NOISE MANAGEMENT GUIDELINES
SUB BASE PLATYPUS
TORPEDO FACTORY RENEWAL PROJECT
SYDNEY HARBOUR FEDERATION TRUST

Prepared for: Sydney Harbour Federation Trust

Prepared by: Emma Hansma, Senior Engineer
Victoria Hale, Environmental Scientist
R T Benbow, Principal Consultant

Report No: 201163_NMP_Rev5
November 2020
(Released: 11 November 2020)

Benbow
ENVIRONMENTAL

Engineering a Sustainable Future for Our Environment

Head Office: 25-27 Sherwood Street, Northmead NSW 2152 AUSTRALIA
Tel: 61 2 9896 0399 Fax: 61 2 9896 0544
Email: admin@benbowenviro.com.au
Visit our website: www.benbowenviro.com.au

DOCUMENT CONTROL

Prepared by:	Position:	Signature:	Date:
Victoria Hale	Environmental Scientist		11 November 2020

Reviewed by:	Position:	Signature:	Date:
Emma Hansma	Senior Engineer		11 November 2020

Approved by:	Position:	Signature:	Date:
R T Benbow	Principal Consultant		11 November 2020

DOCUMENT REVISION RECORD

Revision	Date	Description	Checked	Approved
1	23-10-2020	Draft / Rev1	E Hansma	R T Benbow
2	3-11-2020	Draft / Rev2	E Hansma	R T Benbow
3	6-11-2020	Draft / Rev3	E Hansma	R T Benbow
4	10-11-2020	Draft / Rev4	E Hansma	R T Benbow
5	11-11-2020	Rev5	E Hansma	R T Benbow

DOCUMENT DISTRIBUTION

Revision	Issue Date	Issued To	Issued By
1	23-10-2020	Sydney Harbour Federation Trust	Benbow Environmental
2	3-11-2020	Sydney Harbour Federation Trust	Benbow Environmental
3	6-11-2020	Sydney Harbour Federation Trust	Benbow Environmental
4	10-11-2020	Sydney Harbour Federation Trust	Benbow Environmental
5	11-11-2020	Sydney Harbour Federation Trust	Benbow Environmental

Benbow ENVIRONMENTAL
A.B.N. 17 160 013 641

Head Office:
25-27 Sherwood Street Northmead NSW 2152 Australia
P.O. Box 687 Parramatta NSW 2124 Australia
Telephone: +61 2 9896 0399 Facsimile: +61 2 9896 0544
E-mail: admin@benbowenviro.com.au
Visit our Website at www.benbowenviro.com.au

EXECUTIVE SUMMARY

Benbow Environmental has been engaged by the Sydney Harbour Federation Trust, to prepare noise management guidelines for the Torpedo Factory Renewal Project at Sub Base Platypus located at 120 High Street, North Sydney 2060, Lot A DP 109583.

The Torpedo Factory is proposed to be extensively modified, including demolishing the majority of that part of the structure which protrudes beyond the cliff edge near the waterfront. The ground area underneath the demolished structure is proposed to be turned into a public park. The majority of the existing car park is proposed to be retained, however some of the walls will be removed and part of the roof and part of the southern wall retained, creating more open space and an area where the public can look out over the water and surrounds.

A quantitative assessment of the potential noise impact associated with the various potential land uses has been undertaken, and the noise emissions associated with the potential land uses at the site has been evaluated.

Long term and short-term monitoring were undertaken at the surrounding residential receptors in order to determine the existing background and ambient noise levels in the area.

The noise impact assessment was undertaken in accordance with the following guidelines:

- NSW Noise Policy for Industry (EPA, 2017); and
- NSW Interim Construction Guidelines (DECCW, 2009).

The noise sources associated with the potential operations were identified and their emissions modelled by using SoundPLAN 7.3. Predicted noise levels were assessed against the relevant noise criteria, and recommendation for noise mitigation measures have been provided where necessary.

The predicted noise levels from the operation of the Torpedo Factory carpark in scenarios 1-3 are predicted to comply with the project specific noise levels at all receivers during all time periods. There are exceedances of the night time criteria at five receivers with the inclusion of a potential future pop up café in scenario 4. The following recommendations should be applied:

- The café should operate only during the day time and evening periods i.e. from 7am – 10pm.
- The seating area of the café should be within the confines of the southern façade in order to comply with criteria.

For the construction scenario, noise levels were predicted to exceed the noise affected RBL + 10 dB criteria during worst-case demolition works. The highest exceedance of the RBL + 10 dB criteria was by 20 dB(A) at 140 High Street. However, none of the receivers are predicted to exceed the highly noise affected criteria of 75 dB(A). Construction mitigation measures have been recommended in Section 8.3.

Contents Page

EXECUTIVE SUMMARY **I**

1. INTRODUCTION **1**
1.1 Scope of Works 1

2. PROJECT DESCRIPTION **3**

3. SITE DESCRIPTION **4**
3.1 Site Location 4
3.2 Nearest Sensitive Receptors 7

4. EXISTING ACOUSTIC ENVIRONMENT **10**

5. CURRENT LEGISLATION AND GUIDELINES **11**
5.1 NSW EPA Noise Policy for Industry 11
5.1.1 Introduction 11
5.1.2 Project Intrusiveness Noise Level 11
5.1.3 Amenity Noise Level 11
5.1.4 Sleep Disturbance Criteria 12
5.1.5 Operational Project Noise Trigger Levels 13
5.2 Construction Noise Criteria 15
5.2.1 NSW Interim Construction Noise Guideline 15
5.2.2 Vibration Criteria 17
5.2.3 BS 7385-2:1993 17
5.2.4 DIN4150-3:1999 17
5.2.5 Human Exposure 18
5.2.6 Extension to Construction Work Days 19
5.3 Meteorological Factors 19
5.3.1 Wind Effects 19
5.3.1.1 Wind rose plots 19
5.3.1.2 Local Wind Trends 20
5.3.2 Temperature Inversion 26
5.3.3 Relevant Assessment Weather Conditions 26

6. NOISE IMPACT ASSESSMENT **27**
6.1 Modelling Methodology 27
6.2 Modelling General Assumptions 28
6.3 Noise Sources 29
6.4 Modelling Scenarios and Results 29
6.4.1 Scenario 1: Existing Torpedo Factory Carpark 30
6.4.2 Scenario 2: New Torpedo Car Park (with internal walls) 33
6.4.3 Scenario 3: New Torpedo Factory Car Park (without internal walls) 36
6.4.4 Scenario 4: New Torpedo Factory Car Park and Café (without internal walls) 39
6.5 Operation Management and Mitigation Measures 42

7. ESTIMATED CONSTRUCTION NOISE IMPACT ASSESSMENT **43**
7.1 Construction Activities 43
7.2 Modelled Noise Generating Scenarios 43
7.3 Modelling Methodology 45

7.3.1 Noise Model 45
7.3.2 Noise Sources 45
7.4 Construction Predicted Noise Levels 46
7.5 Stage 1 vs Stage 2 Construction Noise Comparison 47

8. CONSTRUCTION VIBRATION IMPACTS 48
8.1 Recommended Construction Noise Mitigation Measures 48
8.2 Construction Hours of Work 48
8.3 Recommended Mitigation Measures 49
8.3.1 Site specific controls 49
8.3.2 Universal work practices 49
8.3.3 Plant and Equipment 50
8.4 Community Notification 50
8.5 Complaints Procedure 53
8.6 Noise Monitoring 53

9. CONCLUSIONS 55

10. LIMITATIONS 56

Tables Page

Table 5-1: Amenity noise levels. 12
Table 5-2: Project Noise Trigger Levels (PNTL) for Operational Activities, dB(A) 14
Table 5-3: Management Levels at Residences Using Quantitative Assessment 15
Table 5-4: Management Levels at Other Land Uses 16
Table 5-5: Construction Noise Criterion dB(A) 16
Table 5-6: Vibration criteria for cosmetic damage (BS 7385:2 1993) 17
Table 5-7: Structural damage criteria heritage structures (DIN4150-3 1999) 17
Table 5-8: Preferred and maximum weighted rms z-axis values, 1-80 Hz 18
Table 5-9: Noise Wind Component Analysis 2019 Sydney Harbour (Wedding Cake West) 25
Table 5-10: Meteorological Conditions Assessed in Noise Propagation Modelling 26
Table 6-1: A-weighted Sound Power Levels Associated with Operational Activities, dB(A) 29
Table 6-2: Modelling Scenarios 29
Table 6-3: Scenario 1: Noise Modelling Results, dB(A) 32
Table 6-4: Scenario 2: Noise Modelling Results, dB(A) 35
Table 6-5: Scenario 3: Noise Modelling Results, dB(A) 38
Table 6-6: Scenario 4: Noise Modelling Results, dB(A) 41
Table 7-1: Modelled Noise Stages for Proposed Construction Works 44
Table 7-2: A-weighted Sound Power Levels Associated with Construction Activities, dB(A) 45
Table 7-3: Scenario 3: Noise Modelling Results, dB(A) 46
Table 8-1: Recommended safe working distances for vibration intensive plant 48

Figures Page

Figure 3-1: Site Location 4
Figure 3-2: Artist's Impression of the proposed Torpedo Factory Renewal Project from above 5
Figure 3-3: Artist's Impression of the proposed Torpedo Factory Renewal Project from the water 6
Figure 3-4: Nearest Receptors 8

Figure 3-5: Receptor Criteria Areas 9
Figure 5-1: Wind Rose Plots – BOM Sydney Harbour (Wedding Cake West) ID 066196 – 2019 – Day time 21
Figure 5-2: Wind Rose Plots – BOM Sydney Harbour (Wedding Cake West) ID 66196 – 2019 – Evening time 22
Figure 5-3: Wind Rose Plots – BOM Sydney Harbour (Wedding Cake West) ID 66196– 2019 – Night time 23
Figure 6-1: 3D view of Existing Torpedo Factory Scenario 1 31
Figure 6-2: 3D view of Torpedo Factory Scenario 2 34
Figure 6-3: 3D view of Torpedo Factory Scenario 3 37
Figure 6-4: 3D view of Torpedo Factory Scenario 3 40
Figure 7-1: Demolition Works 44
Figure 7-2: Map Showing Most Affected Receivers 47
Figure 8-1: Proposed letterbox notifications 52

Attachments

Attachment 1: Noise Terminology

1. INTRODUCTION

Benbow Environmental has been engaged by the Sydney Harbour Federation Trust to prepare noise management guidelines for the Torpedo Factory Renewal Project at Sub Base Platypus, located at 120 High Street, North Sydney 2060, Lot A DP 109583.

This report provides a quantitative assessment of the potential noise impact associated with the modification to the Torpedo Factory.

Long term and short-term monitoring were undertaken for 161005_NIA_rev4 at the surrounding residential receptors in order to determine the existing background and ambient noise levels in the area which will be utilised for this assessment.

Existing background noise levels have been utilised to derive the noise criteria in accordance with the NSW *Noise Policy for Industry (EPA, 2017).*

The noise sources associated with the potential operations were identified and their emissions modelled by using SoundPLAN 7.3. The modelling predicts the noise impacts at the surrounding receptors and provides the individual noise contribution of the noise sources.

This noise impact assessment has been prepared in accordance with the following guidelines and documents:

- NSW Noise Policy for Industry (EPA, 2017); and
- Interim Construction Noise Guideline (DECC, 2009).

Predicted noise levels were assessed against the relevant noise criteria, and recommendation for noise mitigation measures have been provided where necessary.

A glossary of the terminology utilised throughout the report has been provided in Attachment 1.

1.1 SCOPE OF WORKS

This Noise Impact Assessment has been limited to the following scope of works:

a) Site inspection and review of the potential site operations;
b) Review of existing relevant reports and information for the site;
c) Identification of nearest sensitive receptors;
d) Long term and short term ambient and background noise monitoring in accordance with relevant NSW guidelines;
e) Establish project specific noise levels;
f) Review of existing buildings and determination of sound insulation properties of existing structures;
g) Identification of all potential noise sources associated with the potential land uses;
h) Collect required noise source data;
i) Predict potential noise impacts at the nearest potentially affected receptors to the site;
j) Assess potential noise impacts against relevant legislation and guidelines;
k) Recommend general ameliorative measures/control solutions (where required); and
l) Compile this report with concise statements of potential noise impact.

To aid in the review of this report, supporting documentation has been included in the Attachments.

2. PROJECT DESCRIPTION

The former Sub Base Platypus site has a significant history as a gas works, a Naval Base providing torpedo maintenance for the Royal Australian Navy and Sub Base Platypus submarine base.

The site was handed over to the Sydney Harbour Federation Trust in 2005, and the Trust has since then been the responsible body for the remediation, management and rehabilitation of the site.

The nature of the area, its scale, location and quality of the spaces provides a great opportunity to enrich the civic and cultural life of the area.

The Harbour Trust's proposed Torpedo Factory Renewal Project includes the following works:

- **Foreshore Park** - Create a new foreshore park through a series of landscaped terraces replacing the multi-level, harbour-facing portion of the Torpedo Factory.
- **Entry Forecourt facing High Street** – Create an enlarged entry forecourt through the demolition of a portion of the Torpedo Factory facing High Street.
- **Torpedo Factory Walkway** – Provide public walkways and viewing areas along the northern and eastern sides of the Torpedo Factory, offering elevated views towards Neutral Bay.
- **New pedestrian connections** – Investigate opportunities to connect the upper level and the new foreshore park, and provide a new path to Kesterton Park
- **Sandstone Cliff** - Reveal the large sandstone cliff face that divides the upper and lower levels of the site. The excision of the building at this point will allow for expansive views and an opportunity to better integrate Sub Base Platypus' lower foreshore level with adjoining public land (Kesterton Park).
- **Heritage** – Retain key significant heritage elements of the building, including the majority of the factory floor level, and the characteristic saw-tooth roof.
- **Interpretation**- Interpret the site's multi-layered history – natural, First Nations and defence heritage, with a focus on the ongoing connection to Country.
- **Public Car Park** - Retained portion of Torpedo Factory to include a public car park to support visitors accessing the site.
- **Improved Visual outcomes** - The removal of the multi-storey, harbour-facing section of the building, and the peeling away of walls on three of its sides, will substantially reduce the visual bulk and scale of the building, and open up views to and through the site.
- **Sustainable Design -** Explore opportunities to use the roof to capture solar power and rainwater
- **Amenity** – Protect local amenity by minimising potential impacts such as noise and light
- **Possible future uses** – The covered space of the remnant Torpedo Factory provides the opportunity for a future pop-up café at the harbour-end, or a space for occasional community uses (such as a small market). Any such proposals would be subject to separate assessment and approval.

