GLEBE ISLAND CONCRETE BATCHING PLANT AND AGGREGATE HANDLING FACILITY

Construction Noise and Vibration Management Plan

Prepared for:

Hanson Heidelberg Cement Group
Level 10, 35 Clarence Street SYDNEY NSW 2000

SLR Ref: 610.17533-R02
Version No: -v1.0
October 2021

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Hanson Heidelberg Cement Group (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.17533-R02-v1.0	19 October 2021	John Sleeman	Aaron McKenzie	John Sleeman

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1 Introduction

1.1 Background

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Hanson Constructions Materials (Hanson) to prepare a Construction Noise and Vibration Management Plan (CNVMP) for construction works to be conducted for the intermodal aggregate storage facility and concrete batching plant at Glebe Island (the Facility).

The CNVMP is designed to address the potential construction noise impacts on the surrounding residential receivers and to detail procedures for minimising, managing and monitoring these impacts. The CNVMP addresses Condition C21 of Schedule 2 of the Development Consent Conditions, which is reproduced below. The report locations where the associated Development Consent Conditions are addressed within the report are provided in **Table 1**.

*Prior to the commencement of work, a **Construction Noise and Vibration Management Plan (CNVMP)** must be prepared by a suitably qualified person. The **CNVMP** shall be prepared in consultation with the EPA and Port Authority, and address (but not be limited to):*

(a) the EPA's Interim Construction Noise Guideline;

(b) identify nearby sensitive receivers and land uses;

(c) identify the noise management levels for the project;

(d) identify the construction methodology and equipment to be used and the key sources of noise;

(e) identification of each work area, site compound and access route (both private and public);

(f) details of all reasonable and feasible management and mitigation measures to be implemented to minimise construction noise, including the early erection of operational noise control barriers;

(g) be consistent with and incorporate all relevant recommendations and noise mitigation measures outlined in the Noise Assessment report (Reference: 610.17533-R01-v2.0.docx) prepared by SLR Consulting dated 15 March 2018;

(h) ensure all potentially impacted sensitive receivers are informed by letterbox drops prior to the commencement of construction of the nature of works to be carried out, the expected noise levels and duration, as well as contact details for a construction community liaison officer; and

(i) include a suitable proactive construction noise monitoring program which aims to ensure the construction noise criteria in this consent are not exceeded, and contains measures to respond to complaints.

Table 1 Where Development Consent Conditions are addressed within this Report

Condition	Description	Where Addressed
(a)	address the EPA's Interim Construction Noise Guideline (ICNG)	**Section 4**
(b)	identify nearby sensitive receivers and land uses	**Section 2.2**
(c)	identify the noise management levels for the project	**Section 4**
(d)	identify the construction methodology and equipment to be used and the key sources of noise	**Section 2.3**
(e)	identification of each work area, site compound and access route (both private and public)	**Section 2**
(f)	provide details of all reasonable and feasible management and mitigation measures to be implemented to minimise construction noise, including the early erection of operational noise control barriers	**Section 7**
(g)	be consistent with and incorporate all relevant recommendations and noise mitigation measures outlined in the NIA report	**Section 7**
(h)	ensure all potentially impacted sensitive receivers are informed by letterbox drops prior to the commencement of construction of the nature of works to be carried out, the expected noise levels and duration, as well as contact details for a construction community liaison officer.	**Section 7.3**
(i)	include a suitable proactive construction noise monitoring program which aims to ensure the construction noise criteria in this consent are not exceeded, and contains measures to respond to complaints	**Section 7.2**

Specific acoustic terminology is used in this report. An explanation of common acoustic terms is provided in **Appendix A**.

1.2 Key Policies and Guidelines

This CNVMP references the following documents and guidelines:

- *Interim Construction Noise Guideline (ICNG), (EPA, 2009)*
- *Noise Policy for Industry (NPfI) (EPA, 2017)*
- *NSW Road Noise Policy* (RNP), Department of Environment, Climate Change and Water, 2011
- *Construction Noise and Vibration Strategy* (CNVS), Transport for NSW, 2019
- *Assessing Vibration: a Technical Guideline* (AVaTG), Department of Environment and Conservation, 2006
- *DIN Standard 4150: Part 3 1999 Structural Vibration in Buildings – Effects on Structures, 1999*
- *British Standard 7385: Part 2 1993 Evaluation and Measurement of Vibration in Buildings, 1993*

2 Project Description

2.1 Site Location and Overview

Hanson propose to develop a new intermodal aggregate storage facility and concrete batching plant (the Facility) to be located adjacent to Glebe Island Berth one (GIB1). The proposed Facility site has been selected so as to enable the co-location of the concrete plant with aggregate shipping facilities, located on Glebe Island on the northern side of Anzac Bridge, between White Bay and Jones Bay. **Figure 1** shows the proposed Facility on Glebe Island and nearest sensitive receivers that may be affected by the works, as reproduced from the noise impact assessment (NIA) report 610.17533-R01-v2.0 '*Glebe Island Concrete Batching Plant Noise Impact Assessment*'.

The Facility will be designed with a capacity to produce up to 1 million cubic metres (Mcum) of concrete per annum (pa), with two main purposes:

- To operate as a concrete batching plant that can supply concrete for infrastructure and buildings in the Sydney CBD and inner suburbs; and
- To act as a shipping facility that will support a number of Hanson (and Hymix) concrete batching plants by improving the delivery of aggregates into the city centre.

