BESIX Watpac

NSW GOVERNMENT | sydney METRO

Barangaroo Station

Noise and Vibration Management Plan

N217
Barangaroo COP
4 November 2022

Project overview

Project Site Address:
25 Hickson Road
Barangaroo
NSW 2000

Project Commencement Date:
12 March 2021

BESIX Watpac State Division Address:
Level 24, 44 Market Street
SYDNEY
NSW 2000

BESIX Watpac ABN:
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Document Control

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BESIX Watpac Approvals

Name	Role & Title	Signature	Date
[redacted]	Reviewer / Planning & Environment Manager	[redacted]	04/11/2022
[redacted]	Reviewer / Engineering Manager	[redacted]	04/11/2022

Note: A controlled copy of the Noise and Vibration Management Plan (NVMP) will be distr buted to the Sydney Metro Principal's Representative, Independent Certifier (IC) and it will be made available to all BR COP employees and subcontractors in soft copy format through the project document control system.

The NVMP, when printed, will be uncontrolled and it will the responsibility of each user to confirm the currency of the plan through the project document control system.

RENZO TONIN & ASSOCIATES
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Acoustics
Vibration
Structural Dynamics

BARANGAROO METRO STATION

Noise and Vibration Management Plan (NVMP)

30 September 2022

BESIX Watpac

TM031-01F01 Barangaroo Metro Station NVMP(r10)

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NVMP Compliance Matrix

The Protect Planning Approval conditions for Critical State Significant Infrastructure (CSSI) 7400 and approved modifications relevant to this Plan are listed in the Table below. A cross reference is also included to indicate where the condition is addressed in this Plan or other project management documents.

Table 0-1: Minister's Conditions of approval

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
A2	The CSSI must be carried out in accordance with all procedures, commitments, preventative actions, performance criteria and mitigation measures set out in the EIS as amended by the documents listed in A1, unless otherwise specified in, or required under, this approval.		Project Environment Manager	N/A	Section 2.2
A3	In the event of an inconsistency between the EIS as amended by the description in Chapters 2, 3 and 9 of the PIR, or any other document required under this approval, and a term of this approval, the term of this approval prevails to the extent of the inconsistency. For the purpose of this condition, there will be an inconsistency between a term of this approval and any document if it is not possible to comply with both the term and the document.		Project Environment Manager	N/A	Section 2.2
A9	Where the terms of this approval require consultation with identified parties, details of the consultation undertaken, matters raised by the parties, and how the matters were considered must accompany the strategies, plans, programs, reviews, audits, protocols and the like submitted to the Secretary.		Stakeholder and Community Relations Manager Project Environment Manager	N/A	Section 5.3
C2	The CEMP must provide:		Project Environment Manager		
	(a) a description of activities to be undertaken during construction (including the scheduling of construction);				Section 1.2
	(b) details of environmental policies, guidelines and principles to be followed in the construction of the CSSI;				Section 2.1
	(c) a schedule for compliance auditing;				Section 7

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
	(d) a program for ongoing analysis of the key environmental risks arising from the activities described in subsection (a) of this condition, including an initial risk assessment undertaken before the commencement of construction of the CSSI;	Identification of potential noise and vibration impacts in relevant CNVISs		Prior to construction	Section 5
	(e) details of how the activities described in subsection (a) of this condition will be carried out to: i. meet the performance outcomes stated in the EIS as amended by the documents listed in A1; and ii. manage the risks identified in the risk analysis undertaken in subsection (d) of this condition;	This analysis will be included in relevant CNVISs			Section 5
	(f) an inspection program detailing the activities to be inspected and frequency of inspections;	Preparation of a monitoring program and CNVIS			Section 5 (CNVIS), APPENDIX E (monitoring program)
	(g) a protocol for managing and reporting any: i. incidents; and ii. non-compliances with this approval and with statutory requirements;				Section 7
	(h) procedures for rectifying any non-compliance with this approval identified during compliance auditing, incident management or at any time during construction;				Section 7
	(i) a list of all the CEMP sub-plans required in respect of construction, as set out in Condition C3. Where staged construction of the CSSI is proposed, the CEMP must also identify which CEMP sub-plan applies to each of the proposed stages of construction;				Refer to CEMP Table 1
	(j) a description of the roles and environmental responsibilities for relevant employees and their relationship with the ER;				Refer to CEMP Section 5
	(k) for training and induction for employees, including contractors and sub-contractors, in relation to environmental and compliance obligations under the terms of this approval;				Refer to CEMP Section 5.2
	(l) for periodic review and update of the CEMP and all associated plans and programs.				Refer to CEMP Table 9

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
A24	From commencement of construction until completion of construction, the approved Environmental Representative (ER) must: (a) receive and respond to communications from the Secretary in relation to the environmental performance of the CSSI; (b) consider and inform the Secretary on matters specified in the terms of this approval; (c) consider and recommend any improvements that may be made to work practices to avoid or minimise adverse impact to the environment and to the community; (d) review documents identified in Conditions C1, C3 and C9 and any other documents that are identified by the Secretary, to ensure they are consistent with requirements in or under this approval and if so: i. make a written statement to this effect before submission of such documents to the Secretary (if those documents are required to be approved by the Secretary), or ii. make a written statement to this effect before the implementation of such documents (if those documents are required to be submitted to the Secretary for information or are not required to be submitted to the Secretary); (e) regularly monitor the implementation of environmental management related documents to ensure implementation is being carried out in accordance with what is stated in the document and the terms of this approval; (f) review the Proponent's notification of incidents in accordance with Condition A41 of this approval; (g) as may be requested by the Secretary, help plan, attend or undertake Department audits of the CSSI, briefings, and site visits; (h) if conflict arises between the Proponent and the community in relation to the environmental performance of the CSSI, follow the procedure in the Community Communication Strategy approved under Condition B3 of this approval to attempt to resolve the conflict, and if it cannot be resolved, notify the Secretary; (i) review any draft consistency assessment that may be carried out by the Proponent, and provide advice on any additional mitigation measures required to minimise the impact of the work;	Requirement held by Sydney Metro. The ER has been approved by the Secretary of NSW Department of Planning, Industry and Environment DPIE See Section 2.4	Environmental Representative	N/A	Section 2.3, Section 2.4

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
	(j) consider any minor amendments to be made to the documents listed in Conditions C1, C3 and C9 and any document that requires the approval of the Secretary (excluding noise and vibration documents) that comprise updating or are of an administrative or minor nature, and are consistent with the terms of this approval and the documents listed in Conditions C1, C3 and C9 or other documents approved by the Secretary and, if satisfied such amendment is necessary, approve the amendment. This does not include any modifications to the terms of this approval; (k) assess the impacts of minor ancillary facilities as required by Condition A18 of this approval; and (l) prepare and submit to the Secretary and other relevant regulatory agencies, for information, a monthly Environmental Representative Report detailing the ER's actions and decisions on matters for which the ER was responsible in the preceding month (or other timeframe agreed with the Secretary). The Environmental Representative Report must be submitted within seven (7) days following the end of each month for the duration of works and construction of the CSSI, or as otherwise agreed with the Secretary.				
A25	A suitably qualified and experienced Acoustics Advisor (AA), who is independent of the design and construction personnel, must be nominated by the Proponent and engaged for the duration of construction and for no less than six (6) months following operation of the CSSI. The details of the nominated AA must be submitted to the Secretary for approval no later than one (1) month before commencement of works, or within another timeframe as agreed with the Secretary. The Proponent may nominate additional suitably qualified and experienced persons to assist the lead Acoustics Advisor for the Secretary's approval. The Proponent must cooperate with the AA by: (a) providing access to noise and vibration monitoring activities as they take place; (b) providing for review of noise and vibration plans, assessments, monitoring reports, data and analyses undertaken; and (c) considering any recommendations to improve practices and demonstrating, to the satisfaction of the AA, why any recommendation is not adopted.	Requirement held by Sydney Metro. The AA has been approved by the Secretary of DPIE See Section 2.4	AA	N/A	Section 2.3, Section 2.4
A26	Any activities generating noise and vibration in excess of the Noise Management Level derived from the Interim Construction Noise Guideline must not commence until an AA, nominated under Condition A25 of this approval, has been approved by the Secretary.	Requirement held by Sydney Metro. AA has been appointed by DPIE	N/A	N/A	Section 2.3,
A27	The approved AA must: (a) receive and respond to communication from the Secretary in relation to the performance of the CSSI in relation to noise and vibration; (b) consider and inform the Secretary on matters specified in the terms of this approval relating to noise and vibration;	Requirement held by Sydney Metro. AA has been appointed by DPIE See Section 2.4	N/A	N/A	Section 2.3,

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
	(c) consider and recommend, to the Proponent, improvements that may be made to work practices to avoid or minimise adverse noise and vibration impacts; (d) review all noise and vibration documents required to be prepared under the terms of this approval and, should they be consistent with the terms of this approval, endorse them before submission to the Secretary (if required to be submitted to the Secretary) or before implementation (if not required to be submitted to the Secretary); (e) regularly monitor the implementation of all noise and vibration documents required to be prepared under the terms of this approval to ensure implementation is in accordance with what is stated in the document and the terms of this approval; (f) review the Proponent's notification of noise and vibration incidents in accordance with Condition A41 of this approval; (g) in conjunction with the ER (where required), the AA must: i. consider requests for out of hours construction activities and determine whether to endorse the proposed activities in accordance with Condition E47; ii. as may be requested by the Secretary or Complaints Mediator, help plan, attend or undertake audits of noise and vibration management of the CSSI including briefings, and site visits; iii. if conflict arises between the Proponent and the community in relation to the noise and vibration performance during construction of the CSSI, follow the procedure in the Community Communication Strategy approved under Condition B3 of this approval to attempt to resolve the conflict, and if it cannot be resolved, notify the Secretary; iv. consider relevant minor amendments made to any noise and vibration document approved by the Secretary that require updating or are of an administrative or minor nature, and are consistent with the terms of this approval and the document approved by the Secretary and, if satisfied such amendment is necessary, approve the amendment. This does not include any modifications to the terms of this approval; v. assess the noise impacts of minor ancillary facilities as required by Condition A18 of this approval; and vi. prepare and submit to the Secretary and other relevant regulatory agencies, for information, a monthly Noise and Vibration Report detailing the AAs actions and decisions on matters for which the AA was responsible in the preceding month (or other timeframe agreed with the Secretary). The Noise and Vibration Report must be submitted within seven (7) days following the end of each month for the duration of construction of the CSSI, or as otherwise agreed with the Secretary.				

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
C3	The following CEMP sub-plans must be prepared in consultation with the relevant government agencies identified for each CEMP sub-plan and be consistent with the CEMF and CEMP referred to in Condition C1. Required CEMP sub-plan — Relevant government agencies to be consulted for each CEMP sub-plan (a) Noise and vibration — Relevant Council(s)	Development of this plan	Project Environment Manager Proponent and Key Principal Contractor Project Noise and Vibration Consultant	Construction	Section 2.5, APPENDIX F
C4	The CEMP sub-plans must state how: (a) the environmental performance outcomes identified in the EIS as amended by the documents listed in A1 will be achieved; (b) the mitigation measures identified in the EIS as amended by documents listed in A1 will be implemented; (c) the relevant terms of this approval will be complied with; and (d) issues requiring management during construction, as identified through ongoing environmental risk analysis, will be managed.	Development of this plan	Project Environment Manager Project Noise and Vibration Consultant	Construction	Section 6 This matrix
C5	The CEMP sub-plans must be developed in consultation with relevant government agencies. Where an agency(ies) request(s) is not included, the Proponent must provide the Secretary justification as to why. Details of all information requested by an agency to be included in a CEMP sub-plan as a result of consultation and copies of all correspondence from those agencies, must be provided with the relevant CEMP sub-plan.		Project Environment Manager	N/A	Section 2.5 APPENDIX F
C6	Any of the CEMP sub-plans may be submitted to the Secretary along with, or subsequent to the submission of the CEMP but in any event, no later than one (1) month before commencement of construction		Project Environment Manager	N/A	Section 2.4
C8	Construction must not commence until the CEMP and all CEMP sub-plans have been approved by the Secretary. The CEMP and CEMP sub-plans, as approved by the Secretary, including any minor amendments approved by the ER (or AA in regards to the Noise and Vibration sub-plan), must be implemented for the duration of construction. Where the CSSI is being staged, construction of that stage is not to commence until the relevant CEMP and sub-plans have been approved by the Secretary		Project Environment Manager Construction Managers	Construction	This plan and Section 2.4

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
C9	The following Construction Monitoring Programs must be prepared in consultation with the relevant government agencies identified for each Construction Monitoring Program to compare actual performance of construction of the CSSI against predicted performance. (a) Noise and Vibration — EPA and Relevant Council(s)	This NVMP outlines the monitoring expectations for this project. In addition, the Sydney Metro CNVS outlines monitoring requirements.	Project Environment Manager Project Noise and Vibration Consultant	Construction	Section 2.5 APPENDIX F
C10	Each Construction Monitoring Program must provide:	This NVMP outlines the monitoring expectations for this project. In addition, the Sydney Metro CNVS outlines monitoring requirements.	Project Environment Manager Project Noise and Vibration Consultant	Construction	APPENDIX E
	(a) details of baseline data available;				Section 1.2.1 in APPENDIX E
	(b) details of baseline data to be obtained and when;				Section 1.2.1 in APPENDIX E
	(c) details of all monitoring of the project to be undertaken;				Section 1.2 and Section 1.3 in APPENDIX E
	(d) the parameters of the project to be monitored;				Section 1.2.2 and Section 1.3.1 in APPENDIX E
	(e) the frequency of monitoring to be undertaken;				Section 1.2 and Section 1.3 in APPENDIX E
	(f) the location of monitoring;				Section 1.2 and Section 1.3 in APPENDIX E
	(g) the reporting of monitoring results;				Section 1.6 in APPENDIX E

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
	(h) procedures to identify and implement additional mitigation measures where results of monitoring are unsatisfactory; and				Section 1.2 and Section 1.3 in APPENDIX E
	(i) any consultation to be undertaken in relation to the monitoring programs.				Section 2.5 and APPENDIX F
C11	The Noise and Vibration Construction Monitoring Program and Blast Construction Monitoring Program must include provision of real time noise and vibration monitoring data. The real time data must be available to the construction team, Proponent, ER and AA in real time. The Department and EPA must be provided with access to the real time monitoring data in real time.	This NVMP outlines the monitoring expectations for this project . In addition, the Sydney Metro CNVS outlines monitoring requirements.	Project Environment Manager Construction Managers	Construction	Section 1.2.5 and Section 1.3.3 in APPENDIX E
C12	The Construction Monitoring Programs must be developed in consultation with relevant government agencies as identified in Condition C9 of this approval and must include, to the written satisfaction of the Secretary, information requested by an agency to be included in a Construction Monitoring Programs during such consultation. Details of all information requested by an agency including copies of all correspondence from those agencies, must be provided with the relevant Construction Monitoring Program.		Project Environment Manager		Section 2.5 APPENDIX F
C13	The Construction Monitoring Programs must be endorsed by the ER (or AA in regards to the Noise and Vibration Construction Monitoring Program) and then submitted to the Secretary for approval at least one (1) month before commencement of construction or within another timeframe agreed with the Secretary.		Project Environment Manager		Section 2.4, APPENDIX G
C14	Construction must not commence until the Secretary has approved all of the required Construction Monitoring Programs, and all relevant baseline data for the specific construction activity has been collected.		Project Environment Manager Construction Managers		Section 1 in APPENDIX E
C15	The Construction Monitoring Programs, as approved by the Secretary including any minor amendments approved by the ER (or AA in regards to the Noise and Vibration Construction Monitoring Program), must be implemented for the duration of construction and for any longer period set out in the monitoring program or specified by the Secretary, whichever is the greater.		Project Environment Manager		Section 1 in APPENDIX E
C16	The results of the Construction Monitoring Programs must be submitted to the Secretary for information, and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program.		Project Environment Manager		Section 1.6 in APPENDIX E

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
C17	Where a relevant CEMP sub-plan exists, the relevant Construction Monitoring Program may be incorporated into that CEMP sub-plan	This NVMP incorporates construction programs in APPENDIX E	Project Environment Manager Construction Managers		APPENDIX E, Section 1.4 (interaction with other plans)
E28	The Proponent must ensure that vibration from construction activities does not exceed the vibration limits set out in the British Standard BS 7385-2:1993 Evaluation and measurement for vibration in buildings. Guide to damage levels from ground-borne vibration.	Vibration impact to be assessed for the worksite in CNVIS.	Project Environment Manager	Construction	Sections 4.8.2
E29	Owners of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before construction that generates vibration commences in the vicinity of those properties. The management of construction works in the vicinity of properties at risk of exceeding the screening criteria for cosmetic damage must be considered in the Noise and Vibration management sub plan required by Condition C3.	Properties will be identified in the CNVIS and notified.	Project Environment Manager Construction managers Environment coordinators Project Noise and Vibration Consultant Community communication team	Prior to relevant construction activities	Section 5.3, Section 1.3.2 in APPENDIX E
E30	The Proponent must conduct vibration testing before and during vibration generating activities that have the potential to impact on heritage items to identify minimum working distances to prevent cosmetic damage. In the event that the vibration testing and monitoring shows that the preferred values for vibration are likely to be exceeded, the Proponent must review the construction methodology and, if necessary, implement additional mitigation measures.	Monitoring will be conducted as required under the CNVIS.	Project Environment Manager Construction managers Environment coordinators Project Noise and Vibration Consultant	Prior to and during relevant construction activities	Section 1.3.2 in APPENDIX E
E31	The Proponent must seek the advice of a heritage specialist on methods and locations for installing equipment used for vibration, movement and noise monitoring of heritage-listed structures.	This advice will be included in the Heritage Management Plan (reference document: SMCSWSBR-BWC-SBR-HE-PLN-000010) and managed in conjunction with the AIMS.	Project Environment Manager Construction managers Environment coordinators	Prior to monitor installation	Section 1.3.4 in APPENDIX E

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
E32	The Proponent must review the Sydney Metro City and Southwest Construction Noise and Vibration Strategy in the PIR during detailed construction planning to consider scale and duration of impacts, the requirements of this approval and all measures to limit construction noise impacts to sensitive receivers including: (a) at property or architectural treatment; (b) relocation; and (c) other forms of mitigation where impacts are predicted to be long term and significant. The revised Sydney Metro City and Southwest Construction Noise and Vibration Strategy must be submitted to the Secretary for approval at least one (1) month before construction commences.	Already undertaken by Sydney Metro and incorporated into the CSNIS.	N/A	N/A	N/A
E33	Construction Noise and Vibration Impact Statements must be prepared for each construction site before construction noise and vibration impacts commence and include specific mitigation measures identified through consultation with affected sensitive receivers.	CNVISs will be prepared for all stages of work, under this Plan.	Project Noise and Vibration Consultant Project Environment Manager	Prior to relevant construction activities	Section 5.1.2
E34	Noise generating works in the vicinity of potentially-affected religious, educational, community institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) must not be timetabled within sensitive periods, unless other reasonable arrangements to the affected institutions are made at no cost to the affected institution or as otherwise approved by the Secretary.	Potentially noise affected receivers are identified in Table 5-1. Consultation in accordance with the CCS will determine sensitive periods for these receivers.	Stakeholder and Community Relations Manager Project Environment Manager	Prior to relevant construction activities	Section 5.3.3
E35	The Proponent must review alternative methods to rock hammering and blasting for excavation as part of the detailed construction planning with a view to adopting methods that minimise impacts on sensitive receivers. Construction Noise and Vibration Impact Statements must be updated for each location or activity to adopt the least impact alternative in any given location unless it can be demonstrated, to the satisfaction of the AA, why it should not be adopted.	Section 6.3	Construction Managers Project Environment Manager Environment coordinators	Prior to relevant construction activities as part of relevant CNVIS	Section 6.3

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
E36	Construction, except as allowed by Condition E48 (excluding cut and cover tunnelling), must only be undertaken during the following standard construction hours: (a) 7:00am to 6:00pm Mondays to Fridays, inclusive; (b) 8:00am to 6:00pm Saturdays; and (c) at no time on Sundays or public holidays.	Section 4.2	Construction Managers Project Environment Manager Environment coordinators Project Noise and Vibration Consultant	Construction	Section 4.2
E37	The Proponent must identify all receivers likely to experience internal noise levels greater than Leq(15 minute) 60 dB(A) inclusive of a 5 dB penalty, if rock breaking or any other annoying activity likely to result in regenerated (ground-borne) noise or a perceptible level of vibration is planned (including works associated with utility adjustments), between 7am – 8pm at: (a) Crows Nest, Victoria Cross, Blues Point, Barangaroo, Martin Place, Pitt Street, and Central; and (b) Marrickville, Newtown, St Peters, Sydenham and Tempe for works specified in SSI 7400_MOD 4 referenced in Condition A1 (c).	Section 4.5.2, Section 5.3.3	Stakeholder and Community Relations Manager Project Environment Manager Project Noise and Vibration Consultant	Prior to relevant construction activities as part of relevant CNVIS	Section 4.5.2, Section 5.3.3
E38	The Proponent must consult with all receivers identified in accordance with Condition E37 with the objective of determining appropriate hours of respite so that construction noise (including ground-borne noise), does not exceed internal noise levels of: (a) Leq(15 minute) 60 dB(A) inclusive of a 5 dB penalty if rock breaking or any other annoying activity likely to result in ground-borne noise or a perceptible level of vibration is planned between 7am – 8pm for more than 50 percent of the time; and (b) Leq(15 minute) 55 dB(A) inclusive of a 5 dB penalty if rock breaking or any other annoying activity likely to result in ground-borne noise or a perceptible level of vibration is planned between 7am – 8pm for more than 25 percent of the time, unless an agreement is reached with those receivers. This condition does not apply to noise associated with the cutting surface of a TBM as it passes under receivers. Note This condition requires that noise levels be less than Leq(15 minute) 60 dB(A) for at least 6.5 hours between 7am and 8pm, of which at least 3.25 hours must be below Leq(15 minute) 55 dB(A). Noise equal to or above Leq(15 minutes) 60 dB(A) is allowed for the remaining 6.5 hours between 7am and 8pm.	Section 4.5.2, Section 5.3.3	Stakeholder and Community Relations Manager Construction Managers Project Environment Manager Project Noise and Vibration Consultant	Prior to relevant construction activities	Section 4.5.2, Section 5.3.3

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
E39	The Proponent must consult with proponents of other construction works in the vicinity of the CSSI and take reasonable steps to coordinate works to minimise cumulative impacts of noise and vibration and maximise respite for affected sensitive receivers.	Section 5.3.3	Stakeholder and Community Relations Manager Construction managers Project Environment Manager Project Noise and Vibration Consultant	Prior to relevant construction activities	Section 5.3.3
E40	The Proponent must ensure all works (including utility works associated with the CSSI where undertaken by third parties) are coordinated to provide the required respite periods identified in accordance with the terms of this approval.	All work undertaken will be assessed as noted in this Plan, see Section 5.3.3	Construction managers Project Environment Manager Project Noise and Vibration Consultant	Prior to relevant construction activities	Section 5.3.3
E41	The Proponent must ensure that residential receivers, located in non-residential zones, likely to experience an internal noise level exceeding Leq(15 minute) 60 dB(A) between 8pm and 9pm or Leq(15 minute) 45 dB(A) between 9pm and 7am (inclusive of a 5 dB penalty if rock breaking or any other annoying activity likely to result in ground-borne noise, or a perceptible level of vibration is planned (including works associated with utility adjustments)) must be offered additional mitigation in accordance with the Sydney Metro City and South West Noise and Vibration Strategy referenced in Condition E32.	Section 4.5.1	Construction managers Project Environment Manager Project Noise and Vibration Consultant	Prior to relevant construction activities	Section 4.5.1
E42	The Proponent must ensure that residential receivers in residential zones likely to experience an internal noise level of Leq(15 minute) 45 dB(A) or greater between 8pm and 7am (inclusive of a 5 dB penalty if rock breaking or any other annoying activity likely to result in ground-borne noise, or a perceptible level of vibration is planned (including works associated with utility adjustments)) must be offered additional mitigation in accordance with the Sydney Metro City and South West Noise and Vibration Strategy referenced in Condition E32.	Section 4.5.1	Construction managers Project Environment Manager Project Noise and Vibration Consultant	Prior to relevant construction activities	Section 4.5.1
E43	At no time can noise generated by construction exceed the National Standard for exposure to noise in the occupational environment of an eight-hour equivalent continuous A-weighted sound pressure level of LAeq,8h, of 85dB(A) for any employee working at a location near the CSSI.	See Section 4.5.6	Construction managers Project Environment Manager	Construction	Section 4.5.6

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
E44	Notwithstanding Condition E36 construction associated with the CSSI may be undertaken outside the hours specified under those conditions in the following circumstances: (a) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or (b) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm; or (c) where different construction hours are permitted or required under an EPL in force in respect of the construction; or	Section 4.2	Construction Managers Project Environment Manager	Construction	Section 4.2
	(d) construction that causes LAeq(15 minute) noise levels: i) no more than 5 dB(A) above the rating background level at any residence in accordance with the Interim Construction Noise Guideline (DECC, 2009), and ii) no more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (DECC, 2009) at other sensitive land uses, and iii) continuous or impulsive vibration values, measured at the most affected residence are no more than those for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), and iv) intermittent vibration values measured at the most affected residence are no more than those for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006); or (e) where a negotiated agreement has been reached with a substantial majority of sensitive receivers who are within the vicinity of and may be potentially affected by the particular construction, and the noise management levels and/or limits for ground-borne noise and vibration (human comfort) cannot be achieved. All agreements must be in writing and a copy forwarded to the Secretary at least one (1) week before the works commencing; or (f) construction approved through an Out of Hours Work Protocol referred to in Condition E47, provided the relevant council, local residents and other affected stakeholders and sensitive receivers are informed of the timing and duration at least five (5) days and no more than 14 days before the commencement of the works. Note: This condition does not apply where an EPL is in force in respect of the construction. Note: This condition does not apply where an EPL is in force in respect of the construction.				