3. SITE DESCRIPTION

3.1 SITE LOCATION

The subject site is located at 120 High St, North Sydney 2060, Lot A DP 109583. The site location is shown in Figure 3-1.

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.

A visual impression of the proposed Torpedo Factory modification is shown in Figure 3-2 and Figure 3-3.

Figure 3-1: Site Location

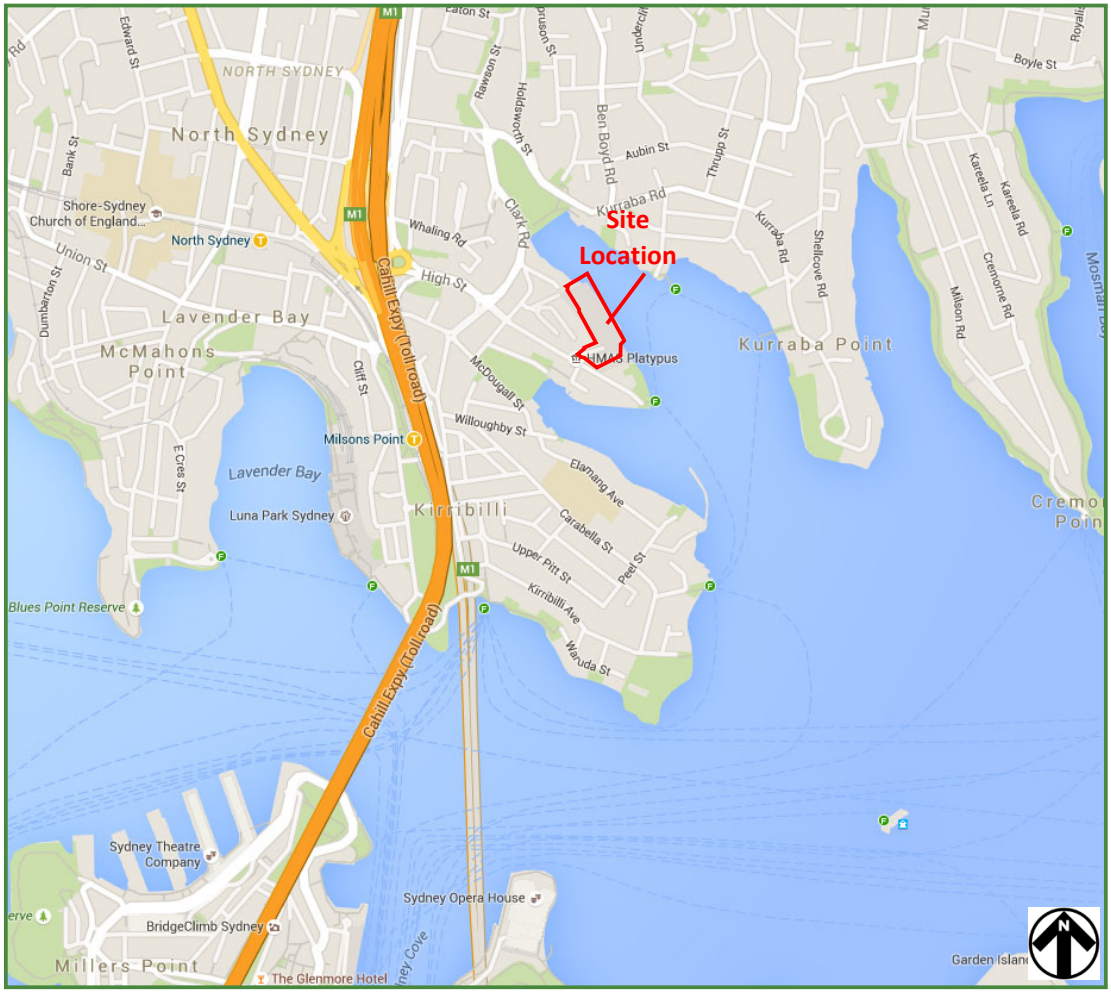


Image Source: Google Maps

Figure 3-2: Artist's Impression of the proposed Torpedo Factory Renewal Project from above

Image Source: The Sydney Harbour Federation Trust

Figure 3-3: Artist's Impression of the proposed Torpedo Factory Renewal Project from the water

Image Source: The Sydney Harbour Federation Trust

3.2 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 opposite the site.

The nearest residential receptors identified are as follows:

- *Residences on High Street, Stannards Place:* located to the south, south-west and west of the subject site.

- *Residences on Kiara Close:* these are located to the west and north-west of the subject site and are principally apartments. The Iora Apartment complex overlooks the site and the residences directly facing the former Sub Base Platypus site are potentially the most affected residential receptors to the west.

- *Residences on Hipwood Street and Adderstone Avenue:* these are located to the north-west and north of the subject site. These comprise primarily single houses and small apartment buildings. The residences at 9 Adderstone Avenue and 24 Adderstone Avenue are situated adjacent to the site and potentially represent the most affected receptors to the north.

- *Residences on Kurraba Rd, Hayes Street, Manns Avenue, Ben Boyd Road, Lower Wycombe Road, Wycombe Lane and Wallaringa Avenue:* These residences are situated across neutral bay to the north, north-east and east of the subject site and include different type of residences such as apartment high-rise buildings, smaller apartment blocks and single/ double storey houses.

- *Four public parks are situated in the vicinity of the site:* Kesterton Park to the south, Milsons Park to the south-east, Anderson Park to the north and Kurraba Point Reserve to the south-west. The noise impact on Milsons Park would be unlikely due to the presence of numerous buildings between the site and the park, and therefore it has not been included in the assessment.

- *The Neutral Bay ferry wharf:* This wharf is located across the water to the west. The Thelma & Louise Cafe is present at this location and it represents the most exposed commercial premises on this side. Other shops are situated along Hayes Street.

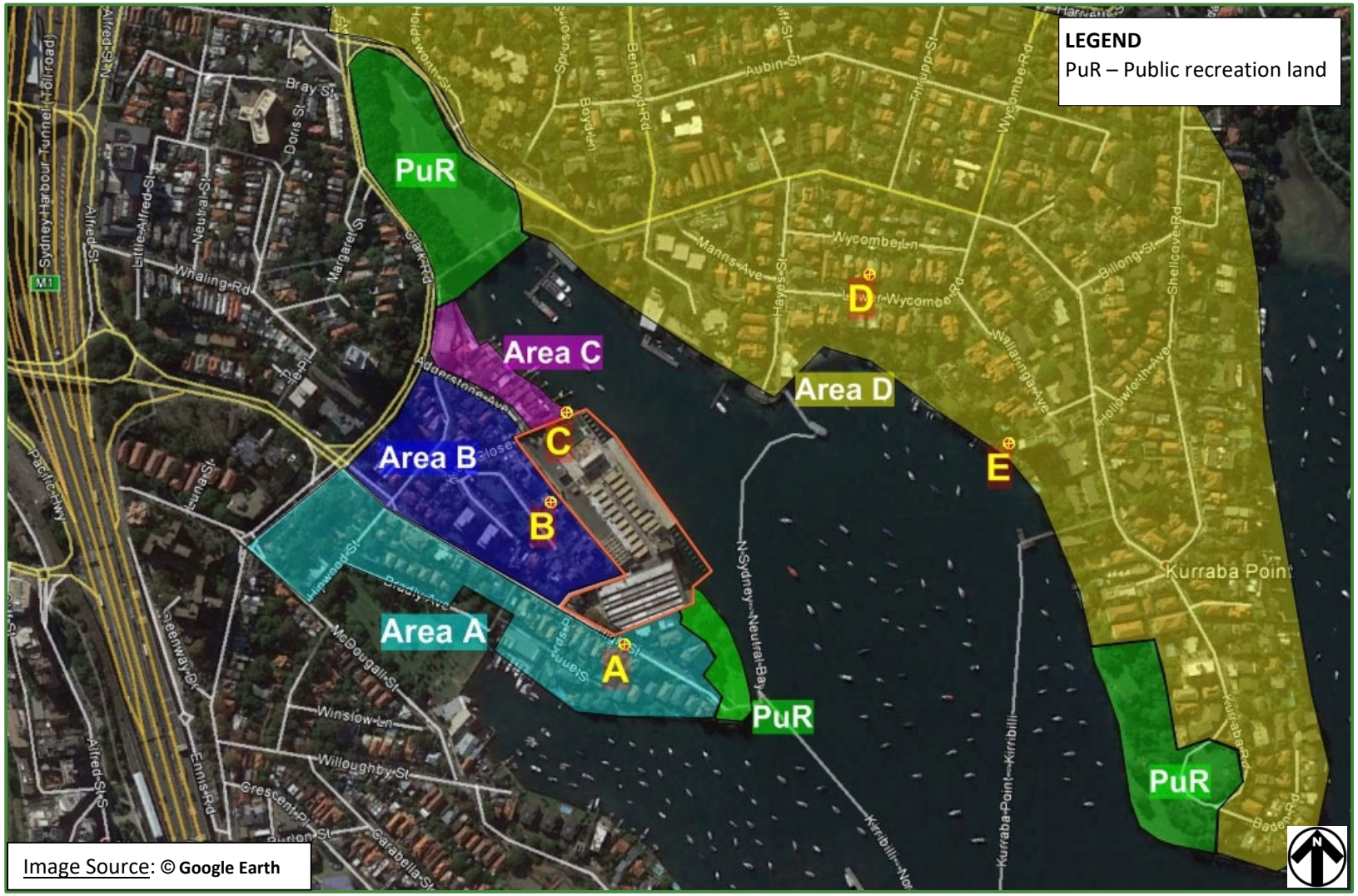
- *The Department of Finance Customs Marine Depot:* This depot is located on the waterfront at the southern end of Ben Boyd Road, to the north-east of the subject site.

- *The Kurraba Point wharf:* This wharf is located to the east of the site. This and the nearby convenience store do not constitute a significant receptor as the area is surrounded by residences. These have been considered instead.

Given the large number of receptor considered these are identified by their address and shown in groups as detailed in Figure 3-4 and Figure 3-5.

Figure 3-4: Nearest Receptors

Figure 3-5: Receptor Criteria Areas



4. EXISTING ACOUSTIC ENVIRONMENT

The level of background noise varies over the course of any 24 hour period, typically from a minimum at 3.00am to a maximum during morning and afternoon traffic peak hours. Therefore the NSW EPA Noise Policy for Industry (2017) requires that the level of background and ambient noise be assessed separately for the daytime, evening and night time periods. The Noise Policy for Industry defines these periods as follows:

- **Day** – the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays;
- **Evening** – the period from 6pm to 10pm; and
- **Night** – the remaining periods.

The existing acoustic environment is described in detail in 161005_NIA_rev4.

5. CURRENT LEGISLATION AND GUIDELINES

5.1 NSW EPA NOISE POLICY FOR INDUSTRY

5.1.1 Introduction

The NSW Noise Policy for Industry was developed by the NSW EPA primarily for the assessment of noise emissions from industrial sites regulated by the NSW EPA.

The policy sets out two components that are used to assess potential site-related noise impacts. The intrusiveness noise level aims at controlling intrusive noise impacts in the short-term for residences. The amenity noise level aims at maintaining a suitable amenity for particular land uses including residences in the long-term. The more stringent of the intrusiveness or amenity level becomes the project noise trigger levels for the project.

5.1.2 Project Intrusiveness Noise Level

The project intrusiveness noise level is determined as follows:

$L_{Aeq,\ 15\ minute}$ = rating background noise level + 5 dB

Where the $L_{Aeq,(15minute)}$ is the predicted or measured L_{Aeq} from noise generated within the project site over a fifteen minute interval at the receptor.

This is to be assessed at the most affected point on or within the residential property boundary or if that is more than 30 m from the residence, at the most affected point within 30 m of the residential dwelling.

5.1.3 Amenity Noise Level

To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.2 of the NSW Noise Policy for Industry 2017. The relevant recommended noise levels applicable from the Noise Policy for Industry are reproduced in Table 5-1. The suburban category has been selected for the residential noise amenity criteria to match the characteristics of the area.

Table 5-1: Amenity noise levels.

Receiver	Noise Amenity Area	Time of Day	L_{Aeq} dB(A) Recommended amenity noise level
Residential	Urban	Day	60
		Evening	50
		Night	45
Industrial premises	All	When in use	70
Place of Worship - External	All	When in use	50
Area specifically reserved for passive recreation (e.g. national park	All	When in use	50
Commercial premises	All	When in use	65

Note: 1) In the case where existing schools are affected by noise from existing sources, the acceptable L_{Aeq} noise level may be increased to L_{Aeq} 1 hour.
2) Where internal amenity noise levels are specified, they refer to the noise level at the centre of the habitable room that is most exposed to the noise and apply with windows opened sufficiently to provide adequate ventilation, except where alternative means of ventilation complying with the Building Code of Australia are provided. In cases where gaining internal access for monitoring is difficult, then external noise levels 10 dB(A) above the internal levels apply.

Source: Table 2.2 and Section 2.6, NSW Noise Policy for Industry

The project amenity noise level for industrial developments = recommended amenity noise level minus 5 dB(A)

The following exceptions to the above method to derive the project amenity noise levels apply:

1. *In areas with high traffic noise levels*
2. *In proposed developments in major industrial clusters*
3. *Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.*
4. *Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant amenity noise level is assigned as the project amenity noise level for development.*

This development is not considered to be captured by the above exceptions.

5.1.4 Sleep Disturbance Criteria

In accordance with the NSW EPA Noise Policy for Industry, the potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

Where the subject development/premises night-time noise levels at a residential location exceed:

- **$L_{Aeq,\ 15\ minute}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or**
- **L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,**

a detailed maximum noise level assessment should be undertaken.