The proposed facility would operate 24 hours a day, 7 days a week with commercial vehicles will operating at the site to deliver cement to the facility, deliver concrete made at the facility to buildings sites, and deliver aggregate to other concrete batching plants.

The majority of on-site activities including concrete batching and aggregate storage would occur in an enclosed building. A view of the proposed Facility is provided as **Figure 2**, and eastern elevation in which shows shipping containers located on the eastern perimeter of the site forming a noise wall (in green) for mitigation and visual amenity.

Figure 1 Site Location, Access Route and Noise Sensitive Receivers

2.2 Residential Receiver Localities

As identified in the NIA report, **Figure 1** identifies the nearest potentially affected residential receiver localities The representative residential receiver localities are generally consistent with those identified in the White Bay Cruise Terminal (WBCT) Project Approval (MP 10_0069), namely:

- Balmain (Donnelly Street, Roberts Road, and Batty Street);
- Pyrmont (Refinery Drive and Bowman Street); and
- Glebe Pt (Oxley Street).

Figure 2 North-Western View of the Facility

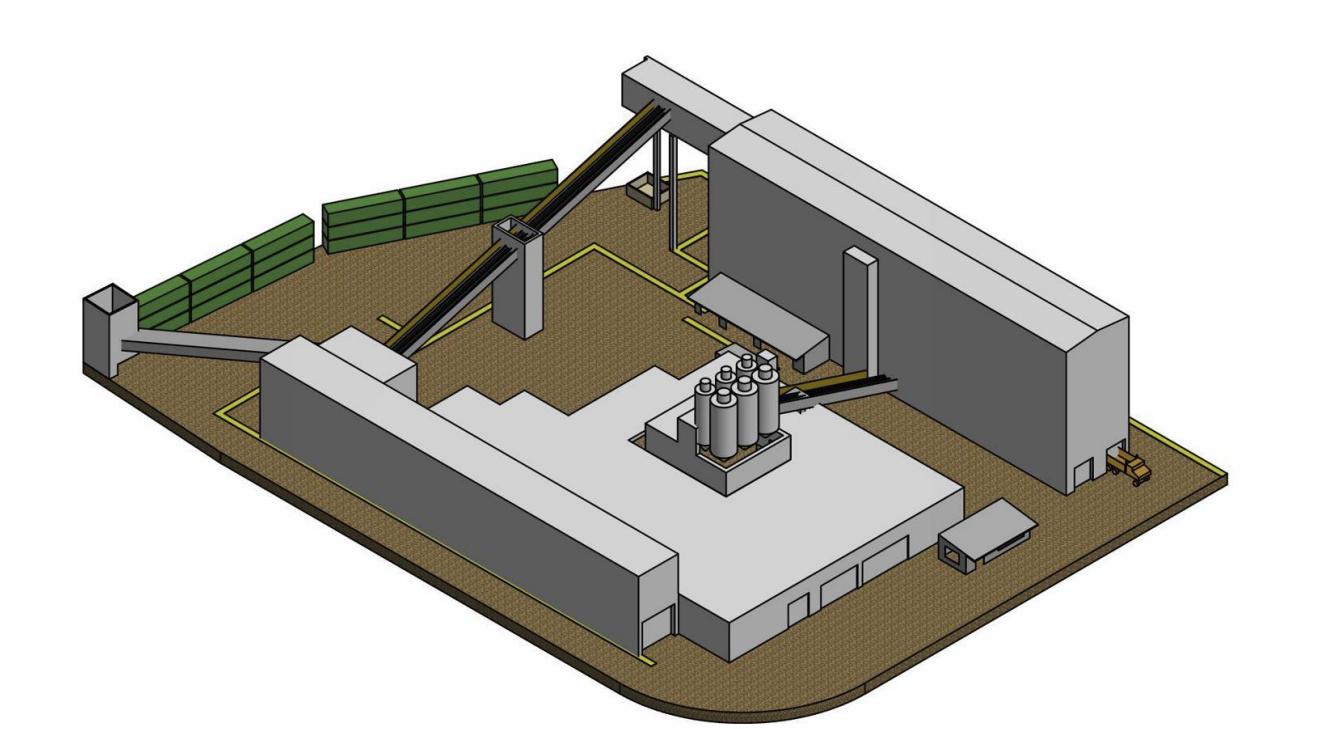
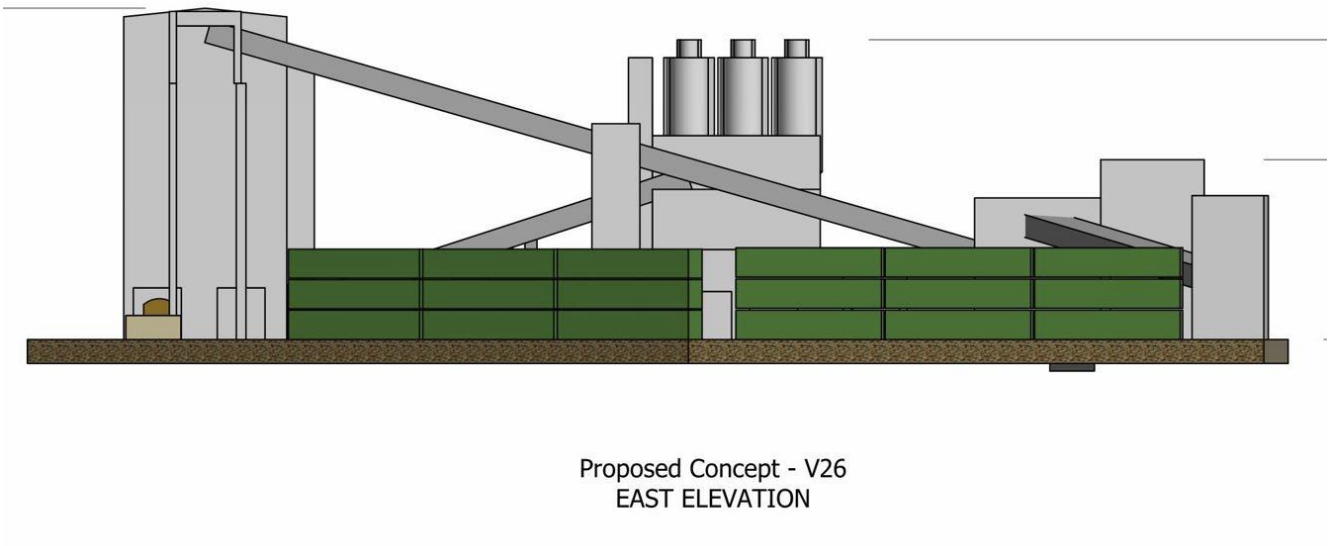


