noise is unwanted, harmful or inharmonious (discordant) sound. Sound is wave motion within matter, be it gaseous, liquid or solid. Noise usually includes vibration as well as sound.

NOISE REDUCTION COEFFICIENT – See: "Sound Absorption Coefficient"

OFFENSIVE NOISE

Reference: Dictionary of the NSW Protection of the Environment Operations Act (1997). "Offensive Noise means noise:

(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:
    (i) is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or
    (ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or
(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."

RATING BACKGROUND LEVEL (RBL)

The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24-hour period used for the assessment background level). This is the level used for assessment purposes. It is defined as the median value of:

- All the day assessment background levels over the monitoring period for the day
- All the evening assessment background levels over the monitoring period for the evening; or
- All the night assessment background levels over the monitoring period for the night.

SOUND PRESSURE

The rms sound pressure measured in pascals (Pa). A pascal is a unit equivalent to a newton per square metre (N/m^2).

SOUND PRESSURE LEVEL, Lp

The level of sound measured on a sound level meter and expressed in decibels (dB). Where $L_P = 10 \log_{10} (Pa/Po)^2$ dB (or 20 log10 (Pa/ Po) dB) where Pa is the rms sound pressure in Pascal and Po is a reference sound pressure conventionally chosen is 20 µPa (20×10^{-6} Pa) for airborne sound. L_p varies with distance from a noise source.

SOUND POWER

The rms sound power measured in watts (W). The watt is a unit defined as one joule per second. A measures the rate of energy flow, conversion or transfer.

SOUND POWER LEVEL, Lw

The sound power level of a noise source is the inherent noise of the device. Therefore sound power level does not vary with distance from the noise source or with a different acoustic environment. $Lw = Lp + 10 \log_{10}$ 'a' dB, re: 1pW, (10^{-12} watts) where 'a' is the measurement noise-emission area (m^2) in a free field.

STATISTICAL NOISE LEVELS, Ln.

Noise which varies in level over a specific period of time 'T' (standard measurement times are 15 minute periods) may be quantified in terms of various statistical descriptors for example:

- The noise level, in decibels, exceeded for 1 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF1}, T. This may be used for describing short-term noise levels such as could cause sleep arousal during the night.
- The noise level, in decibels, exceeded for 10 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF10}, T. In most countries the LAF10, T is measured over periods of 15 minutes, and is used to describe the average maximum noise level.
- The noise level, in decibels, exceeded for 90 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF90}, T. In most countries the LAF90, T is measured over periods of 15 minutes, and is used to describe the average minim um or background noise level.