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
E45	On becoming aware of the need for emergency construction in accordance with Condition E44(b), the Proponent must notify the AA, the ER and the EPA (if an EPL applies) of the need for those activities or work. The Proponent must also use best endeavours to notify all affected sensitive receivers of the likely impact and duration of those works.	Section 4.2, Section 5.1.3	Construction managers Project Environment Manager	If emergency works required	Section 4.2, Section 5.1.3
E46	Notwithstanding Conditions E44 and E48, rock breaking and other particularly annoying activities for station shaft or cut and cover stations is not permitted outside of standard construction hours, except at Central (excluding Central Walk works at 20-28 Chalmers Street, Surry Hills); or (a) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm; or (b) where different construction hours are permitted or required under an EPL in force in respect of the construction; or (c) construction that causes LAeq(15 min) noise levels: i. no more than 5 dB(A) above the rating background level at any residence in accordance with the Interim Construction Noise Guideline (DECC, 2009); and ii. no more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (DECC, 2009) at other sensitive land uses; and iii. continuous or impulsive vibration values, measures at the most affected residence are no more than those for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006); and iv. intermittent vibration values measured at the most affected residence are no more than those for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006).	Section 4.2	Construction managers Project Environment Manager	Construction	Section 4.2

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
E47	An Out of Hours Work Protocol for the assessment, management and approval of work outside of standard construction hours, as defined in Condition E36 of this approval, must be prepared in consultation with the EPA and submitted to the Secretary for approval before construction commences for works not subject to an EPL. The protocol must include: • the identification of low and high risk construction activities; • a risk assessment process in which the AA reviews all proposed out of hours activities and identifies their risk levels; • a process for the endorsement of out of hours activities by the AA and approval by the ER for construction activities deemed to be of: i. low environmental risk; or ii. high risk where all construction works cease by 9pm. All other high risk out of hours construction must be submitted to the Secretary for approval unless otherwise approved through an EPL. The protocol must detail standard assessment, mitigation and notification requirements for high and low risk out of hours works, and detail a standard protocol for referring applications to the Secretary.	Project will use the City & Southwest Out of hour works protocol (sm-1700005396, version 5.2)	Construction managers Project Environment Manager	Prior to commencement of OOHW not subject to the EPL	Section 5.1.3
E48	Notwithstanding Condition E36 of this approval and subject to Condition E47, the following activities may be undertaken 24 hours per day, seven (7) days per week: (a) tunnelling and associated support activities (excluding cut and cover tunnelling, and excluding the installation and decommissioning of the Blues Point acoustic shed except where compliance with Condition E44 is achieved); (b) excavation within an acoustic enclosure (excluding the Blues Point temporary site except where compliance with Condition E44 is achieved); (c) excavation at Central (excluding Central Walk works at 20-28 Chalmers Street, Surry Hills) without an acoustic enclosure; (d) station and tunnel fit out; and (e) haulage and delivery of spoil and materials. E48.1 Notwithstanding E48(a), the Proponent must use best endeavours to schedule annoying activities, including steel hammering and movement of the self-propelled modular trailer, at the Blues Point temporary site between 7am and 8pm.	Section 4.2	Approvals, Environment and Sustainability Manager Construction managers Project Environment Manager	Construction	Section 4.2
E49	All acoustic sheds must be erected as soon as site establishment works at the facilities are completed and before undertaking any works or activities which are required to be conducted within the sheds.	N/A, the Project will use the existing acoustic shed on Hickson Road, see Section 6.3			

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
E50	A Blast Management Strategy must be prepared and include: (a) sequencing and review of trial blasting to inform blasting; (b) regularity of blasting; (c) intensity of blasting; (d) periods of relief; and (e) blasting program.	Blasting is not currently proposed and so has been excluded from this NVMP	N/A	N/A	N/A
E51	The Blast Management Strategy must be endorsed by a suitably qualified and experienced person and reviewed by an independent specialist.	Blasting is not currently proposed and so has been excluded from this NVMP	N/A	N/A	N/A
E52	The Blast Management Strategy must be prepared so that all blasting and associated activities are carried out so as not to generate unacceptable noise and vibration impacts or pose a significant risk to sensitive receivers. The Blast Management Strategy must be prepared in accordance with relevant guidelines including the principles outlined in Hazardous Industry Planning Advisory Paper No 6: Hazard Analysis (Department of Planning, January 2011) and Assessment Guideline: Multi-Level Risk Assessment (Department of Planning and Infrastructure, May 2011) for the handling and storage of hazardous materials and include: (a) details of blasting to be performed, including location, timing, method and justification of the need to blast; (b) identification of all potentially affected noise and vibration sensitive sites including heritage buildings and utilities; (c) establishment of appropriate criteria for blast overpressure and ground vibration levels at each category of noise sensitive site; (d) details of the storage and handling arrangements for explosive materials and the proposed transport of those materials to the construction site; (e) identification of hazardous situations that may arise from the storage and handling of explosives, the blasting process and recovery of the blast site after detonation of the explosives; (f) determination of potential noise and vibration and risk impacts from blasting and appropriate best management practices; and (g) community consultation procedures.	Blasting is not currently proposed and so has been excluded from this NVMP	N/A	N/A	N/A
E53	The Blast Management Strategy must be submitted to the Secretary one (1) month before blasting commences, or as agreed by the Secretary. The Blast Management Strategy as submitted to the Secretary, must be implemented for all blasting activities.	Blasting is not currently proposed and so has been excluded from this NVMP	N/A	N/A	N/A

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
E54	Blasting associated with the CSSI must not exceed the following criteria, measured at the most affected residence or other sensitive receiver as specified below: (a) airblast overpressure (dB(Lin Peak)) 125 dBL; and (b) vibration (PPV): i. 25 mm/s generally; or ii. 7.5mm/s for heritage structures except where detailed investigation of the construction of the building determines that increasing the screening criterion to 25 mm/s is acceptable. The investigation must be undertaken by a suitably qualified structural engineer with experience assessing heritage structures that is approved by the Secretary. Any decision to adopt the higher vibration criterion must be supported by evidence to demonstrate the higher criterion is appropriate.	Blasting is not currently proposed and so has been excluded from this NVMP	N/A	N/A	N/A
E55	Blasting must be limited to a single detonation in any one day, and a maximum of six per week, at each station location, or any other frequency agreed by the Secretary. Note: for the purpose of this Condition, a single detonation may involve a number of individual blasts fired in quick succession in a discrete area.	Blasting is not currently proposed and so has been excluded from this NVMP	N/A	N/A	N/A
E56	Blasting associated with the project must be undertaken at a time to have the least impact on the nearby sensitive receivers determined in consultation with those receivers. All sensitive receivers affected by any blast must be advised fortnightly of the proposed blasting schedule. The Secretary must also be advised of the advance blasting schedule for any location.	Blasting is not currently proposed and so has been excluded from this NVMP	N/A	N/A	N/A
E58	The CSSI must be designed and constructed with the objective of minimising impacts to, and interference with, third party property and infrastructure, and that such infrastructure and property is protected during construction	This Plan	Construction managers Project Environment Manager	During design and construction	This Plan
E59	Before commencement of construction, all property owners of buildings identified as being at risk of damage must be offered a building condition survey. Where an offer is accepted a structural engineer must undertake the survey. The results of the surveys must be documented in a Building Condition Survey Report for each building surveyed. Copies of Building Condition Survey Reports must be provided to the owners of the buildings surveyed, and if agreed by the owner, the Relevant Council within three (3) weeks of completing the Survey Report and no later than one (1) month before the commencement of construction.	See Building Condition Survey Report (to be prepared if any properties are at risk of damage).	Construction managers Project Environment Manager Community communication team	Pre-construction	Section 1.3.2 in APPENDIX E

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
E60	Within three (3) months of the completion of construction, all property owners of buildings for which a building condition survey was carried out in accordance with Condition E59 must be offered a second building condition survey. Where an offer is accepted, building condition surveys must be undertaken by a structural engineer. The results of the surveys must be documented in a Building Condition Survey Report for each building surveyed. Copies of Building Condition Survey Reports must be provided to the owners of the buildings surveyed within one (1) month of the survey being completed.	See Building Condition Survey Report (to be prepared if any properties are at risk of damage).	Construction managers Project Environment Manager Community communication team	Post construction	Section 1.3.2 in APPENDIX E

Table 0-2: Construction Environmental Management Framework

No.	Requirement	Proposed actions	Responsible Key Contributor	Timing	Relevant NVMP section
9.1 a	The following noise and vibration management objectives will apply to construction: i) Minimise unreasonable noise and vibration impacts on residents and businesses; ii) Avoid structural damage to buildings or heritage items as a result of construction vibration; iii) Undertake active community consultation; and iv) Maintain positive, cooperative relationships with schools, childcare centres, local residents and building owners.	See Section 1.3, Section 4, Section 5.3, Section 6	Project Environment Manager Project Noise and Vibration Consultant	Construction	This plan Section 1.3
9.2 a	Principal Contractors will develop and implement a Construction Noise and Vibration Management Plan for their scope of works consistent with the Interim Construction Noise Guidelines (Department of Environment and Climate Change, 2009). The Construction Noise and Vibration Management Plan will include as a minimum:	Development of this plan	Project Environment Manager Project Noise and Vibration Consultant	Construction	This plan
(i)	Identification of work areas, site compounds and access points;				APPENDIX C
(ii)	Identification of sensitive receivers and relevant construction noise and vibration goals;				Section 3 and Appendix B
(iii)	Be consistent with, and include the requirements of the noise and vibration mitigation measures as detailed in the environmental approval documentation and the Sydney Metro Construction Noise and Vibration Strategy (CNVS);				Section 2
(iv)	Details of construction activities and an indicative schedule for construction works, including the identification of key noise and/or vibration generating construction activities (based on representative construction scenarios) that have the potential to generate noise or vibration impacts on surrounding sensitive receivers, in particular residential areas;				Section 1.2, APPENDIX C

No.	Requirement	Proposed actions	Responsible Key Contributor	Timing	Relevant NVMP section
(v)	Identification of feasible and reasonable procedures and mitigation measures to ensure relevant vibrations and blasting criteria are achieved, including a suitable blast program;				Section 6.2 (Blasting is not currently proposed and so has been excluded from this NVMP)
(vi)	Community consultation requirements and Community notification provisions specifically in relation to blasting;				Section 5.3 (Blasting is not currently proposed and so has been excluded from this NVMP)
(vii)	The requirements of any applicable EPL conditions;				No EPL required
(viii)	Additional requirements in relation to activities undertaken 24 hours of the day, 7 days per week;				Section 5.1.3
(ix)	Pre-construction compliance requirements and hold points;				Section 2
(x)	The responsibilities of key project personnel with respect to the implementation of the plan;				Table 0-1
(xi)	Noise monitoring requirements;				APPENDIX E
(xii)	Compliance record generation and management; and				Section 7
(xiii)	An Out of Hours Works Protocol applicable to all construction methods and sites.				Section 5.1.3
9.2 b	Detailed Construction Noise and Vibration Impact Statements will be prepared for noise-intensive construction sites and or activities, to ensure the adequacy of the noise and vibration mitigation measures. Specifically, Construction Noise and Vibration Impact Statements will be prepared for EPL variation applications and works proposed to be undertaken outside of standard construction hours.	CNVISs will be prepared progressively for all worksites, under this Plan. EPL not required.	Project Environment Manager Project Noise and Vibration Consultant	Prior to the commencement of relevant construction activities	Section 5.1.2

No.	Requirement	Proposed actions	Responsible Key Contributor	Timing	Relevant NVMP section
9.2 c	Noise and vibration monitoring would be undertaken for construction as specified in the CNVIS.	This NVMP outlines the monitoring expectations for this project. In addition, the Sydney Metro CNVS outlines monitoring requirements.	Project Environment Manager Project Noise and Vibration Consultant	As specified in CNVIS and APPENDIX E	APPENDIX E
9.2 d	The following compliance records would be kept by Principal Contractors: i) Records of noise and vibration monitoring results against appropriate NMLs and vibration criteria; and ii) Records of community enquiries and complaints, and the Contractor's response.	Records of noise monitoring will be kept as outlined in Section 7.4	Project Environment Manager Project Noise and Vibration Consultant	Construction	Section 7.4
9.3 a	All feasible and reasonable mitigation measures would be implemented in accordance with the CNVS. Examples of noise and vibration mitigation measures include: i) Construction hours will be in accordance with the working hours specified in Section 5.1; ii) Hoarding and enclosures will be implemented where required to minimise airborne noise impacts; and iii) The layout of construction sites will aim to minimise airborne noise impacts to surrounding receivers.	The CNVIS will form the key to manage noise and vibration impact. All reasonable and feasible measures detailed in the CNVIS will be adhered to by the relevant construction manager. See Section 5.1.2	Construction Manager Project Environment Manager Environment Co-ordinators Project Noise and Vibration Consultant	Construction	Section 5.1.2

1 Introduction

1.1 Context

This Noise and Vibration Management Sub Plan (NVMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for the Sydney Metro Barangaroo Metro Station (the Project).

This Plan has been prepared to address the relevant requirements of Sydney Metro's Construction Environmental Management Framework (Appendix B of the *Submissions and Preferred Infrastructure Report*), the Revised Environmental Mitigation Measures (REMMs), the Revised Environmental Performance Outcomes, applicable legislation, the SMCSWCS Environmental Impact Statement (EIS) (Sydney Metro, 2016) and contractual requirements and the Project Planning Approval and approved modifications.

1.2 Project background and description of works

The Minister approved the Stage 2 (Chatswood to Sydenham) Metro application lodged by Transport for NSW (TfNSW) as a Critical State Significant Infrastructure (CSSI) project (reference SSI 7400) (the CSSI Consent) on 9 January 2017. The construction of Barangaroo station forms part of the Sydney City Metro & Southwest (Chatswood to Sydenham) (SMCSWCS) project. This project falls under the construction and operation of the section between Chatswood and the Sydenham dive site known as "CSSI_7400". Approval was granted on 9 January 2017 followed by eight approved modifications:

MOD 1 – Victoria Cross and Artarmon Substation (determined 18 October 2017)

MOD 4 – Sydenham Station and Metro Facility South (determined 13 December 2017)

MOD 2 – Central Walk (determined 21 December 2017)

MOD 3 – Martin Place Metro Station (determined 22 March 2018)

MOD 5 – Blues Point Acoustic Shed (determined 2 November 2018)

MOD 6 – Administrative Changes (determined 21 February 2019)

MOD 7 – Administrative Changes (determined 24 June 2020)

MOD 8 – Blues Point Access Site (determined 25 November 2020)

MOD 9 – Extension to standard construction hours (determined 30 June 2022)

BESIX Watpac have been contracted by Sydney Metro for the construction of the Sydney Metro Barangaroo station, including station fit-out, building a station entrance next to Nawi Cove and reinstatement of Hickson Road. A preliminary construction program for the project has been developed by BESIX Watpac and is presented in Table 1-1 and Figure 1.1. The two major stages for the Project are:

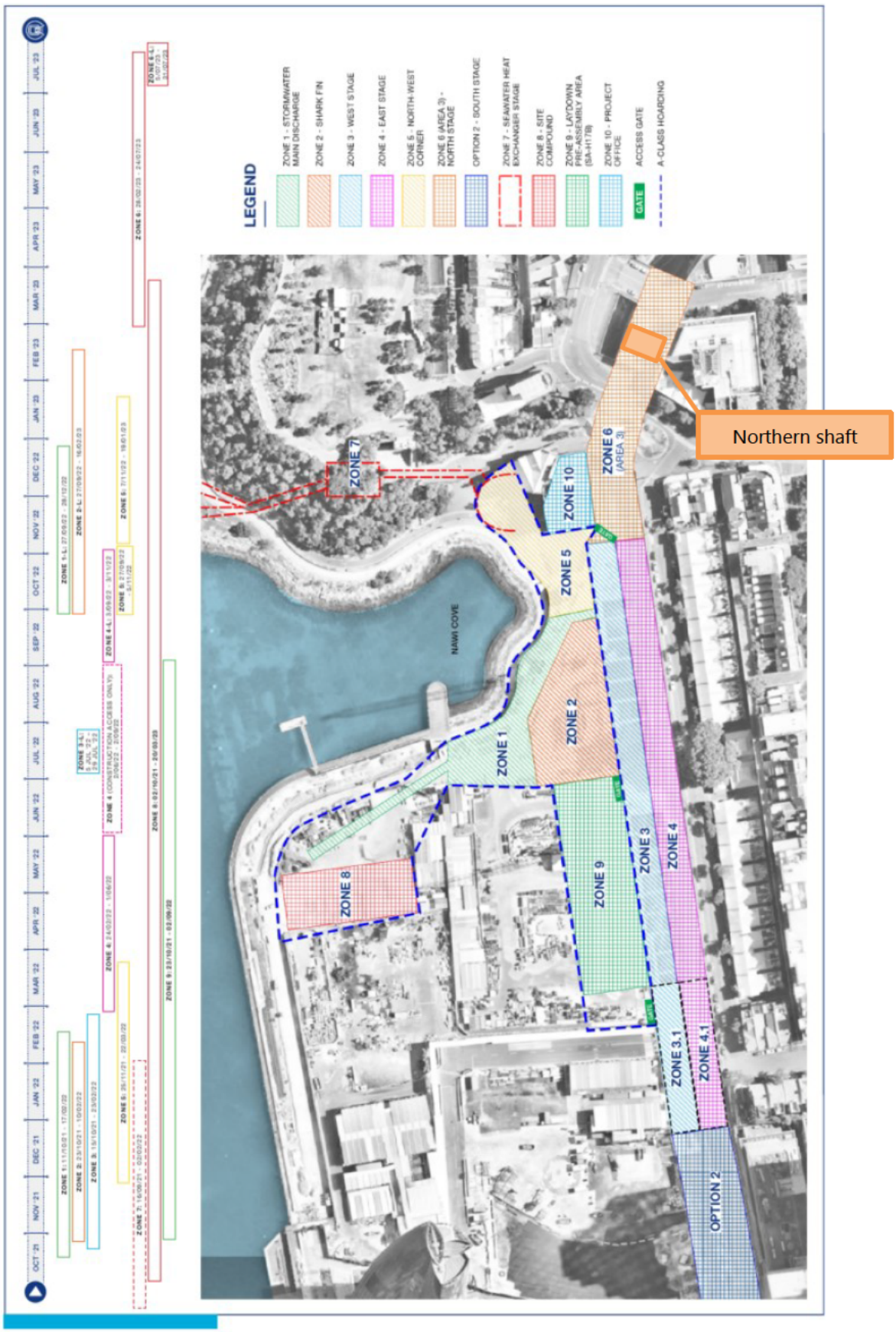
1. Station construction works;

2. Surface works including all utility and road reinstatement works.

Table 1-1: Indicative construction program

Stage	Work zone (see Figure 1.1)	Activity	Commencement	Completion
Station construction works	Station box (underground), Northern shaft shed and Zone 9 for deliveries	Basements Structure/ Core Structure/Fitout	September 2021	July 2023
Surface works	All zones	Site preparation and establishment (mobilisation, fencing, etc)	August 2021	October 2021
	Zone 3, Zone 4	Demolition works (girders. etc)	October 2021	November 2021
	Zone 1, Zone 2, Zone 3.1, Zone 4.1, Zone 5, Zone 6, Zone 7	Utility works (stormwaters and other services)	November 2021	July 2023
	Zone 3, Zone 4, zone 6	Road upgrading works	November 2021	July 2023
	Northern shaft	Northern shaft backfill	February 2023	March 2023
	Northern shaft	Northern shaft shed demolition and removal	March 2023	April 2023

Figure 1.1: Project work zones and indicative construction program



1.3 Purpose and objectives of this Plan

The purpose of this Plan is to describe how the BESIX Watpac proposes to manage potential noise and vibration impacts during construction of the Project. It provides the framework and mechanisms for the implementation of feasible and reasonable mitigation and management of potential noise and vibration impacts.

The objectives for this noise and vibration management plan are to ensure:

- Compliance with applicable conditions in CSSI 7400 and approved modifications 1-9.
- Noise levels would be minimised with the aim of achieving the noise management levels where feasible and reasonable;
- The project would avoid any structural damage to buildings or heritage items as results of construction vibration;
- Construction noise and vibration impacts are mitigated and managed in accordance with the Sydney Metro City and Southwest Construction Noise and Vibration Strategy (CNVS);
- Maintain a good relationship with the potential noise affected community (e.g. schools, childcare centres, local residents and building owners) through an effective, transparent and efficient communication strategy
- Affected sensitive receivers are notified of upcoming works and any out-of-hours works;
- Reasonable and feasible mitigation measures are implemented to minimise and manage noise and vibration impacts on surrounding residents, commercial and other sensitive receivers;
- Any complaints are addressed in a timely and efficient manner.

1.4 Interactions with other management plans

This NVMP is a sub-plan of the Construction Environmental Management Plan (CEMP). The environmental management system overview is described in the CEMP. Used together, the CEMP and the NVMP form management guides that clearly identify required environmental management actions for reference by BESIX Watpac personnel and contractors.

The NVMP has the following relationships with other management plans and documents:

- Construction Noise & Vibration Impact Statements (CNVIS) detail predicted noise and vibration impacts and site-specific management and mitigation measures for the Barangaroo Station works
- Site Environmental Control Maps identify adjacent residential and other sensitive receivers and Noise Catchment Areas and will be progressively updated to incorporate physical noise and vibration management measures identified in CNVIS

- Construction Heritage Management Plan (HMP) developed for the Project to provide details of heritage structures and items in the areas surrounding the Project. The HMP is a sub plan of the CEMP.
- Community Communications Strategy and Business Management Plan details the procedures and processes for community notification, consultation, and complaints management.

2 Environmental requirements

2.1 Relevant legislation and guidelines

2.1.1 Legislation

This NVMP is prepared in accordance with the:

- *Environmental Planning and Assessment Act 1979*
- *Protection of the Environment Operations Act 1997* (POEO Act)
- *Environmental Planning and Assessment Amendment (Part 3A Repeal) Act 2011*
- *State Environmental Planning Policy (State and Regional Development) 2011.*

Refer to the CEMP for further details.

2.1.2 Guidelines

The main guidelines and standards relating to the management of construction noise and vibration from this project include:

- NSW Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change 2009
- NSW Road Noise Policy (RNP), Department of Environment, Climate Change and Water 2011
- NSW Assessing Vibration – a technical guideline (AVTG), Department of Environment and Conservation 2006
- Australian Standard AS/NZS 2107:2016 *Acoustics - Recommended design sound levels and reverberation times for building interiors*
- Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration
- Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives
- Australian Standard AS2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites
- British Standard BS 6472-2008, 'Evaluation of human exposure to vibration in buildings (1-80Hz);
- British Standard 7385: Part 2-1993 'Evaluation and measurement of vibration in buildings
- German Standard DIN4150-2016 Structural vibration Part 3: Effects of vibration on Structures
- Environmental Noise Management Manual (ENMM), Roads and Traffic Authority 2001.

2.1.3 Sydney Metro Construction Noise and Vibration Strategy

Sydney Metro City & Southwest Construction Noise and Vibration Strategy (Report No. 610.14213-R3, 2016) provides practical guidance on how to minimise, to the fullest extent possible, the impacts of noise and vibration on the community. They outline all feasible and reasonable mitigation measures that should be considered by the Project to reduce airborne noise, ground-borne noise and vibration during the construction of infrastructure projects. The above reference strategies will be adopted to guide management of construction noise and vibration impacts.

The Sydney Metro City & Southwest Construction Noise and Vibration Strategy (Addendum A v2) has been updated by Sydney Metro to satisfy Condition of Approval E32. The Addendum provides internal noise criteria for sensitive receivers, consistent with the requirements of Conditions of Approval E38, E41, E42 and E43. Where internal noise criteria are applicable, additional steps are required when preparing CNVISs to predict internal noise levels based on the facade transmission loss of affected receivers and applying appropriate levels of mitigation, consultation and respite (refer Sections 4.5.1 and 6.3).

2.2 Environmental performance outcomes

CoA C4(a) requires that the environmental performance outcomes identified in the EIS as amended by the documents listed in CoA A1 will be achieved.

As a CEMP sub-plan, this NVMP describes how noise and vibration will be managed and mitigated during construction of the Project. To achieve environmental performance outcomes, this Plan has been prepared to address the relevant requirements of Sydney Metro's Construction Environmental Management Framework (Appendix B of the Submissions and Preferred Infrastructure Report), the Revised Environmental Mitigation Measures (REMMs), the Revised Environmental Performance Outcomes, applicable legislation, the SMCSWCS Environmental Impact Statement (EIS) (Sydney Metro, 2016),contractual requirements and the Project Planning Approval. In the event of an inconsistency between the EIS as amended by the description in Chapters 2, 3 and 9 of the PIR, or any other document required under the CSSI 7400 conditions of approval and a term of the approval, the term of the approval prevails to the extent of the inconsistency.

2.3 Environmental Representative and Acoustic Advisor

The Project Planning Approval requires Sydney Metro to appoint an independent Environmental Representative (ER) for the duration of the Project and an independent Acoustic Advisor (AA) to oversee construction noise and vibration planning, modelling, management and reporting. The ER and AA have been appointed by Sydney Metro. The role of the ER and the AA is set out in the Construction Environmental Management Plan (CEMP) and in:

- Project Planning Approval Conditions A22 to A24, in relation to the ER
- Project Planning Approval Conditions A25 to A27, in relation to the AA.

The principal role of the ER and the AA with regard to noise and vibration from the SMCSWCS works is as follows:

- Receive and respond to communication from the Secretary of NSW Government Department of Planning and Environment (DPIE) in relation to the performance of SMCSWCS Works in relation to noise and vibration;
- Consider and inform the Secretary on matters specified in the terms of this approval relating to noise and vibration;
- Consider and recommend, to the Proponent, improvements that may be made to work practices to avoid or minimise adverse noise and vibration impacts;
- Review all noise and vibration documents required to be prepared under the terms of this approval and, should they be consistent with the terms of this approval, endorse them before submission to the Secretary (if required to be submitted to the Secretary) or before implementation (if not required to be submitted to the Secretary);
- Regularly monitor the implementation of all noise and vibration documents required to be prepared under the terms of this approval to ensure implementation is in accordance with what is stated in the document and the terms of this approval;
- Notify the Secretary of noise and vibration incidents in accordance with Condition A41 of this approval;
- In conjunction with the ER, the AA must:
    - Consider requests for out of hours construction activities and determine whether to endorse the proposed activities in accordance with Condition E47
    - As may be requested by the Secretary or Complaints Commissioner, help plan, attend or undertake audits of noise and vibration management of the SMCSWCS Works including briefings, and site visits;
    - If conflict arises between the Proponent and the community in relation to the noise and vibration performance during construction of the Project, follow the procedure in the Community Communication Strategy approved under Condition B3 of the CSSI Consent to attempt to resolve the conflict, and if it cannot be resolved, notify the Secretary;
    - Consider relevant minor amendments made to this CEMP, relevant sub-plans and noise and vibration monitoring programs that require updating or are of an administrative nature, and are consistent with the terms of this approval and the management plans and monitoring programs approved by the Secretary and, if satisfied such amendment is necessary, endorse the amendment. This does not include any modifications to the terms of this approval;
    - Prepare and submit to the Secretary and other relevant regulatory agencies, for information, a monthly Noise and Vibration Report detailing the AAs actions and decisions on matters for which the AA was responsible in the preceding month (or other timeframe agreed with

the Secretary). The Noise and Vibration Report must be submitted within seven (7) days following the end of each month for the duration of construction of the Project, or as otherwise agreed with the Secretary of DPIE.