Figure 3 Eastern Elevation View of the Facility



2.3 Construction Stages

The proposed construction work scenarios with high noise impacts identified in the NIA report are detailed in **Table 2**. As shown in **Table 3**, rock breaking is expected to occur as part of the construction works with the potential to generate vibration from the Facility construction site. As shown in **Figure 1** site access would be from City West Link via James Craig Road, south of the Anzac Bridge western approach.

The Facility would be constructed during the approved construction hours of Monday to Friday 7am to 6pm; Saturday 7.30am to 3.30pm with no work on Sundays or Public holidays. Noisy works (rock breaking, sheet piling, pile driving, and similar activities) are only to be carried out Monday to Friday 9.00am - 12.00pm & 2.00pm - 5.00pm; Saturday 9.00am - 12.00pm. The estimated timeframes for construction activities are 25 weeks for civil works, 52 to 75 weeks for construction and 12 weeks or commissioning and 4 weeks for landscaping.

Table 2 Construction Work Scenarios and Scheduling

Stage	Activity	Description	Timing
S1	Enabling Works	Establishment of site compound, traffic controls and environmental control measures. Drainage, footings, electrical trenching, concrete cutting, moving of materials	Standard hours
S2	Silo Construction	Auger drilling to complete foundations Concreting and construction of silos	Standard hours
S3	Building Construction	Auger drilling to complete foundations Concreting and construction of buildings and conveyors	Standard hours

Table 3 reproduces the plant and equipment proposed for the activities listed in **Table 2** and the corresponding equipment sound power levels. This equipment list has been updated since publication of the NIA as a result of the refinement of construction activities, with a concrete saw and the occasional use of a loader now proposed during enabling works.

Table 3 Equipment Sound Power Levels Per Construction Stage

Equipment	$L_{Aeq(15minute)}$ Sound Power Level (dBA)	Construction Stage		
		S1	S2	S3
Auger Piling Rig	111		√	√
Bobcat	104	√		
Concrete Pump	106		√	√
Concrete saw	115[1]		√	
Concrete Truck / Agitator	108		√	√
Concrete Vibrator	110		√	√
Loader	112	√		
Excavator (15 tonne)	96	√		
Excavator breaker (15 tonne)	117[1]	√		
Hand Tools	94	√	√	√
Mobile Crane (100 tonne)	101		√	√
Truck (12 -15 tonne)	108	√	√	√
Truck (25 tonne)	110		√	√

Note 1: The SWL includes a 5 dB impulsive penalty.

2.4 Glebe Island and White Bay Master Plan

The Glebe Island and White Bay Master Plan (the Master Plan) (Sydney Ports, 2000) presents the historical text and planned future development for Glebe Island and White Bay. The Facility is generally consistent with the continued use of Glebe Island and White Bay as a commercial port. The current configuration of port facilities at Glebe Island and White Bay have existed since at least 1968 when reclamation works at White Bay were completed. While the Facility will be located within the broader Bays Precinct, the existing port facilities are under the jurisdiction and management of the Port Authority of NSW (Port Authority).

In addition to the port related uses, Glebe Island accommodates warehouses, manufacturing plants, and low to mid rise commercial office buildings. The port's two eastern berths (GIB1 and GIB2) are located along the length of the Glebe Islands south-eastern perimeter and are currently utilised for bulk shipping. The Multi-user Facility (adjacent GIB1 and GIB2) has existing approval, and the Port Authority is separately seeking activity approval to accommodate changes to the Multi-user Facility.

Subject to delivery schedules, the construction phases of the Facility and Multi-user Facility may also coincide, and the potential construction noise impacts are considered cumulatively in Section 7.2.1.

3 Existing Noise Environment

3.1 Noise Environment

Noise levels have been measured around the port facilities at Glebe Island and White Bay since the mid 1990's. The ambient noise environment has been established based on a review of the historical data as well as the more recent public information presented in the Report 610.11854 '*Interim Exhibition Facility Glebe Island White Bay & Wharves 4 & 5 Noise Impact Assessment*' (SLR, November 2012) and Report 610-04309-R51 '*Glebe Island Wharves 1 & 2 Proposed Multi User Facility*' (SLR, May 2013). The reports document ambient noise level measurements in the surrounding residential areas, and the relevant results are presented in **Table 4**.