5.1.5 Operational Project Noise Trigger Levels

The operational project noise trigger levels for the site have been established in accordance with the principles and methodologies of the NSW Noise Policy for Industry (EPA, 2017).

The table below presents the rating background level, project intrusive noise level, recommended amenity noise level, and project amenity noise level. The project noise trigger level is the lowest value of intrusiveness or project amenity noise level after conversion to $L_{Aeq\ 15\ minute}$, dB(A) equivalent level. Sleep disturbance trigger levels associated with operational activities are presented in Table 5-2.

Different time periods apply for the noise criteria as the intrusive criterion considers a 15 minute assessment period while the amenity criterion requires assessment over the total length of time that a site is operational within each day, evening or night period. In order to ensure compliance under all circumstances, a 15 minute period assessment has been considered for all receptors.

Table 5-2: Project Noise Trigger Levels (PNTL) for Operational Activities, dB(A)

Receiver	Type of Receptor	Time of day	Rating background noise level	Project intrusiveness noise level $L_{eq\ 15\ minute}$	Recommended amenity noise level $L_{Aeq\ period}$	Project amenity noise level $L_{Aeq\ 15\ minute}$ [1]	PNTL $L_{Aeq\ 15\ minute}$	Sleep Disturbance L_{Amax}
A	Residential – Urban	Day	44	**49**	60	58	**49**	-
		Evening	45	49[2]	50	**48**	**48**	-
		Night	38	43	45	**43**	**43**	**53**
B	Residential – Urban	Day	46	**51**	60	58	**51**	-
		Evening	45	50	50	**48**	**48**	-
		Night	35	**40**	45	43	**40**	**52**
C	Residential – Urban	Day	47	**52**	60	58	**52**	-
		Evening	47	52	50	**48**	**48**	-
		Night	39	44	45	**43**	**43**	**54**
D	Residential – Urban	Day	40	**45**	60	58	**45**	-
		Evening	41	**45**[2]	50	48	**45**	-
		Night	36	**41**	45	43	**41**	**52**

Notes:
1) These levels have been converted to $L_{Aeq\ 15\ minute}$ using the following: $L_{Aeq\ 15\ minute} = L_{Aeq\ period}$ + 3 dB (NSW Noise Policy for Industry Section 2.
2) When the background for evening time is greater than day time the criteria for evening time is set to be equal to daytime in accordance with the Noise Policy for Industry.

5.2 CONSTRUCTION NOISE CRITERIA

Criteria for construction and demolition 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.

5.2.1 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 are reproduced in Table 5-3 below. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

Table 5-3: 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: 1. 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. 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Table 5-3: Management Levels at Residences Using Quantitative Assessment

Time of Day	Management Level $L_{Aeq(15\ minute)}$	How to Apply
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 5-4 sets out management levels for construction noise at other land uses applicable to the surrounding area.

Table 5-4: Management Levels at Other Land Uses

Land use	Management Level $L_{Aeq(15\ minute)}$ (applies when properties are being used)
Industrial Premises	External Noise Level 75 dB(A)
Places of worship	Internal Noise Level 45 dB(A) External Noise Level 55 dB(A)

There are no other sensitive land uses in the area surrounding the site.

Noise Criterion

The noise criterion for construction noise is presented in Table 5-5.

Table 5-5: Construction Noise Criterion dB(A)

Receiver location	Land Use	Period	RBL L_{A90}	Management Level $L_{Aeq(15\ minute)}$
A	Residential	Standard Hours	44	54
B	Residential	Standard Hours	46	56
C	Residential	Standard Hours	47	57
D	Residential	Standard Hours	40	50

5.2.2 Vibration Criteria

Vibration criteria from construction works are 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 BS 7385–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.

5.2.3 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 5-6: Vibration criteria for cosmetic damage (BS 7385:2 1993)

Type of building	Peak component particle velocity in frequency range of predominant pulse		
	4 Hz 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	20 to 50 mm/s	50 mm/s

5.2.4 DIN4150-3:1999

The German standard DIN4150-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 5-7: Structural damage criteria heritage structures (DIN4150-3 1999)

Type of building	Peak component particle velocity (PPV) mm/s			
	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	
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

Type of building	Peak component particle velocity (PPV) mm/s			
	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	
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

5.2.5 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 5-8: 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

5.2.6 Extension to Construction Work Days

As part of the NSW Government's response to the COVID 19 pandemic, Environmental Planning and Assessment (COVID-19 Development – Construction Work Days) Order 2020 commenced on 2 April 2020.

These Orders will be in place until 25 March 2021, unless otherwise advised by the NSW Government.

Under the Order, on weekends and public holidays during the COVID-19 pandemic, construction hours have been extended to the same hours normally allowed on weekdays. This is necessary to ensure workers can practice social distancing and allow construction work to continue safely. The Order requires that all feasible and reasonable measures to minimise noise are taken.

Construction sites must take all feasible and reasonable measures to minimise noise and noisy works. Rock breaking, rock hammering, sheet piling, pile-driving or similar activities are not permitted on weekends and public holidays unless an existing consent or approval already allows these works to occur on any of the extended days.

5.3 METEOROLOGICAL FACTORS

Wind and temperature inversions may affect the noise emission from the site and are to be assessed when these are considered to be a feature of the area.

This section of the report presents the analysis undertaken on the 2019 weather data in order to establish whether wind and temperature inversion are features of the area.

Meteorological factors that are considered features of the area and likely to enhance noise levels should be included in the assessment.

5.3.1 Wind Effects

Wind is considered to be a feature where source-to-receiver wind speeds (at 10 m height) of 3 m/s or below occur for 30% of the time or more in any assessment period in any season.

5.3.1.1 Wind rose plots

Wind rose plots show the direction that the wind is coming from, with triangles known as "petals". The petals of the plots in the figures summarise wind direction data into 8 compass directions i.e. north, north-east, east, south-east, etc. The length of the triangles, or "petals", indicates the frequency that the wind blows from that direction. Longer petals for a given direction indicate a higher frequency of wind from that direction. Each petal is divided into segments, with each segment representing one of two wind speed classes.

Thus, the segments of a petal show what proportion of wind for a given direction falls into each class. The proportion of time for which wind speed is less than 0.5 m/s, when speed is negligible, is referred to as calm hours or “calms”. Calms are not shown on a wind rose as they have no direction, but the proportion of time consisting of the period under consideration is noted under each wind rose.

The concentric circles in each wind rose are the axis, which denote frequencies. In comparing the plots it should be noted that the axis varies between wind roses, although all wind roses are similar in size. The frequencies denoted on the axes are indicated beneath each wind rose.

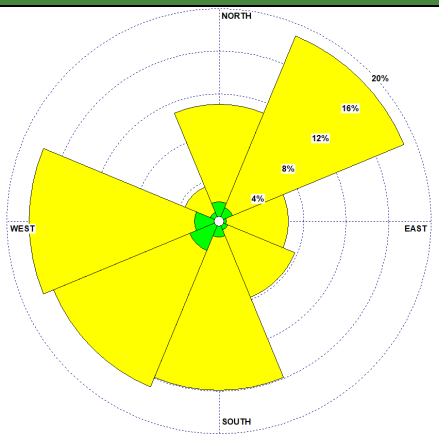
The meteorological data was obtained from the BOM weather data from Sydney Harbour (Wedding Cake West) weather station ID 066196.

5.3.1.2 Local Wind Trends

The seasonal wind rose plots for the site representative meteorological file have been included in Figure 5-1, Figure 5-2 and Figure 5-3 based on the BOM data.

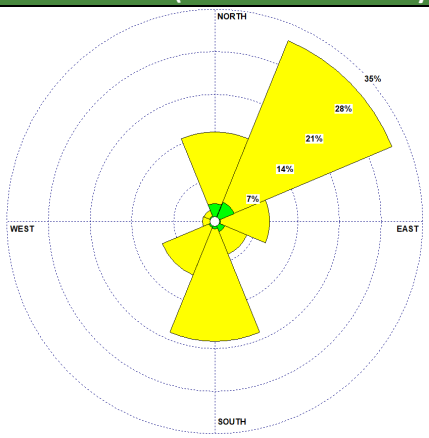
Figure 5-1: Wind Rose Plots – BOM Sydney Harbour (Wedding Cake West) ID 066196 – 2019 – Day time

All Seasons



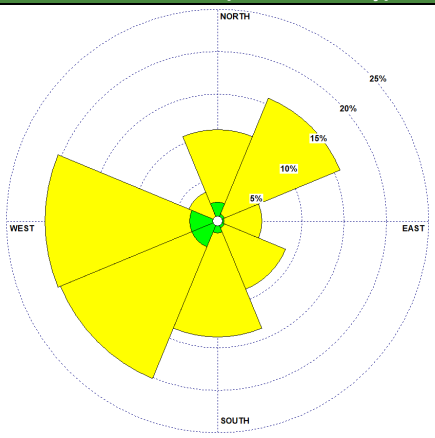
Average Wind Speed: 5.76 m/s
Calms Frequencies: 0.87 %
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Summer Season (December – February)



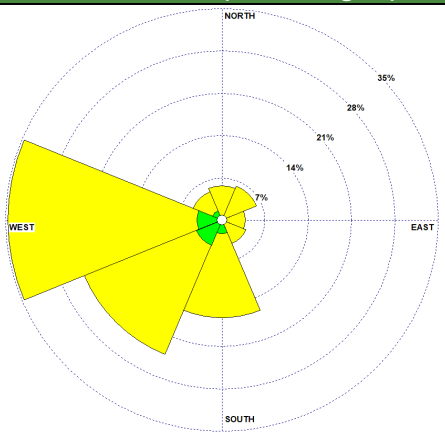
Average Wind Speed: 5.90 m/s
Calms Frequencies: 1.48 %
Axis Frequencies: 7%, 14%, 21%, 28%, 35%

Autumn Season (March – May)



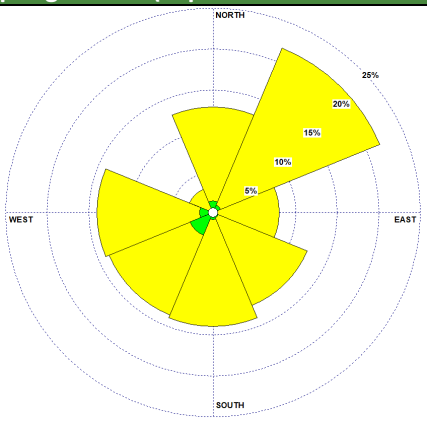
Average Wind Speed: 5.22 m/s
Calms Frequencies: 1.54%
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Winter Season (June – August)



Average Wind Speed: 5.68 m/s
Calms Frequencies: 0.18%
Axis Frequencies: 7%, 14%, 21%, 28%, 35%

Spring Season (September – November)



Average Wind Speed: 6.26 m/s
Calms Frequencies: 0.27%
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Legend

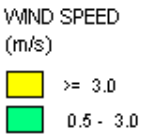
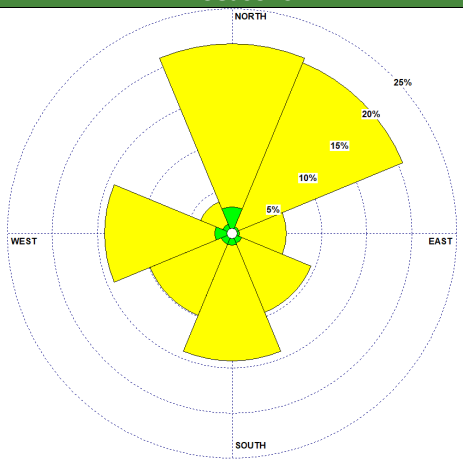


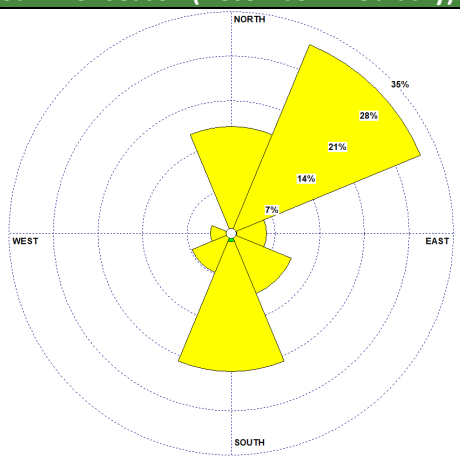
Figure 5-2: Wind Rose Plots – BOM Sydney Harbour (Wedding Cake West) ID 66196 – 2019 – Evening time

All Seasons



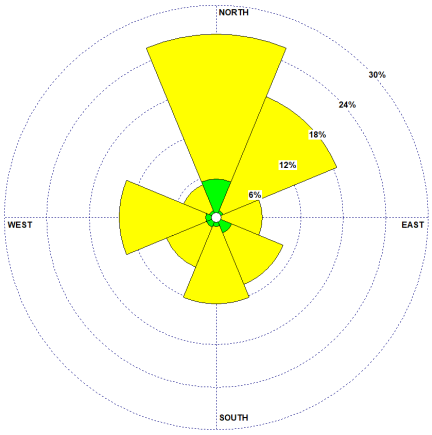
Average Wind Speed: 6.09 m/s
Calms Frequencies: 0.27 %
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Summer Season (December – February)



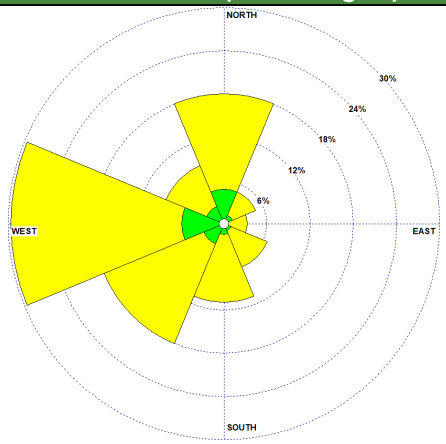
Average Wind Speed: 7.07 m/s
Calms Frequencies: 0.44%
Axis Frequencies: 7%, 14%, 21%, 28%, 35%

Autumn Season (March – May)