2.4 Collaboration with Sydney Metro, ER and AA

The Environment Representative (ER) and the Acoustic Advisor (AA) have roles that include overseeing noise and vibration management. These roles are set out in the Construction Environmental Management Plan (CEMP).

BESIX WATPAC will provide Sydney Metro, the ER and the AA with:

- Noise and vibration documents for review
- Access to monitoring activities and data

BESIX WATPAC will work collaboratively with Sydney Metro, the ER and the AA to ensure all reasonable and feasible noise mitigation is implemented in accordance with the Conditions of Approval (CoA), the Revised Mitigation Measures and Performance Environmental Outcomes and this NVMP.

AA and ER endorsement of the NVMP is required prior to submission to DPIE for approval no later than one(1) month before the commencement of construction. Evidence of endorsement is presented in APPENDIX G.

Construction will not commence until this Plan has been approved by the Secretary. The NVMP, as approved by the Secretary, including any minor amendments approved by the AA will be implemented for the duration of construction. Where the CSSI is being staged, construction of that stage is not to commence until the relevant CEMP and sub-plans have been approved by the Secretary.

2.5 Consultation

This Plan is to be provided[1] to City of Sydney Council in accordance with CoA C3 (a), C5.

The Construction monitoring plan[2] (APPENDIX E of this Plan) is to be provided to EPA and City of Sydney Council in accordance with CoA C9(a).

A summary of the consultation undertaken in relation this Plan is included in APPENDIX F.

[1] Paragraph to be updated following agency consultation.

[2] Paragraph to be updated following agency consultation.

3 Existing noise environment and noise/vibration sensitive receivers

3.1 Surrounding receivers and land use

The location of the project site, and the nearby surrounding land use is presented in Appendix B.

A detailed land-use survey has been completed and will be further refined (if required) as part of each CNVIS. The survey brought the NSW cadastral database, a building basement survey conducted by Sydney Metro and identified land use details into a Geographic Information System (GIS). The GIS allows potentially critical areas that are sensitive to construction noise, vibration and ground-borne noise impacts to be easily identified and updated as land uses change during the project timeline. The data can be readily included into the noise and vibration modelling, to allow effective management of noise and vibration impacts on identified sensitive receivers.

3.2 Existing acoustic environment and residential receivers

The primary contributor to the ambient noise environment in the study area is traffic noise from the existing road network and urban hum (e.g. commercial building mechanical plant and equipment). SLR conducted long-term noise monitoring on behalf of TfNSW to quantify ambient noise levels for the EIS of the SMCSWCS project. Section 3.5 of the EIS Noise and Vibration Technical Paper provides noise data results.

Table 3-1 below summarises the NCAs for the Project and the representative Rating Background Levels (RBLs). These are used to establish construction noise management levels (NMLs) at residential receivers in accordance with the NSW ICNG.

Table 3-1: Nearest Noise and Vibration Sensitive Residential Receivers and Rating Background Noise Levels (RBLs)

NCA	EIS monitoring ID[1]	Address	Rating Background noise Levels, dBA			Ambient noise levels (L_{Aeq})		
			Day	Evening	Night	Day	Evening	Night
BN_01	EIA B.12	26A High Street, Millers Point (Barangaroo)	50	45	40	61	64	51
BN_02	EIA B.12	26A High Street, Millers Point (Barangaroo)	50	45	40	61	64	51
BN_03	EIA B.12	26A High Street, Millers Point (Barangaroo)	50	45	40	61	64	51
BN_04	EIS B.13	2-60 Cumberland Street, The Rocks	62	62	52	66	65	63
BN_05	EIS B.28	56A Pirrama Road, Pyrmont (Wharf 8)	51	46	41	56	52	47
BN_06	EIS B.29	Goat Island	49	49	41	55	55	49

Notes: 1) Based upon EIS and Submissions and Preferred Infrastructure Reports for the Sydney City Metro & Southwest (Chatswood to Sydenham) (SMCSWCS) project.

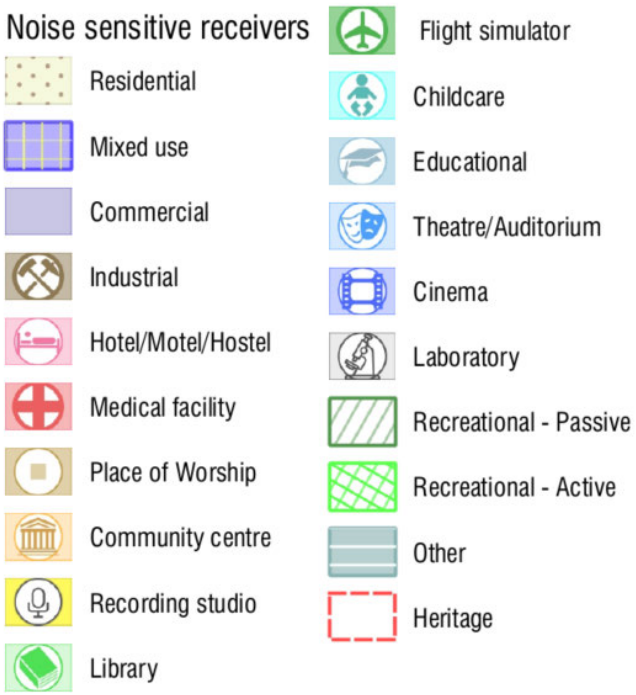
3.2.1 Noise and vibration sensitive receivers

The sensitivity of occupants to noise and vibration varies according to the nature of the occupancy and the activities performed within the affected premises. For example, recording studios are more sensitive to vibration and ground-borne noise than residential premises, which in turn are more sensitive than typical commercial premises.

To assess and manage construction noise impacts, the areas around the worksite (up to approximately 250 m from the worksite) have been divided into Noise Catchment Areas (NCAs). These are based on each area's similar acoustic environment before construction works start. The NCAs, based upon the SMCSWCS EIS, have been reviewed and modified, based on more detailed design information and site-specific characteristics.

The land use information was collated from a combination of site inspections; review of street-level imagery and aerial photography; and review of publicly available land and property information. All cadastral lots within the identified NCAs were classified into one of the following receiver categories:

Figure 3.1: Land use categories identified in Land Use Survey GIS and Appendix B



The comprehensive updated land-use survey in each project NCA are included in Appendix B.

3.2.2 Heritage receivers

Renzo Tonin and Associates, in consultation with BESIX Watpac, have identified potentially vibration sensitive heritage properties in each NCA near the construction site. Heritage properties (see list provided in Table 3-2) have been included in the land use GIS database, and subsequently incorporated into the vibration models to ensure vibration impacts are managed to minimise the risk of property damage.

APPENDIX B identifies heritage receivers in close proximity to the worksite.

Table 3-2: Identified heritage receivers in proximity to the project

Site	Item	Address	Significance
Barangaroo	Terrace duplex group including interiors	2–36 High Street	Item 883 City of Sydney LEP ; SHR Item 00920
	Terrace duplex group including interiors	3, 5, 7, 9 High Street	Item 884 City of Sydney LEP ; SHR Item 00918
	Lance Kindergarten including buildings and their interiors, early remnant fencing and grounds	37 High Street	Item 886 City of Sydney LEP
	Terrace duplex group including interiors	38–72 High Street	Item 888 City of Sydney LEP ; SHR Item 00919
	Terrace duplex group including interiors	74–80 High Street	Item 889 City of Sydney LEP ; SHR Item 00868
	Palisade Hotel including interior and archaeological site	35-37 Bettington Street	Item 874 City of Sydney LEP ; Archaeological site A1191 ; SHR Item 00510
	Bridges over Hickson Road	Argyle Place (and Munn and Windmill Streets)	Item 869 City of Sydney LEP
	Retaining Wall, Palisade Fence and Steps	High Street	Item 881 City of Sydney LEP/Item 882 City of Sydney LEP
	Hickson Steps	16-28 Windmill St	Maritime NSW S170 Register Item 4920007
	Dalgety Terrace	7, 9, 11, 13 Dalgety Terrace	SHR00867
	Terraces	27a, 29a, 31a, 33, 35a Dalgety Terrace	SHR00923
	Terraces	15, 17, 19, 21, 23, 25 Dalgety Terrace	SHR00867
	Dalgety's Bond Stores Group of Buildings	6-20 Munn Street	Maritime NSW S170 Register; SHR Item 00526
	Shops	10, 10a, 12, 12a Argyle Place	SHR00891
	Lord Nelson Hotel	19 Kent Street	SHR00509

4 Construction noise and vibration objectives

4.1 Summary of construction noise and vibration objectives

The policies and standards outlined in Table 4-1 have been used to establish construction noise and vibration management levels for the Project.

Table 4-1: Construction noise and vibration levels

Environment impact	Relevant policy/ standard used to establish noise and vibration management level
Airborne noise	ICNG Conditions of Approval
Sleep disturbance and maximum noise events	Road traffic noise - NSW Road Noise Policy (RNP) and the RMS Environmental Noise Management Manual (ENMM) Practice Note 3. Construction noise – NSW Environmental Criteria for Road Traffic Noise
Ground-borne noise	NSW Interim Construction Noise Guideline (ICNG) Conditions of Approval Australian Standard AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors
Construction-related road traffic noise	No specific guidelines, but guidance taken from the NSW Interim Construction Noise Guideline (ICNG) and the NSW Road Noise Policy (RNP).
Vibration (disturbance to building occupants)	NSW DECC's Assessing vibration; a technical guideline, published in February 2006, in line with CoA D16(b), which incorporates: British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)
Vibration (structural damage to buildings)	British Standard 7385:1993 Evaluation and measurement of vibration in buildings – Part 2 Guide to damage from ground-borne vibration
Vibration (structural damage to buried services)	German Standard DIN 4150:2016 – Part 3 Structural vibration in buildings – Effects on structures
Vibration (sensitive scientific and medical equipment)	ASHRAE Applications Handbook (SI) 2003, Chapter 47 Sound and Vibration Control Gordon GC 28 September 1999 Generic Vibration Criteria for Vibration Sensitive Equipment Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration
Blast noise and vibration*	Australian Standard AS 2187.2-2006 Explosives – Storage and use – Part 2 Use of explosives British Standard 7385: Part 2 Evaluation and measurement of vibration in buildings

*No blasting will be undertaken as part of the Barangaroo station project described in this management plan.

4.2 Construction hours

The construction hours for the Project are defined by the CSSI Project Planning Approval. The standard construction hours of work are defined in Project Planning Approval Condition E36 and summarised in Table 4-3. Works may be carried out outside standard hours under Project Planning Approval Conditions E44, E46, E47 and E48.

The standard hours and out-of-hours work (OOHW) periods are depicted in Table 4-2. The Sydney Metro CNVS defines the construction hours in Section 5.2, then further categorises the OOHW into two time periods, for the purpose of managing impacts and identifying additional mitigation measures. These two OOHW periods are both named 'OOHW' in the Sydney Metro CNVS. Guidance has been taken from the TfNSW Construction Noise and Vibration Strategy, which defines the OOHW periods as OOHW Period 1 and OOHW Period 2. The naming of the OOHW periods assists when reviewing, assessing and managing impacts from OOHW.

Table 4-2: Assessment periods

Day/ Time	12am – 1am	1am – 2am	2am – 3am	3am – 4am	4am – 5am	5am – 6am	6am – 7am	7am – 8am	8am – 9am	9am – 10am	10am – 11am	11am – 12pm	12pm – 1pm	1pm – 2pm	2pm – 3pm	3pm – 4pm	4pm – 5pm	5pm – 6pm	6pm – 7pm	7pm – 8pm	8pm – 9pm	9pm – 10pm	10pm – 11pm	11pm – 12am
Monday to Friday										Standard construction Hours								OOHW Period 1						
Saturday																								
Sunday or Public Holiday		OOHW Period 2									OOHW Period 1								OOHW Period 2					

Table 4-3 summarises the information that the CoA require regarding construction working hours for the Project. Construction would be undertaken during the approved construction hours wherever possible.

Table 4-3: Summary of construction working hours for the Project

CoA	Description	Working hours applicable		
		Monday to Friday	Saturday	Sunday / Public Holiday
E36	**Standard construction hours**	7:00am to 6:00pm	8:00am to 6:00pm	No work[1]
E37/E38	**Respite for receivers** The Proponent must consult with all receivers likely to experience internal noise levels greater than LAeq,15min 60dB(A) inclusive of a 5 dB penalty (rock breaking or other annoying activity) with the objective of determining appropriate hours of respite so that construction noise (including ground-borne noise), does not exceed internal noise levels of: (a) $L_{Aeq,15min}$ 60 dB(A) inclusive of a 5 dB penalty if rock breaking or any other annoying activity likely to result in ground-borne noise or a perceptible level of vibration is planned between 7am – 8pm for more than 50 percent of the time; and (b) $L_{Aeq,15min}$ 55 dB(A) inclusive of a 5 dB penalty if rock breaking or any other annoying activity likely to result in ground-borne noise or a perceptible level of vibration is planned between 7am – 8pm for more than 25 percent of the time, unless an agreement is reached with those receivers.	7:00am to 8:00pm	7:00am to 8:00pm	7:00am to 8:00pm
E44	**Variation to Standard Construction Hours** Notwithstanding Condition E36 construction associated with the CSSI may be undertaken outside the hours specified under those conditions in the following circumstances: (a) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or (b) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm; or (c) where different construction hours are permitted or required under an EPL in force in respect of the construction; or (d) construction that causes LAeq(15 minute) noise levels: (i) no more than 5 dB(A) above the rating background level at any residence in accordance with the Interim Construction Noise Guideline (DECC, 2009), and (ii) no more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (DECC, 2009) at other sensitive land uses, and (iii) continuous or impulsive vibration values, measured at the most affected residence are no more than those for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), and (iv) intermittent vibration values measured at the most affected residence are no more than those for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006); or	6:00 pm to 7:00 am	6:00 pm to 8:00 am	8:00am to 7:00am

CoA	Description	Working hours applicable		
		Monday to Friday	Saturday	Sunday / Public Holiday
	(e) where a negotiated agreement has been reached with a substantial majority of sensitive receivers who are within the vicinity of and may be potentially affected by the particular construction, and the noise management levels and/or limits for ground-borne noise and vibration (human comfort) cannot be achieved. All agreements must be in writing and a copy forwarded to the Secretary at least one (1) week before the works commencing; or (f) construction approved through an Out of Hours Work Protocol referred to in Condition E47, provided the relevant council, local residents and other affected stakeholders and sensitive receivers are informed of the timing and duration at least five (5) days and no more than 14 days before the commencement of the works.			
E46	**Out of Hour rock breaking and other particularly annoying activities** Notwithstanding Conditions E44 and E48, rock breaking and other particularly annoying activities for station shaft or cut and cover stations is not permitted outside of standard construction hours, except at Central (excluding Central Walk works at 20-28 Chalmers Street, Surry Hills); or (a) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm; or (b) where different construction hours are permitted or required under an EPL in force in respect of the construction or approved through an Out of Hours Work Protocol developed in accordance with Condition E47; or (c) construction that causes LAeq(15 min) noise levels: (d) no more than 5 dB(A) above the rating background level at any residence in accordance with the Interim Construction Noise Guideline (DECC, 2009); and (e) no more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (DECC, 2009) at other sensitive land uses; and (f) continuous or impulsive vibration values, measures at the most affected residence are no more than those for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006); and (g) intermittent vibration values measured at the most affected residence are no more than those for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006).	6:00 pm to 7:00 am	6:00 pm to 8:00 am	8:00am to 7:00am
E47	**Out of Hour Work Protocol** An Out of Hours Work Protocol for the assessment, management and approval of work outside of standard construction hours, as defined in Condition E36 of this approval, must be prepared in consultation with the EPA and submitted to the Secretary for approval before construction commences for works not subject to an EPL.	6:00 pm to 7:00 am	6:00 pm to 8:00 am	8:00am to 7:00am

CoA	Description	Working hours applicable		
		Monday to Friday	Saturday	Sunday / Public Holiday
E48	**24 Hour Construction** Notwithstanding Condition E36 of this approval and subject to Condition E47, the following activities may be undertaken 24 hours per day, seven (7) days per week: (a) tunnelling and associated support activities (excluding cut and cover tunnelling, and excluding the installation and decommissioning of the Blues Point acoustic shed except where compliance with Condition E44 is achieved); (b) excavation within an acoustic enclosure (excluding the Blues Point temporary site except where compliance with Condition E44 is achieved); (c) excavation at Central (excluding Central Walk works at 20-28 Chalmers Street, Surry Hills) without an acoustic enclosure; (d) station and tunnel fit out; and (e) haulage and delivery of spoil and materials.	All	All	All

Notes 1) No work unless permitted and approved under the Out of Hours Work Protocol

4.3 COVID-19 extended construction hours

The Environmental Planning and Assessment (COVID-19 Development – Infrastructure Construction Work Days) Order 2020 commenced on 9 April 2020 and will continue until 31 March 2022. The order permits standard construction hours on this project to be extended as follows:

- Saturday from 7am to 8am and from 1pm to 6pm (no high noise work permitted)
- Sundays from 7am to 6pm (no high noise work permitted)
- Public holidays from 7am to 6pm (no high noise work permitted).

High noise work means activities such as rock breaking, rock hammering, sheet piling, pile driving or similar noisy activities, unless an existing consent or approval already allows these works to occur on any of the extended days.

4.4 Out of hours works

4.4.1 Utility and road works

Most utility and road area works will be undertaken during standard construction hours. However, when works are proposed to be carried out along Hickson Road, Road Occupancy Licence (ROL) may not be granted during the day due to the importance of the road to the functionality of the road network. This may preclude or restrict access to the work area before 10 pm, so that construction works would have to be carried out during the 'night' period, or OOHW Period 2.

The existing background noise levels around the project site are generally controlled by ambient urban noise since the Project site is an inner-city site. The noise logging results indicate that background noise levels remain steady or marginally decrease in the early night between 10 pm to 12 am, and decrease to minimum levels around 2 am to 4 am.

As such, it would be unduly stringent to apply stricter 'night' criteria during the 10 pm to 12 am period. Accordingly, a shoulder period has been derived in line with guidance provided in the NSW Industrial Noise Policy (INP) (Section 3.3) so that the assessment NMLs are consistent with the existing background noise levels during this assessment period. As such, an additional OOHW Period, OOHW Shoulder has been identified for assessing and managing OOHW at residential receivers and outlined in APPENDIX B.

4.4.2 Station works

In accordance with CoA E48(d), underground station fit out work may be undertaken 24 hours per day, seven days per week. These works will be completed underground inside the station box which would be enclosed with a concrete roof.

4.4.3 Material delivery to northern shed for station and tunnel fit out

In accordance with CoA E48(d)(e), delivery of materials for station and tunnel fit out through the northern shed may be undertaken 24 hours per day, seven days per week.

4.4.4 Northern shaft backfill

Works to backfill the northern shaft which has been utilised for construction material and operative access into the cross-over cavern, and forms part of the Barangaroo Station works is proposed to be undertaken 24 hours per day as part of the station construction works. This activity will only be undertaken for a relatively short period of time (three to four weeks) toward the conclusion of the project. The northern shaft needs to remain operational for as long as possible to facilitate the completion of the works by Sydney Metro Linewide and the other interfacing contractors. Out of hours works will be undertaken within the existing acoustic shed on Hickson road. In addition all reasonable and feasible mitigation and management measures will be implemented endeavouring to achieve ICNG NMLs where reasonable and feasible.

4.5 Airborne construction noise management levels

Construction noise management levels have been determined using the NSW Interim Construction Noise Guideline (ICNG) and the Conditions of Approval, in accordance with the Sydney Metro City & Southwest Construction Noise and Vibration Strategy. They are as follows:

- Internal noise management levels are applicable at sensitive receiver locations during the 7am to 8pm period per Conditions of Approval E37 and E38. This worksite is referred to as 'identified precincts' in Addendum A of the Sydney Metro CNVS;
- If approved OOHW are undertaken at the worksite, internal noise management levels are applicable at residential receiver locations during the 8pm to 7am period per Conditions of Approval E41 and E42. In addition, the requirements of Sydney Metro CNVS apply including OOHWA process.

4.5.1 Internal noise criteria from Conditions of Approval

Table 4-4 below (reproduced from Addendum A of Sydney Metro CNVS) sets out the internal noise criteria levels for residential and other sensitive receivers. The Project site falls within and an Identified Precinct in accordance with Condition E37.

Table 4-4: Internal construction noise criteria levels (Conditions of Approval)

Area	Receiver Type	Approval Condition	Time Period	Criteria (internal)[4]
Identified Precincts[1]	All	E38	7am to 8pm	Noise levels are required to be less than $L_{Aeq(15\ minute)}$ 60 dB(A) for at least 6.5 hours between 7am and 8pm, of which at least 3.25 hours must be below $L_{Aeq(15\ minute)}$ 55 dB(A). Noise equal to or above $L_{Aeq(15\ minute)}$ 60 dB(A) is allowed for the remaining 6.5 hours between 7am and 8pm.[3]

Area	Receiver Type	Approval Condition	Time Period	Criteria (internal)[4]
Non-residential zones[2]	Residential	E41	8pm to 9pm	$L_{Aeq(15minute)}$ 60 dB(A)
			9pm to 7am	$L_{Aeq(15minute)}$ 45 dB(A)
Residential zones[2]	Residential	E42	8pm to 7am	$L_{Aeq(15minute)}$ 45 dB(A)
All	All	E43	All	$L_{Aeq(8hour)}$ 85 dB(A) (external) near the CSSI

Notes: 1. Identified precincts are provided in Condition E37 and include Crows Nest, Victoria Cross, Barangaroo, Martin Place and Pitt Street.

2. These are identified by the applicable Local Environmental Plan land zoning of the receiver.

3. Criteria as described in Condition E38

4. A 5 dB penalty shall be applied if rock breaking or any other annoying activity likely to result in ground-borne noise or a perceptible level of vibration is planned.

4.5.2 Respite periods for high noise impact activities

Construction activities (including works associated with utility adjustments) between 7am and 8pm that result in high noise impact, such as rock breaking or other annoying activities, shall be managed in accordance with CoA E37 and E38 (refer Table 4-4).

Condition E38 requires consultation with all receivers with predicted internal noise levels greater than $L_{Aeq(15minute)}$ 60 dB(A) to determine appropriate hours of respite.

4.5.3 Noise Management Levels from SM CNVS (Residential receivers)

Table 4-5 below sets out the noise management levels and how they are to be applied to residential receivers in accordance with Section 5.3 of SM CNVS.

Table 4-5: ICNG Construction noise management levels (residential receivers)

Time of Day	Noise Management Level LAeq(15min)	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 6 pm No work on Sundays or public holidays	RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
Standard hours	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, considering: times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times

Time of Day	Noise Management Level LAeq(15min)	How to apply
Outside recommended standard hours	Noise affected RBL + 5dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

4.5.4 Noise Management Levels at other noise sensitive receivers

Table 4-6 sets out the noise management levels for various noise-sensitive land use developments, including commercial premises adopted from the ICNG. Internal (or indoor) noise management levels for land uses not identified in the ICNG are referenced to the 'maximum' internal noise levels presented in Australian Standard AS2107. The noise management levels presented in Table 4-6 are applicable where the premises are in use.

Table 4-6 presents a detailed, but not exhaustive list of typical 'other' land uses. Where a land use has not been identified in Table 4-6, a suitable noise management level can be determined by taking guidance from Australian Standard AS2107.

As identified for residential receivers, where the predicted or measured $L_{Aeq(15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. All of the potentially impacted receivers shall be informed of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

Table 4-6: ICNG airborne construction noise management levels at other noise sensitive land uses

Land Use	Noise Management Level $L_{Aeq(15min)}$	Where NML applies	Referenced from:	Assumed facade loss (conservative)	External equivalent NML - $L_{Aeq(15min)}$
Studio building (music recording studio)	25 dB(A)	Internal noise level	AS2107 'maximum'	20 dB(A)	45 dB(A)
Studio building (film or television studio)	30 dB(A)	Internal noise level	AS2107 'maximum'	20 dB(A)	50 dB(A)
Cinema space, theatre, auditorium	35 dB(A)	Internal noise level	AS2107 'maximum'	20 dB(A)	55 dB(A)
Hotel (Sleeping areas: Hotels near major roads)	40 dB(A)	Internal noise level	AS2107 'maximum'	20 dB(A)[1]	60 dB(A)
Classrooms at schools and other educational institutions	45 dB(A)	Internal noise level	ICNG	10 dB(A)	55 dB(A)
Childcare centre (sleeping areas)	40 dB(A)	Internal noise level	AAAC - guideline for Child Care Centre Acoustic Assessment	10 dB(A)	50 dB(A)

Land Use	Noise Management Level $L_{Aeq(15min)}$	Where NML applies	Referenced from:	Assumed facade loss (conservative)	External equivalent NML - $L_{Aeq(15min)}$
Hospital wards and operating theatres	45 dB(A)	Internal noise level	ICNG	20 dB(A)	65 dB(A)
Places of worship	45 dB(A)	Internal noise level	ICNG	10 dB(A)	55 dB(A)
Library (reading areas)	45 dB(A)	Internal noise level	AS2107 'maximum'	20 dB(A)	65 dB(A)
Hotel (bars and lounges)	50 dB(A)	Internal noise level	AS2107 'maximum'	20 dB(A)	70 dB(A)
Community centres – Municipal Buildings	50 dB(A)	Internal noise level	AS2107 'maximum'	10 dB(A)	60 dB(A)
Restaurant, bar (Bars and lounges/ Restaurant)	50 dB(A)	Internal noise level	AS2107 'maximum'	20 dB(A)	70 dB(A)
Passive recreation (e.g. area used for reading, meditation)	60 dB(A)	External noise level	ICNG	-	60 dB(A)
Active recreation (e.g. sports fields)	65 dB(A)	External noise level	ICNG	-	65 dB(A)
Commercial premises (including offices and retail outlets)	70 dB(A)	External noise level	ICNG	-	70 dB(A)
Industrial premises	75 dB(A)	External noise level	ICNG	-	75 dB(A)

NOTES: 1) Most affected hotels are expected to have high performance façade (i.e. more than 20dB). Appropriate criteria should be set which takes into account the existing face performance of affected hotels

4.5.5 Sleep Disturbance

The ICNG recommends that where construction works are planned to extend over more than two consecutive nights, maximum noise levels and the extent and frequency of maximum noise level events exceeding the RBL should be considered. In line with the ICNG, further guidance is taken from the NSW Environmental Criteria for Road Traffic Noise (ECRTN) (Environment Protection Authority 1999).