Table 4 Summary of RBLs and L_{Aeq} Ambient Noise Levels Year 2009 and 2012 (dBA re 20µPa)

Locality	Location	Rating Background Level (RBL)[1,2] All Noise Sources			$L_{Aeq(period)}$[1] All Noise Sources		
		Daytime	Evening	Night-time	Daytime	Evening	Night-time
Balmain	17 Donnelly Street [2]	47	45	40	57	54	51
	1 Batty Street [3]	51	49	42	57	53	47
Pyrmont	22 Refinery Drive [2]	50	49	47	56	55	53
Glebe	53 Leichhardt Street [2]	46	46	40	58	55	53

Note 1: Daytime 0700 hours to 1800 hours, Evening 1800 hours to 2200 hours and Night-time 2200 hours to 0700 hours.

Note 2: The Donnelly Street, Refinery Drive and Leichhardt Street ambient noise level survey results from 2012.

Note 3: The Batty Street ambient noise level survey generally in the absence of port activities in 2009. Ambient noise survey in 2012 undertaken during some activity increased the night-time noise level by 3 dBA up to 45 dBA.

The ambient noise environment includes noise contributions from traffic and existing port facilities (when operating) and other local activities. The 2012 survey was conducted over a nine (9) day period when berths GIB7 and GIB8 were both occupied and unoccupied for similar periods. Hence when operating, the noise levels may include contributions from ships, the handling of bulk goods and containers. However, it can be reasonably inferred that the relatively elevated and longer term $L_{Aeq(period)}$ ambient noise levels result largely from non-industrial activities, in particular the Anzac Bridge and Western Distributor/City West Link traffic. Overall, the ambient noise levels are reasonably representative of the typical noise environment at the three nearest residential localities (ie Balmain, Pyrmont and Glebe) and considered suitable for the setting of construction noise criteria.

4 Construction Noise Assessment Criteria

The EPA's *Interim Construction Noise Guideline* (ICNG) recommends that the $L_{Aeq(15minute)}$ noise levels arising from a construction project, at residences should not exceed the Construction Noise Management Levels (CNMLs) indicated in **Table 5**. The ICNG also contains "highly noise affected" daytime CNMLs which are set at 75 dBA $L_{Aeq(15minute)}$.

The EPA's Guideline also recognises other kinds of noise sensitive receivers and provides recommended CNMLs for them. Those specific receiver types adjacent to the Facility and their recommended noise levels are presented in **Table 6**.

Table 5 Recommended EPA General Construction Noise Management Levels

Period of Noise Exposure	$L_{Aeq(15minute)}$ Construction NML
Recommended Standard Hours	Noise affected RBL + 10 dBA
	Highly noise affected 75 dBA [1]
Outside Recommended Standard Hours	Noise affected RBL + 5 dBA

Note 1: The noise affected level represents the point above which there may be some community reaction to noise.

Table 6 Noise at Sensitive Land Uses (other than Residences)

Land use	$L_{Aeq(15minute)}$ Construction NML
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dBA
Offices, retail outlets	External noise level 70 dBA
Industrial premises	External noise level 75 dBA

As the Facility construction works would be limited to the daytime hours specified in the Conditions of Consent only, the corresponding CNMLs are as presented in **Table 7**.

Table 7 Intrusive $L_{Aeq(15minute)}$ Construction Noise Management Levels (dBA re 20 µPa)

Locality	Location	Daytime CNML (noise affected) RBL plus 10 dBA [1]	Daytime CNML (highly noise affected) [1]
Balmain	17 Donnelly Street [2]	57	75
	1 Batty Street [3]	61	
Pyrmont	22 Refinery Drive [2]	60	
Glebe	53 Leichhardt Street [2]	56	

Note 1: Working hours as dictated by the Conditions of Consent: Monday to Friday 7am to 6pm; Saturday 7.30am – 3.30pm with no work on Sundays or Public holidays

5 Vibration Assessment Criteria

5.1 Categories of Vibration in Structures

The effects of vibration in buildings can be divided into three main categories; those in which the occupants or users of the building are inconvenienced or possibly disturbed, those where the building contents may be affected and those in which the integrity of the building or the structure itself may be compromised.

For the Facility construction works, the nearest structures are the heritage listed Glebe Island Silos approximately 100 m to the west and the Glebe Island 'swing bridge' approximately 100 m to the south. Additionally the eastern berths Glebe Island 1 and Glebe Island 2 are supported by piles. The nearest residential dwellings are located in Pyrmont (ie Refinery Drive) and approximately 300 m across Jones/Johnstons Bay.

5.2 Assessment Criteria

Most commonly specified 'safe' structural vibration limits are designed to minimise the risk of cosmetic damage such as surface cracks, and are set well below the levels that have potential to cause structural damage. The British Standard BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2, provides frequency-dependent vibration limits related to the cosmetic damage risk.

The German Standard DIN 4150-3:1999 "Structural Vibration Part 3: Effects of vibration in structures" provides guideline values for evaluating the effect of vibration on buried pipework. In addition, SLR has identified appropriate vibration criteria for computer room floors and the operating of mechanical plant where applicable.

The EPA's "Assessing Vibration: A Technical Guideline" (DEC 2006) provides guideline building vibration levels associated with a low probability of annoyance from occupants. The applicable damage risk and annoyance risk vibration velocity criteria are further discussed in **Appendix B** and summarised in **Table 8**.