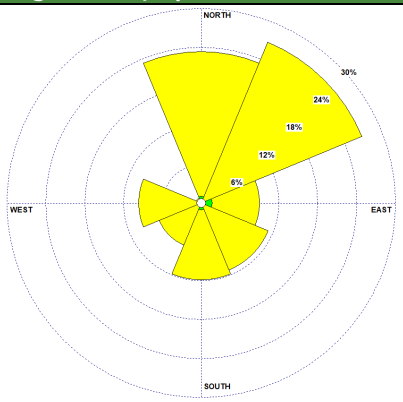
Average Wind Speed: 5.46 m/s
Calms Frequencies: 0.43%
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Winter Season (June – August)



Average Wind Speed: 5.14 m/s
Calms Frequencies: 0.22%
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Spring Season (September – November)



Average Wind Speed: 6.73 m/s
Calms Frequencies: 0.00%
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Legend

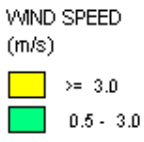
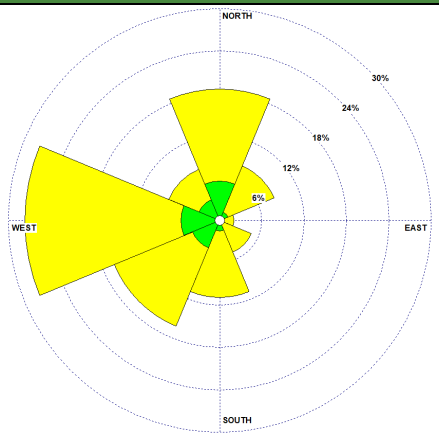


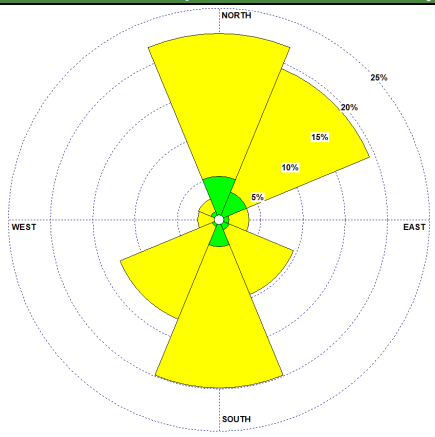
Figure 5-3: Wind Rose Plots – BOM Sydney Harbour (Wedding Cake West) ID 66196– 2019 – Night time

All Seasons



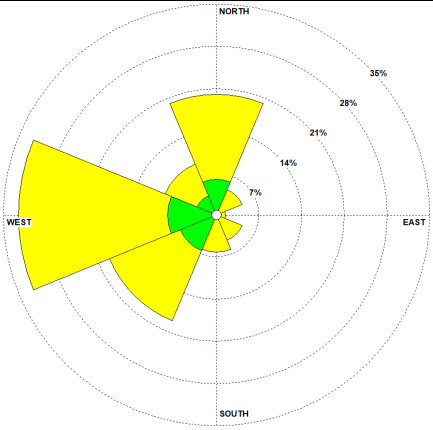
Average Wind Speed: 4.72 m/s
Calms Frequencies: 2.82%
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Summer Season (December – February)



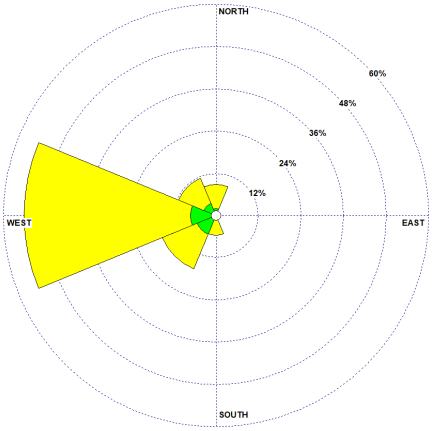
Average Wind Speed: 4.90 m/s
Calms Frequencies: 5.13%
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Autumn Season (March – May)



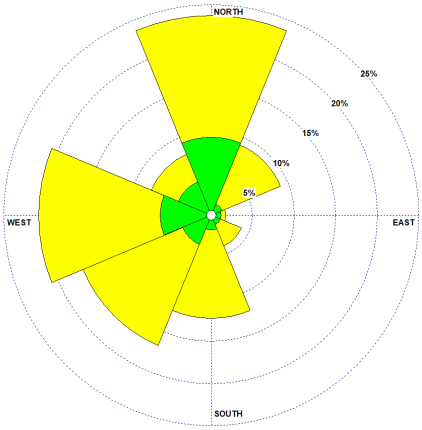
Average Wind Speed: 4.45 m/s
Calms Frequencies: 2.61%
Axis Frequencies: 7%, 14%, 21%, 28%, 35%

Winter Season (June – August)



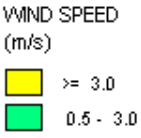
Average Wind Speed: 5.09 m/s
Calms Frequencies: 0.11%
Axis Frequencies: 12%, 24%, 36%, 48%, 60%

Spring Season (September – November)



Average Wind Speed: 4.47 m/s
Calms Frequencies: 3.52%
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Legend



Appendix D2 of the Noise Policy for Industry (EPA, 2017), refers to utilising the Noise Enhancing Wind Analysis (NEWA) program on the NSW EPA website to determine the significance of source-to-receiver winds.

Table 5-9 below contains the noise wind component analysis from the NEWA software. Wind speeds are taken up to 3 m/s and wind direction is taken from source-to-receiver, plus and minus 45 degrees, as per appendix D2 of the Noise Policy for Industry.

It can be seen from Table 5-9 that there are no instances where during a period/season, more than 30% of wind speeds are less than 3 m/s in the plus and minus 45 degree arc from source to receiver. Therefore, wind effects have not been included in the assessment.

Table 5-9: Noise Wind Component Analysis 2019 Sydney Harbour (Wedding Cake West)

Receiver Direction	Day				Evening				Night			
	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
North	1.4	2.9	1.5	1.7	2.5	2.4	1.6	1.9	3.2	0.4	0.1	1.8
North East	1.8	6.7	10.3	4	4.4	8.4	12	2.2	4.3	21.1	18	11.2
East	0.6	5.8	10	3.2	0.8	8.2	12.5	1.6	2.7	24.1	17.5	14.2
South East	0.6	3.6	7.4	1.4	0.6	9	14.4	1.4	2.3	22.8	16.8	14.3
South	3.7	3	2.8	1.4	2.8	10.3	10.6	4.4	14.2	8.3	5	16
South West	3.9	4.7	2.8	2.7	4.7	9.2	7.9	5.8	13.5	5.7	1.6	9.5
West	3.3	3.9	2.2	2.2	3.6	1.4	0.5	4.7	3.5	0.7	0.2	2.6
North West	3.4	5.1	2.4	1.9	3.1	4.1	1.4	4.4	4.6	1.1	0.1	2.9

Noise enhancing meteorological conditions occur for 30% or more of the period and season

5.3.2 Temperature Inversion

Temperature inversions are considered a feature where they occur more than 30% of the total night time during winter (June, July and August) between 6:00pm and 7:00am. This is different from the night noise assessment period over which inversions are to be assessed, which is from 10:00pm to 7:00am.

This involves determining the percentage occurrence of moderate (Class F) and strong (Class G) inversions. Weak inversions (Class E) should not be included in the analysis.

The analysis conducted on the 2019 weather data highlighted that during winter 2.91% of the nights presented temperature inversion conditions, therefore these effects have not been included in the noise impact assessment.

5.3.3 Relevant Assessment Weather Conditions

The following conditions will be considered in this noise impact assessment:

- Condition A: Neutral Weather Conditions.

Details of the considered meteorological conditions have been displayed in Table 5-10.

Table 5-10: Meteorological Conditions Assessed in Noise Propagation Modelling

Condition	Classification	Ambient Temp.	Ambient Humidity	Wind Speed	Wind Direction (blowing from)	Temperature Inversion	Affected Receiver	Applicability
A	Neutral	10 °C	70%	-	-	No	All	All periods

6. NOISE IMPACT ASSESSMENT

An outline of the predictive noise modelling methodology and operational noise modelling scenarios have been provided in this section of the report.

6.1 MODELLING METHODOLOGY

Predictive Noise Modelling was carried out using the ISO 9613-2:1996 algorithm within SoundPLAN v7.3. This model has been extensively utilised by Benbow Environmental for assessing noise emissions for numerous sites, and is recognised by regulatory authorities throughout Australia. The model accurately predicts of noise from a site, at the specified receptor, by calculating the contribution of each noise source.

The noise sources, as well as the topographical features of the subject area and receiver locations, were all input into the noise model to determine the noise emissions of the potential development at the nearest potentially affected residences.

A digital ground model was implemented in SoundPLAN by combining LIDAR terrain data with the on-site plans provided by the Sydney Harbour Federation Trust. The LIDAR terrain data has 1 m resolution and combined with the detailed terrain obtained from the site plans and survey plans an accurate model for both on-site and off-site topography was implemented.

Benbow Environmental carried out a detailed site inspection and determined the construction materials of the existing buildings present at the site.

Estimation of the sound insulation properties was undertaken using an OmniPower Sound Source – Type 4292 Dodecahedron. The sound source was placed within the building and measurements of the noise levels from this source were taken from outside. These measurements were used to verify and calibrate the building sound insulation properties in the noise model.

On-site structures were included in the model to account for shielding provided by the walls of the existing buildings. Indoor noise sources were included in the model, and external noise emissions were calculated by considering the sound insulation properties of the existing buildings.

In addition to the above, other parameters were included in the noise model such as ground absorption, atmospheric absorption, existing walls around the site, noise sources locations and directivity.

Several modelling scenarios were implemented in order to provide results for a range of possible uses of different site areas.

The modelling scenarios have been carried out using the L_{Aeq} and L_{max} descriptor. The L_{Aeq} descriptor is utilised for assessments against the NSW EPA Noise Policy for Industry standards, while the L_{max} descriptor is used to assess sleep disturbance. Noise emission levels were predicted at the nearest potentially affected sensitive receivers to determine the noise impact against the project specific noise levels and other relevant noise criteria established in accordance with the NSW EPA Noise Policy for Industry standard noise criteria.

6.2 MODELLING GENERAL ASSUMPTIONS

The relevant assessment period for operational noise emissions is 15 minutes when assessing noise levels against the Intrusive Criterion. As such, noise source durations detailed throughout the following assumptions section 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 new park at the northern end of the site was obtained by on-site measurement.

- 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.

- Car ignition has been modelled for 1 second at 1 m above ground level.

- Car door closing has been modelled for 0.5 seconds at 1 m above ground level.

- Car driving has been modelled as a line source 1 m above ground level, representing vehicles travelling at 15 km/hr.

- The speaker playing music has been modelled 1.5 m above ground level for 100% of the time

- Four groups of four people in moderate conversation has been modelled 1.2 m above the ground level for 100% of the time.

- On-site structures have been included in the model:

    - Existing structures have been modelled considering façade composition, configuration and openings present on site
    - Proposed buildings/alterations have been modelled based on the comprehensive plan. The altered buildings utilise the same materials from the existing buildings, unless stated otherwise.
        - The Torpedo Factory has been modelled in scenarios with setbacks as shown on the comprehensive plan. For the new Torpedo Factory alterations the eastern, western and northern facades have been removed with the southern façade keeping the external cladding of brick and corrugated metal sheet, with glass windows.

6.3 NOISE SOURCES

The sound power levels for the identified noise sources associated with the site activities have been calculated from measurements of sound pressure levels undertaken by acoustic engineers from Benbow Environmental during operations at similar facilities or sourced from the Benbow Environmental extensive noise database.

One-third octave band centre frequency sound power level data for the noise sources included in the noise model have been presented in Table 6-1

Table 6-1: A-weighted Sound Power Levels Associated with Operational Activities, dB(A)

Noise Source	Overall	L_{Amax}	Third Octave Band Centre Frequency (Hz)									
			25	31	40	50	63	80	100	125	160	200
			250	315	400	500	630	800	1000	1250	1600	2000
			2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Car Ignition	**84**	89	29	32	36	39	40	45	48	43	46	53
			54	49	52	60	65	63	64	67	70	71
			69	68	65	65	65	64	57	-	-	-
Car Door Slam	**95**	100	60	62	67	70	74	73	73	69	73	72
			73	79	82	86	85	83	86	88	86	79
			76	75	72	72	71	65	60	-	-	-
Car Manoeuvring	**82**	88	39	56	47	52	52	55	60	65	66	64
			68	72	75	75	74	74	72	67	64	61
			58	56	57	50	40	57	47	-	-	-
Speaker Playing Music	**70**	73	11	15	24	32	37	40	45	45	47	49
			50	52	61	65	61	63	56	55	49	54
			52	51	49	50	50	49	45	52	51	49
4 People "Moderate conversation"	**80**	83	29	34	44	46	36	42	43	54	55	61
			70	66	70	75	73	68	64	65	64	64
			63	60	62	58	55	52	50	-	-	-

6.4 MODELLING SCENARIOS AND RESULTS

Three individual scenarios have been implemented in SoundPLAN 7.3.

Table 6-2 provides the description of each modelling scenario. Details for each scenario are presented in the remainder of this section.

Table 6-2: Modelling Scenarios

Scenario	Description and Noise Sources
	Individual Scenarios
Scenario 1	Existing torpedo factory car park
Scenario 2	New torpedo factory car park with internal walls
Scenario 3	New torpedo factory car park without internal walls
Scenario 4	New torpedo factory car park without internal walls and use of a café

Given the large number of receptors included, for simplicity, a summary of the modelling results is presented in each section showing the results for the most affected residences only.