To assess the likelihood of sleep disturbance, an initial screening level of L_{Amax} <$L_{A90,15min}$ + 15 is used. In situations, where this results in an internal screening levels of less than 45 dB(A) (internal), a minimum internal screening level of 45 dB(A) is set. Note that this is equivalent to an external maximum noise level of 55 dB(A) with windows open or 65 dB(A) with closed windows, based on an outside-to-inside noise reduction of respectively 10 dB(A) and 20 dB(A).

Where there are noise events found to exceed the initial screening level, further analysis is made to identify:

- The likely number of events that might occur during the night assessment period
- Whether events exceed an 'awakening reaction' level of 55dBA L_{Amax} (internal) that equates to an external NML of L_{Amax} 75 dB(A) (assuming closed windows).

The ICNG recommends that where construction works are planned to extend over more than two consecutive nights, maximum noise levels and the extent and frequency that maximum noise levels exceed the RBL should be analysed.

4.5.6 National Standard for exposure to noise

In accordance with CoA E43, project worksites will be managed to ensure that noise generated by construction will not exceed the National Standard for exposure to noise in the occupational environment of an eight-hour equivalent continuous A-weighted sound pressure level of $L_{Aeq,8h}$, of 85dB(A) for any employee working at a location near a Project worksite. Noise monitoring will be conducted to verify compliance with this condition (APPENDIX E).

4.6 Construction-related road traffic noise

When trucks and other vehicles are operating within the boundary of a construction site, road vehicle noise contributions are included in the overall predicted $L_{Aeq(15minute)}$ construction site noise emissions. When construction-related traffic moves onto the public road network a different noise assessment methodology is appropriate, as vehicle movements would be regarded as 'additional road traffic' rather than as part of the construction site.

On roads located immediately adjacent to construction sites, the community may associate heavy vehicle movements with the project works. However, once the heavy vehicles move further from construction sites onto major collector or arterial roads, the noise may be perceived as being part of the general road traffic.

Noise from construction traffic on public roads is not assessed under the ICNG, although the guideline does reference the Environmental Criteria for Road Traffic Noise (Environment Protection Authority, 1999), which has been superseded by the RNP. The RNP states that in assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person. For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments (in this case the construction area), any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'without construction' scenario.

Where the road traffic noise levels are predicted to increase by more than 2 dB as a result of construction traffic, consideration would be given to applying feasible and reasonable noise mitigation measures to reduce the potential noise impacts and preserve acoustic amenity.

In considering feasible and reasonable mitigation measures where the relevant noise increase is greater than 2 dB, consideration would also be given to the actual noise levels associated with construction traffic and whether or not these levels comply with the following road traffic noise criteria in the RNP:

- 60 dB $L_{Aeq(15hour)}$ day and 55 dB $L_{Aeq(9hour)}$ night for existing freeway/ arterial/ sub-arterial roads.
- 55 dB $L_{Aeq(1hour)}$ day and 50 dB $L_{Aeq(1hour)}$ night for existing local roads.

This approach is consistent with the Sydney Metro City & Southwest Construction Noise and Vibration Strategy.

4.7 Ground-borne construction noise management levels

Ground-borne noise management levels (GNMLs) are based on the ICNG and Conditions of Approval, in accordance with the Sydney Metro City & Southwest Construction Noise and Vibration Strategy.

4.7.1 Noise criteria from Project Planning Approval Conditions

The internal noise criteria outlined in Section 4.5.1 represent the total noise levels from airborne and ground-borne noise sources.

4.7.2 Ground-borne Noise management levels from ICNG (Residential receivers)

The following GNMLs for residences are nominated in the ICNG and indicate when management actions would be implemented. These levels recognise the temporary nature of construction and are only applicable when ground-borne noise levels are higher than airborne noise levels. This is typically where noise sensitive receivers are located vibration intensive construction activities (e.g. rock breaking).

Table 4-7 below (taken from the ICNG) sets out the GNMLs and how they are to be applied to residential receivers. The proponent should also inform all potentially impacted receivers of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

Table 4-7: ICNG Ground-borne Construction Noise Management Levels at Residential Receivers

Assessment Period	Time of Day	Ground-borne Noise Management Level, LAeq(15minute)
Daytime	7:00am to 6:00pm	45 dB(A) internal
Evening	6:00pm to 10:00pm	40 dB(A) internal
Night	10:00pm to 7:00am	35 dB(A) internal

4.8 Construction vibration criteria

Effects of ground vibration on buildings resulting from construction may be segregated into the following three categories:

- Human comfort – disturbance to building occupants: vibration in which the occupants or users of the building are inconvenienced or possibly disturbed.
- Effects on building contents – vibration where the building contents may be affected.
- Effects on building structures – vibration in which the integrity of the building or structure itself may be prejudiced.

4.8.1 Disturbance to buildings occupants

Assessment of potential disturbance from construction vibration on human occupants of buildings is made in accordance with the guideline 'Assessing Vibration; a technical guideline' (DECC, 2006). The guideline provides criteria which are based on the British Standard BS 6472-1992 'Guide to evaluation of human exposure to vibration in buildings (1-80Hz)'.

The vibration dose values recommended in the guideline 'Assessing Vibration; a technical guideline' are presented in Table 4-8.

Table 4-8: Vibration Dose Values for intermittent vibration

Place and Time	Preferred Vibration Dose Value (VDV) in $m/s^{1.75}$	Maximum Vibration Dose Value (VDV) in $m/s^{1.75}$
Critical areas[1] (day or night)	0.1	0.2
Residential buildings 16 hr day	0.2	0.4
Residential buildings 8 hr night	0.13	0.26
Offices, schools, educational institutions and places of worship (day or night)	0.4	0.8
Workshops (day or night)	0.8	1.6

Notes:
1) Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above.

To assess the potential for vibration impact on human comfort, an initial screening test will be done based on peak velocity units, as this metric is also used for the cosmetic damage vibration assessment. This screening test is a conservative approach since it is based on the continuous vibration velocity criteria (i.e. vibration that continues uninterrupted for a defined assessment period) whilst construction works are mostly intermittent. The screening test (Table 4-9) will be based on maximum peak values for surface construction works, which are intermittent in nature. This approach has been adopted so that the screening test is not unduly stringent.

If the predicted vibration exceeds the initial screening test, the total estimated Vibration Dose Value (i.e. eVDV) will be determined based on the level and duration of the vibration event causing exceedance.

Table 4-9: Construction vibration disturbance – initial screening test.

Place and Time	Preferred peak velocity, mm/s (>8Hz)	Maximum peak velocity, mm/s (>8Hz)
Critical areas (day or night)	0.14	0.28
Residential buildings 16 hr day	0.28	0.56
Residential buildings 8 hr night	0.20	0.40
Offices, schools, educational institutions and places of worship (day or night)	0.56	1.10
Workshops (day or night)	1.10	2.20

4.8.2 Structural damage to buildings

Potential structural damage of buildings caused by vibration is typically managed by ensuring vibration induced into the structure does not exceed certain limits and standards, such as British Standard 7385 Part 2 (1993) as required by Project Planning Approval Condition E28. BS7385 suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur.

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

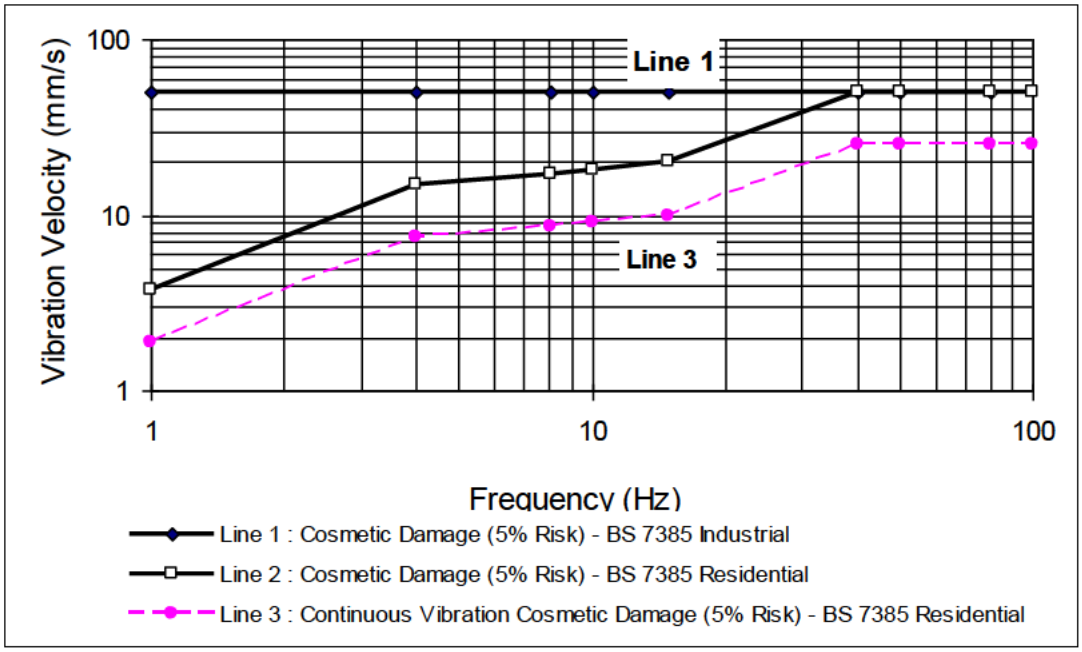
Table 4-10 sets out the recommended limits from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential, commercial and industrial buildings. This is shown graphically in Figure 4.1.

Table 4-10: Transient vibration guide values - minimal risk of cosmetic damage (BS 7385) - peak component particle velocity

Line	Type of structure	Frequency range 4 to 15 Hz	Frequency range 15 to 40 Hz	Frequency range 40 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s	50 mm/s	50 mm/s
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4Hz, increasing to 20 mm/s at 15Hz	20 mm/s at 15Hz, increasing to 50 mm/s at 40Hz	50 mm/s

BS7385 states that the guide values in Table 4-10 relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 4-10 may need to be reduced by up to 50%, as shown by Line 3 of Figure 4.1 for residential buildings.

Figure 4.1: Graph of Transient Peak Component Particle Velocity Vibration Guide Values for Cosmetic Damage



4.8.3 General vibration screening criterion

The British Standard states that the guide values in Table 4-9 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings. Where the dynamic loading caused by continuous vibration may give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 4-9 may need to be reduced by up to 50%. This is especially applicable at the lower frequencies where lower guide values apply.

On this basis, consistent a conservative vibration screening criteria per receiver type is given below:

- Reinforced or framed structures (Line 1): **25.0 mm/s**
- Unreinforced or light framed structures (Line 2): **7.5 mm/s**

At locations where the predicted and/or measured vibration levels are greater than shown above (peak component particle velocity), a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be required to determine the applicable vibration level. The analysis would take into consideration the transient vibration guide values for minimal risk of cosmetic damage set out in Figure 4.1.

4.8.4 Heritage structures/buildings

The British Standard BS7385 states that *"A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive."*

In accordance with Project Planning Approval Condition E31, the advice of a heritage specialist on methods and locations for installing equipment used for vibration, movement and noise monitoring of heritage-listed structures will be sought.

Unless otherwise advised, a conservative vibration damage screening level (peak component particle velocity) for heritage buildings/structures can be set to 2.5mm/s (the more stringent criterion in the German Standard DIN 4150-2016 Structural Vibration Part 3: Effects of Vibration on Structures). This screening level will allow potentially impacted heritage structures to be identified. If a heritage structure is predicted to be exposed to vibration levels above the conservative vibration screening level of 2.5mm/s, further investigation would be undertaken to determine whether the structure is structurally unsound. Where a heritage building is deemed to be sensitive to vibration impacts, the more stringent DIN 4150-2016 Group 3 guideline values can be applied. Otherwise, structural damage vibration limits based on BS 7385 (Section 4.8.3) can be applied.

4.8.5 Sensitive scientific and medical equipment

Some scientific equipment (e.g. electron microscopes and microelectronics manufacturing equipment) can require more stringent objectives than those applicable to human comfort.

No such equipment has been identified in proximity to the Project area. If required, objectives for the satisfactory operation of sensitive instruments will be identified in the relevant CNVIS. Where manufacturer's data is not available, generic vibration criterion (VC) curves as published by the Society of Photo-Optical Instrumentation Engineers (Colin G. Gordon - 28 September 1999) may be adopted as vibration goals.

4.8.6 Utilities and other vibration sensitive structures

Some structures and utilities located near the Project may be particularly sensitive to vibration. A vibration goal which differs from the cosmetic damage goals presented in Section 4.8.2 may need to be adopted. Examples of such structures and utilities include:

- Tunnels
- Gas pipelines
- Fibre optic cables

The British Standard BS 7385-2:1993 'Evaluation and measurement for vibration in buildings - Part 2: Guide to damage levels from ground-borne vibration' notes that structures below ground are known to sustain higher levels of vibration and are very resistant to damage unless in very poor condition (British Standard BS 7385-2:1993, p5). Further guidance is taken from the German Standard DIN 4150: Part 3-1999.02 'Structural vibration in buildings - Effects on Structures'. Section 5.3 of DIN 4150: Part 3 sets out guideline values for vibration velocity to be used when evaluating the effects of vibration on buried pipework.

Table 4-11 presents the initial reference guideline for utilities and other buried pipework to evaluate the effects of short-term vibration impact. Specific vibration goals should be determined on a case-by-case basis as part of the CNVIS for each work site.

Table 4-11: DIN 4150-3 Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on buried pipework

Line	Pipe Material	Guideline values for vibration velocity measured on the pipe
1	Steel (including welded pipes)	100 mm/s
2	Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80 mm/s
3	Masonry, plastic	50 mm/s

Note 1. Rock breaking/hammering and sheet piling activities are considered to have the potential to cause dynamic loading in some structures and it may therefore be appropriate to reduce the transient values by 50%.

5 Construction noise and vibration assessment

5.1 Construction noise and vibration management system

5.1.1 Overview

This Plan has been prepared to provide a framework for assessment of noise and vibration impacts and the identification of reasonable and feasible noise mitigation measures. Site specific Construction Noise and Vibration Impact Statements (CNVIS) will be progressively prepared to address:

- Surface works (utility and road works);
- Station construction works.

Each CNVIS will provide detailed construction noise and vibration predictions, assessment, mitigation design outcomes and discussion of management measures to limit impacts to sensitive receivers.

The outcomes of the CNVIS feed into the Community Communication Strategy and Business Management Plan to inform the affected community of the likely noise and vibration that will be experienced during construction.

5.1.2 Construction noise and vibration impact statements

The CNVISs will be a key site management tool that will give BESIX Watpac clear instructions for managing the worksite. Each CNVIS will be prepared before construction noise and vibration impacts commence and will set out the mitigation and management measures required for the construction stage, through consultation with affected receivers (in accordance with Condition of Approval E33) and the specific measures that must be in place before any construction works may start.

Each CNVIS will address:

- Scope of work covered by the CNVIS;
- Justification for OOHW (where required);
- Nearest noise and vibration sensitive receivers, based on land use survey;
- Construction noise and vibration objectives;
- Construction noise and vibration assessment;
- Construction ground-borne noise;
- Construction traffic;
- Cumulative impacts;
- Mitigation options and preferred management measures;

- Noise and vibration monitoring requirements for each construction worksite/activity.

Physical noise mitigation measures such as noise barriers, fan attenuators and acoustic shed will be outlined in the CNVIS. Furthermore, management measures such as staging of works; respite periods and community notification will also be summarised. In accordance with CoA E33, site specific mitigation measures identified through consultation with affected sensitive receivers will be included in the CNVIS. The CNVIS will identify how the proponent is required to notify the community of works pending to ensure the community is informed of the likely noise and vibration impacts during the assessed works, the duration of impact and any additional mitigation (e.g. respite periods) that may be required to manage noise and vibration impacts. The CNVIS will aid in reducing noise and vibration impact from construction.

5.1.3 OOHW - Management procedures and hold points

All OOHWs will be assessed and managed in accordance with the Sydney Metro Out of Hours Works Protocol[3]. This document addresses internal approval and hold points relating to:

- The justification of OOHW
- Noise and vibration assessment
- External approvals, including high noise/vibration risk works, either
  - ER approval following endorsement by AA
  - DPE approval following endorsement by AA and ER for high risk works after 9 pm
- Community notification
- Tool boxing of the workforce on sensitive receivers and management requirements prior to the commencement of works
- Additional mitigation measures to be implemented
- Noise and vibration verification monitoring.

All OOHW (except in emergency situations) will be documented on the relevant OOHW Form and submitted to the AA and Sydney Metro for approval.

For emergency construction works, additional requirements are applicable per CoA E45 including notifying the AA of the need for those activities or work and using best endeavours to notify all affected sensitive receivers of the likely impact and duration of those works.

5.2 Overview of evaluation and assessment process

Renzo Tonin & Associates recognises construction noise and vibration management is a key community issue. Detailed models are developed to accurately model and predict airborne noise, ground-borne noise

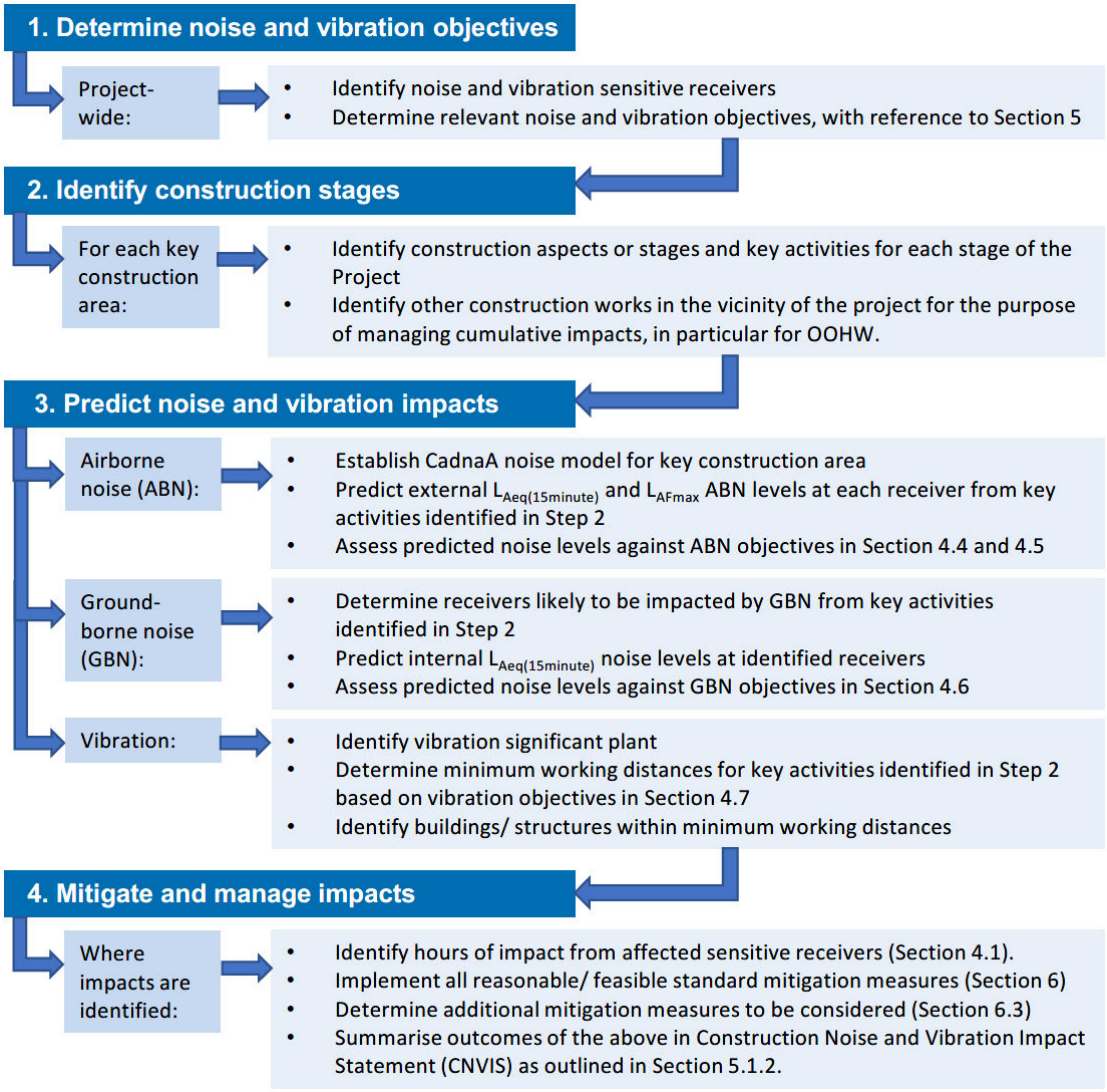
[3] City & Southwest out of hours works strategy/Protocol, reference SM-17-00005396, version 5.2, dated 9/10/2020

and vibration impacts related to the Project. In close consultation with the construction team, all potential options and optimum solutions for reasonable and feasible noise and vibration mitigation are identified for the construction works. This process includes:

- Use of CadnaA noise modelling software to develop detailed models of the construction worksites. The models allow different stages of construction to be modelled and noise emissions predicted, giving greater ability to find noise mitigation solutions that suit each construction stage of the worksite. Verification monitoring on previous infrastructure projects has found that measured noise levels are within the predicted noise levels, giving greater confidence in the modelled outcomes. The noise models consider:
  - Location of noise sources at each worksite, sources located within acoustic sheds and enclosures
  - Sensitive receiver locations, including land use details obtained from the GIS database, to ensure appropriate NMLs are applied
  - Height of sources and receivers referenced to digital ground contours within the construction site area and 1 to 2 metre digital ground contours outside the construction site area
  - Noise source levels of individual construction plant, based Renzo Tonin & Associate's extensive database of construction plant and equipment noise data
  - Outcomes from CadnaR modelling of acoustic enclosures (if required) to ensure noise inputs from these sources are representative in the CadnaA model
  - Ground type between sources and receivers (mixed soft/ hard)
  - Attenuation from barriers (natural and purpose built) and other structures such as buildings surrounding the construction site
  - Identifying facade transmission loss of airborne noise affected receivers to predict internal airborne noise levels.
- Training engineers on noise modelling and required inputs to ensure accurate information for the modelling process. Key details regarding the construction site layout, the likely plant and equipment (including truck movements), and hours of operation will be provided by the Design and Construction Teams
- Sensitivity analysis to determine the best combination of management measures including scheduling (avoiding impacts at night where possible), using quieter plant and equipment where practicable, using barriers and enclosures, and training staff in quiet noise practices
- Under the PPA, an independent Acoustic Advisor (AA) has been engaged by Sydney Metro to review noise and vibration assessments.
- Comprehensive community notification and complaints management. BESIX WATPAC will engage with residents, utility owners, businesses and stakeholders to help them understand what to expect during the Project works.

The assessment process for construction noise and vibration impacts is detailed in the flow diagram in Figure 5.1.

Figure 5.1: Process for assessing and managing construction noise and vibration



5.2.1 Construction traffic

The worksite will generate additional traffic movements in the form of:

- Light vehicle movements generated by construction personnel travelling to and from work
- Heavy vehicle movements generated by:
  - Delivery vehicles bringing raw materials, plant, and equipment to the site
  - Trucks removing demolition / excavation material from the site

Construction traffic on the site is included as part of the construction noise assessment of the work activities, while when construction-related traffic moves on the public road network, a different noise

assessment methodology is appropriate as vehicle movements would be regarded as additional road traffic on public roads rather than as part of the construction site's activities.

As part of the planning works for the project, BESIX WATPAC has developed a Construction Traffic Management Plan (CTMP). Noise impacts from construction related traffic on public roads will be reviewed and addressed in each CNVIS, to mitigate the potential impacts throughout the construction of the Project.

5.3 Communication and consultation

5.3.1 Overview of approach

The aim during construction is to minimise disruption, delay and inconvenience to nearby residents and businesses. The Community Communication Strategy (CSS) and Business Management (BMP) Plan outlines how essential commitment to collaboration, mutual respect and genuine consideration of community and business concerns is in achieving this. It also details how the proponent will meet the community relations obligations of the Project Approval. It acknowledges that robust community and stakeholder engagement depends on effective communications and on strong collaboration and coordination between Sydney Metro and BESIX Watpac, other Project contractors and other significant projects under construction near the Project construction site. The overarching objectives of the CCS are to:

- Comply with the community consultation obligations and Project Planning Approval;
- Summarise site-specific mitigation measures previously identified through community consultation in accordance with CoA E33.
- Summarise relevant information on nearby noise affected receivers such as sensitive periods, complaints, effectiveness and preferences on mitigation measures previously identified by JHCPBG JV on Sydney Metro City and Southwest Project at Barangaroo worksite.
- Work cooperatively with Sydney Metro to provide a coordinated and consistent approach;
- Identify and appropriately address stakeholder, business and community issues;
- Maximise stakeholders and the community understanding of the Project activities, the objectives and benefits and the timing, potential impacts, mitigation measures and expected outcomes;
- Provide timely, accurate and relevant information to the community;
- Minimise, where possible, the Project impacts on stakeholders, businesses and the community;
- Enhance and protect the reputation of the Project, the NSW Government and Sydney Metro.

There will be a diverse range of residential, commercial and government stakeholders, with potentially changing communication needs across the life of the project. A range of communication and consultation tools will be implemented for the Project. Recognising the relative strengths of different communication tools, they can be matched to stakeholders and their need for accurate information and interaction.

Capitalising on opportunities created by technology allows the proponent to better inform, receive and respond to feedback with interactive communication.

In the event of inconsistency between the CCS & BMP from this NVMP for communication, consultation and complaints, the CSS and BMP prevails.

5.3.2 Proactive consultation and notification

Residents, property owners, businesses and community facilities near the construction site will have a wide range of unique needs and concerns about construction impact. BESIX Watpac will engage through multiple channels to notify and build understanding of the likely impacts of airborne noise, ground-borne noise and vibration, and the reasonable and feasible options available to mitigate these impacts, including respite. Every effort will be made by the project team to mitigate these impacts. BESIX WATPAC will ensure proactive stakeholder and community liaison and communication at all times, is embraced across the project, delivering timely, quality information and consultation to local stakeholders and community as outlined in the Community Communication Strategy and Business Management Plan for the project. Using multiple communication channels, clear points of contact will be provided and face-to-face communication for those most affected. With the scale of construction currently underway in Sydney, the stakeholders and the community will be affected by multiple sources of impacts and information. When they are affected, they may not understand which of the projects or contractors should be contacted to address their issues. They are also likely to have interests in different stages of the Project (e.g. demolition works vs station fit-out works) for various reasons.

A key feature of the strategy is extensive collaboration with Sydney Metro, agencies and interface contractors to find opportunities to minimise cumulative impacts. Coordinated communications in 'plain English' will serve to guide the community to the right points of contact for information and complaints and minimise frustration.

When informing sensitive receivers on the level of noise and vibration to be expected from construction activities, potential impacts will be described using qualitative terminology consistent with the TfNSW Construction Noise and Vibration Strategy (e.g. noticeable, clearly audible, moderately intrusive, highly intrusive).