Table 8 Vibration Velocity Damage Risk and Annoyance Risk Criteria (mm/s)

Receiver Area	Damage Risk (mm/s)		Annoyance Risk (mm/s)	
	Horizontal	Vertical	Horizontal	Vertical
Residential/Dwellings	7.5	7.5	1.2	0.45
Commercial/Offices	25	25	1.6	0.6
Industrial/Workshops			3.2	1.2
Reinforced structures (ie silos, swing bridge abutment ,wharf piles)			-	-
Electronic/Computers	5	5	-	-
Mechanical (On/Off) [1]	20/5	20/5	-	-
Subsurface structures	50-100	50-100	-	-

Note 1: 'On' refers to when machinery is turned on, and 'Off' is when machinery is off. Criteria are stricter for 'Off' as machinery is more likely to be damaged by vibration when it is not operating due to potential for brinelling.

6 Construction Noise and Vibration Impact Assessment

6.1 Noise Modelling Procedure

In order to facilitate the computation of environmental noise emissions from the operation of the Facility at Glebe Island, a three dimensional computer noise model has been developed, based on available ground topography and aerial photography of the study area.

Noise emission modelling was undertaken using SoundPLAN noise prediction software, based on utilising the CONCAWE algorithm, a commercial software system developed by Braunstein & Berndt International. The acoustical algorithms utilised by this software are endorsed by the NSW EPA as suitable for use. The noise modelling algorithms account for the octave band sound power levels of the sources, their heights, the distances to receivers, the natural topography, buildings, air absorption and ground effects.

6.2 Construction Noise Impact Assessment

Based on the scenarios developed for the enabling and building works presented in **Section 2.3**, noise levels have been predicted at the nearest residential and commercial receivers.

The predicted daytime construction noise levels at the nearest residential localities and adjacent commercial properties for the three construction scenarios are presented **Table 9**. The table also presents the recommended NMLs (from **Table 7**) during the construction hours specified in the Conditions of Consent.

Table 9 Predicted Daytime Construction Intrusive $L_{Aeq(15minute)}$ Noise Levels (dBA re 20 µPa)

Locality	Location	Enabling	Silo	Building	CNML (noise affected)	CNML (highly noise affected)
Balmain	Donnelly Street	48	47	46	57	75
	Batty Street / Roberts Road [1]	53	52	51	61	
Pyrmont	Bowman Street [2]	63	62	61	60	
	Refinery Drive	58	57	56		
Glebe	Glebe Point Road	51	50	49	56	

Note 1 The higher noise level from receivers at Batty Street and Roberts Road is shown

Note 2 The higher noise level at multilevel apartment buildings is shown

Note 3: Predicted noise level complies with the CNML (noise affected)

Note 4: Minor to moderate residual noise exceedances of 1 to 3 dBA above CNML (noise affected)

6.3 Cumulative Construction Noise Impact Assessment

6.3.1 Multi-user Facility Construction Works

As described in Section 1.4, subject to delivery schedules the construction phases of the Facility and Multi-user Facility may coincide for a period over 24 months. Given the proximity of the sites to each other, there is a potential for cumulative construction noise impacts.

The Multi-User Facility REF Appendix D (*Noise Impact Assessment*, *Table 19*) presents the predicted construction noise levels from similar phases of construction to that of the Facility. In the event that construction works do occur concurrently, the cumulative predicted daytime intrusive $L_{Aeq(15minute)}$ noise levels from the Facility and the Multi-User Facility to the nearest common residential localities are presented **Table 10**, together with recommended CNMLs (Table 7) during construction hours specified in the Conditions of Consent (Table 2).

Table 10 Predicted Cumulative Daytime Construction Intrusive $L_{Aeq(15minute)}$ Noise Levels (dBA re 20 µPa)

Locality	Location	Enabling	Silo	Building	CNML (noise affected)	CNML (highly noise affected)
Balmain	Batty Street	60	55	54	57	75
Pyrmont	Refinery Drive	67	62	62	60	
Glebe	Glebe Point	59	54	53	56	

Note 1: Predicted noise level complies with the CNML (noise affected)

Note 2: Minor to moderate residual noise exceedances of 1 to 4 dBA above CNML (noise affected)

Note 3: Appreciable residual noise exceedance >5 dBA above CNML (noise affected) but less than CNML 75 dBA

Note that **Table 10** presents the cumulative impact when the noisiest construction activities of the Facility correspond to the noisiest construction activities of the Multiuser facility over the nominal 24 month construction period of the Facility, and would be therefore be expected to occur for limited periods.

6.3.2 Westconnex M4-M5 Link Rozelle Construction Works

While it is anticipated that construction phase of the Facility may coincide with Westconnex M4-M5 Link (Rozelle) construction works for a period, it is concluded that any cumulative construction noise impacts will be minimal due to the separation of the respective construction sites and the absence of common residential receivers.

6.4 Construction Vibration Impact Assessment

As described in **Section 5.1**, for the Facility construction works, the nearest structures are the heritage listed Glebe Island Silos approximately 100 m to the west and the Glebe Island 'swing bridge' approximately 100 m to the south. The nearest residential dwellings are located in Pyrmont (ie Refinery Drive) and approximately 300 m across Johnstons Bay.

The predicted safe working distances to comply with both the vibration damage Risk and annoyance risk criteria (**Table 8**) are presented in **Table 11** due to the use of a medium rock breaker (900 kg - 12 to 18t excavator) as proposed on the construction site.