6.4.1 Scenario 1: Existing Torpedo Factory Carpark

Noise Sources and Assumptions:

- Existing Torpedo Factory building
- 20 cars per hour passing — Line Source
- 36 car doors slamming per hour — Point Source
- 36 car ignitions per hour — Point Source

Location of Sources:

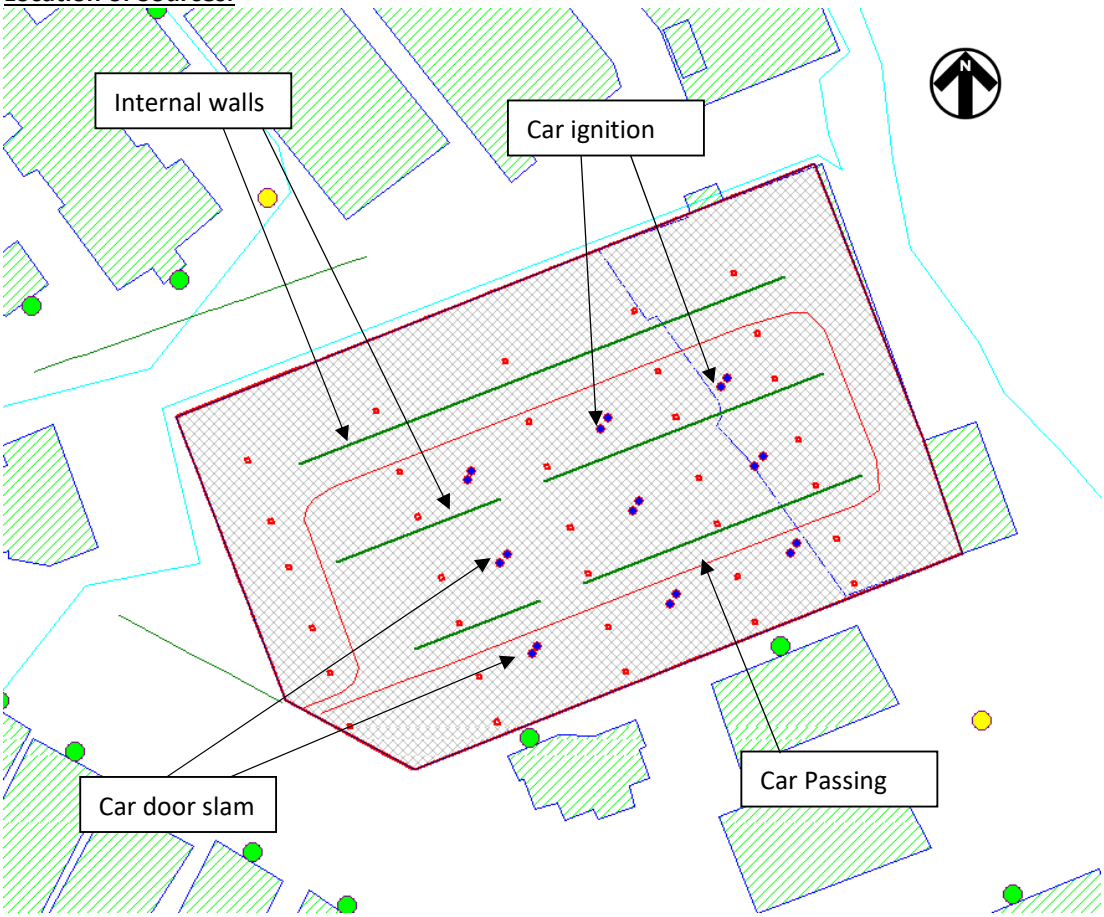
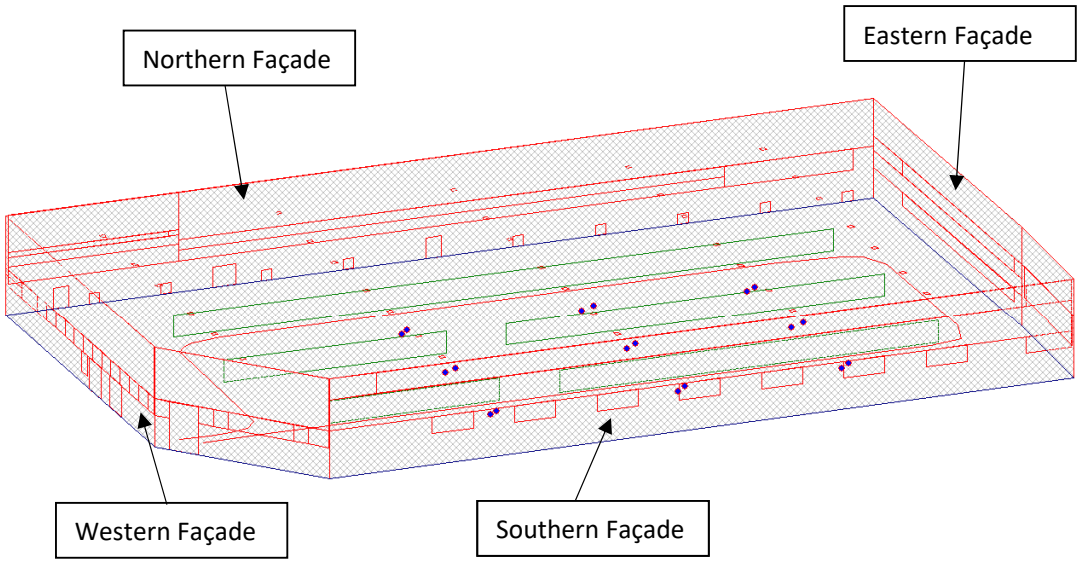


Figure 6-1: 3D view of Existing Torpedo Factory Scenario 1



Predicted Noise Levels

Table 6-3: Scenario 1: Noise Modelling Results, dB(A)

Area	Receptor		Predicted Noise Levels		PNTL			
	Address	Floor Level	Day, Evening Night $L_{eq, 15min}$	Night Sleep Disturbance L_{max}	Day $L_{eq, 15min}$	Evening $L_{eq, 15min}$	Night $L_{eq, 15min}$	Night Sleep Disturbance L_{max}
	Residential Receptors							
B	1 Kiara Close, North Sydney, Eastern Building Backyard	GF	22	28	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, NE façade	F 4	<15	<21	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, NE façade	GF	<15	<21	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 1	30	36	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 2	30	36	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 4	29	35	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, SE façade	F 4	21	27	51	48	40	52
B	1 Kiara Close, North Sydney, Northern Building, E façade	F 1	<15	<21	51	48	40	52
D	2 Ben Boyd Road, Neutral Bay	F 3	<15	<21	45	45	41	52
D	2 Hayes Street, Neutral Bay, Backyard	GF	<15	<21	45	45	41	52
D	4 Hayes Street, Neutral Bay	GF	<15	<21	45	45	41	52
D	4A Hayes Street, Neutral Bay	F 2	<15	<21	45	45	41	52
C	20 Adderstone Avenue, North Sydney	F 1	<15	<21	52	48	43	54
C	22a Adderstone Avenue, North Sydney	F 2	<15	<21	52	48	43	54
A	135-137 High Street, North Sydney	F 1	23	29	49	48	43	53
A	140 High Street, North Sydney, Western Building	GF	29	35	49	48	43	53
A	140 High Street, North Sydney, Eastern Building	F 1	27	33	49	48	43	53
A	140 High Street, North Sydney, Eastern Building	GF	25	31	49	48	43	53
A	141 High Street, North Sydney	F 1	28	34	49	48	43	53
A	142 High Street, North Sydney Backyard	GF	15	21	49	48	43	53
A	143 High Street, North Sydney	F 1	29	35	49	48	43	53
A	145 High Street, North Sydney	F 1	30	36	49	48	43	53
A	147 High Street, North Sydney	F 1	31	37	49	48	43	53

Note: Exceed the Day, Evening and Night time criteria
Exceed the Evening and Night time criteria
Exceed the Night time criteria

Comments – Scenario 1

The noise emissions associated with the use of the existing carpark was predicted to comply with the noise criteria at all residential receptors during the daytime, evening and night time. There are no exceedances of the sleep disturbance L_{max} criteria at any of the sensitive receivers.

6.4.2 Scenario 2: New Torpedo Car Park (with internal walls)

Noise Sources and Assumptions:

- New Torpedo Factory building with internal walls intact
- 20 cars per hour passing — Line Source
- 36 car doors slamming per hour — Point Source
- 36 car ignitions per hour — Point Source

Location of Sources:

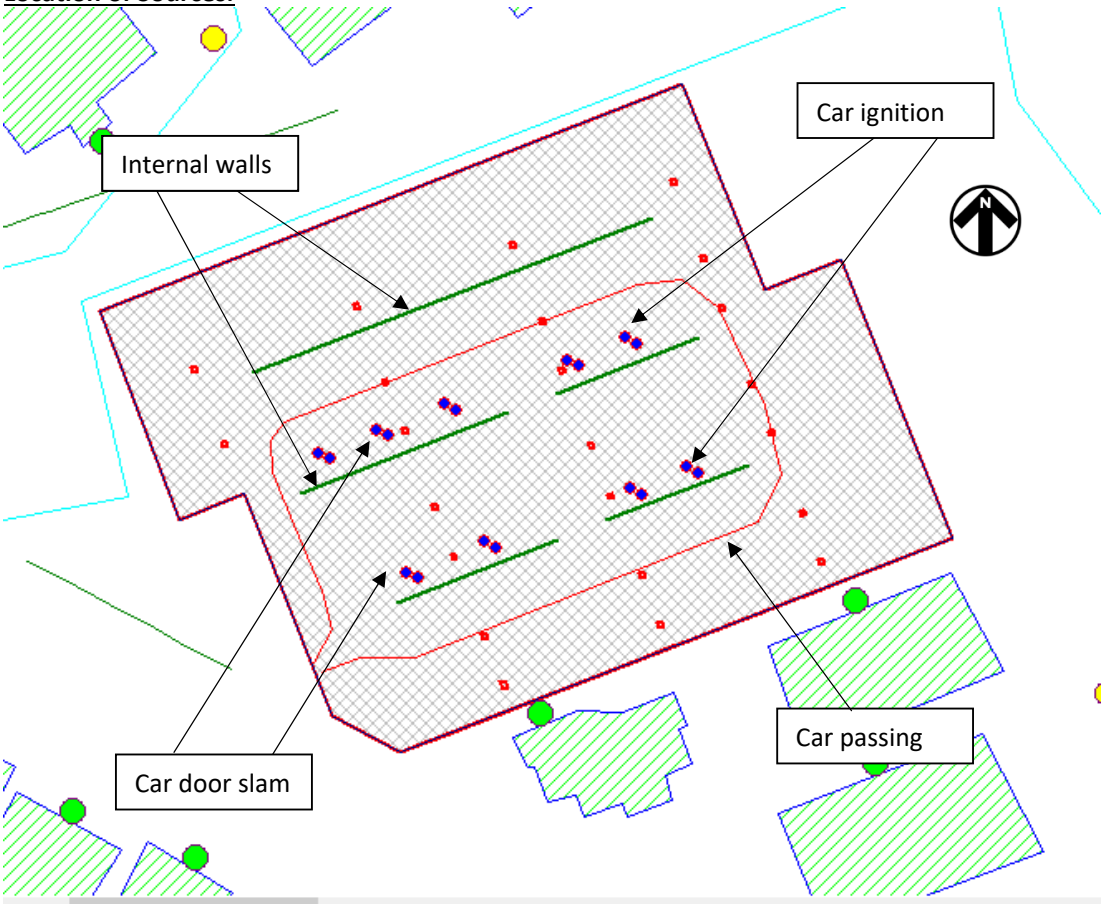
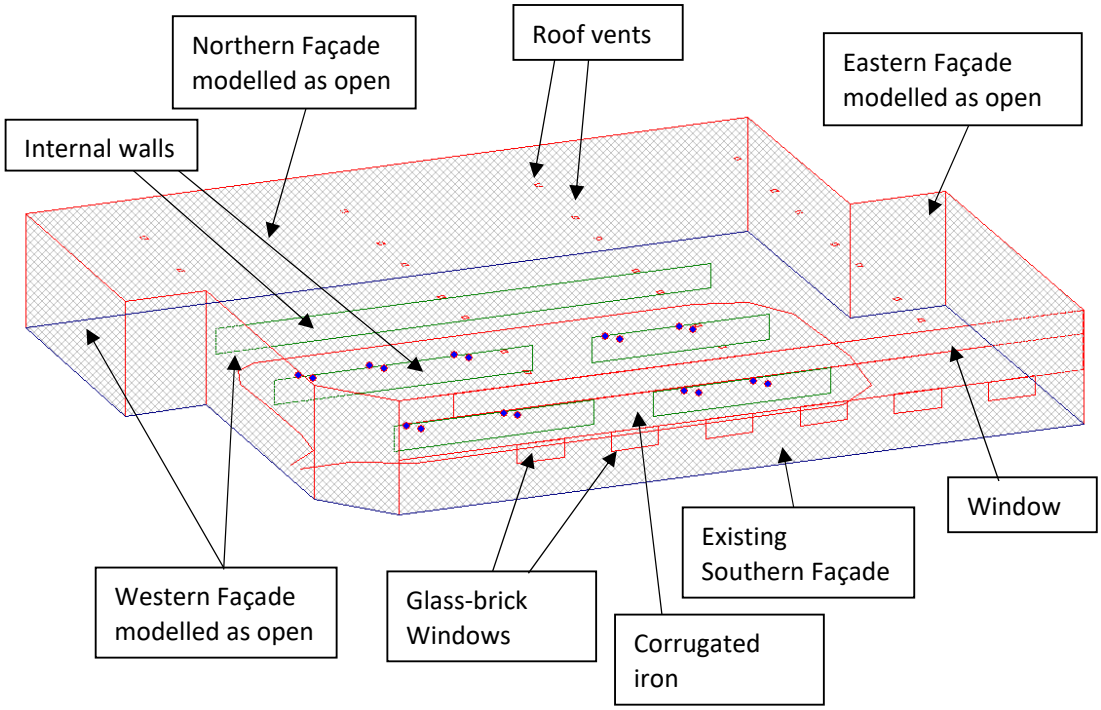


Figure 6-2: 3D view of Torpedo Factory Scenario 2



Predicted Noise Levels

Table 6-4: Scenario 2: Noise Modelling Results, dB(A)

Area	Receptor		Predicted Noise Levels		PNTL			
	Address	Floor Level	Day, Evening Night $L_{eq, 15min}$	Night Sleep Disturbance L_{max}	Day $L_{eq, 15min}$	Evening $L_{eq, 15min}$	Night $L_{eq, 15min}$	Night Sleep Disturbance L_{max}
Residential Receptors								
B	1 Kiara Close, North Sydney, Eastern Building Backyard	GF	31	37	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, NE façade	F 4	21	27	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, NE façade	GF	19	25	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 1	38	44	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 2	38	44	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 4	37	43	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, SE façade	F 4	29	35	51	48	40	52
B	1 Kiara Close, North Sydney, Northern Building, E façade	F 1	17	23	51	48	40	52
D	2 Ben Boyd Road, Neutral Bay	F 3	17	23	45	45	41	52
D	2 Hayes Street, Neutral Bay, Backyard	GF	19	25	45	45	41	52
D	4 Hayes Street, Neutral Bay	GF	19	25	45	45	41	52
D	4A Hayes Street, Neutral Bay	F 2	19	25	45	45	41	52
C	20 Adderstone Avenue, North Sydney	F 1	<15	<21	52	48	43	54
C	22a Adderstone Avenue, North Sydney	F 2	15	21	52	48	43	54
A	135-137 High Street, North Sydney	F 1	29	35	49	48	43	53
A	140 High Street, North Sydney, Western Building	GF	26	32	49	48	43	53
A	140 High Street, North Sydney, Eastern Building	F 1	21	27	49	48	43	53
A	140 High Street, North Sydney, Eastern Building	GF	20	26	49	48	43	53
A	141 High Street, North Sydney	F 1	34	40	49	48	43	53
A	142 High Street, North Sydney Backyard	GF	30	36	49	48	43	53
A	143 High Street, North Sydney	F 1	35	41	49	48	43	53
A	145 High Street, North Sydney	F 1	36	42	49	48	43	53
A	147 High Street, North Sydney	F 1	38	44	49	48	43	53

Note: Exceed the Day, Evening and Night time criteria
Exceed the Evening and Night time criteria
Exceed the Night time criteria

Comments – Scenario 2

The noise emissions associated with the use of the new carpark with internal walls was predicted to comply with the noise criteria at all residential receptors during the daytime, evening and night time. There are no exceedances of the sleep disturbance L_{max} criteria at any of the sensitive receivers.