5.3.3 Specific Project Planning Approval requirements

CoA C3 requires relevant council(s) to be consulted for each CEMP sub-plan. The records of consultation with relevant agencies in this plan, responses to agency comments and how these were implemented in this plan are attached in APPENDIX F.

To satisfy the CoA E33, consultation will be carried out to develop specific mitigation measures for the works with the affected sensitive receivers. The outcomes of this consultation will be fed back into the construction noise and vibration management system and will assist with the final detailed design of mitigation measures for the site, where reasonable and feasible.

As presented in Table 5-1 and APPENDIX B, there are 'other' noise and vibration sensitive receivers (e.g. hotels, museums, cafes and restaurants) around the construction sites that have been identified. In accordance with CoA E34, relevant CNVIS's will assess the noise and vibration impacts at these receivers to determine if consultation is required as part of the management of the works to determine if respite periods or other suitable arrangements are required to avoid or minimise impacts during sensitive periods.

Table 5-1: E34 affected receiver locations

Other sensitive receivers (Condition E34)		
Address	**Business name**	**Other Sensitive Receiver Category**
35 Bettington St, Millers Point NSW 2000	Hotel Palisade	Restaurant, Cafes
1 Barangaroo Ave, Barangaroo NSW 2000	Crown Casino	Hotel, Restaurant, Cafes
1 Merriman St, Barangaroo NSW 2000	The Cutaway	Museum
89-113 Kent St, Millers Point NSW 2000	Langham hotel	Hotel, Restaurant
37 High St, Millers Point NSW 2000	KU Lance childcare centre	Childcare

CoA E38 requires consultation with all receivers likely to experience internal noise levels greater than $L_{Aeq,15min}$ 60 dB(A) inclusive of 5dB penalty (for rock breaking and any other annoying activities) at Barangaroo to determine appropriate hours of respite. These receivers will be identified in the CNVISs.

In addition, currently other worksites such as One Sydney Harbour and Sydney Metro Linewide are active in the area. Proponents of these construction sites near the worksite will be consulted and reasonable steps will be taken to coordinate works in order to minimise cumulative noise and vibration impact and coordinate respite for affected sensitive receivers, to satisfy CoA E39 and Condition E40. Furthermore, cumulative impacts will be assessed in the CNVISs.

In accordance with CoA E33, consultation with affected receivers identified in the CNVIS will take place prior to the works commencing and will include discussion on specific mitigation measures. However, CoA C3 does not require this for approval of the NVMP.

In accordance with CoA E29, owners of properties at risk of exceeding the screening criteria for cosmetic damage will be notified before construction that generates vibration commences in the vicinity of those properties.

5.3.4 Complaints management

A complaint is defined as any communication received from a stakeholder expressing dissatisfaction. This is a purposely broad definition and is used to ensure that matters of concern to stakeholders are addressed promptly.

Stakeholders will be able to register enquiries and complaints through several channels as set out in the Community Communications Strategy and Business Management Plan including:

- 24-hour, 1800 community information line (1800 171 386 which is run by Sydney Metro for the Project as a whole)
- Dedicated project email mailbox
- Dedicated project website
- Face to face meetings

Specific details on the above communication channels are made available within the project Community Communication Strategy and Business Management Plan. Complaints may be received directly or referred by Sydney Metro or other contractors.

All calls to the 1800-number will be answered and responded to 24 hours a day, seven days a week. A call centre reception service managed by Sydney Metro records contact details and basic information about the nature and location of the complaint. The complainant is made aware that an on-call officer will contact them shortly to address the issue. With this approach, the caller is not placed on hold or referred to a recorded message. If the rostered officer cannot receive a call (e.g. they are on the phone responding to another caller), calls can be directed to an alternate rostered on-call officer. Translators will be arranged if a stakeholder or community member is unable to communicate their concerns in English. Email and other contact options will assist those with disabilities.

Specific protocols and procedures have been arranged to ensure a consistent approach to managing enquires and complaints, including systems for recording and monitoring stakeholder contact. All staff and work crews will be informed that all contact from the community must be referred to the community relations team for action. To facilitate this everyone will be provided with community contact cards to direct enquiries to the community information line or email address.

Each stakeholder contact is an opportunity to build understanding about the Project and allay concerns. Complaints provide important feedback to improve project processes and mitigation measures to avoid or minimise further complaints. All reasonable measures will be taken to prevent the reoccurrence of stakeholder and community complaints. The strategic approach to managing complaints consists of:

- Courtesy
- Accessibility
- Responsiveness
- Delegation of authority to resolve the issue
- Access to accurate information.

All employees and subcontractors are required to respond to stakeholders with courtesy and professionalism. This will be reinforced during Project inductions. Specific toolbox talks will further consolidate the approach.

BESIX WATPAC Community and Stakeholder Liaison Manager will manage the ongoing communication with the complainant until they are satisfied with the actions taken. The BESIX WATPAC Community and Stakeholder Liaison Manager will immediately report all environmental complaints to the Project Environment and Planning Manager to confirm any required action, including but not limited to:

- Noise, and/or vibration monitoring (see APPENDIX D)
- Subject to monitoring results consideration of options to reduce impacts including:
  - Scheduling activities to minimise impacts
  - Targeted inspection to determine if it is reasonable and to install additional controls (i.e. noise barriers)
  - Respite offers (for example, coffee vouchers, movie tickets ormeal vouchers)
- Site visit with complainant to assist in understanding our operations and mitigation strategies.

The complaint is escalated to the BESIX Watpac Project Director and Sydney Metro representative if the complainant remains unsatisfied. Further escalation will be in line with the Sydney Metro Overarching Community Communications Strategy (Sydney Metro Document Reference: A5732897) and the Sydney Metro Construction Complaints Management System and may include the:

- Environmental Representative required under Project Planning Approval Condition A22,
- Acoustic Advisor required under Project Planning Approval Condition A25,
- Community Complaints Commissioner required under Project Planning Approval Conditions B11 to B14 or
- Independent Property Impact Assessment Panel (IPIAP) required under Project Planning Approval Condition E62 as appropriate.

5.4 Blasting assessment

No blasting assessment has been undertaken, as blasting is not proposed for the Project. In the event that this circumstance changes, a blast management strategy will be prepared.

6 Environmental control measures

As outlined in Section 5.1.2, each CNVIS will review in detail the noise and vibration mitigation and management measures for each construction stage, including all physical noise mitigation measures such as noise barriers, fan attenuations and acoustic sheds, along with all management measures such as staging of works; respite periods and community notification that are appropriate to the construction stage.

This section outlined the standard noise and vibration mitigation and management measures (including the Revised Environmental Management Measures NV1 to NV7) that are to be reviewed and adopted where reasonable and feasible across the project and will be considered in each CNVIS.

6.1 Revised Environmental Management Measures

Revised Environmental Mitigation Measures detailed in the EIS and Submissions Report that are relevant to the Barangaroo Metro Station works are summarised in Table 6-1 below (REMMs that are not applicable in accordance with staging report have not been included). This includes reference to required outcomes, the timing of when the commitment applies and relevant documents or sections of the environmental assessment influencing the outcome and implementation.

Table 6-1: Applicable Revised Environmental Management Measures

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
NV1	The Construction Noise and Vibration Strategy would be implemented with the aim of achieving the noise management levels where feasible and reasonable. This would include the following example standard mitigation measures where feasible and reasonable: • Provision of noise barriers around each construction site • Provision of acoustic sheds at Barangaroo • The coincidence of noisy plant working simultaneously close together would be avoided • Offset distances between noisy plant and sensitive receivers would be increased • Residential grade mufflers would be fitted to all mobile plant • Dampened rock hammers would be used • Non-tonal reversing alarms would be fitted to all permanent mobile plant • High noise generating activities would be scheduled for less sensitive period considering the nearby receivers • The layout of construction sites would consider opportunities to shield receivers from noise. • This would also include carrying out the requirements in relation to construction noise and vibration monitoring	All example NV1 mitigation measures will be considered and included in the development of CNVIS assessments (including use of the existing northern shed for deliveries and shaft backfill). Indicative mitigation and management measures are summarised in Section 6.2.	Environment Manager Construction Managers	Construction	Section 5.1.2 Section 6.2. Section 2.1.3
NV3	Where vibration levels are predicted to exceed the screening criteria, a more detailed assessment of the structure and attended vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for that structure. For heritage items, the more detailed assessment would specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed.	Vibration screening criteria and protocols to follow when exceedance of the screening criteria occurs are outlined in Section 4.8.3. Criteria for vibration sensitive and special structures (including heritage) are outlined in Section 4.8.4. Monitoring vibration protocols are presented in APPENDIX E	Construction Managers Project Noise and Vibration Consultant Heritage Consultant Project Environment Manager	Prior to the start of demolition/construction	Section 4.8.3. Section 4.8.4. APPENDIX E

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
NV4	Feasible and reasonable measures would be implemented to minimise ground-borne noise where exceedances are predicted.	CNVISs will review potential ground-borne noise impact and identify feasible and reasonable measures to manage this. See Section 5.1.2	Construction Managers Project Noise and Vibration Consultant	Prior to the start of demolition/construction stage	Section 5.1.2
NV6	Transport for NSW would engage an Independent Acoustic Advisor to act independently of the design and construction teams and provide oversight of construction methods, construction noise and vibration planning, management and mitigation, and construction noise and vibration monitoring and reporting. The key responsibilities of the Independent Acoustic Advisor would include: • Assurance of contractor noise and vibration planning, modelling, management and monitoring practices • Verification of compliance with relevant guidelines and approval requirements • Audit noise and vibration management practices	Independent Acoustic Advisor (Section 2.4).	N/A	N/A	Section 2.4 Section 2.3

No.	Requirement	Proposed actions	Responsible role	Timing	Relevant NVMP section
NV7	Alternative demolition techniques that minimise noise and vibration levels would be investigated and implemented where feasible and reasonable. This would include consideration of: • The use of hydraulic concrete shears in lieu of hammers/rock breakers • Sequencing works to shield noise sensitive receivers by retaining building wall elements • Locating demolition load out areas away from the nearby sensitive receivers • Providing respite periods for noise intensive works • Methods to minimise structural-borne noise to adjacent buildings including separating the structural connection prior to demolition through saw-cutting and propping, using hand held splitters and pulverisers or hand demolition • Installing sound barrier screening to scaffolding facing noise sensitive neighbours • Modifying demolition works sequencing/hours to minimise impacts during peak pedestrian times and/or adjoining neighbour outdoor activity periods.	See Alternative construction methods to rock hammering and blasting in Section 6.3 All example NV7 mitigation measures will be considered in the development of CNVIS assessments.	Construction Manager Project Environment Manager Demolition Subcontractor	Prior to construction commencement	Section 6.3

6.2 Standard noise and vibration management measures

An indicative list of standard noise and vibration mitigation measures to be implemented for the Project construction works to reduce construction noise and vibration is provided in the tables that follow. This information is based on information available at the time of preparation of this NVMP and includes:

- Table 6-2 which identifies standard noise and vibration management measures;
- Table 6-3 which lists standard noise and vibration source mitigation measures;
- Table 6-4 which lists standard noise and vibration path mitigation measures;
- Table 6-5 which sets out standard noise and vibration receptor mitigation measures.

Table 6-2: Standard noise and vibration management measures

Action required	Applies to[1]	Details	Estimated noise benefit[2]	Comments on feasibility/ reasonableness	Recommend to adopt for project where reasonable & feasible?
Construction Noise and Vibration Management Plan update	Prior to construction	The NVMP and associated CNVIS, must be prepared prior to the commencement of Construction and regularly updated to account for changes in noise management issues and strategies.	N/A	N/A	Yes
Implementation of any project specific mitigation measures required	ABN, GBN, V	Project specific measures will be determined on a site by site basis and outlined in the CNVISs	0-30dB reduction	Yes	Yes
Implement community consultation or notification measures	ABN, GBN, V	Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night period, any operational noise benefits from the works (where applicable) and contact telephone number. Notification should be a minimum of seven calendar days prior to the start of works. For this project, more advanced consultation or notification should be adopted, including: • Website • Contact telephone number for community • Email distribution list (if required) More detail regarding community consultation and notifications is provided in Section 5.3 and Section 6.3	Ensures stakeholders know what to expect and keeps stakeholders informed of the likely impact. Community may identify solution to assist in managing impacts.	N/A	Yes
Register of Noise Sensitive Receivers	ABN, GBN, V	A register of all noise and vibration sensitive receivers (NSRs) would be kept. The register would include the following details for each NSR: • Address of receiver • Category of receiver (e.g. Residential/Commercial etc.) • Contact name and phone number This register will be based on the knowledge held by the contractor previously working on Sydney Metro City and Southwest Project at Barangaroo worksite (JHCPBG JV).	N/A Ensures worksites can contact NSRs.	N/A	Yes

Notes
1. ABN = Airborne noise, GBN = Ground-borne noise, V = Vibration
2. Estimated noise benefits are not necessarily cumulative

Action required	Applies to[1]	Details	Estimated noise benefit[2]	Comments on feasibility/ reasonableness	Recommend to adopt for project where reasonable & feasible?
Site inductions and briefings	ABN, GBN, V	All employees, contractors and subcontractors are to receive environment and community inductions and site briefings that will detail: • all project specific and relevant standard noise and vibration mitigation measures • relevant licence and approval conditions • community consultation and notification requirements • permissible hours of work • any limitations on high noise generating activities • location of nearest sensitive receivers • construction employee parking areas • designated loading/unloading areas and procedures • site opening/closing times (including deliveries) • community contact protocols • complaints management requirements.	Keeps construction workforce informed of actions required to minimise noise and vibration impact.	N/A	Yes
Behavioural practices	ABN, GBN, V	• No swearing or unnecessary shouting or loud stereos/radios on site. • No dropping of materials from height where practicable, throwing of metal items or solid objects onto metal items, and slamming of doors. • No excessive revving of plant and vehicle engines • Controlled release of compressed air.	0-20dB reduction Reduce annoyance + sleep disturbance.	Reasonable cost, limited noise reduction, reduced overall impact.	Yes
Verification	ABN, GBN, V	A noise verification program is to be carried out for the duration of the works in accordance with the NVMP and any approval and licence conditions. More detail on the program is provided in APPENDIX D. Ongoing noise monitoring during construction at sensitive receivers during critical periods (i.e. times when noise emissions are expected to be at their highest - e.g. piling and hammering) to identify and assist in managing high risk noise events.	Identifies and minimises noise and vibration impacts.	Reasonable cost, limited noise/vibration reduction, reduced overall impact.	Yes
Attended vibration measurements	V	Attended vibration measurements are required at the commencement of vibration generating activities to confirm that vibration levels satisfy the criteria for that vibration generating activity. Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the applicable safe-working distances.	Reduces vibration impact + risk of building damage. Identifies and minimises noise and vibration impacts.	Reasonable cost, and consideration of refinement of operations to reduce overall impact.	Yes

Notes 1. ABN = Airborne noise, GBN = Ground-borne noise, V = Vibration

2. Estimated noise benefits are not necessarily cumulative

Table 6-3: Standard noise and vibration source mitigation measures

Action required	Applies to[1]	Details	Estimated noise benefit[2]	Comments on feasibility/ reasonableness	Recommend to adopt for project where reasonable & feasible?
Construction hours and scheduling	ABN, GBN, V	Where feasible and reasonable, construction would be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels would be scheduled during less sensitive time periods. When working adjacent to recording studios, particularly noisy activities should be scheduled outside recording periods, where feasible and reasonable.	Minimise high noise impact and reduce risk of annoyance.	The diverse mix of land uses around worksites will make reaching any agreement on scheduling a significant challenge	Yes
Construction respite period - standard hours	ABN, GBN, V	Appropriate construction respites for each stage of the works will be finalised after consultation with receivers identified in accordance with Condition E37. As a guide, high noise generating activities near receivers should be carried out in blocks that do not exceed three hours each, with a minimum respite period of one hour between each block. The duration of each block of work and respite should be flexible to accommodate the usage and amenity at nearby receivers.	Minimise noise and vibration impact and reduce risk of annoyance.	Reasonable cost, limited noise/vibration reduction, reduced overall impact.	Yes
Consider vibration in selecting plant and equipment	ABN, GBN, V	Use quieter and less vibration emitting construction methods where feasible and reasonable.	0-20dB reduction depending on selected equipment	Reasonable cost, limited noise reduction, reduced overall impact.	Yes
Construction methodology/ Equipment selection	ABN, GBN, V, notably high noise impact works	Use quieter and less noise emitting construction methods where feasible and reasonable, especially where they can replace high noise or vibration impact works.	0-20dB reduction/ less vibration impact + risk of annoyance.	Variable noise/vibration reduction, reduced overall impact, cost varies. Reasonableness and feasibility needs to be determined on a case by case basis.	Yes
Maximum noise levels	ABN	The noise levels of plant and equipment must have operating Sound Power Levels compliant with the maximum noise levels stated in the CNVIS. Regular compliance checks on the noise emissions of all plant and machinery used for the project would indicate whether noise emissions from plant items were higher than predicted. This also identifies defective silencing equipment on the items of plant.	Varies depending on plant sound power level	Reasonable cost, variable noise reduction, minimum requirement.	Yes
Plant and equipment maintenance	ABN	Plant and equipment to be maintained and operated competently and in a proper and efficient manner by an appropriately qualified and experienced person	Varies depending on plant sound power level	Reasonable cost, variable noise reduction, minimum requirement.	Yes
Rental plant and equipment	ABN	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the maximum noise levels stated in the CNVIS.	Varies depending on plant sound power level	Reasonable cost, variable noise reduction, minimum requirement.	Yes

Plan worksites and activities to minimise noise and vibration	ABN, V	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site. Use site sheds and other structures within the worksite to provide additional noise barriers to receivers. The offset distance between noisy plant items and nearby NSRs should be as great as possible	Reduce noise/ vibration impact + risk of annoyance.	Reasonable cost, variable noise/vibration reduction, reduced overall impact.	Yes
Switch off plant not in use	ABN, V	Avoid the coincidence of noisy plant working simultaneously close together and adjacent to sensitive receivers to reduce noise to NSRs.	3-6dB reduction	Reasonable cost, medium reduction, where practicable	Yes
Non-tonal reversing alarms	ABN	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Whilst the use of non-tonal reversing alarms is suggested to ensure noise impacts are minimised, it is noted that WHS requirements must also be fully satisfied.	5-10dB reduction + reduce vibration	Reasonable cost, medium noise reduction	Yes
Minimise disturbance arising from delivery of goods to construction sites	ABN	Loading and unloading of materials/deliveries is to occur as far as possible from NSRs Select site access points and roads as far as possible away from NSRs Dedicated loading/unloading areas to be shielded if close to NSRs Delivery vehicles to be fitted with straps rather than chains for unloading, wherever feasible and reasonable	Reduce noise/ vibration impact + risk of annoyance.	Reasonable cost, variable noise/vibration reduction, reduced overall impact.	Yes
Engine silencing	ABN	The minimising of noise emissions from mobile plant by fitting residential grade mufflers on all mobile plant regularly used at worksites. Ensure plant including the silencer is well maintained. Heavy vehicle vehicles using the sites should have RMS compliant mufflers to control engine breaking noise.	0-20dB reduction Reduce annoyance + sleep disturbance.	Medium cost of install, moderate to high noise reduction.	Yes
Air brake silencing	OOHW truck movements ABN	Air brake silencers should be installed and fully operational for any heavy regularly used at worksite. This will reduce potential sleep disturbance impacts, especially at OOHW site exits	5-10dB LAmax reduction	Reasonable cost, medium noise reduction	Yes
Engine compression braking	ABN	Limit the use of engine compression brakes at night and in residential areas. Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedure' and standard.	5-20dB reduction	Reasonable cost, medium noise reduction	Yes

Notes
1. ABN = Airborne noise, GBN = Ground-borne noise, V = Vibration
2. Estimated noise benefits are not necessarily cumulative

Table 6-4: Standard noise and vibration path mitigation measures

Action required	Applies to[1]	Details	Estimated noise benefit[2]	Comments on feasibility/ reasonableness	Preferred action where reasonable & feasible?
Shield stationary noise sources such as pumps, compressors, fans, etc.	ABN	Stationary noise sources should be enclosed or shielded where feasible and reasonable whilst ensuring that the occupational health and safety of workers is maintained. Appendix D of AS 2436:2010 lists materials suitable for shielding.	5-10dB reduction	Reasonable cost, medium noise reduction, reduced overall impact.	Yes
Shield sensitive receivers from noisy activities	ABN	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.	5-10dB reduction	Reasonable cost, medium noise reduction, reduced overall impact.	Yes
Use temporary noise barriers around worksites	ABN	Where construction compounds share a common boundary with residential or other noise sensitive receivers, a temporary noise barrier of nominal height 2 to 3 metres should be installed to reduce noise impact to receivers.	5-10dB reduction	Medium cost, medium noise reduction, reduced overall impact.	Yes

Notes 1. ABN = Airborne noise, GBN = Ground-borne noise, V = Vibration

2. Estimated noise benefits are not necessarily cumulative

Table 6-5: Standard noise and vibration receptor mitigation measures

Action required	Applies to	Details	Estimated noise benefit[2]	Comments on feasibility/ reasonableness	Preferred action where reasonable & feasible?
Building condition surveys	Prior to commencement of construction using vibration significant plant	Undertake building dilapidation surveys on all buildings assessed as being at risk of property damage prior to commencement of activities with the potential to cause property damage.	Limits building damage.	Reasonable cost, limited vibration reduction, reduced overall impact.	Yes
Condition surveys and vibration monitoring	Prior to using vibration significant plant near highly sensitive buildings	Pre-construction condition surveys of vibration sensitive buildings may be warranted. At locations where there are high-risk receptors, such as the heritage buildings listed in Appendix B vibration monitoring should be conducted during the activities causing vibration.	Limits building damage and risk of annoyance to receivers.	Reasonable cost, limited vibration reduction, reduced overall impact.	Yes
Notes	1. ABN = Airborne noise, GBN = Ground-borne noise, V = Vibration 2. Estimated noise benefits are not necessarily cumulative				

6.3 Existing acoustic shed

BESIX Watpac will utilise the existing acoustic shed on the northern shaft on Hickson road to access the underground station and cross-over cavern and deliver materials required for the station fitout works.

6.4 Alternative methods to rock hammering

In accordance with CoA E35, the Proponent must review alternative methods to rock hammering and blasting (not currently proposed) for excavation as part of the detailed construction planning with a view to adopting methods that minimise impacts on sensitive receivers. The construction methodology is to adopt the least impact alternative in any given location unless it can be demonstrated, to the satisfaction of the AA, why it should not be adopted.

No excavation works are planned for the Project, however, hydraulic hammers are required for the demolition of piled walls, capping and steel beams, girders and the access bridge of the station box. After reviewing alternative demolition methodologies, BESIX Watpac is proposing to use a combination of pulverisers and hydraulic hammers whenever practicable. The use of pulveriser will be the preferred construction method, however, due to access limitations, hydraulic hammers may also be required. It is noted that the reduction in time spent using hydraulic hammers will provide the opportunity to offer respite periods to affected receivers.

6.5 Minimising vibration impacts

The pattern of vibration radiation is very different to the pattern of airborne noise radiation and is very site specific. Final vibration levels are dependent on many factors including the actual plant used, its operation and the intervening geology between the activity and the receiver.

Recommended minimum working distances presented in the following sections provide a conservative screening method for indicating buildings and structures where there is a risk of vibration impact. Vibration monitoring would be carried out to confirm the minimum working distances at specific sites, where vibration significant plant is required to operate within or near the recommended minimum working distances.

6.5.1 Human exposure

Many building occupants assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that can cause damage to structures. At properties near the construction works nearby receivers may be able to feel vibration when vibration-generating equipment is being utilised. For this reason it is appropriate identify properties where there is a probability of adverse comment so that impacts can be managed.

Recommended minimum working distances for typical vibration intensive construction equipment for human comfort (response) are shown in Table 6-6. These recommended distances relate to continuous vibration and are presented as a guide only. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels occurring over shorter time periods are allowed (see Section 4.8).

Table 6-6: Recommended minimum working distances (m) – human comfort (response)

Vibration significant plant item	Critical area	Residence (Day)	Residence (Night)	Office	Workshop
Concrete saw	15	10	10	5	5
Excavator 5t with auger	20	10	15	5	5
Excavator (tracked) ≤ 15t + hydraulic hammer	30	20	25	15	10
Excavator (tracked) ≤ 35t + hydraulic hammer	40	25	30	20	15
Piling rig - vibratory driven	305	170	225	100	55
Pneumatic hammer (jackhammer)	25	15	20	10	5
Vibratory roller ≤ 25t padfoot	120	70	90	40	25
Wacker packer	20	10	15	5	5

6.5.2 Buildings and structures

To limit the risks of vibration-induced damage on all nearby buildings and structures, pre- and post-construction building condition surveys will be conducted, in accordance with CoA E59 and E60. The inspections will document the existing condition of the property and typically note the location of all visible cracks and/or defects observed by the inspector. The post construction survey will record any changes to the property at construction completion.

Recommended minimum working distances to reduce the risk of cosmetic damage to buildings or structures from typical vibration intensive construction equipment are presented in Table 6-7 following. These are aimed at reducing the risk of cosmetic damage (as per BS 7385:1993 and DIN 4150-3:-2016) and are based on the vibration screening criteria set in Section 4.8.

Unlike noise, vibration cannot be readily predicted. The minimum working distances below are indicative and will vary depending on the plant item, building types and foundations and local geotechnical conditions. Vibration monitoring would be carried out to confirm the site specific minimum working distances for this Project.

Table 6-7: Minimum working distances (m) – cosmetic damage[1]

Vibration significant plant item	Reinforced or frame structures (BS7385)[2]	Unreinforced or light framed structures (BS7385)[2]	Structurally unsound heritage structures (DIN 4150-3)[3]	Site-specific MWD for the Hickson Road wall[7]
Concrete/ road saw	5	5	5	1[5]
Excavator 5t with auger	5	5	10	1[5]

Vibration significant plant item	Reinforced or frame structures (BS7385)[2]	Unreinforced or light framed structures (BS7385)[2]	Structurally unsound heritage structures (DIN 4150-3)[3]	Site-specific MWD for the Hickson Road wall[7]
Excavator (tracked) ≤ 25t + hydraulic hammer	5	5	10	1[4]
Excavator (tracked) 26-35t + hydraulic hammer	5	10	10	5[6]
Piling rig - vibratory driven (upper range)	10	20	50	10[6]
Pneumatic hammer (jackhammer)	5	5	5	1[5]
Vibratory roller ≤ 25t padfoot	5	10	20	5[6]
Wacker packer	5	5	5	1[5]

Notes:
1. Minimum working distances are in 5m increments only to account for the intrinsic uncertainty of this screening method
2. Minimum working distance based on vibration screening criterion which reduced the cosmetic damage levels set by BS7385 (see table 4-10) by 50% due to potential dynamic magnification.
3. A building condition inspection should determine whether a heritage item is structurally unsound.
4. Refer to vibration monitoring report (reference: TM031-05F02 Rockhammering Noise and Vibration Monitoring Report, dated: 19/09/2022, revision 2).
5. The site-specific MWDs has been derived from the rockhammering vibration monitoring assuming this plant is less vibration intensive.
6. Valid until monitoring verification onsite confirms otherwise.
7. Applicable in situations where there is the same structural connection to the Hickson Road wall as during the vibration measurements on 15/07/2022

CoA E29 requires owners of properties at risk of exceeding the screening criteria for cosmetic damage to be notified before the commencement of vibration-generating works. Properties at risk of cosmetic damage will be identified through the vibration screening drawings, prepared based on proposed vibration intensive construction activities and presented in the CNVIS prepared for the Project. To provide an indication of the typical worst case vibration impact, vibration screening drawings based on the likely highest vibration generating plant are presented in the . Structures within the minimum working distance screening limits and potentially at risk of damage from vibration are identified on the drawings in APPENDIX D.