Table 11 Predicted Safe Working Distances to Comply with Damage Risk and Annoyance Risk Criteria

Receiver Area	Damage Risk Safe Distance (m)	Annoyance Risk Safe Distance (m)
Residential/Dwellings	7 m	23 m
Commercial/Offices	2 m	19
Industrial/Workshops		15 m
Reinforced structures (ie silos, swing bridge abutment, wharf piles)		-

Based on the predicted safe working distances presented in **Table 11**, it is concluded that residential dwelling vibration damage and occupant annoyance risks are minimal, as the nearest residential dwellings are beyond 300 m from the Facility construction site.

Similarly, commercial and industrial property vibration damage and occupant annoyance risks are minimal, as the nearest commercial and industrial structures are beyond 100 m from Facility construction site. Moreover, the heritage listed Glebe Island silos and swing bridge vibration damage risk is also minimal due to the intervening distance between the structures and Facility construction site.

7 Noise and Vibration Management Measures

7.1 Standard Mitigation Measures

It is recognised that due to the nature of construction activity occurring on construction sites in close proximity to sensitive receptors, the potential for disturbance from noise and vibration can be significant.

Consequently, the project should apply all feasible and reasonable work practices to meet the NMLs, where possible, and inform all potentially impacted sensitive receivers of the nature of works to be carried out, the expected noise levels, duration of noise generating construction works, and contact details during construction.

The recommended construction migitation measures are shown in **Table 12**.

Table 12 Recommended Mitigation Measures

Project stage	Measure
Project planning	Where possible, consider the application of alternative, low-impact construction techniques to rock breaking and concrete sawing.
	Use the minimum sized equipment necessary to complete the work, this is particularly relevant to compacting and hydraulic hammering / rock breaking.
	No public address (PA) system will be used at this site.
Scheduling	Carry out community consultation and provide advanced warning of potential disruptions to sensitive receivers.
	Deliveries will be carried out within the hours set out in **Section 2.3** as dictated by the Conditions of Consent
	Noisy works are only to be undertaken during the specified times and respite periods are to be strictly adhered too.
Site Layout	Site entry and exit points will be located as far as possible from sensitive receivers, taking into account the importance of safe access.
	Compounds, refuelling areas and work areas will be designed to promote one-way traffic so that vehicle reversing movements are minimised.
	Work compounds, parking areas, equipment and material stockpile sites will be positioned away from noise-sensitive locations
	Trucks will be carefully scheduled and not queue up at the site entrance.
Training	Training will be provided to all project personnel, including relevant sub-contractors on noise requirements through inductions, toolboxes and targeted awareness training.
	All relevant staff and sub contractors will be informed of areas and work practises where potential noise impacts have been identified.
	Horn signals between drivers are not permitted.
Contractor management	Delivery vehicles should be fitted with straps rather than chains for unloading, wherever possible.
	Truck drivers should avoid compression braking as far as practicable and should use main roads where feasible.
Noise source mitigation and	Switch off generators/items of plant when not in use.
	Avoid dropping materials from a height.

Project stage	Measure
controlling the transmission of noise	Shut down or throttle down machinery when not in operation.
	Avoid simultaneous operation of noisy plant within discernible range of a sensitive receiver
	Ensure equipment is operated in the correct manner including replacement of engine covers, repair of defective silencing equipment, tightening of rattling components, repair of leakages in compressed air lines and shutting down equipment not in use.
	Siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise
	Plant will be fitted with noise control devices, where practicable, including acoustic lining of engine bays and air intake / discharge silencers
	Ensure that all doors/hatches are shut during operation of plant and equipment.
	Check hatches/enclosures regularly to ensure that seals are in good working order and doors close properly against seals.
	Use residential-grade mufflers on plant.
	Use dampened bits on impulsive tools such as jackhammers to avoid 'ringing' noise.
	An acoustic shroud (skirt) can be installed on hydraulic rockbreakers and concrete saws.
	Ensure truck movements are kept to a minimum, ie that trucks are fully loaded on each trip.
	Mobile plant and trucks operating on site for a significant portion of the project will have reversing alarm noise emissions minimised, where possible, recognising the need to maintain occupational safety standards. This may potentially be achieved through restrictions on reversing activities or installation of non-tonal reversing alarms on mobile plant and equipment.
	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.
	Construct the eastern noise walls as early as practicable in the construction program.
Community consultation	Provide at least five and not more than 14 days' notice to affected receivers prior to starting works (refer to **Section 7.3**).
	Provide signage detailing who is undertaking the works and a contact number.
	Where there are complaints about noise from an identified work activity, review and implement, where feasible and reasonable, additional control measures.
Monitoring	Conduct noise monitoring in response to any complaints received to verify that levels do not substantially exceed predicted levels.
	Initial noise monitoring of plant and equipment will be undertaken to ensure the noise levels are being met (refer to **Section 7.2**)

The following vibration mitigation measures will be implemented by the Construction Contractor:

Table 13 Recommended Vibration Mitigation Measures

Project stage	Measure
Project planning	Relocate any vibration generating plant and equipment to areas within the site in order to lower the vibration emissions..

Project stage	Measure
	Use the minimum sized equipment necessary to complete the work, this is particularly relevant to compacting and hydraulic hammering / rock breaking.
	Prior to the works conduct a dilapidation survey of the existing wharf structure on the eastern side of the site.
Scheduling	Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
Vibration source mitigation and controlling transmission	Use lower vibration-generating plant and equipment eg smaller capacity plant.
	Schedule respite periods, particularly when long periods of vibration-intensive activities occur.
Monitoring	Should rock breaking be proposed adjacent to the eastern wharf structure, undertake vibration monitoring at the commencement of vibration-intensive activities.