6.4.3 Scenario 3: New Torpedo Factory Car Park (without internal walls)

Noise Sources and Assumptions:

- New Torpedo Factory building without internal walls
- 20 cars per hour passing — Line Source
- 36 car doors slamming per hour — Point Source
- 36 car ignitions per hour — Point Source

Location of Sources:

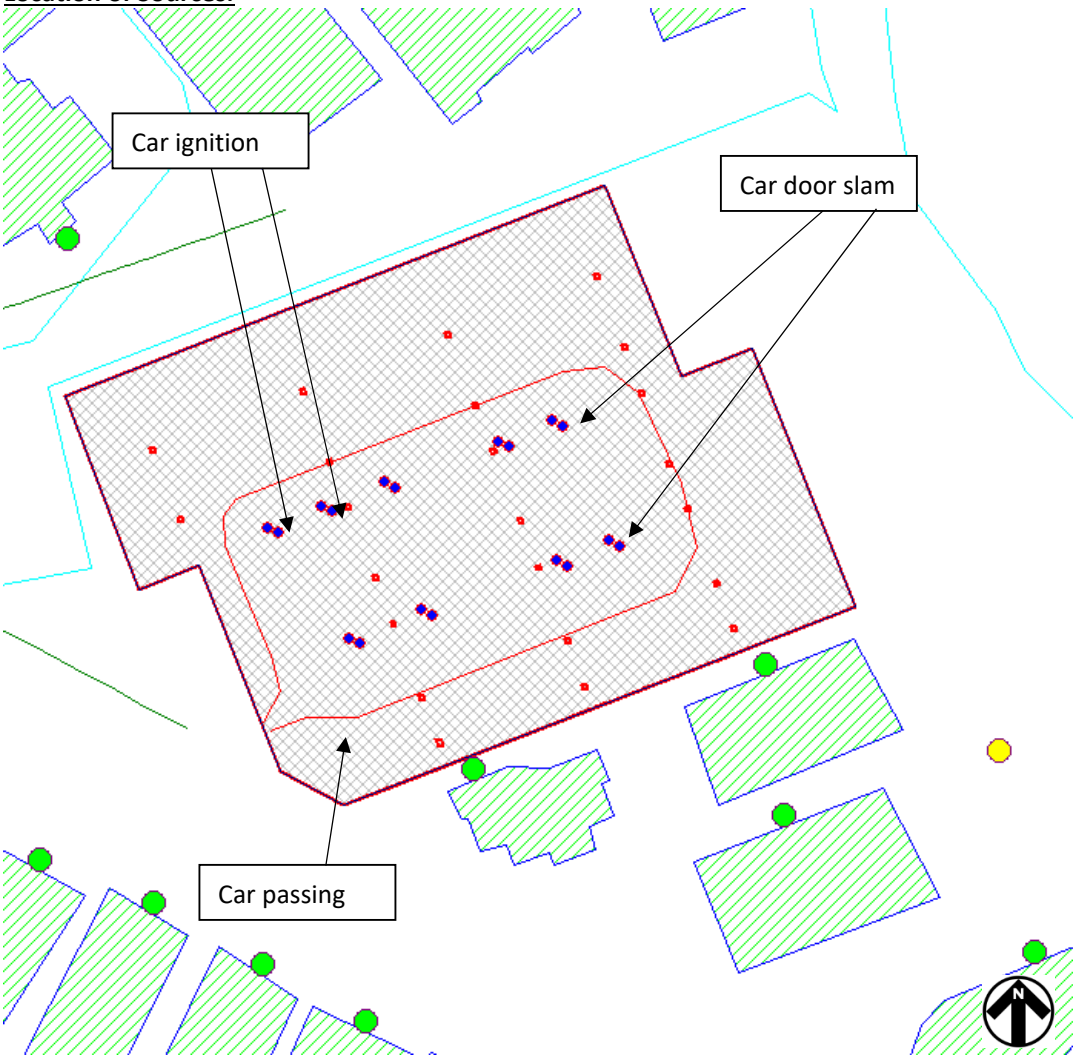
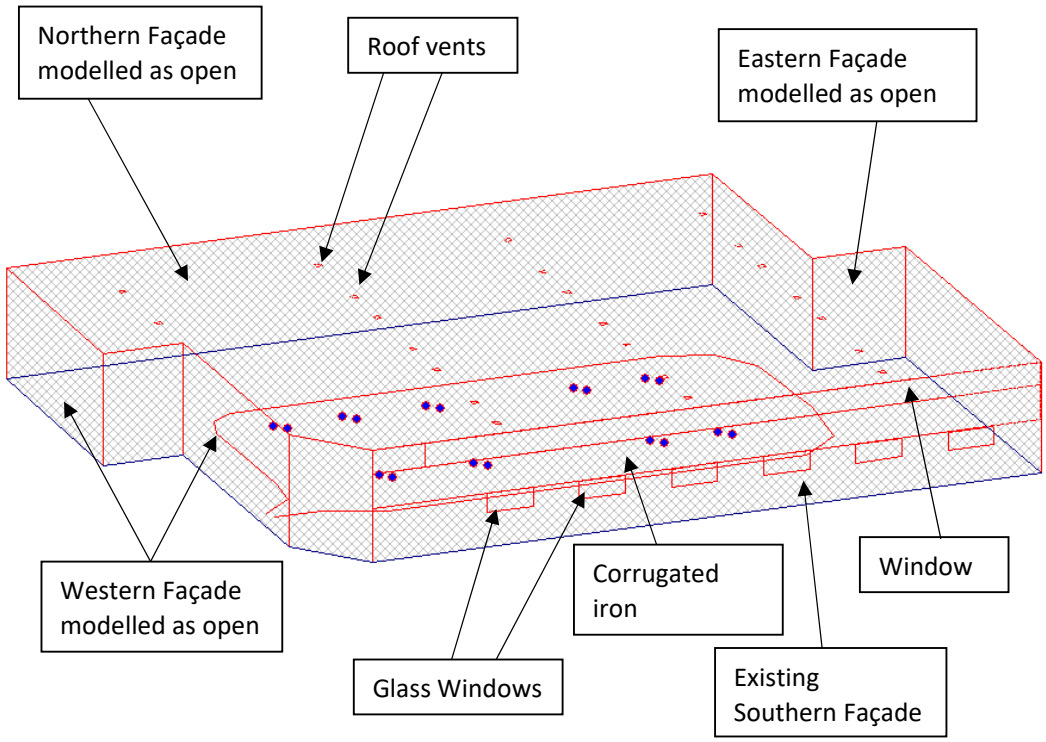


Figure 6-3: 3D view of Torpedo Factory Scenario 3



Predicted Noise Levels

Table 6-5: Scenario 3: Noise Modelling Results, dB(A)

Area	Receptor		Predicted Noise Levels		PNTL			
	Address	Floor Level	Day, Evening Night $L_{eq, 15min}$	Night Sleep Disturbance L_{max}	Day $L_{eq, 15min}$	Evening $L_{eq, 15min}$	Night $L_{eq, 15min}$	Night Sleep Disturbance L_{max}
	Residential Receptors							
B	1 Kiara Close, North Sydney, Eastern Building Backyard	GF	32	38	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, NE façade	F 4	21	27	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, NE façade	GF	19	25	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 1	38	44	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 2	38	44	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 4	37	43	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, SE façade	F 4	29	35	51	48	40	52
B	1 Kiara Close, North Sydney, Northern Building, E façade	F 1	17	23	51	48	40	52
D	2 Ben Boyd Road, Neutral Bay	F 3	17	23	45	45	41	52
D	2 Hayes Street, Neutral Bay, Backyard	GF	19	25	45	45	41	52
D	4 Hayes Street, Neutral Bay	GF	19	25	45	45	41	52
D	4A Hayes Street, Neutral Bay	F 2	19	25	45	45	41	52
C	20 Adderstone Avenue, North Sydney	F 1	<15	<21	52	48	43	54
C	22a Adderstone Avenue, North Sydney	F 2	15	21	52	48	43	54
A	135-137 High Street, North Sydney	F 1	29	35	49	48	43	53
A	140 High Street, North Sydney, Western Building	GF	26	32	49	48	43	53
A	140 High Street, North Sydney, Eastern Building	F 1	21	27	49	48	43	53
A	140 High Street, North Sydney, Eastern Building	GF	21	27	49	48	43	53
A	141 High Street, North Sydney	F 1	34	40	49	48	43	53
A	142 High Street, North Sydney Backyard	GF	31	37	49	48	43	53
A	143 High Street, North Sydney	F 1	35	41	49	48	43	53
A	145 High Street, North Sydney	F 1	36	42	49	48	43	53
A	147 High Street, North Sydney	F 1	38	44	49	48	43	53

Note: Exceed the Day, Evening and Night time criteria
Exceed the Evening and Night time criteria
Exceed the Night time criteria

Comments – Scenario 3

The noise emissions associated with the use of the new carpark without any internal walls was predicted to comply with the noise criteria at all residential receptors during the daytime, evening and night time. There are no exceedances of the sleep disturbance L_{max} criteria at any of the sensitive receivers.

6.4.4 Scenario 4: New Torpedo Factory Car Park and Café (without internal walls)

Noise Sources and Assumptions:

- New Torpedo Factory building without internal walls
- 20 cars per hour passing — Line Source
- 36 car doors slamming per hour — Point Source
- 36 car ignitions per hour — Point Source
- 1 speaker at 70 dB(A) — Point Source
- 16 people in moderate conversation — Point Source

Location of Sources:

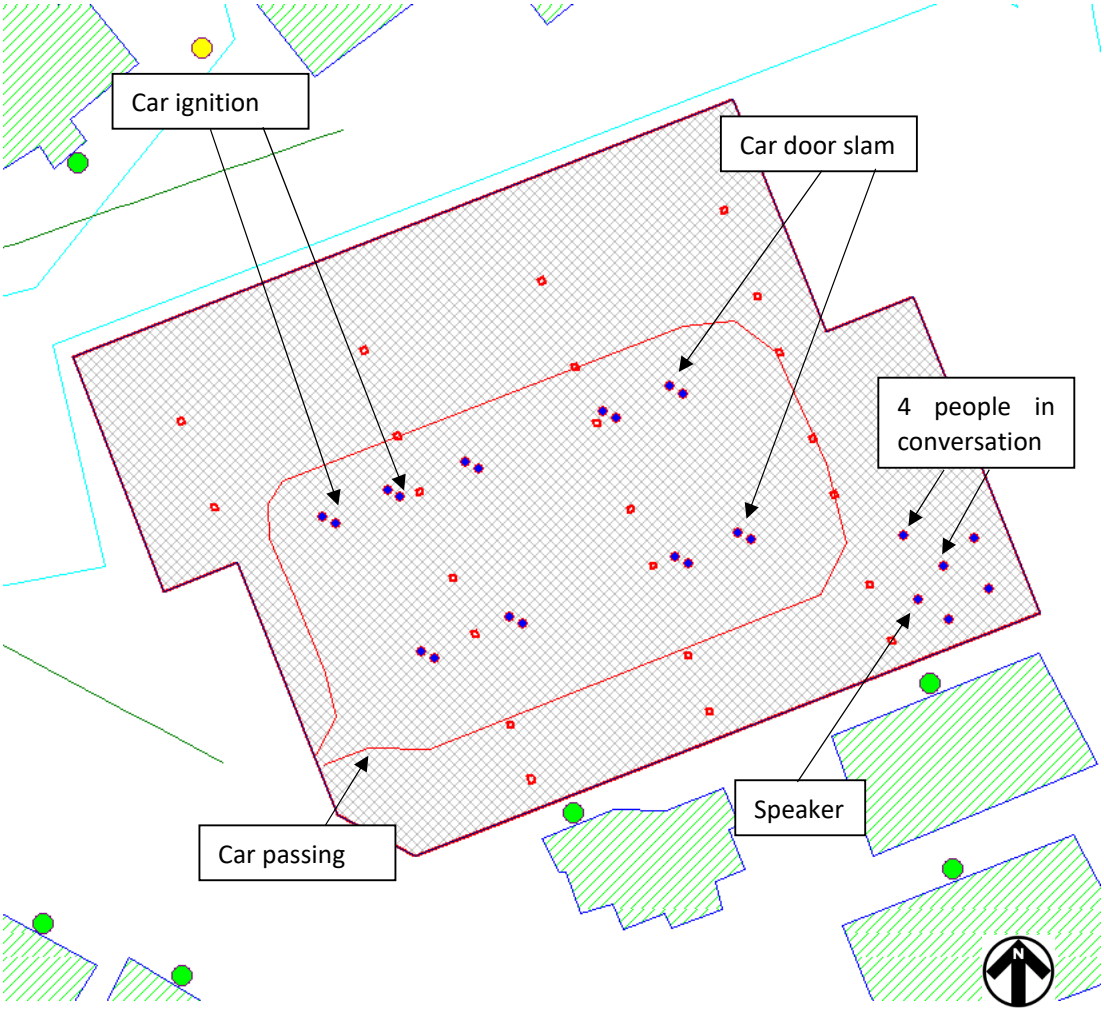
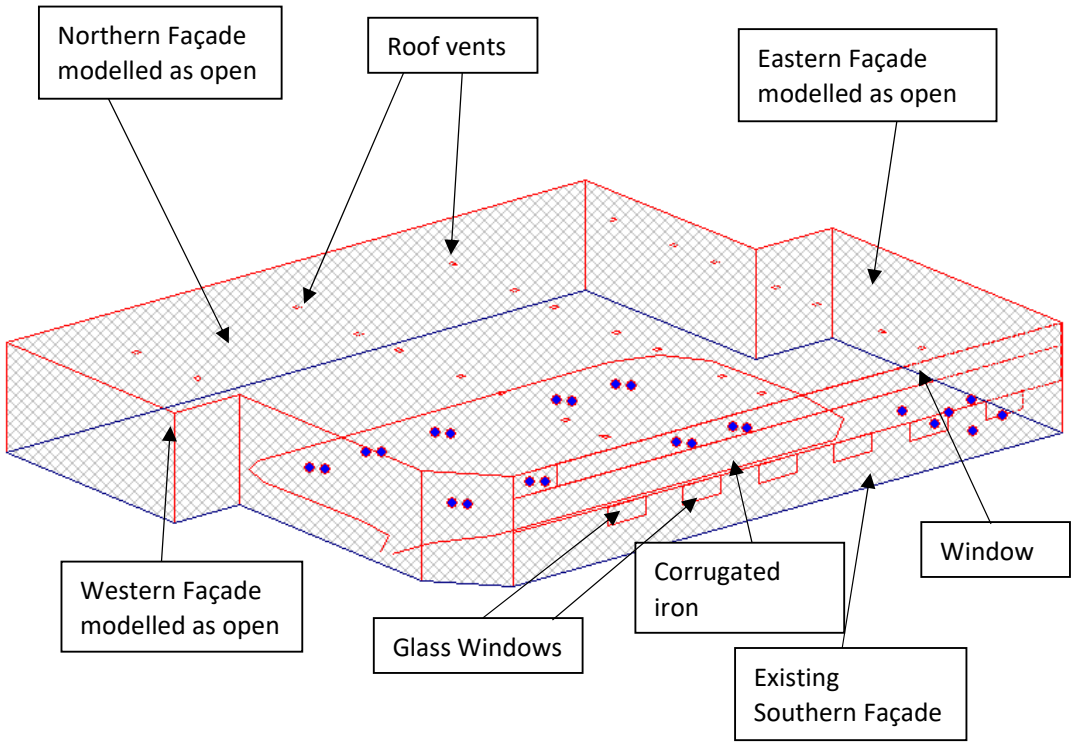


Figure 6-4: 3D view of Torpedo Factory Scenario 3



Predicted Noise Levels

Table 6-6: Scenario 4: Noise Modelling Results, dB(A)

Area	Receptor		Predicted Noise Levels		PNTL			
	Address	Floor Level	Day, Evening Night $L_{eq, 15min}$	Night Sleep Disturbance L_{max}	Day $L_{eq, 15min}$	Evening $L_{eq, 15min}$	Night $L_{eq, 15min}$	Night Sleep Disturbance L_{max}
Residential Receptors								
B	1 Kiara Close, North Sydney, Eastern Building Backyard	GF	39	45	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, NE façade	F 4	30	36	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, NE façade	GF	27	33	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 1	46	52	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 2	45	51	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 4	44	50	51	48	40	52
B	1 Kiara Close, North Sydney, Eastern Building, SE façade	F 4	37	43	51	48	40	52
B	1 Kiara Close, North Sydney, Northern Building, E façade	F 1	27	33	51	48	40	52
D	2 Ben Boyd Road, Neutral Bay	F 3	29	35	45	45	41	52
D	2 Hayes Street, Neutral Bay, Backyard	GF	32	38	45	45	41	52
D	4 Hayes Street, Neutral Bay	GF	31	37	45	45	41	52
D	4A Hayes Street, Neutral Bay	F 2	31	37	45	45	41	52
C	20 Adderstone Avenue, North Sydney	F 1	15	21	52	48	43	54
C	22a Adderstone Avenue, North Sydney	F 2	24	30	52	48	43	54
A	135-137 High Street, North Sydney	F 1	36	42	49	48	43	53
A	140 High Street, North Sydney, Western Building	GF	34	40	49	48	43	53
A	140 High Street, North Sydney, Eastern Building	F 1	31	37	49	48	43	53
A	140 High Street, North Sydney, Eastern Building	GF	31	37	49	48	43	53
A	141 High Street, North Sydney	F 1	41	47	49	48	43	53
A	142 High Street, North Sydney Backyard	GF	46	52	49	48	43	53
A	143 High Street, North Sydney	F 1	42	48	49	48	43	53
A	145 High Street, North Sydney	F 1	43	49	49	48	43	53
A	147 High Street, North Sydney	F 1	45	51	49	48	43	53

Note: Exceed the Day, Evening and Night time criteria
Exceed the Evening and Night time criteria
Exceed the Night time criteria

Comments – Scenario 4

The noise emissions associated with the use of the new carpark without any internal walls and the use of a potential future pop up café was predicted to comply with the noise criteria at all residential receptors during the daytime and evening. During the night time there are exceedances at five receivers, the largest of which being 6 dB(A) over the criteria at 1 Kiara Close, north Sydney, Eastern Building S Façade Floor 1 and 142 High Street, North Sydney Backyard Ground Floor. There are no exceedances of the sleep disturbance L_{max} criteria at any of the sensitive receivers. Although the establishment of a pop up café is not part of the Renewal Project, potential noise impacts relating to the operation of a café have been assessed to establish parameters and inform the design for a potential pop up café.

6.5 Operation Management and Mitigation Measures

The predicted noise levels from the operation of the Torpedo Factory carpark in scenarios 1-3 are predicted to comply with the noise criteria as outlined in Section 6.4. There are exceedances of the night time criteria at five receivers with the inclusion of a potential future pop up café and associated music and patrons in scenario 4. The following recommendations should be applied:

- The café should operate only during the day time and evening periods ie. From 7am – 10pm.
- The seating area of the café should be within the confines of the southern façade in order to comply with criteria.

To further reduce the predicted noise levels, the following noise mitigation measures are recommended:

- Torpedo Factory car park has a low speed limit – 15 kph.
- The Torpedo Factory gate may be open when the car park is in use, and locked after hours, to reduce noise from the opening and closing.
- The Torpedo Factory car park only scenarios comply with all time periods, however the hours could be restricted to reduce noise impacts further during more sensitive periods, such as night time.
- Retain internal walls where possible.
- A version of the complaints procedure outlined in Section 8.5 should be considered for adoption during the operational phase of the project.

7. ESTIMATED CONSTRUCTION NOISE IMPACT ASSESSMENT

7.1 CONSTRUCTION ACTIVITIES

Construction activities are proposed to include the following:

- **Foreshore Park** - Create a new foreshore park through a series of landscaped terraces replacing the multi-level, harbour-facing portion of the Torpedo Factory.
- **Entry Forecourt facing High Street** – Create an enlarged entry forecourt through the demolition of a portion of the Torpedo Factory facing High Street.
- **Torpedo Factory Walkway** – Provide public walkways and viewing areas along the northern and eastern sides of the Torpedo Factory, offering elevated views towards Neutral Bay.
- **New pedestrian connections** – Investigate opportunities to connect the upper level and the new foreshore park, and provide a new path to Kesterton Park
- **Sandstone Cliff** - Reveal the large sandstone cliff face that divides the upper and lower levels of the site. The excision of the building at this point will allow for expansive views and an opportunity to better integrate Sub Base Platypus' lower foreshore level with adjoining public land (Kesterton Park).
- **Heritage** – Retain key significant heritage elements of the building, including the majority of the factory floor level, and the characteristic saw-tooth roof.
- **Interpretation**- Interpret the site's multi-layered history – natural, First Nations and defence heritage, with a focus on the ongoing connection to Country.
- **Public Car Park** - Retained portion of Torpedo Factory to include a public car park to support visitors accessing the site.
- **Improved Visual outcomes** - The removal of the multi-storey, harbour-facing section of the building, and the peeling away of walls on three of its sides, will substantially reduce the visual bulk and scale of the building, and open up views to and through the site.
- **Sustainable Design -** Explore opportunities to use the roof to capture solar power and rainwater
- **Amenity** – Protect local amenity by minimising potential impacts such as noise and light
- **Possible future uses** – The covered space of the remnant Torpedo Factory provides the opportunity for a future pop-up café at the harbour-end, or a space for occasional community uses (such as a small market). Any such proposals would be subject to separate assessment and approval.

7.2 MODELLED NOISE GENERATING SCENARIOS

Considering the construction activities outlined in Section 7.1, one construction stage is listed in Table 7-1 are modelled for:

- Demolition works.

The noise generating stages consider a worst case scenario in which all equipment is running for 100% of the time over the 15 minute assessment period.

The likely equipment list for the stages is detailed in Table 7-1, with an equipment location diagrams in Figure 7-1. Equipment is primarily located near the main building and office area, as equipment will be most likely to be positioned at these spots.

All construction works are proposed to be undertaken during standard construction hours mentioned in Table 5-3, that is

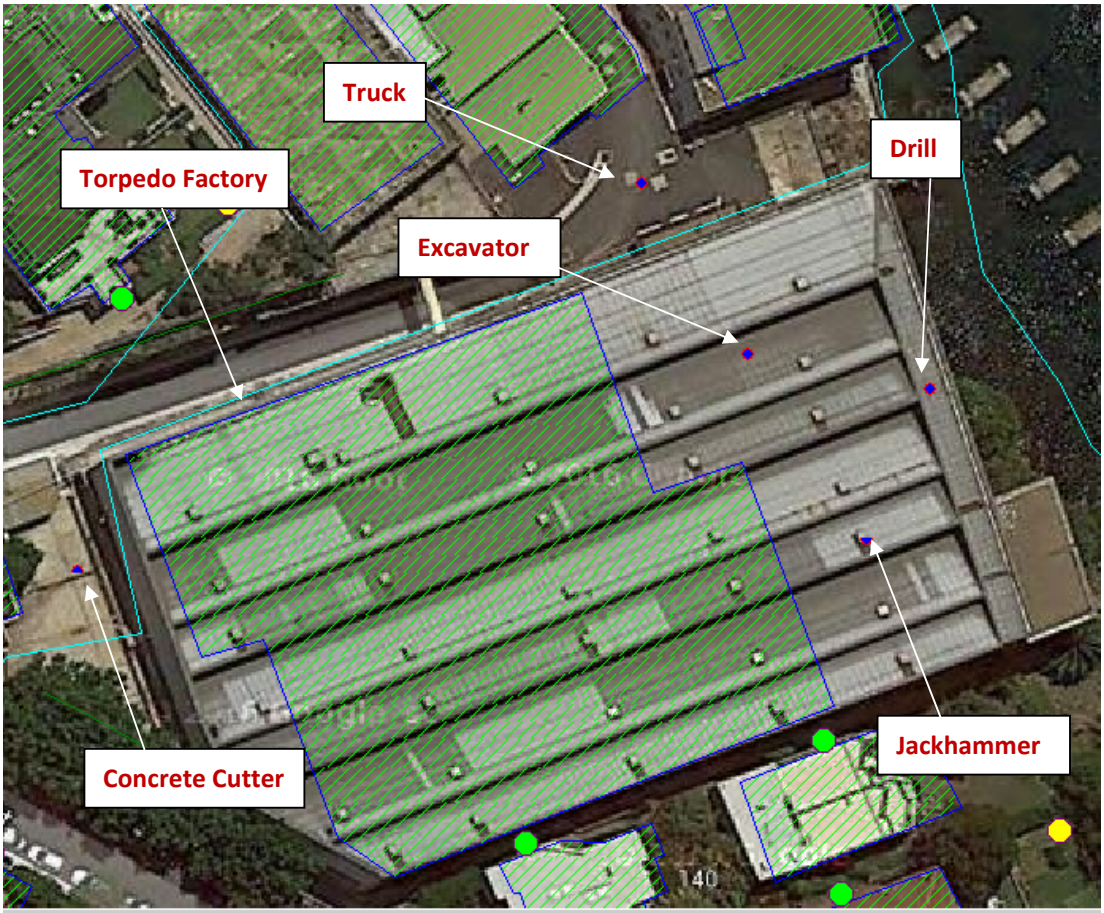
- Monday to Friday, 7am to 6pm;
- Saturday 8am to 1pm; and
- No work on Sundays or public holidays.

Table 7-1: Modelled Noise Stages for Proposed Construction Works

Scenario	Time of the day	Noise Sources for Worst 15-minute Period
1. Demolition work	Standard hours	• Jackhammer[1] • Excavator • Truck • Drill • Concrete cutter

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 7-1: Demolition Works



7.3 MODELLING METHODOLOGY

7.3.1 Noise Model

Noise propagation modelling for the construction activities was carried out using the ISO 9613-2:1996 algorithm within SoundPLAN. The construction stage was modelled using the $L_{Aeq,\ 15\ minutes}$ descriptor.

Assumptions made in the noise modelling of the construction noise stages are as follows:

- The relevant assessment period for operational noise emissions has been considered to be 15 minutes. The construction scenario assume all equipment is running 100% of the time during the 15 minute assessment period, and the concrete cutter 50% of the time to provide a worst case scenario;
- Topographical information for off-site areas was obtained from Google Earth;
- Topographical information for on-site areas was obtained from the site survey;
- All receptors were modelled at 1.5 m above ground level;
- All ground areas have been modelled considering different ground factors ranging from 0 to 1 (Soft to Hard ground).
- All noise sources associated with the construction works have been modelled as point sources.