Where properties are identified as within the recommended minimum working distances presented in CNVIS, vibration monitoring is recommended to determine site specific minimum working distances that will prevent cosmetic and structural damage. If the monitoring above identifies that vibration is likely to exceed the screening criteria for cosmetic damage, further analysis would be undertaken, including consideration of a different construction method with lower source vibration levels and/or implement additional mitigation measures to prevent damage.

6.6 Additional noise and vibration management measures

During the Project construction works there will be circumstances where after application of the all reasonable and feasible mitigation measures identified in Table 6-2 to Table 6-5, the construction noise and vibration objectives (refer Section 4) will be exceeded. In these instances, and consistent with the Sydney Metro CNVS, additional noise and vibration management may be applicable, taking into

consideration when works are being undertaken (standard hours or OOHW) and the level of exceedance.

Additional management measures to be applied when mitigating and managing impacts from the Project construction works in the CNVISs are described in Table 6-8.

Table 6-8: Additional management measures

Measure	Description	Abbreviation
Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time.	AA[1]
Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.	M
Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.	IB
Letter box drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.	LB
Project specific respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.	RO
Phone calls and emails	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.	PC
Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.	SN

Notes:
1) In this section, this abbreviation refers to Alternative Accommodation. It has been also used for Acoustic Advisor in Section 2.

6.6.1 Applying additional management measures - airborne construction noise

In circumstances where, after application of all reasonable and feasible mitigation measures, the $L_{Aeq(15minute)}$ airborne construction noise levels are still predicted to exceed the NMLs, additional airborne noise management measures can be applied to further limit the risk of annoyance from construction noise. This requirement is supplemental to the basic requirements in the ICNG. These measures are consistent with the approach outlined in the Sydney Metro City and Southwest Construction Noise and Vibration Strategy (SMCSNVS) [15].

The steps to be carried out to determine the additional management measures to be implemented are identified in Figure 6.1.

Figure 6.1: Additional airborne noise mitigation measures

Time Period		Mitigation Measures			
		Predicted $L_{Aeq(15minute)}$ Noise Level Above Background (RBL)			
		0 to 10 dB	10 to 20 dB	20 to 30 dB	> 30 dB
Standard	Mon-Fri (7.00 am - 6.00 pm)	-	-	M, LB,	M, LB
	Sat (8.00 am - 1.00 pm)				
	Sun/Pub Hol (Nil)				
OOHW 1	Mon-Fri (6.00 pm - 10.00 pm)	-	LB	M, LB	M, IB, LB, PC, RO,SN
	Sat (1.00 pm - 10.00 pm)				
	Sun/Pub Hol (8.00 am - 6.00 pm)				
OOHW 2	Mon-Fri (10.00 pm - 7.00 am)	-	M, LB,	M, IB, LB, PC, RO, SN	AA, M, IB, LB, PC, RO, SN
	Sat (10.00 pm - 8.00 am)				
	Sun/Pub Hol (6.00 pm - 7.00 am)				

Notes: LB = Letter box drops
M = Monitoring
PC = Phone Call and email
SN = Specific notifications
IB = Individual Briefing
RO = Project specific respite offer
AA* = Alternative accommodation

Where OOHW occur in the evening/night shoulder period (10:00pm to 12:00am) or the night/morning shoulder period (5:00am to 7:00am) apply additional airborne mitigation measures from the OOHW Period 2, excluding AA.

*AA applies where a construction activity impacts receivers over 2 or more consecutive nights.

6.6.2 Applying additional management measures – ground-borne construction noise

In circumstances where, after application of all reasonable and feasible mitigation measures, the $L_{Aeq(15minute)}$ ground-borne construction noise levels are still predicted to exceed the ground-borne NML identified in Table 4-7 ,additional ground-borne noise management measures can be applied to further limit the risk of annoyance from construction noise. This requirement is supplemental to the basic requirements in the ICNG.

The steps to be carried out to determine the additional management measures to be implemented are identified in Figure 6.2.

Figure 6.2: Additional ground borne noise management measures

Time Period		Mitigation Measures		
		Predicted $L_{Aeq(15minute)}$ Noise Level Exceedance		
		0 to 10 dB	10 to 20 dB	> 20 dB
Standard	Mon-Fri (7.00 am - 6.00 pm)	LB	LB	M, LB, SN,
	Sat (8.00 am - 1.00 pm)			
	Sun/Pub Hol (Nil)			
OOHW 1	Mon-Fri (6.00 pm - 10.00 pm)	LB	M, LB, SN,	M, IB, LB, PC, RO, SN
	Sat (1.00 pm - 10.00 pm)			
	Sun/Pub Hol (8.00 am - 6.00 pm)			
OOHW 2	Mon-Fri (10.00 pm - 7.00 am)	M, LB, SN,	AA, M, IB, LB, PC, RO, SN	AA, M, IB, LB, PC, RO, SN
	Sat (10.00 pm - 8.00 am)			
	Sun/Pub Hol (6.00 pm - 7.00 am)			

Notes: LB = Letter box drops
M = Monitoring
PC = Phone call and email
SN = Specific notifications
IB = Individual briefing
RO = Project specific respite offer
AA** = Alternative accommodation

Where OOHW occur in the evening/night shoulder period (10:00pm to 12:00am) or the night/morning shoulder period (5:00am to 7:00am) apply additional airborne mitigation measures from the OOHW Period 2, excluding AA.

*AA applies where a construction activity impacts receivers over 2 or more consecutive nights.

6.6.3 Applying additional management measures – construction vibration

In circumstances where, after application of all reasonable and feasible mitigation measures, construction vibration is still found to exceed the maximum Vibration Dose Value outlined in Table 4-8, additional vibration management measures can be applied to further limit the risk of annoyance from construction noise.

The steps to be carried out to determine the additional management measures to be implemented are identified in Figure 6.3.

Figure 6.3: Additional vibration management measures

Time Period		Mitigation Measures Predicted Vibration Levels Exceed Maximum Levels
Standard	Mon-Fri (7.00 am - 6.00 pm)	M, LB, RP
	Sat (8.00 am - 1.00 pm)	
	Sun/Pub Hol (Nil)	
OOHW 1	Mon-Fri (6.00 pm - 10.00 pm)	M, IB, LB, PC, RO, SN
	Sat (1.00 pm - 10.00 pm)	
	Sun/Pub Hol (8.00 am - 6.00 pm)	
OOHW 2	Mon-Fri (10.00 pm - 7.00 am)	AA, M, IB, LB, PC, RO, SN
	Sat (10.00 pm - 8.00 am)	
	Sun/Pub Hol (6.00 pm - 7.00 am)	

Notes: LB = Letter box drops
M = Monitoring
PC = Phone call and email
SN = Specific notifications
IB = Individual briefing
RO = Project specific respite offer
AA* = Alternative accommodation

Where OOHW occur in the evening/night shoulder period (10:00pm to 12:00am) or the night/morning shoulder period (5:00am to 7:00am) apply additional airborne mitigation measures from the OOHW Period 2, excluding AA.

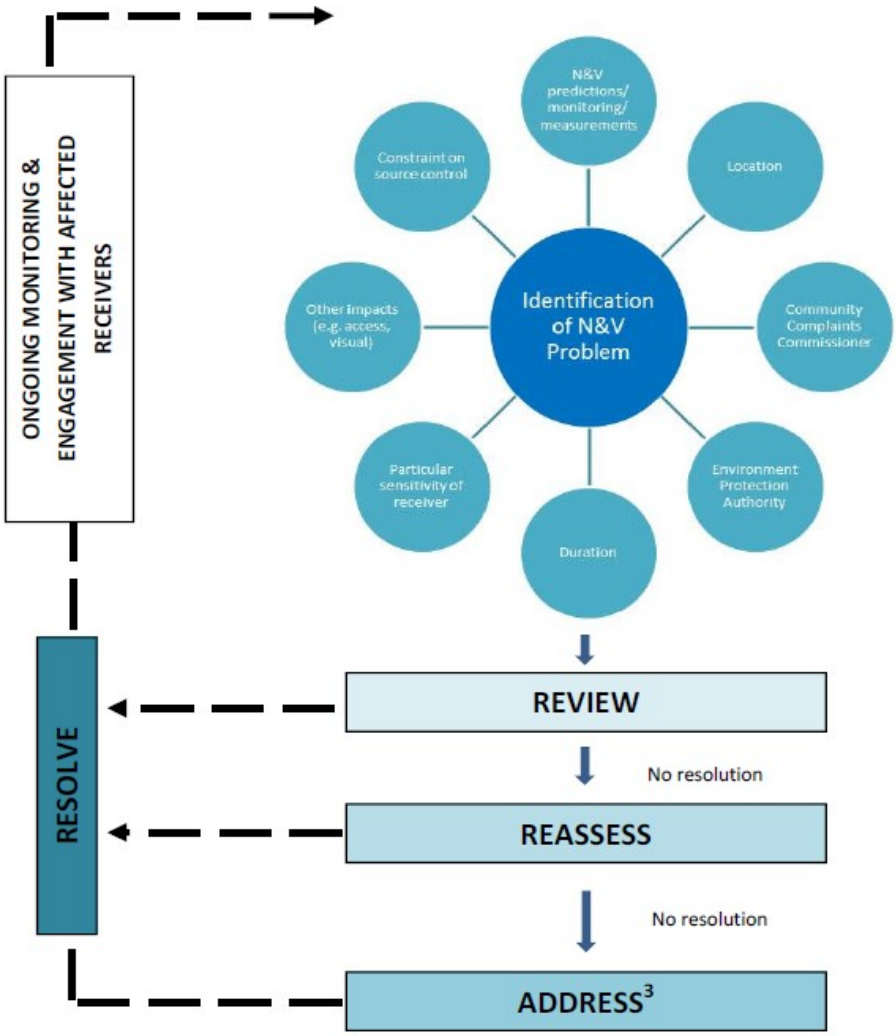
*AA applies where construction activity impacts receivers over 2 or more consecutive nights.

If the predicted ground-borne vibration levels exceed the structural damage objectives in Section 4, a different construction method with lower source vibration levels should be considered. Attended measurements should be undertaken at the commencement of all high vibration generating activities. If there is any risk of exceedance of the structural damage objective, a permanent vibration monitoring system should be installed, to warn plant operators (via flashing light, audible alarm, SMS, etc.) when vibration levels are approaching the structural damage objective.

6.6.4 Applying additional management measures – Exceedances of internal noise levels

Should detailed modelling as part of CNVIS predictions indicate exceedances of the noise and vibration objectives, the process described in Addendum A2 of the Sydney Metro CNVS (Figure 6.4) will be followed to identify additional mitigation and management measures.

Figure 6.4: Mitigation process for locations where impacts are predicted to be long term and significant



Note 3 – Additional mitigation measures are to be considered (e.g. at property treatment, temporary relocation, other forms of mitigation where impacts are predicted to be long term and significant)

7 Compliance management

7.1 Roles and responsibilities

Specific responsibilities for the implementation of environmental controls are detailed in NVMP compliance matrix.

7.2 Training

All employees, contractors, sub-contractors and utility staff working on site will undergo site induction training that includes construction noise and vibration management issues. The induction training will address elements related to noise and vibration management including:

- Existence and requirements of this sub-plan
- Relevant legislation
- Approved construction hours
- The process for seeking approval for OOHW, including consultation
- Location of noise sensitive areas
- Complaints reporting
- General noise and vibration management measures

Specific responsibilities to minimise impacts on the community and built environment from noise and vibration associated with the works.

7.3 Inspection and monitoring

Weekly and other routine inspections by the BESIX Watpac Team, Sydney Metro, AA will occur throughout construction.

Noise and vibration monitoring will also occur routinely for the duration of the Project, in accordance with the Project's Noise and Vibration Monitoring Program, which is detailed in APPENDIX E.

The noise and vibration monitoring program details when monitoring will be undertaken, as well as the representative locations adjacent to the construction works where noise and vibration monitoring will be undertaken.

To satisfy CoA C11, where real time noise and vibration monitoring is undertaken, the data would be readily available to the construction team, Sydney Metro, AA. DPIE and EPA would be provided with access to the real-time monitoring data in real-time.

Monitored noise and vibration levels will be analysed against the predictions made in the relevant noise and vibration assessments. Where monitored noise levels are found to be above modelling predictions or vibration goals are exceeded, the following actions will be undertaken:

- Cease the noise and/or vibration generating source which causes the exceeded predictions,
- Confirm the monitored levels are not being impacted by other (non-Project related) noise or vibration sources,
- Confirm if the exceedance is due to an uncharacteristically loud piece of equipment,
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant, or if additional mitigation can be included in the site design,
- Confirm that the modelling reflects the actual activity being undertaken,
- Implement other feasible and reasonable measures which may include reducing plant size, modifying time of works, changing operational settings (such as turning off the vibratory function of the machine), and utilising alternative construction methodology or a combination of these,
- Review and revision of additional mitigation measures previously applied where appropriate,
- Review work practices to ensure compliance with the management levels set out in this NVMP,
- Ensure that the learnings from the above are fed back into the noise modelling assessment process for fine-tuning,
- Continue work where impacts can be reduced and
- Communicate lessons learnt to relevant personnel.

7.4 Complaints

Complaints will be recorded and managed as detailed in the Community Communications Strategy and Business Management Plan.

7.5 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this NVMP, CoA and other relevant approvals and guidelines.

Audit requirements are detailed in the CEMP.

7.6 Reporting

Reporting requirements and responsibilities are documented in the CEMP. The complaints management and reporting procedure is described in Section 5.3.4.

7.7 Records Management

Records will be maintained by the Planning and Environment manager and Stakeholder and Community Manager of the following:

- Any complaints received in relation to noise or vibration
- Out of Hours permits applied for and issued
- Approvals received
- Hold point clearances for out of hours works
- Compliance Monitoring undertaken

8 Review and improvement

8.1 Continuous improvement

Continuous improvement of this Plan will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

- Identify areas of opportunity for improvement of environmental management and performance;
- Determine the cause or causes of non-conformances and deficiencies;
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies;
- Verify the effectiveness of the corrective and preventative actions;
- Document any changes in procedures resulting from process improvement;
- Make comparisons with objectives and targets.

8.2 Update and amendment

The processes described the CEMP may result in the need to update or revise this Plan. This will occur as needed, in accordance with the process outlined in the CEMP.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure – refer to the CEMP.

References

1. Department of Environment and Climate Change 2009 NSW Interim Construction Noise Guideline
2. Environment Protection Authority 1999 NSW Environmental Criteria for Road Traffic Noise
3. Department of Environment Conservation NSW 2006 Assessing Vibration; a technical guideline
4. British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)
5. German Standard DIN 4150-3: 1999-02, Structural vibration - Effects of vibration on structures, February 1999
6. ASHRAE Applications Handbook (SI) 2003, Chapter 47 Sound and Vibration Control, pp47.39-47.40
7. Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration, p16
8. Australian Standard AS/NZS 2107:2016 *Acoustics - Recommended design sound levels and reverberation times for building interiors*
9. Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives
10. Gordon CG 1991 Generic Vibration Criteria for Vibration Sensitive Equipment *Proceedings of International Society for Optical Engineering (SPIE)*, Vol. 1619, San Jose, CA, November 4-6, 1991, pp. 71-85
11. Transport for NSW Construction Noise and Vibration Strategy, reference ST-157/4.1, version 4.1, dated 23 April 2019
12. Australian Standard AS2187:2-1993 Explosives - Storage and use Part 2: Use of explosives (superseded by AS2187:2-2006)
13. Sydney Metro City and Southwest Chatswood to Sydenham, Out of Hours Works Protocol , Document reference: SM-17-00005396, version 5.2, dated 9 October 2020
14. Sydney Metro Overarching Community Communications Strategy, Sydney Metro Document Reference: A5732897, Revision 5.3 (FINAL), 12 April 2017
15. Sydney Metro City and Southwest Chatswood to Sydenham, Construction Noise and Vibration Strategy, Document reference: 610.14213 R3, version 0.4, dated 8 August 2016

APPENDIX A Glossary of terminology

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

Absorption Coefficient α	The absorption coefficient of a material, usually measured for each octave or third-octave band and ranging between zero and one. For example, a value of 0.85 for an octave band means that 85% of the sound energy within that octave band is absorbed on coming into contact with the material. Conversely, a low value below about 0.1 means the material is acoustically reflective.
Adverse weather	Weather effects that enhance noise (particularly wind and temperature inversions) occurring at a site for a significant period of time. In the NSW INP this occurs when wind occurs for more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of nights in winter.
Active recreation	Active recreation area, characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion, e.g. school playground, golf course
Air-borne noise	Noise which is fundamentally transmitted by way of the air and can be attenuated by the use of barriers and walls placed physically between the noise source and receiver.
Alternate Solution	An Alternative Solution is a design that complies with the relevant Performance Requirements of the National Construction Code other than by using Deemed-to-Satisfy Provisions.
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Amenity	A desirable or useful feature or facility of a building or place.
AS	Australian Standard
Assessment period	The time period in which an assessment is made. e.g. Day 7am-6pm, Evening 6pm-10pm, Night 10pm-7am.
Assessment Point	A location at which a noise or vibration measurement is taken or estimated.
Attenuation	The reduction in the level of sound or vibration.
Audible Range	The limits of frequency which are audible or heard as sound. The normal hearing in young adults detects ranges from 20 Hz to 20 kHz, although some people can detect sound with frequencies outside these limits.
A-weighting	A filter applied to the sound recording made by a microphone to approximate the response of the human ear.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the LA90 noise level if measured as an overall level or an L90 noise level when measured in octave or third-octave bands.
Barrier (Noise)	A natural or constructed physical barrier which impedes the propagation of sound and includes fences, walls, earth mounds or berms and buildings.
Berm	Earth or overburden mound.
Buffer	An area of land between a source and a noise-sensitive receiver and may be an open space or a noise-tolerant land use.
Bund	A bund is an embankment or wall of brick, stone, concrete or other impervious material, which may form part or all of the perimeter of a compound.
BS	British Standard
CoRTN	United Kingdom Department of Environment entitled "Calculation of Road Traffic Noise (1988)"

Decibel [dB]	The units of sound measurement. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear, defined as 20 micro Pascal 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibel. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies. The dB(C) level is not widely used but has some applications.
Diffraction	The distortion of sound waves caused when passing tangentially around solid objects.
DIN	German Standard
DnT,w	Weighted Standardised Field Level Difference A measure of sound insulation performance of a building element. It is characterised by the difference in noise level on each side of a wall or floor. It is measured in-situ. It is a field measurement that relates to the Rw laboratory measured value but is not equal to it because an in-situ space is not of the same quality as a laboratory space. The value is indicative of the level of speech privacy between spaces. The higher its value the better the insulation performance.
ECRTN	Environmental Criteria for Road Traffic Noise, NSW, 1999
EPA	Environment Protection Authority
Field Test	A test of the sound insulation performance in-situ. See also 'Laboratory Test' The sound insulation performance between building spaces can be measured by conducting a field test, for example, early during the construction stage or on completion. A field test is conducted in a non-ideal acoustic environment. It is generally not possible to measure the performance of an individual building element accurately as the results can be affected by numerous field conditions.
Fluctuating Noise	Noise that varies continuously to an appreciable extent over the period of observation.
Free-field	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Ground-borne noise	Vibration propagated through the ground and then radiated as noise by vibrating building elements such as wall and floor surfaces. This noise is more noticeable in rooms that are well insulated from other airborne noise. An example would be vibration transmitted from an underground rail line radiating as sound in a bedroom of a building located above.

Habitable Area	Includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom. Excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.
Heavy Vehicle	A truck, transporter or other vehicle with a gross weight above a specified level (for example: over 8 tonnes).
Impact Noise	The noise in a room, caused by impact or collision of an object onto the walls or the floor. Typical sources of impact noise are footsteps on the floor above a tenancy and the slamming of doors on cupboards mounted on the common wall between tenancies.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
INP	NSW Industrial Noise Policy, EPA 1999
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
Intrusive noise	Refers to noise that intrudes above the background level by more than 5 dB(A).
ISEPP	State Environmental Planning Policy (Infrastructure), NSW, 2007
ISEPP Guideline	Development Near Rail Corridors and Busy Roads - Interim Guideline, NSW Department of Planning, December 2008
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
$L_{10(1hr)}$	The L10 level measured over a 1 hour period.
$L_{10(18hr)}$	The arithmetic average of the L10(1hr) levels for the 18 hour period between 6am and 12 midnight on a normal working day.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{Aeq} or L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time, which would produce the same energy as a fluctuating sound level. When A-weighted, this is written as the L_{Aeq}.
$L_{Aeq(1hr)}$	The L_{Aeq} noise level for a one-hour period. In the context of the NSW EPA's Road Noise Policy it represents the highest tenth percentile hourly A-weighted L_{eq} during the period 7am to 10pm, or 10pm to 7am (whichever is relevant).
$L_{Aeq(8hr)}$	The L_{Aeq} noise level for the period 10pm to 6am.
$L_{Aeq(9hr)}$	The L_{Aeq} noise level for the period 10pm to 7am.
$L_{Aeq(15hr)}$	The L_{Aeq} noise level for the period 7am to 10pm.
$L_{Aeq\ (24hr)}$	The L_{Aeq} noise level during a 24 hour period, usually from midnight to midnight.
L_{max}	The maximum sound pressure level measured over a given period. When A-weighted, this is usually written as the L_{Amax}.
L_{min}	The minimum sound pressure level measured over a given period. When A-weighted, this is usually written as the L_{Amin}.
Ln,w	Weighted Normalised Impact Sound Pressure Level A measure of the sound level transmitted from impacts on a floor to a tenancy below. It is measured in very controlled conditions in a laboratory and is characterised by how much sound reaches the receiving room from a standard tapping machine. A lower value indicates a better performing floor.

LnT,w	Weighted Standardised Field Impact Sound Pressure Level As for Ln,w but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement. The equivalent measurement in a laboratory is the Ln,w. A lower value indicates a better performing floor.
Laboratory Test	The performance of a building element when measured in a laboratory. The sound insulation performance of a building element installed in a building however can differ from its laboratory performance for many reasons including the quality of workmanship, the size and shape of the space in which the measurement is conducted, flanking paths and the specific characteristics of the material used which may vary from batch to batch.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on. That is, the sound of 85 dB is four times or 400% the loudness of a sound of 65 dB.
Microphone	An electro-acoustic transducer which receives an acoustic signal and delivers a corresponding electric signal.
NCA	Noise Catchment Area. An area of study within which the noise environment is substantially constant.
Noise	Unwanted sound
NRC	Noise Reduction Coefficient. A measure of the ability of a material to absorb sound. The NRC is generally a number between 0 and 1 but in some circumstances can be slightly greater than 1 because of absorption at the edges of the material. A material with an NRC rating of 1 absorbs 100% of incoming sound, that is, no sound is reflected back from the material. The NRS is the average of the absorption coefficient measured in the octave bands 250Hz, 500Hz, 1kHz & 2kHz which correspond to the predominant frequencies associated with the human voice.
Passive recreation	Area specifically reserved for passive recreation, characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion e.g. reading, meditation
PPA	Project Planning Approval
Reflection	Sound wave reflected from a solid object obscuring its path.
Reverberation Time	The time (in seconds) it takes for a noise signal within a confined space to decay by 60dB. The longer the reverberation time (usually denoted as RT60), the more echoic a room. Longer reverberation times generally result in higher noise levels within spaces.
RMS	Root Mean Square value representing the average value of a signal.
Rw	Weighted Sound Reduction Index A measure of the sound insulation performance of a building element. It is measured in very controlled conditions in a laboratory. The term supersedes the value STC which was used in older versions of the Building Code of Australia. Rw is measured and calculated using the procedure in ISO 717-1. The related field measurement is the DnT,w. The higher the value the better the acoustic performance of the building element.
R'w	Weighted Apparent Sound Reduction Index. As for Rw but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement. The higher the value the better the acoustic performance of the building element.
RNP	Road Noise Policy, NSW, March 2011
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.