7.2 Monitoring

Attended noise measurements will be undertaken at the start of noise intensive works that are near to sensitive receivers to verify the levels are as predicted and to check the effectiveness of mitigation and management measures.

Noise and/or vibration monitoring would also be undertaken in response to any formal complaints. All monitoring will be completed by suitably qualified acoustic specialists. The location and extent of attended monitoring will be determined in consultation with project staff and would be dependent on the activities taking place.

The monitoring will take place during the expected noisiest construction periods and be representative / indicative of the impacts at the potentially affected sensitive receivers.

All items of acoustic instrumentation utilised will be designed to comply with IEC 61672.1-2004 *Electroacoustics – Sound level meters* (AS IEC 61672) and carry current calibration certificates.

A monitoring report will be prepared after each monitoring survey. Summaries of monitoring reports will be provided on the company website and in the instance of an exceedance the relevant authority is to be alerted. Monitoring reports would include the following details, at a minimum:

- Noise monitoring locations
- Date, time and length of noise monitoring/measurements
- Weather conditions during the measurements
- Name and position of personnel undertaking measurements
- Construction activities being undertaken during measurements
- Locations of construction equipment and distance from monitoring location
- Measured L_{Aeq} and LAmax noise levels during construction works (for each activity) along with a comparison to the predicted noise levels
- Measured L_{A90} background noise level in absence of the construction works

- Operator observations noting any extraneous noise sources or other points of relevance.

7.3 Community Consultation

Community consultation is recommended prior to the commencement of activities likely to generate levels of noise or vibration in excess of the criteria described in **Section 4** and **Section 5**. Community consultation will be undertaken via the Construction Contractor and include:

- Advising the commercial neighbours and residents of work to be undertaken, eg activity, duration, likely noise levels (based on this Plan).
- Contact details for the Construction Contractor will be provided to the potentially affected party.
- Recording and managing any complaints.

7.4 Complaint Handling

The nature of the project will be such that most significant noise and vibration events will be relatively short in duration. This protocol is intended to ensure that the issues are addressed and that appropriate corrective action is identified and implemented as necessary. Where a complaint relating to noise or vibration is received, the Construction Contractor shall:

- Record all verbal and telephone complaints in writing, together with details of the circumstance leading to the complaint and all subsequent actions.
- As an initial step, investigate the complaint in order to determine whether a criterion exceedance has occurred or whether noise and/or vibration have occurred unnecessarily.
- Plan and implement corrective action, as necessary.
- Inform Complainants that their complaints are being addressed, and (if appropriate) that corrective action is being taken.
- Where the activity will occur again, carry out noise monitoring and other investigations to confirm the effectiveness of the corrective action and the compliance status of the activity with the project criteria.
- All measurements and reporting will be undertaken in general accordance with Section 5 “Methods for measurement of Noise and Vibration” of Australian Standard 2436:2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* (AS 2436).
- Inform Complainants of the implementation of the corrective action that has been taken to mitigate any adverse effects and monitoring outcome.
- Undertake subsequent noise monitoring of that activity as required.

7.5 Summary of Mitigation Measures

The noise and vibration mitigation measures to be implemented by the Construction Contractor are listed in **Table 14**.

Table 14 Noise and Vibration Mitigation Measures

Item	Description
Construction Hours	Works will be carried out within the hours set out in **Section 2.3** as dictated by the Conditions of Consent.

Item	Description
Deliveries	Deliveries will be carried out within the hours set out in **Section 2.3** as dictated by the Conditions of Consent.
Site Layout	Where possible, plant and equipment will be located and orientated to direct noise away from sensitive receivers.
Quietest Suitable Equipment	Plant and equipment will be selected to minimise noise and vibration emission, where possible. Silencers/mufflers and other technologies will be fitted where possible and all noise control equipment will be maintained in good order.
Reversing Alarms	Mobile plant and trucks operating at the site may use less intrusive reversing alarm, where possible.
PA System	No public address system will be used at this site.
Vibration Minimum Work Distances	General minimum working distances for rock breakers rollers are described in **Section 6.4**. Monitoring may be carried out to confirm safe work distances at locations where structures are closest or where there is considered to be a risk that vibration levels may exceed the relevant structural damage criteria.
Community Consultation	Advise the community of noisy and vibration-intensive work to be undertaken, eg activity, duration, likely noise or vibration levels. Contact details for **Hanson** will be provided. Complaint response will be implemented.
Noise or vibration Measurements	In response to complaints, conduct measurements of noise or vibration measurements to: Confirm degree of compliance with project limits, or otherwise Effectiveness of mitigation treatments
Training	Site induction training will include a noise awareness component.

7.6 Roles and Responsibilities

Responsibility for implementation of this CNVMP is summarised in **Table 15**.

Table 15 Summary of Responsibility

Action	Responsibility
Overall implementation of CNVMP	Construction Project Manager
Implement methodology for avoiding excessive noise and vibration emissions	Construction Contractor
Ensure all potentially impacted sensitive receivers are informed by letterbox drops prior to the commencement of construction	Construction Community Liaison Officer
Collate and maintain records of complaints, respond to complainant	Construction Community Liaison Officer
Identify Non Conformances and notify Construction Project Manager	Construction Contractor
Authorise and confirm the implementation of mitigation measures	Construction Contractor
Community Liaison	Construction Community Liaison Officer

7.7 Review and Improvement of Noise Management Plan

This CNVMP will be reviewed, and if necessary, updated in the following circumstances:

- Significant changes to the equipment, machinery and plant operated within the site
- Where it is identified via monitoring that the performance of the project is not meeting the objectives of the CNVMP
- At the request of the relevant regulatory authority or other relevant government agency.