7.3.2 Noise Sources

A-weighted octave band centre frequency sound power levels are presented shown in Table 7-2 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 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 7-2: 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
Concrete Cutter	**116**	113	102	100	98	100	104	110	105
Truck	**106**	77	84	89	104	95	93	88	88
Jackhammer	**114**	82	92	99	112	109	105	102	95
Drilling	**92**	58	61	69	75	80	86	89	84
Excavator (5T)	**108**	101	99	98	99	100	100	95	88

7.4 CONSTRUCTION PREDICTED NOISE LEVELS

Results of the predictive noise modelling of the construction activities are shown in Table 7-3. For the construction scenario, noise levels were predicted to exceed the noise affected RBL + 10 dB criteria during worst-case demolition works. The highest exceedance of the RBL + 10 dB criteria was by 20 dB(A) at 140 High Street. However, none of the receivers are predicted to exceed the highly noise affected criteria of 75 dB(A).

Table 7-3: Scenario 3: Noise Modelling Results, dB(A)

	Receptor		Predicted Noise Levels	Criteria
Area	Address	Floor Level	Day $L_{eq, 15min}$	Day $L_{eq, 15min}$
		Residential Receptors		
B	1 Kiara Close, North Sydney, Eastern Building Backyard	GF	59 ×	56
B	1 Kiara Close, North Sydney, Eastern Building, NE façade	F 4	59 ×	56
B	1 Kiara Close, North Sydney, Eastern Building, NE façade	GF	55 ✓	56
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 1	73 ×	56
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 2	72 ×	56
B	1 Kiara Close, North Sydney, Eastern Building, S façade	F 4	72 ×	56
B	1 Kiara Close, North Sydney, Eastern Building, SE façade	F 4	63 ×	56
B	1 Kiara Close, North Sydney, Northern Building, E façade	F 1	55 ✓	56
D	2 Ben Boyd Road, Neutral Bay	F 3	45 ✓	50
D	2 Hayes Street, Neutral Bay, Backyard	GF	58 ×	50
D	4 Hayes Street, Neutral Bay	GF	55 ×	50
D	4A Hayes Street, Neutral Bay	F 2	52 ×	50
C	20 Adderstone Avenue, North Sydney	F 1	41 ✓	57
C	22a Adderstone Avenue, North Sydney	F 2	53 ✓	57
A	135-137 High Street, North Sydney	F 1	59 ×	54
A	140 High Street, North Sydney, Western Building	GF	50 ✓	54
A	140 High Street, North Sydney, Eastern Building	F 1	74 ×	54
A	140 High Street, North Sydney, Eastern Building	GF	74 ×	54
A	141 High Street, North Sydney	F 1	73 ×	54
A	142 High Street, North Sydney Backyard	GF	62 ×	54
A	143 High Street, North Sydney	F 1	72 ×	54
A	145 High Street, North Sydney	F 1	70 ×	54
A	147 High Street, North Sydney	F 1	67 ×	54

Note: ✓Complies × Non-compliance

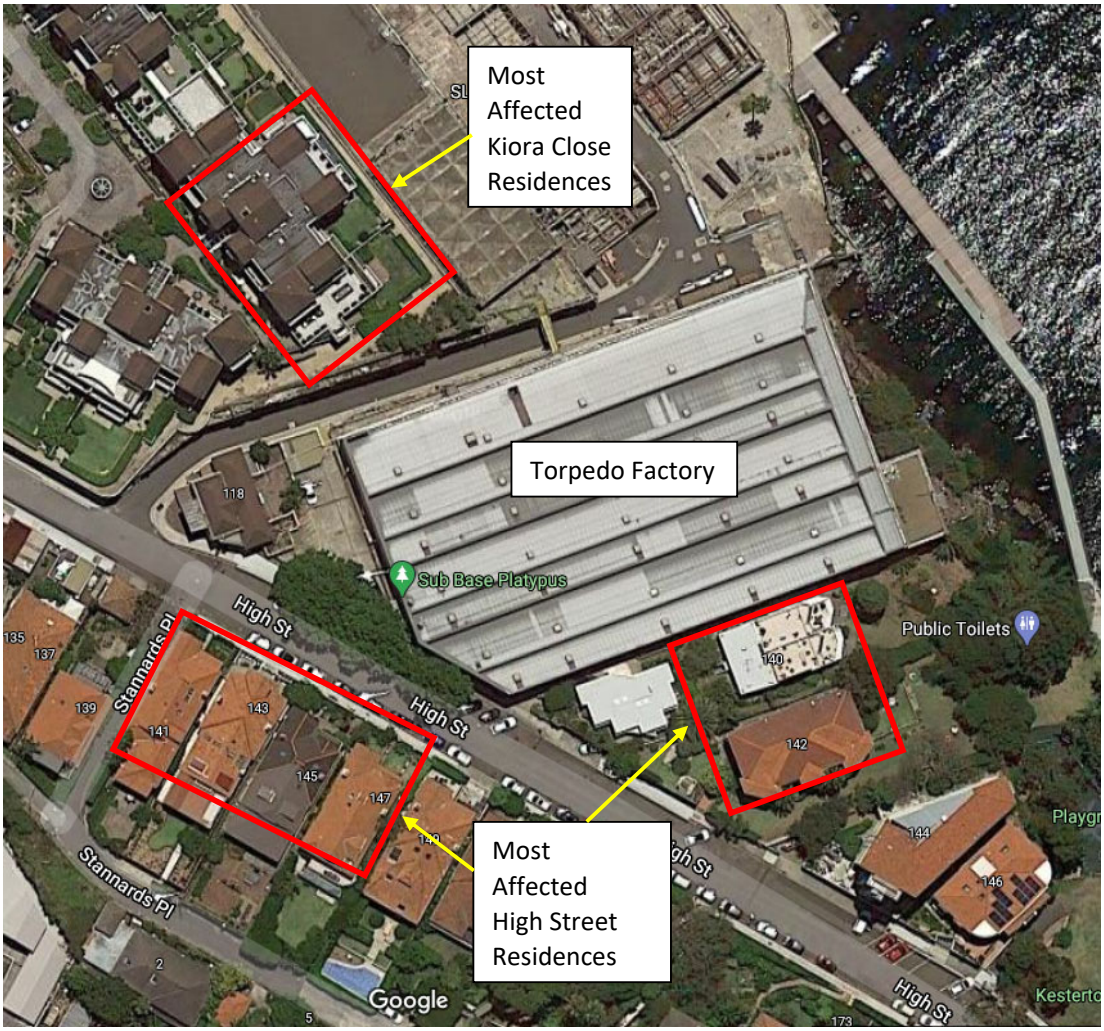
7.5 STAGE 1 VS STAGE 2 CONSTRUCTION NOISE COMPARISON

A previous noise management plan 171067-02_NMP_Rev5 for construction noise for connection improvements, public domain improvements, access improvements and refurbishment of selected buildings (Stage 1) was conducted at Sub Base Platypus.

Comparing the predicted levels from Stage 1 (completed) and Stage 2 (future) construction works the following impacts are note:

- Residents at 1 Kiora Close Eastern building on the Southern and South-eastern façades and 140-147 High Street will be the most affected by stage 2 works as these receivers are the closest to the Torpedo Factory (see Figure 7-2); and
- Residents to the north (Adderstone avenue, 1 Kiora Close Northern building and Northern façade of the Eastern building) and across the water will experience less noise impacts during Stage 2 than Stage 1.

Figure 7-2: Map Showing Most Affected Receivers



8. 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 jackhammers and hydraulic hammers has the potential to generate vibration. Human annoyance from vibration from construction equipment is considered more likely than structural damage to buildings.

Table 8-1: Recommended safe working distances for vibration intensive plant

Plant item	Rating/ description	Safe Working Distance	
		Cosmetic Damage[1]	Human Response[2]
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

Dwellings are well beyond the nominal 1 m cosmetic damage criteria for jackhammer use at the Torpedo Factory.

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

8.1 RECOMMENDED CONSTRUCTION NOISE 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 8.2);
- Mitigation Measures (Section 8.3);
- Community Notification (Section 8.4);
- Complaints Procedure (Section 8.5); and
- Noise Monitoring (Section 8.6).

8.2 CONSTRUCTION HOURS OF WORK

It is proposed that construction works take place during standard hours, in line the NSW Interim Construction Noise Guideline.

The following hours for works are as recommended:

Monday to Friday:	7am to 5pm
Saturday:	8am to 1pm
Sunday and Public Holidays:	No works permitted

It is noted the above construction hours may be extended in line with the NSW Government's response to the COVID 19 pandemic, Environmental Planning and Assessment (COVID-19 Development – Construction Work Days) Order 2020 commenced on 2 April 2020 described in Section 5.2.6. On weekends and public holidays during the COVID-19 pandemic, construction hours have been extended to the same hours normally allowed on weekdays. These Orders will be in place until 25 March 2021, unless otherwise advised by the NSW Government.

8.3 Recommended Mitigation Measures

A number of general mitigation measures are recommended to be adopted where possible, including site specific controls (8.3.1), universal work practices (8.3.2), plant and equipment (8.3.3).

It is important to note that installation of Echo sound barrier curtains has been considered ineffective due to mobile nature of equipment used on site.

8.3.1 Site specific controls

- Where possible, internal demolition must be carried out whilst the external facades and roof of the building are still standing to aid in the reduction of noise emissions.
- 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.
- 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.
- Examine different types of saws/cutters that perform the same function and compare the noise level data to select the least noisy machine.

8.3.2 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.

8.3.3 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.

8.4 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 program prior to construction works commencing.

Residents at potentially affected properties are to be notified of upcoming 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 works, with a proposed area of letterbox drop is shown in Figure 8-1. Information is recommended to arrive at the residents' properties between 5 and 14 days before the works commence.

Figure 8-1: Proposed letterbox notifications

↑N	LEGEND: Proposed letterbox notifications	Benbow Environmental 25 Sherwood Street, Northmead NSW 2152

The SHFT website is also to contain information on the construction works, including the above newsletters and complaints procedure (Section 8.5).

8.5 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 may 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.

8.6 NOISE MONITORING

During the demolition, 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. jackhammering.

Any 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 program.

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.

9. CONCLUSIONS

Benbow Environmental has been engaged by the Sydney Harbour Federation Trust, to prepare a noise management plan for the Torpedo Factory Renewal Project at Sub Base Platypus, located at 120 High Street, North Sydney 2060, Lot A DP 109583.

A quantitative assessment of the potential noise impact associated with the various potential land uses has been undertaken, and the noise emissions associated with the potential land uses at the site has been evaluated.

Long term and short term monitoring were undertaken at the surrounding residential receptors in order to determine the existing background and ambient noise levels in the area.

The noise impact assessment was undertaken in accordance with the following guidelines:

- NSW Noise Policy for Industry (EPA, 2017); and
- NSW Interim Construction Guidelines (DECCW, 2009).

The noise sources associated with the potential operations were identified and their emissions modelled by using SoundPLAN 7.3. Predicted noise levels were assessed against the relevant noise criteria.

The predicted noise levels from the operation of the Torpedo Factory carpark in scenarios 1-3 are predicted to comply with the project specific noise levels at all receivers during all time periods. There are exceedances of the night time criteria at five receivers with the inclusion of a potential future pop up café in scenario 4. The following recommendations should be applied:

- The café should operate only during the day time and evening periods i.e.. From 7am – 10pm.
- The seating area of the café should be within the confines of the southern façade in order to comply with criteria.

Further recommendations to aid in reducing noise impacts have been provided in Section 6.5.

For the construction scenario, noise levels were predicted to exceed the noise affected RBL + 10 dB criteria during worst-case demolition works. The highest exceedance of the RBL + 10 dB criteria was by 20 dB(A) at 140 High Street. However, none of the receivers are predicted to exceed the highly noise affected criteria of 75 dB(A). Construction mitigation measures have been recommended in Section 8.3.

This concludes the report.

Emma Hansma	Victoria Hale	R T Benbow
Senior Engineer	Environmental Scientist	Principal Consultant

10. 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 in 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

'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.

dB(A) – 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.

FREE FIELD

In acoustics a free field is a measurement area not subject to significant reflection of acoustical energy. A free field measurement is typically not closer than 3.5 metres to any large flat object (other than the ground) such as a fence or wall or inside an anechoic chamber.

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.

IMPULSE NOISE

An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

MAXIMUM NOISE LEVEL, L_{AFmax}

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.

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."

SOUND ABSORPTION COEFFICIENT, α

Sound is absorbed in porous materials by the viscous conversion of sound energy to a small amount of heat energy as the sound waves pass through it. Sound is similarly absorbed by the flexural bending of internally damped panels. The fraction of incident energy that is absorbed is termed the Sound Absorption Coefficient, α. An absorption coefficient of 0.9 indicates that 90 % of the incident sound energy is absorbed. The average α from 250 to 2 kHz is termed the Noise Reduction Coefficient (NRC).

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, L_p

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, L_w

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. $L_w = L_p + 10 \log_{10}$ '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.

STEADY NOISE

Noise, which varies in level by 6 dB or less, over the period of interest with the time-weighting set to "Fast", is considered to be "steady". (Refer AS 1055.1 2018).

WEIGHTED SOUND REDUCTION INDEX, R_w

This is a single number rating of the airborne sound insulation of a wall, partition or ceiling. The sound reduction is normally measured over a frequency range of 100 Hz to 3.150 kHz and averaged in accordance with ISO standard weighting curves (Refer AS/NZS 1276.1:2004). Internal partition wall R_w + C ratings are frequency weighted to simulate insulation from human voice noise. The R_w + C is similar in value to the STC rating value. External walls, doors and windows may be $R_w + C_{tr}$ rated to simulate insulation from road traffic noise. The spectrum adaptation term C_{tr} adjustment factor takes account of low-frequency noise. The weighted sound reduction index is normally similar or slightly lower number than the STC rating value.

'Z' FREQUENCY WEIGHTING

The 'Z' (Zero) frequency weighting is 0 dB within the nominal 1/3 octave band frequency range centred on 10 Hz to 20 kHz. This is within the tolerance limits given in AS IEC 61672.1–2019: 'Electroacoustics - Sound level meters – Specifications'.