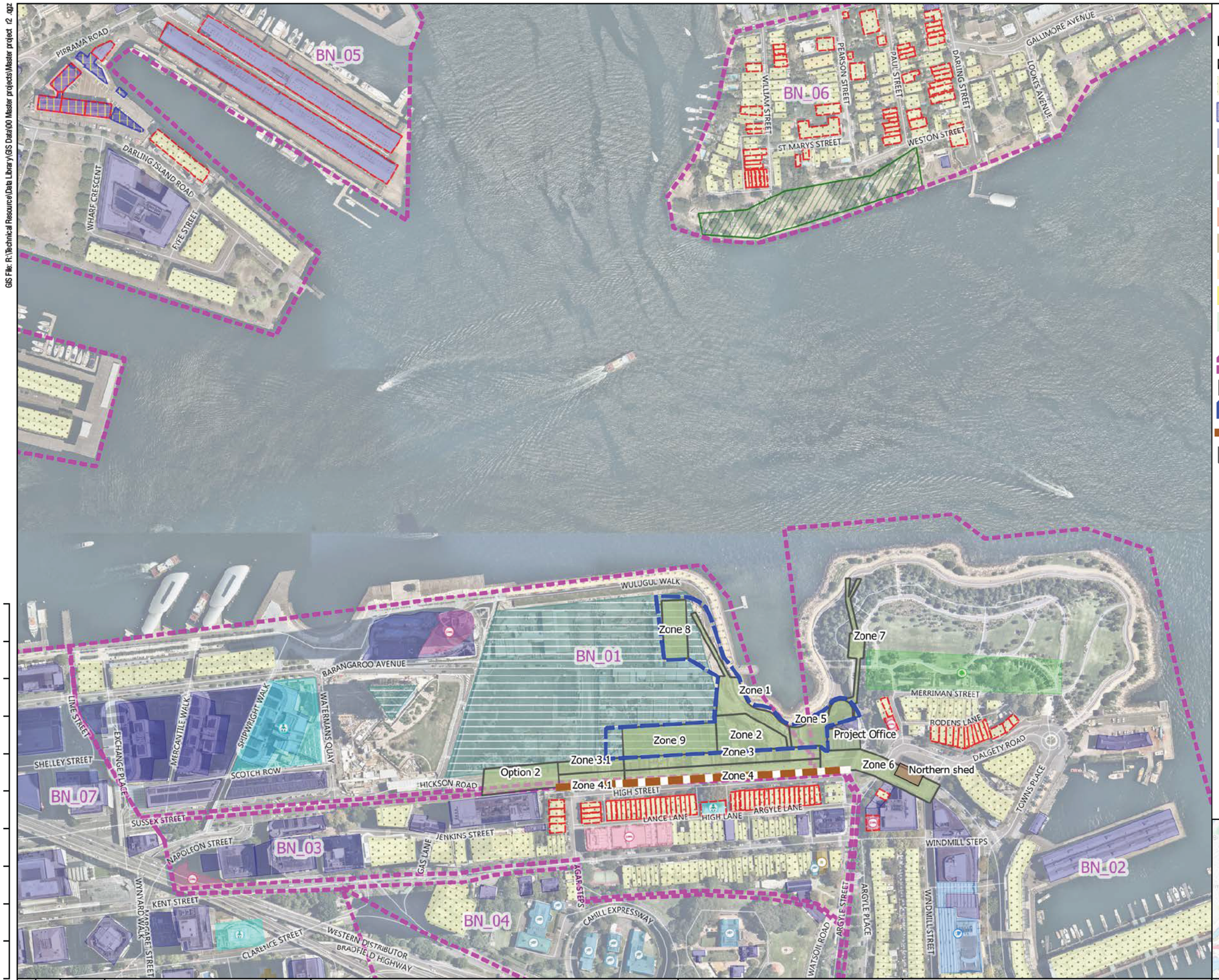
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy by conversion to thermal energy.
Sound Insulation	Sound insulation refers to the ability of a construction or building element to limit noise transmission through the building element. The sound insulation of a material can be described by the Rw and the sound insulation between two rooms can be described by the DnT,w.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 pico watt.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone referenced to 20 mico Pascal.
Spoil	Soil or materials arising from excavation activities.
Standardised	A method of adjusting the measured noise indices in-situ so that they are independent of the measuring space. The noise level in a room is affected by reverberation in the room. For example, the L'n,w impact sound pressure level measured in a room is dependent upon the amount of absorptive material in the receiving room. The value is adjusted to what would be measured if the reverberation time in the receiving room is set at 0.5 seconds. This enables the same value to be reported independent of whether the room contains carpet and furnishings and the like. See also 'Normalised'.
STC	Sound Transmission Class A measure of the sound insulation performance of a building element. It is measured in controlled conditions in a laboratory. The term has been superseded by Rw.
Structure-borne Noise	Audible noise generated by vibration induced in the ground and/or a structure. Vibration can be generated by impact or by solid contact with a vibrating machine. Structure-borne noise cannot be attenuated by barriers or walls but requires the isolation of the vibration source. This can be achieved using a resilient element placed between the vibration source and its support such as rubber, neoprene or springs or by physical separation (using an air gap for example). Examples of structure-borne noise include the noise of trains in underground tunnels heard to a listener above the ground, the sound of footsteps on the floor above a listener and the sound of a lift car passing in a shaft. See also 'Impact Noise'.
Tonal Noise	Sound containing a prominent frequency and characterised by a definite pitch.
Transmission Loss	The sound level difference between one room or area and another, usually of sound transmitted through an intervening partition or wall. Also the vibration level difference between one point and another. For example, if the sound level on one side of a wall is 100dB and 65dB on the other side, it is said that the transmission loss of the wall is 35dB. If the transmission loss is normalised or standardised, it then becomes the Rw or R'w or DnT,w.

APPENDIX B Land Use Survey, Noise Catchment Areas (NCA) and Noise Management Levels (NML)

Land-Use file revision date: r37 19/05/21

Plot Date: 16/06/21 - 11:56 Layout: TM031 Vibration screening for cosmetic damage r0

GIS File: R:\Technical Resource\Data Library\GIS Data\00 Master projects\Master project r2.aprx



LEGEND

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- Residen ial
- Mixed use
- Commercial
- ndus rial
- Ho el/Mo el/Hos el
- Medical facili y
- Place of Worship
- Communi y cen re
- Recording s udio
- Library/Museum
- Childcare
- Educa ional
- Thea re/Audi orium
- Cinema
- Labora ory
- Fligh simula or
- Horse S able
- Recrea ional - Passive
- Recrea ional - Ac ive
- O her
- Heri age

- NCA
- Nor hern shed
- A-class hoarding
- Heri age Wall
- Pro ec Work Zones

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BESIX Watpac

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RENZO TONIN & ASSOCIATES

inspired to achieve

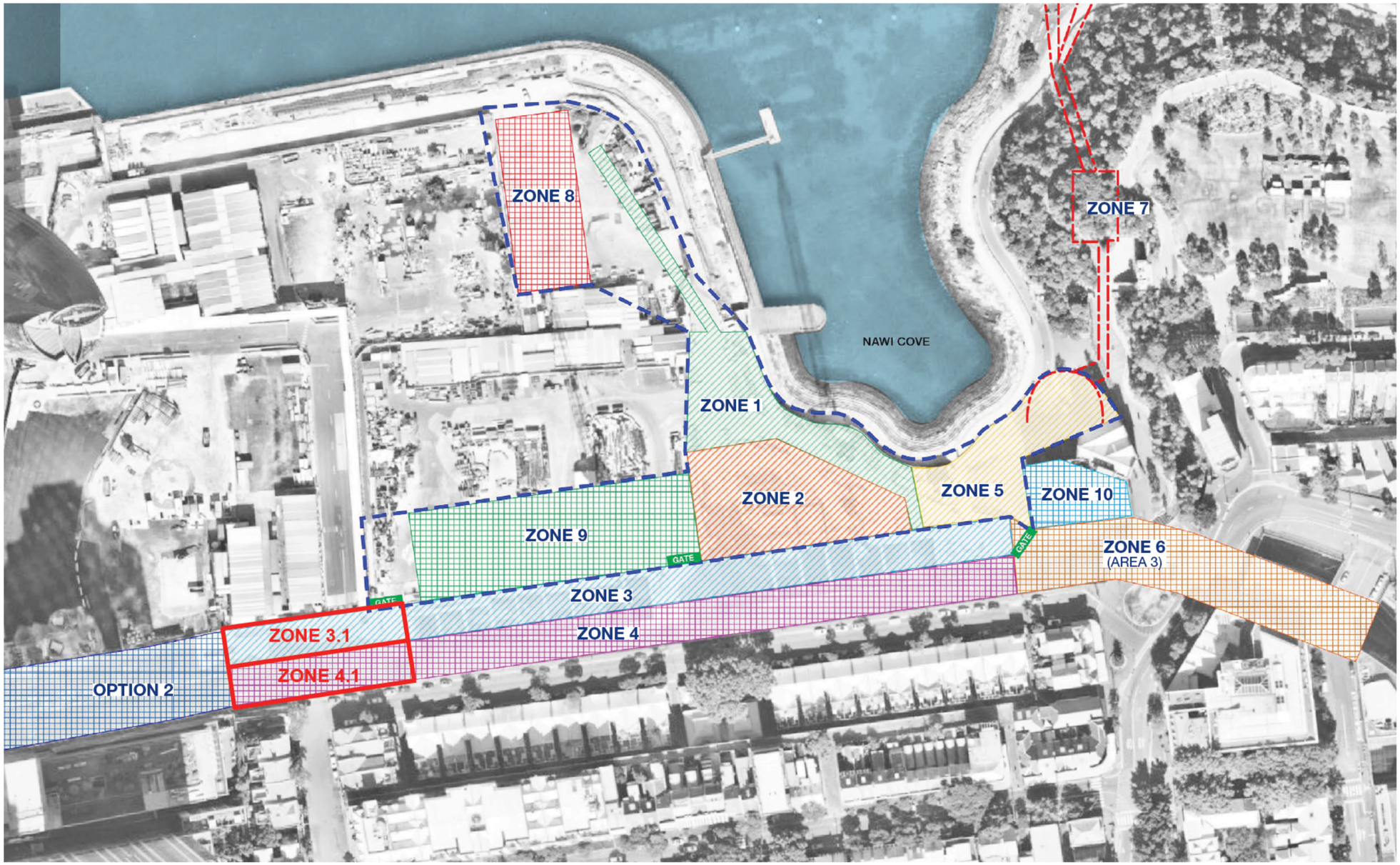
Ph (02) 8218 0500 Fax (02) 8218 0501

Sydney Metro Barangaroo Stat on

Land Use, NCAs
All Project Work Zones

Sheet 1 o 1

APPENDIX C Indicative site layouts and schedule of construction activities



LEGEND

- ZONE 1 - STORMWATER MAIN DISCHARGE
- ZONE 2 - SHARK FIN
- ZONE 3 - WEST STAGE
- ZONE 4 - EAST STAGE
- ZONE 5 - NORTH-WEST CORNER
- ZONE 6 (AREA 3) - NORTH STAGE
- OPTION 2 - SOUTH STAGE
- ZONE 7 - SEAWATER HEAT EXCHANGER STAGE
- ZONE 8 - SITE COMPOUND
- ZONE 9 - LAYDOWN PRE-ASSEMBLY AREA (SA-H17B)
- ZONE 10 - PROJECT OFFICE
- GATE — ACCESS GATE
- A-CLASS HOARDING

Sydney Metro City & South West

Barangaroo Construct Only Package

NOT TO SCALE
NOT FOR CONSTRUCTION

DRAWING NAME:
PROJECT WIDE ZONING

REV: 01 **DATE:** 23/4/2021

BESIX Watpac

Table C1: Construction timetable/ activities/ equipment **BARANGAROO**

Activity	Aspect	Indicative timing/ Duration	Work area	Plant/ Equipment	Plant/ Equipment (as provided by client)	Number of plant/equipment items (operating on site)			Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise plant	Vibration intensive plant	Notes
						Day 7am - 6pm	Evening 6pm - 10pm	Night 10pm - 7am	L_{Aeq}	Penalty	L_{Amax}			
Surface Works	Site preparation and establishment (mobilisation fencing etc)	October 2021 / Less than 1 month	All Zones	Telehander / Franna crane (20t)	Franna Crane	1	-	-	98	-	102	-	-	
				Handtool - power	Hand tools	2	-	-	108	-	118	-	-	
				EWP	EWP	1	-	-	95	-	98	-	-	
				Excavator with auger (5t)	Excavator with auger attachment	1	-	-	102	-	106	-	X	
				Hiab	Hiab	2	-	-	95	-	98	-	-	
				Excavator w bucket (5t)	Small excavators	1	-	-	101	-	114	-	-	
				Forklift	Forklift	1	-	-	99	-	103	-	-	
	Demolition works (girders etc)	October 2021 - November 2021 / 1 month	Zone 3	Excavators with hammers (35-45T)	30t excavator with rock breaking tool	1	-	-	118	5	126	HN	X	
			Zone 3 Zone 9	Mobile crane (20t-250t)	150t crawler crane	1	-	-	104	-	108	-	-	
			Zone 3 Zone 4	Handtool - rattle gun	Rattle guns	2	-	-	107	-	118	-	-	
			Zone 9	Welding tools /oxy	Oxy Acetylene torch	1	-	-	96	-	107	-	-	
			Zone 3 Zone 4	Excavators with hammers (10-15T)	Concrete pecker / rock hammer	1	-	-	118	5	123	HN	X	
			Zone 4	Excavator w bucket (25t)	30t excavator	1	-	-	103	-	108	-	-	
	Utility works (stormwater and other services) (OOHW Zone 6)	Novermber 2021 - July 2023 / 19 months	Zone 1	Concrete cutting saw	Concrete saw	1	-	-	119	5	124	HN	X	
			Zone 1 Zone 5	Excavator w bucket (25t)	30t excavator	2	-	-	103	-	108	-	-	
			Zone 1	Mobile crane (20t-250t)	150t crawler crane	1	-	-	104	-	108	-	-	
			Zone 1	Piling Rig - vibratory	High frequency vibrodriver type PTC 24 HVF or similar	1	-	-	116	5	119	HN	X	
			Zone 1	Telehander / Franna crane (20t)	Franna Crane	2	-	-	98	-	102	-	-	
			Zone 1	Water pump - D esel	Water pumps	3	-	-	99	-	101	-	-	
			Zone 1	Concrete vibrator	Concrete vibrators	1	-	-	97	-	100	-	-	
			Zone 1	Tipper	Tipper	1	-	-	103	-	111	-	-	
			Zone 2	Mobile crane (20t-250t)	Truck mounted crane	1	-	-	104	-	108	-	-	
			Zone 2	Marr Diesel Tower Crane	Tower crane	1	-	-	115	-	122	-	-	
			Zone 2	Vibratory Roller (20T Padfoot)	Roller compactor	1	-	-	108	5	113	HN	X	
			Zone 7	Mobile crane (20t-250t)	15t mobile crane	1	-	-	104	-	108	-	-	
			Zone 7	Vacuum truck	Suction truck	2	-	-	107	-	111	-	-	
			Zone 7	-	Cable roll feed	1	-	-	-	-	-	-	-	
			Zone 7	Handtool - power	Hand tools	1	-	-	108	-	118	-	-	
			Zone 6	Tipper	Asphalt trucks	1	1	1	103	-	111	-	-	OOHW required due to ROL
			Zone 6	Vibratory Roller (20T Padfoot)	Rollers	1	1	1	108	5	113	HN	X	OOHW required due to ROL
			Zone 6	Concrete Agitator	Concrete trucks	2 p.h.	2 p.h.	2 p.h.	108	-	111	-	-	OOHW required due to ROL
			Zone 6	Concrete pump	Concrete pumps	1	1	1	103	-	107	-	-	OOHW required due to ROL
			Zone 9	Forklift	14t forklift	1	1	1	99	-	103	-	-	OOHW requred to support main laydown area materials equipment in Zone 9
			Zone 9	Telehander / Franna crane (20t)	Franna Crane	1	1	1	98	-	102	-	-	OOHW requred to support main laydown area materials equipment in Zone 9
	Road upgrading works (OOHW zone 6)	Novermber 2021 - July 2023 / 19 months	Zone 3 Zone 4	Excavator w bucket (25t)	30t excavator	2	-	-	103	-	108	-	-	
			Zone 3 Zone 4	Tipper	Tipper trucks	1	-	-	103	-	111	-	-	
			Zone 3 Zone 4	Vibratory Roller (20T Padfoot)	Roller compactor	1	-	-	108	5	113	HN	X	
			Zone 3 Zone 4	Tipper	Asphalt trucks	1	-	-	103	-	111	-	-	
			Zone 3 Zone 4	Vibratory Roller (20T Padfoot)	Rollers	2	-	-	108	5	113	HN	X	
			Zone 3 Zone 4	Concrete Agitator	Concrete trucks	4 p.h.	-	-	108	-	111	-	-	
			Zone 3 Zone 4	Concrete pump	Concrete pumps	1	-	-	103	-	107	-	-	
			Zone 3 Zone 4	Concrete cutting saw	Wet saws	1	-	-	119	5	124	HN	X	
			Zone 3 Zone 4	Handtool - power	Hand tools	1	-	-	108	-	118	-	-	
			Zone 3	Mobile crane (20t-250t)	Truck mounted crane	1	-	-	104	-	108	-	-	
			Zone 6	Mobile crane (20t-250t)	Truck mounted crane	1	1	1	104	-	108	-	-	OOHW required due to ROL
			Zone 6	Excavators with hammers (10-15T)	Concrete pecker / rock hammer	1	1	1	118	5	123	HN	X	OOHW required due to ROL
			Zone 6	Truck and Dog	Trucks	4 p.h.	2 p.h.	2 p.h.	106	-	111	-	-	OOHW required due to ROL
			Zone 9	Forklift	14t forklift	1	1	1	99	-	103	-	-	OOHW requred to support main laydown area materials equipment in Zone 6
			Zone 9	Telehander / Franna crane (20t)	Franna Crane	1	1	1	98	-	102	-	-	OOHW requred to support main laydown area materials equipment in Zone 6
	Traffic switch	Novermber 2021 - July 2023 / 19 months	Zone 3.1 Zone 4.1 Zone 3 Zone 4 Zone 6	Excavator w bucket (25t)	30t excavator	1	1	1	103	-	108	-	-	OOHW is proposed during the traffic switch from East to West Zone 6
			Zone 3.1 Zone 4.1 Zone 3 Zone 4 Zone 6	Tipper	Tipper trucks	1	1	1	103	-	111	-	-	OOHW required to install concrete barriers for traffic switch
			Zone 3.1 Zone 4.1 Zone 3 Zone 4 Zone 6	Lighting tower	Lighting towers	2	2	2	99	-	102	-	-	OOHW is proposed during the traffic switch from East to West Zone 6
			Zone 3.1 Zone 4.1 Zone 3 Zone 4 Zone 6	Mobile crane (20t-250t)	Truck mounted crane	2	2	2	104	-	108	-	-	OOHW is proposed during the traffic switch from East to West Zone 6
			Zone 3.1 Zone 4.1 Zone 3 Zone 4 Zone 6	Telehander / Franna crane (20t)	Franna Crane	1	1	1	98	-	102	-	-	OOHW is proposed during the traffic switch from East to West Zone 6
			Zone 9	Forklift	14t forklift	2	2	2	99	-	103	-	-	OOHW requred to support main laydown area materials equipment in Zone 9
			Zone 9	Telehander / Franna crane (20t)	Franna Crane	2	2	2	98	-	102	-	-	OOHW requred to support main laydown area materials equipment in Zone 9
	Northern shaft backfill	Feb 2023 - March 2023 / 1 month	Northern shaft	Truck and Dog	Spoil trucks	8 p.h.	-	-	106	-	111	-	-	Up to 24 trucks per day
			Northern shaft	Compactor / Wacker packer	Compactors	1	1	1	108	-	110	-	X	Within the Northern Shed. Limited use during OOHW subject to noise verification
			Northern shaft	Gantry Crane - electric	Gantry crane	1	1	1	96	-	100	-	-	Gantry crane used to lower stabilised sand into the shaft compactors small excavators to move material around in the Northern shaft. Only flash lighting OOH.
			Northern shaft	Excavator w bucket (5t)	Small excavators	1	1	1	101	-	114	-	-	Loading Gantry crane inside the Northern Shed
	Northern shaft shed demolition and removal	March 2023 - April 2023 / 1 month	Zone 6	Excavator with pulver zer	Excavator with pulverizer	3	-	-	104	-	108	-	-	
			Zone 6	Excavator w bucket (25t)	30t excavator	2	-	-	103	-	108	-	-	
			Zone 6	Handtool - rattle gun	Rattle guns	3	-	-	107	-	118	-	-	
			Zone 6	EWP	EWP	3	-	-	95	-	98	-	-	
			Zone 6	Concrete cutting saw	Concrete Saw	2	-	-	119	5	124	HN	X	
			Zone 6	Dump truck	Dump Truck	8 p.h.	-	-	106	-	111	-	-	
	General landscaping/hardscaping	Not specif ed (TBC by the client)	Zone 2	Handtool - power	Hand tools	3	-	-	108	-	118	-	-	
			Zone 2 Zone 4 Zone 5	Concrete cutting saw	Wet saws	1	-	-	119	5	124	HN	X	
			Zone 4	EWP	Scissor lift	1	-	-	95	-	98	-	-	
			Zone 4	EWP	Cherry picker	1	-	-	95	-	98	-	-	
			Zone 5	Marr Diesel Tower Crane	Tower crane	1	-	-	115	-	122	-	-	
			Zone 5	Handtool - power	General landscaping equipment	3	-	-	108	-	118	-	-	
			Zone 5	Generator	Generator	2	-	-	94	-	95	-	-	
Station works	Station works and fitouts (including deliveries)		Zone 2 Zone 3	Handtool - power	Power hand tools	3	-	-	108	-	118	-	-	
			Zone 4	Concrete Agitator	Concrete trucks	4 p.h.	-	-	108	-	111	-	-	
			Zone 4	Concrete vibrator	Concrete vibrators	2	-	-	97	-	100	-	-	
			Zone 4	Concrete Agitator	Concrete agitator	2	-	-	108	-	111	-	-	
			Zone 4	Concrete pump	Concrete pumps	2	-	-	103	-	107	-	-	
			Zone 4	-	Finishing screed	2	-	-	-	-	-	-	-	It is assumed that the finishing creed does not requre a motor to operate. Hence not producing any noise. TBC by the client
			Station Box	EWP	Scissor lift	2	2	2	95	-	98	-	-	Underground ins de the station
			Station Box	Handtool - power	Hand tools	3	3	3	108	-	118	-	-	Underground inside the station
			Northern shaft	Delivery truck	Vehicle movements	4 .ph.	4 .ph.	4 .ph.	106	-	111	-	-	Vehicle movements reversing into the Northern shaft to deliver goods into the crossover cavern
			Station Box	Forklift	14t forklift	2	2	1	99	-	103	-	-	Underground inside the station
			Station Box	Telehander / Franna crane (20t)	Franna Crane	3	3	3	98	-	102	-	-	Underground inside the station
			Station Box	Concrete cutting saw	Wet saws	1	-	-	119	5	124	HN	X	Inside the station OOHW limited used subject to noise verification

APPENDIX D Vibration screening for cosmetic damage - Indicative minimum working distances

Land-Use file revision date: r36 29/04/21

Plot Date: 06/05/21 - 12:03 Layout: TM031 Vibration screening for cosmetic damage r0

GIS File: R:\Technical Resource\Data Library\GIS Data\00 Master projects\Master project r0.qgz

LEGEND

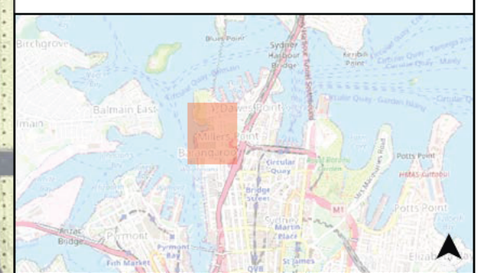
No se sens t ve rece vers

- Residen ial
- Mixed use
- Commercial
- ndus rial
- Ho el/Mo el/Hos el
- Medical facili y
- Place of Worship
- Communi y cen re
- Recording s udio
- Library
- Fligh simula or
- Childcare
- Educa ional
- Thea re/Audi orium
- Cinema
- Labora ory
- Recrea ional - Passive
- Recrea ional - Ac ive
- O her
- Heri age

- Heri age Wall
- Pro ec Work Zones
- Receivers wi hin MWD for cosme ic damage

MWD for cosmet c damage for v brat on ntens ve p ant (35T excavator w th hammer attachment and v bratory ro er)

- Unreinforced s ruc ures (7 5mm/s ppv)
- Heri age s ruc ures (2 5mm/s ppv)



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CL EN

BESIX Watpac

ACOUS C CONSUL AN

RENZO TONIN & ASSOCIATES

inspired to achieve

Ph (02) 8218 0500 Fax (02) 8218 0501

Sydney Metro Barangaroo Stat on

V brat on screen ng for cosmet c damage
Project Work Zones: 2, 3, 4 and 6

Sheet 1 o 1

APPENDIX E Monitoring program

RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

BARANGAROO METRO STATION

Construction Noise and Vibration Monitoring Plan

6 August 2021

BESIX Watpac

TM031-01F01 Barangaroo Metro Station - NVMP APPE Monitoring program (r4)

35 1982-2017 ACOUSTIC ENGINEERING EXCELLENCE

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aaac Association of Australian Acoustical Consultants

Document details

Detail	Reference
Doc reference:	TM031-01F01 Barangaroo Metro Station - NVMP APPE Monitoring program (r4)
Prepared for:	BESIX Watpac
Address:	Level 24, 44 Market Street Sydney NSW 2000
Attention:	[redacted]

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Authorised
21.05.02021	Draft to client	0	1	[redacted]	-	[redacted]
18.06.2021	Update following comments from AA, ER and Sydney Metro	-	2	[redacted]	-	[redacted]
08.07.2021	Minor edits	-	3	[redacted]	-	[redacted]
06.08.2021	Update following comments from DPIE	-	4	[redacted]	-	[redacted]

Contents

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List of figures

1 Introduction

The Construction Noise and Vibration Monitoring Guideline in the Sydney Metro CNVS sets out the requirements for:

- Operator attended monitoring (short term)
- Continuous, unattended monitoring (including real-time monitoring)

This construction noise and vibration monitoring program will apply for the duration of works that pose a risk of exceeding set criteria. Monitoring is not required where activities to be undertaken do not pose risk of exceeding set criteria from the project planning approval.

The Construction Noise and Vibration Monitoring Program results will be submitted to the EPA and relevant Councils, as required by PPA Condition C9. Construction will not commence until the Secretary has approved this monitoring plan.

The Construction Noise Monitoring Program, as approved by the Secretary including any minor amendments approved by the AA will be implemented for the duration of construction and for any longer period set out in the monitoring program or specified by the Secretary, whichever is the greater.

Noise and vibration monitoring will be undertaken to verify compliance with the noise and vibration objectives and/or the predicted levels in the relevant CNVIS's. Real-time noise and vibration monitoring will be undertaken at the affected receivers as detailed in the following sections. After application of all reasonable and feasible mitigation measures identified in Section 6.2 of the NVMP, monitoring may still be above the construction noise and vibration objectives. In these instances, additional noise and vibration managements outlined in Section 6.6 of the NVMP may be applicable, taking into consideration when works are being undertaken (standard hours or OOHW) and the level of exceedance.

1.1 Guidelines

The main guidelines, specifications and policy documents relevant to monitoring include:

- NSW Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change 2009
- NSW Noise Policy for Industry (NPfI), Environment Protection Authority 2017
- NSW Assessing Vibration – a technical guideline (AVTG), Department of Environment and Conservation 2006
- Australian Standard AS/NZS 1055 Acoustics - Description and Measurement of Environmental Noise
- Australian Standard AS 2659.1 1988 Guide to use sound measuring equipment

- Australian Standard AS/NZS 2012.1 Acoustics - Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors - Stationary test condition - Determination of compliance with limits for exterior noise
- Australian Standard AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors
- Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives
- Australian Standard AS2436-2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites
- Australian Standard 2775 Mechanical Mounting of Accelerometers
- British Standard BS 6472-2008, 'Evaluation of human exposure to vibration in buildings (1-80Hz)
- British Standard 7385: Part 2-1993 'Evaluation and measurement of vibration in buildings'
- German Standard DIN4150- 2016 Structural vibration Part 3: Effects of vibration on Structures,
- ISO 3744 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane
- ISO 3746 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane
- ISO 6393 Earth-moving machinery - Determination of sound power level - Stationary test condition
- ISO 6395 Earth-moving machinery - Determination of sound power level - Dynamic test conditions.

1.2 Noise Monitoring

1.2.1 Baseline noise monitoring data

Baseline noise monitoring data was reported in the SMCSWCS EIS. Ambient noise measurements were undertaken at four noise monitoring locations near Barangaroo worksite. A summary of the noise monitoring results at these locations is provided below:

Table 1.1 Summary of unattended noise monitoring results

NCA	EIS monitoring ID[1]	Address	Rating Background noise Levels, dBA			Ambient noise levels (L_{Aeq})		
			Day	Evening	Night	Day	Evening	Night
BN_01	EIA B.12	26A High Street, Millers Point (Barangaroo)	50	45	40	61	64	51
BN_02	EIA B.12	26A High Street, Millers Point (Barangaroo)	50	45	40	61	64	51
BN_03	EIA B.12	26A High Street, Millers Point (Barangaroo)	50	45	40	61	64	51
BN_04	EIS B.13	2-60 Cumberland Street, The Rocks	62	62	52	66	65	63
BN_05	EIS B.28	56A Pirrama Road, Pyrmont (Wharf 8)	51	46	41	56	52	47
BN_06	EIS B.29	Goat Island	49	49	41	55	55	49

Notes: 1) Based upon EIS and Submissions and Preferred Infrastructure Reports for the Sydney City Metro & Southwest (Chatswood to Sydenham) (SMCSWCS) project.

No further baseline data is required to be obtained.

1.2.2 Parameters to be monitored

The following noise parameters are required to be measured when assessing construction noise levels:

- $L_{Aeq(15minute)}$ (internal or external) to assess compliance with the relevant internal or external NMLs
- L_{Amax} or L_{A1min} to assess potential sleep disturbance at residential receivers.

Environmental noise monitoring (excluding spot checks of plant and equipment) will be recorded over 15-minute sample intervals, excluding periods of extraneous noise until a representative sample has been obtained. A representative sample will be determined by the operator, who will be competent, suitability trained and experienced in undertaking noise measurements and familiar with the relevant Australian Standards.

For spot checks of noise intensive plant and equipment, duration of monitoring will depend on the source of noise being monitored. Sources of continuous noise (such as generators or fans), measurements will be monitored over one-to-two-minute intervals. For dynamic plant, such as front-end loaders, spot checks will capture a representative activity, such as one truck-and-trailer load cycle.

1.2.3 Airborne noise monitoring in the community

Attended monitoring of construction noise levels will be undertaken as follows:

- Monitoring will be carried out at the commencement of activities identified in the CNVIS as requiring verification monitoring, to confirm that actual noise levels are consistent with

predicted noise impacts and that the management measures that have been implemented are appropriate.

- Where a change in methodology, plant or equipment is anticipated to result in a significant increase in construction noise impact than what has been assessed (i.e. more than 5dB).
- To ensure that noise generated by construction will not exceed the National Standard for exposure to noise in the occupational environment of an eight-hour equivalent continuous A-weighted sound pressure level of $L_{Aeq,8h}$, of 85dB(A) for any employee working at a location near a Project worksite.
- Where appropriate in response to a noise related complaint(s) (determined by the project environmental manager on a case-by- case basis following procedures outlined in the CCS).
- As otherwise required by the CNVIS. Specific monitoring requirements will be identified in the relevant CNVIS as they are location and task specific.
- As required by the Out of Hours Works (OOHW) Protocol.
- As identified in the OOHW application.
- Following the implementation of mitigation measures or noise attenuation as a result of exceedance of predicted noise levels.
- Ongoing spot checks for noise intensive plant and equipment will be undertaken at the first opportunity withing the fire month of staring construction activities as well as throughout construction to ensure compliance with the noise levels for construction equipment assumed in the CNVIS or the levels established in Table 11 of the Sydney Metro City and South West CNVS. Spot checks would be carried out approximately every 6 months depending on the plant/equipment, in response to a specific noise related complaint and during noise and vibration assessment validation monitoring when it is possible to isolate the noise from one piece of plant or equipment.
- Unattended airborne noise monitoring may also be undertaken, with a noise logger deployed to obtain noise results over longer periods.

Attended and unattended noise monitoring locations may vary throughout the life of the Project. Monitoring locations would be determined on a case-by-case basis based on the locations recommended in a CNVIS, in response to complaints and on the location of the noise source to be monitored.

In accordance with the ICNG the duration and amount of noise monitoring will depend on the scale of the construction activities and extent of expected noise impacts. Noise monitoring will cover a representative period of the construction activity. A representative period is the stage of a construction activity where all the plant and equipment operating is consistent with the full range of plant and equipment modelled in the noise assessment, i.e. noise monitoring is not to be undertaken when the key noise contributing plant and equipment are turned off.

Where possible, monitoring will be undertaken at the most affected noise sensitive receiver location in proximity to the Project's construction activities. Noise monitoring locations will consider factors, including the:

- Location of previous monitoring sites,
- Proximity of the receiver to a Project worksite,
- Sensitivity of the receiver to noise,
- Background noise levels, and
- Safety of personnel undertaking the measurements,
- Expected duration of the impact.

Where noise monitoring indicates that the activity, work or combination of simultaneous activities or works has caused or is causing noise or vibration levels higher than the predicted levels at any noise sensitive receiver, BESIX WATPAC must review and where possible, modify the work or activity to prevent any recurrence and additional mitigation measures applied.

1.2.4 Ground-borne noise monitoring

Attended monitoring of ground-borne construction noise levels will be undertaken as follows:

- At the first opportunity following the commencement of works if ground-borne noise impacts are identified in the CNVIS,
- Where appropriate in response to a ground-borne noise related complaint(s) (determined on a case-by- case basis), and
- As otherwise required by a CNVIS or OOHW Protocol.

Monitoring will be undertaken in the most affected habitable room of the sensitive receiver building and will be conducted in conjunction with vibration measurements whenever practicable. The room selected for noise monitoring should be well shielded from airborne noise intrusions, such as road traffic noise to allow the ground-borne noise to dominate over non-construction generated airborne noise.

There may be instances where the resident does not allow access to monitor in the most suitable habitable room. In these instances, BESIX Watpac will endeavour to monitor at the next most suitable available room or location, noting this in the monitoring form.

Given that ground-borne noise is mostly noticed during the evening or at night, noise loggers may also be left in place over night and picked up at a mutually agreed time with the resident. In these instances, noise loggers will record audio to allow for the identification construction noise contribution and the presence of any extraneous noise, provided privacy concerns can be overcome. Where the sensitive receiver will not allow the noise logger to record audio, attended noise monitoring will be offered instead.

Measurements will be carried out by an appropriately trained and competent person in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures.

1.2.5 Real-time (unattended) noise monitoring

Real time (unattended) noise monitoring will be undertaken to satisfy PPA Condition C11. A real time noise monitor will be deployed to manage noise impacts from 'high risk' activities where there is likely to be a high risk of annoyance from construction noise (i.e. road reinstatement works and utility works).

Real-time noise monitor will be installed along High Street or Hickson Road. An indicative monitoring location is presented in APPENDIX A. The timing, duration and final location of the real-time noise monitoring equipment will be subject to the construction program, availability of mains power, safety requirements and consultation.

Real-time noise monitoring will continue during works that pose a risk of exceeding set criteria. Where activities being undertaken do not pose risk of exceeding set criteria from the project planning approval, real-time monitoring may be ceased. A secure website is required for data storage for the duration of monitored construction activities.

The monitor will be installed by an appropriately trained person in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures.

The real-time monitoring data will be available to the construction team, Sydney Metro, ER, AA, DPIE and EPA via a web-based portal.

1.2.6 Calibration, QA and competency

All monitoring will be undertaken by competent personnel, suitability trained and experienced in undertaking noise measurements.

Noise monitoring equipment used will be at least Type 2 instruments and calibrated in accordance with manufacturer specifications or relevant Australian Standards. Records of equipment laboratory calibration will be maintained by BESIX Watpac throughout the delivery of the Project. The calibration of the monitoring equipment will be checked in the field before and after the noise measurement period.

All monitoring records will be retained throughout the delivery of the Project by BEISX Watpac. Noise monitoring records will be completed to record:

- Date and time of measurement,
- Name of person undertaking the measurement,
- Type and model number of monitoring instrumentation and calibrator,

- Date of last laboratory calibration in a NATA accredited facility for the monitoring instrumentation and calibrator,
- Results of field calibration checks,
- Time of day, length of measurement and any measurement time intervals,
- Monitoring location, including a sketched map of area and/or photographs clearly identifying the monitoring location,
- Measurement location details and number of measurements at each location,
- Weather conditions during measurements,
- Operation and activities of the noise sources under investigation,
- Estimated contribution of the Project's activities,
- Construction works location, and
- Noise due to other extraneous and environmental sources (e.g. traffic, aircraft, trains, dogs barking, insects).

Noise monitoring will be undertaken and recorded in accordance with the relevant noise measurement requirements in the reference standards and documents in Section 1.1.

All outdoor noise measurements will be undertaken with a windscreen over the microphone and measurements of noise will be disregarded when rain or wind affects the measured noise levels as described in the AS 1055.. Where high background noise levels obscure construction noise contribution during attended noise measurements, operators will either:

- Measure closer to the source and calculate back to the required position, or
- Measure with the source noise off and then on (where possible) and calculate the difference or use the 'pause and cut' feature on the sound level meter to try to exclude as much of the extraneous noise as possible.

Where possible, outdoor noise monitoring is to be carried out at least 3.5 m from any reflective surface other than the ground. The preferred microphone/measurement height is 1.2-1.5 m above the ground level.

Measurements taken inside buildings should be at least one metre from walls or other reflective surface, and about 1.5 metres from windows, where such instrument siting is possible. The preferred microphone/measurement height is 1.2-1.5 m above the floor level.

1.3 Vibration Monitoring

1.3.1 Parameters to be monitored

The following noise parameters are required to be measured when assessing construction noise levels:

- Peak Particle Velocity (ppv) in mm/s to assess compliance with the relevant cosmetic damage criteria;
- Root-Mean-Square acceleration (a) in m/s^2 to estimate the Vibration Dose Value (eVDV) and determine compliance with relevant human annoyance management levels.

All short term attended vibration monitoring will be recorded over a representative sampling interval where the worst-case vibration levels can be captured. Where unattended vibration monitoring is proposed, monitoring will be undertaken continuously whilst the vibrating plant is operational to capture the worst-case vibration impacting on the structure.

1.3.2 Vibration monitoring

Attended vibration monitoring is to be undertaken as follows:

- To confirm/identify the site-specific minimum working distances to prevent cosmetic damage or damage to sensitive equipment or buried pipework.
- at the commencement of vibration intensive activities on site that have been identified in a CNVIS as likely to exceed the vibration screening criteria.
- at the commencement of vibration generating activities that have the potential to impact on heritage items.
- where vibration sensitive locations are found to fall within the recommended minimum working distances established for vibration intensive plant.
- Where appropriate in response to a vibration related complaint(s) (determined on a case-by-case basis).
- As otherwise required by a CNVIS (note that specific monitoring requirements will be identified in the relevant CNVIS and not prescribed in this Program), OOHW Protocol.

Vibration monitoring will be undertaken in accordance with the relevant vibration measurement requirements in the reference standards and documents in Section 1.1.

Where human comfort is a concern, vibration monitoring would be undertaken as outlined in Figure 1.1. Vibration monitoring results would be assessed and reported against the values set out in Tables 2.2 and 2.4 of the EPA's Assessing Vibration – a technical guideline.

Where property damage is a concern, vibration monitoring would be undertaken as outlined in Figure 1.2. Vibration monitoring results will be assessed and reported against the British Standard 7385 and German Standard DIN 4150. The approach that will be adopted for the Project to assess and manage potential vibration impact, including on heritage structures is outlined in Section 4.6 of the NVMP.

The following notes of importance are included:

- Vibration monitoring equipment shall be placed outside at the footings or foundations of the building of interest, closest to the vibrating plant, where access is permitted.
- The surface should be solid and rigid to best represent the vibration entering the structure of the building under investigation.
- The vibration sensor or transducer shall not be mounted on loose tiles, loose gravel or other resilient surfaces.
- The vibration sensor or transducer shall be directly mounted to the vibrating surface using either bees wax or a magnetic mounting plate onto a steel washer, plate or bracket which shall be either fastened or glued to the surface of interest.
- Where a suitable mounting surface is unavailable, then a metal stake of at least 300mm in length shall be driven into solid ground adjacent to the building of interest and the vibration sensor or transducer shall be mounted on that.

Where attended vibration monitoring is not feasible, due to extended periods of vibration intensive works, an unattended vibration monitoring system will be installed where initial monitoring to establish site specific minimum working distances is insufficient to ensure vibration criteria are met, due to changing plant or unknown/unstable ground conditions. Unattended monitors will warn plant operators (e.g. SMS, etc.) that vibration is approaching levels where there is potential for cosmetic damage to buildings and structures.

Where unattended vibration monitors are left in place on a private property they will be picked up at a mutually agreed time with the resident.

In accordance with PPA Condition E29, owners of properties at risk of exceeding the screening criteria for cosmetic damage (if any) will be notified before construction that generates vibration commences in the vicinity of those properties. A building condition survey will be prepared prior to construction for all properties identified at risk of damage and a follow-up survey will be offered within three months of the completion of works in accordance with PPA Conditions E59 and E60.

Figure 1.1: Vibration monitoring (human comfort) flowchart

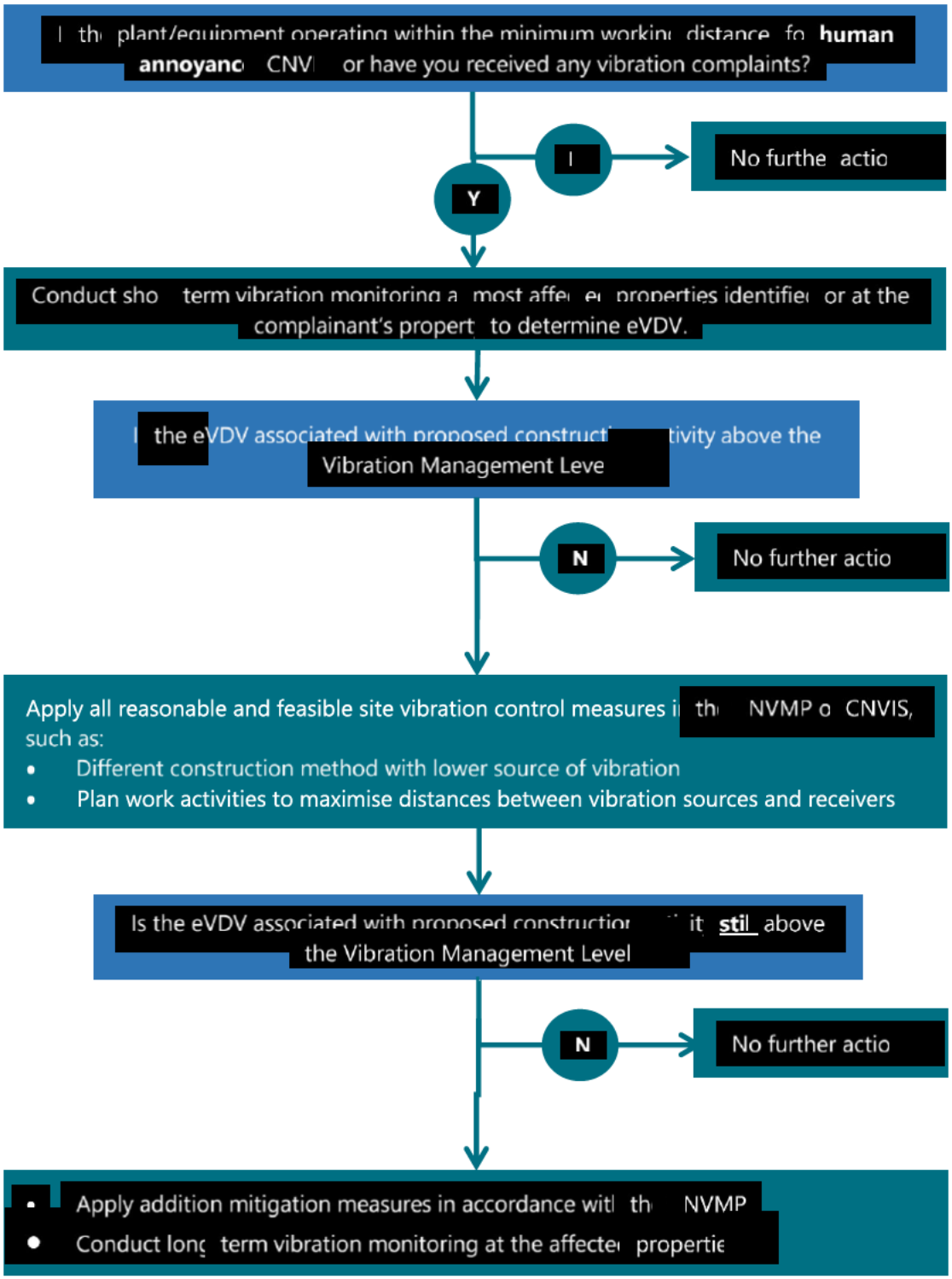
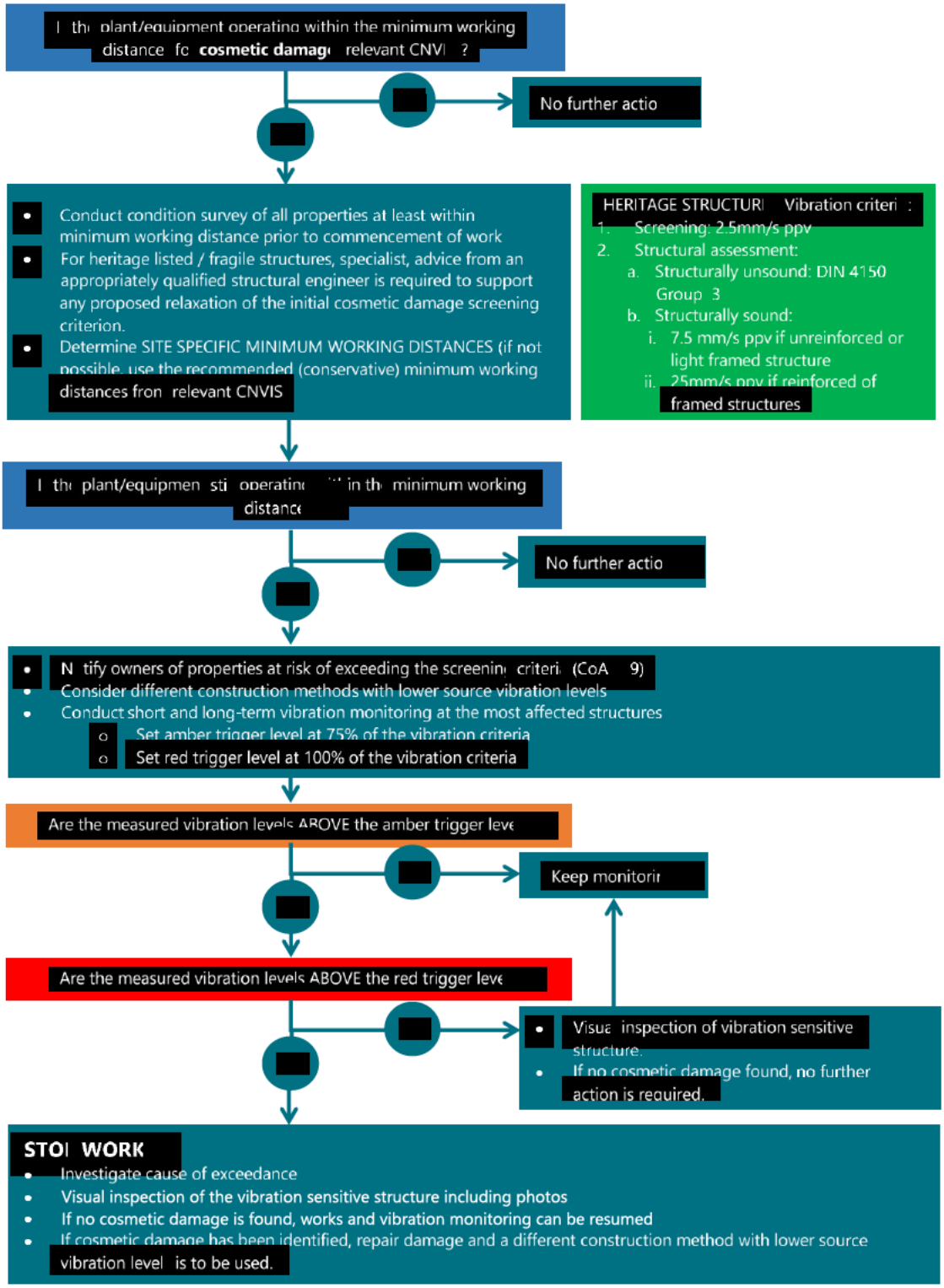


Figure 1.2: Vibration monitoring (cosmetic damage to structures) flowchart



1.3.3 Real-time (unattended) vibration monitoring

Real time (unattended) vibration monitoring will be undertaken to satisfy PPA Condition C11. A real time vibration monitor will be deployed to manage vibration impacts from 'high risk' activities, where there is an increased risk of annoyance (or potential building damage) from construction vibration.

Real time vibration monitors will be installed when works are proposed to occur within minimum working distances established for cosmetic damage. The final timing, duration and location of the real-time vibration monitoring equipment will be subject to the construction program, availability of mains power, safety requirements and consultation. Real-time vibration monitoring will continue during works that pose a risk of exceeding set criteria. Where activities being undertaken do not pose risk of exceeding set criteria from the project planning approval, real-time monitoring may be ceased. An indicative monitoring location is presented in APPENDIX A.

The monitor will be installed by an appropriately trained person in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures.

The real-time monitoring data will be available to Sydney Metro, ER, AA, DPIE and EPA via a web-based portal.

1.3.4 Heritage-listed structures

BESIX WATPAC will seek the advice of a Heritage Engineer on methods and locations for installing equipment used for vibration, movement and noise monitoring of heritage-listed structures. Heritage structures near the works are identified in Section 3.2.2 of the NVMP. The location and activity specific CNVIS prepared for the Project will identify which nearby heritage items at risk of impact from vibration intensive activities.

In accordance with PPA E30, BESIX Watpac will conduct vibration testing before and during vibration generating activities that have the potential to impact on heritage items, as identified in the CNVIS, to identify minimum working distances to prevent as far as practicable cosmetic damage. Should vibration testing and monitoring show that the preferred values for vibration are likely to be exceeded, BESIX Watpac will follow the process in Figure 1.2.

1.4 Blast monitoring

Blasting will not be adopted for the Project, therefore blast vibration and air-overpressure monitoring is not required.

1.5 Continual improvement and corrective action

Monitored noise and vibration levels will be analysed against the predictions made in the relevant CNVIS. Where monitored construction noise levels are found to be above modelling predictions or vibration criteria are exceeded, the following actions will be undertaken:

- Cease the noise and/or vibration generating activity which causes the exceeded predictions,
- Confirm the monitored levels are not being impacted by other noise or vibration sources,
- Confirm if the exceedance is due to an uncharacteristically loud piece of equipment,
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant,
- Confirm if the exceedance is due to an uncharacteristically vibratory piece of equipment and if an alternative, less vibration generating mode of operation can be used,
- Confirm that the modelling reflects the actual activity being undertaken,
- Implement other feasible and reasonable measures which may include reducing plant size, modifying time of works, changing operational settings (such as turning off the vibratory function of the machine), and utilising alternative construction methodology or a combination of these,
- Review work practices to ensure compliance with the relevant guidelines,
- Review and revision where appropriate of previously applied adaptation mitigation measure,
- Ensure that the learnings from the above are fed back into the noise and vibration assessment process,
- Continue work where impacts can be reduced,
- Where no alternative construction method is available and an exceedance of vibration objectives is still measured, site specific mitigation measures should be identified on a case-by-case basis. In this case, a site and activity specific management strategy for the vibration intensive works should be established so that the risk of building/structure damage can be minimised.
- Communicate lessons learnt to relevant personnel.

BESIX Watpac will review the work or activity or combination of simultaneous works or activities and where possible, modify the work or activity to prevent any recurrence. Lessons learnt will be communicated to relevant personnel in toolbox talks.

1.6 Reporting of monitoring results

The results of noise and vibration monitoring shall be documented every 6 months in a noise and vibration monitoring report and submitted to the Secretary for information.

PPA Condition 16 includes the following requirements:

> *The results of the Construction Monitoring Programs must be submitted to the Secretary for information, and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program.*

APPENDIX A Barangaroo Metro Station – Indicative monitoring locations

APPENDIX F Records of Agency Consulation

Date	Report Section	Agency Comment	BESIX Watpac Response
City of Sydney Council			
16.06.2021	NVMP (including monitoring plan)	City of Sydney responded on 6th July 2021 finding the plan satisfactory (accepted)	No further action
NSW Environment Protection Authority			
09.07.2021	Monitoring plan	EPA responded on 13th July 2021 with no comments (accepted)	No further action
Acoustics Advisor and Environmental Representative			
01/06/2021	All comments are summarised in the document SMCCSWSBR-BWC-SBR-EM-PLN-000018, dated 01/06/2021		All responses are summarised in the document SMCCSWSBR-BWC-SBR-EM-PLN-000018, dated 16/06/2021 (SMCSW2 - Feedback on Document Comments or Responses (003) - RTA response)

APPENDIX G Endorsement letters

APPROVAL
CITY & SOUTHWEST ACOUSTICS ADVISOR

Review of:	Barangaroo Metro Station Noise and Vibration Management Plan (NVMP)	**Document reference:**	TM031-01F01 Barangaroo Metro Station NVMP (r10) (Besix Watpac Version 2) Prepared by Renzo Tonin & Associates Pty Ltd 30 September 2022
Prepared by:	[redacted] Acoustics Advisor		
Date of issue:	10 November 2022		

As approved Acoustics Advisor for the Sydney Metro City & Southwest project, I have reviewed the Noise and Vibration Management Plan (NVMP; revision 10) for the Barangaroo Metro Station, as required under A27 (g) (iv) of the project approval conditions.

This revision includes minor updates to construction hours on Saturdays to reflect the extended hours in the approved Modification 9.

I am satisfied that such amendments are necessary, approve revision 10 of the NVMP, and consider that the document is appropriate for submission to the Secretary for information.

[redacted]

Daniel Weston, City & Southwest Acoustics Advisor