All employees and contractors will be informed of any revisions to the CNVMP by Site Management during toolbox talks. The most recent version of the CNVMP as approved by the Planning Secretary, will be implemented for the duration of construction works.

8 CONCLUSION

SLR has prepared a CNVMP for the proposed redevelopment of a Aggregate Storage Facility and Concrete Batching Plant at Glebe Island. The CNVMP addresses the Conditions of the Development Consent as issued by the Independent Planning Commission.

The objectives of the CNVMP were to identify the potential noise and vibration emissions from the enabling and construction activities at the site and to provide recommendations with regard to management strategies and mitigation measures, where necessary.

Project specific noise and vibration criteria have been established in accordance with the NSW guidelines and the Conditions of Consent.

APPENDIX A

Acoustic Terminology

1. Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that 'noise' often refers to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range with the loudest sound pressure to which the human ear can respond being ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2 x 10^{-5} Pa.

2. 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB(lin) or dB.

3. Sound Power Level

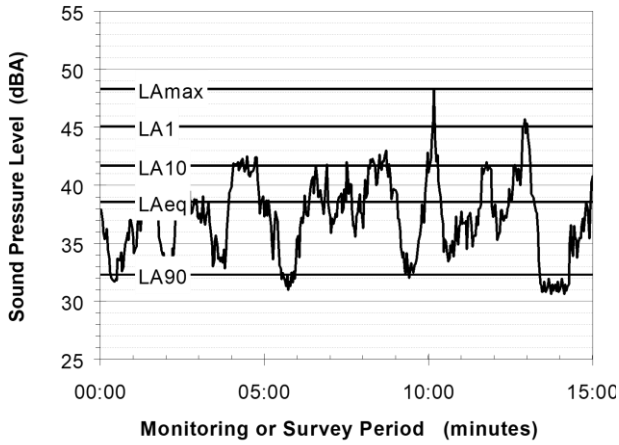
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but

The relationship between Sound Power and Sound Pressure is similar to the effect of an electric radiator, which is characterised by a power rating but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4. Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

LA1 The noise level exceeded for 1% of the 15 minute interval.

LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

LAeq The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

5. Frequency Analysis

Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

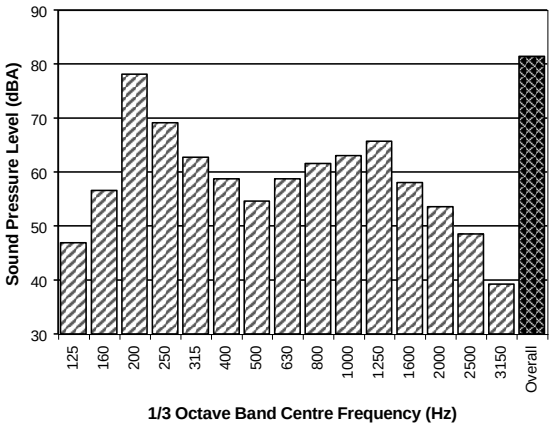
The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (three bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



6. Annoying Noise (Special Audible Characteristics)

A louder noise will generally be more annoying to nearby receivers than a quieter one. However, noise is often also found to be more annoying and result in larger impacts where the following characteristics are apparent:

- **Tonality** - tonal noise contains one or more prominent tones (ie differences in distinct frequency components between adjoining octave or 1/3 octave bands), and is normally regarded as more annoying than 'broad band' noise.
- **Impulsiveness** - an impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.
- **Intermittency** - intermittent noise varies in level with the change in level being clearly audible. An example would include mechanical plant cycling on and off.
- **Low Frequency Noise** - low frequency noise contains significant energy in the lower frequency bands, which are typically taken to be in the 10 to 160 Hz region.

7. Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements (ie vertical, longitudinal and transverse).

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used.

8. Human Perception of Vibration

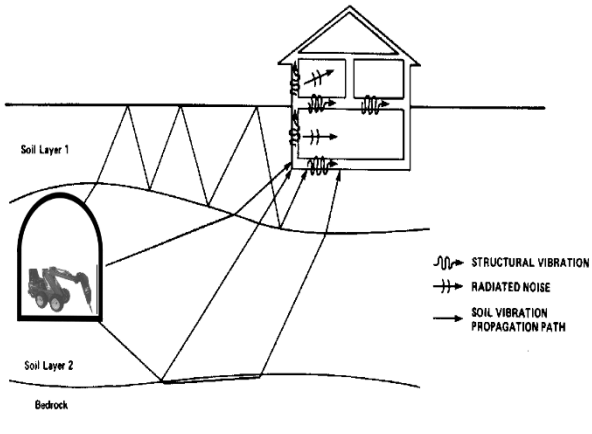
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

9. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise.

APPENDIX B

Construction Vibration Assessment Criteria

Vibration - Building Structures Cosmetic Damage Risk

Most commonly specified 'safe' structural vibration limits are designed to minimise the risk of cosmetic damage such as surface cracks, and are set well below the levels that have potential to cause structural damage. British Standard BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings Part 2,* provides frequency-dependent vibration limits related to the cosmetic damage risk. Noting, cosmetic damage is very minor in nature, is readily repairable and does not affect the structural integrity of the building.

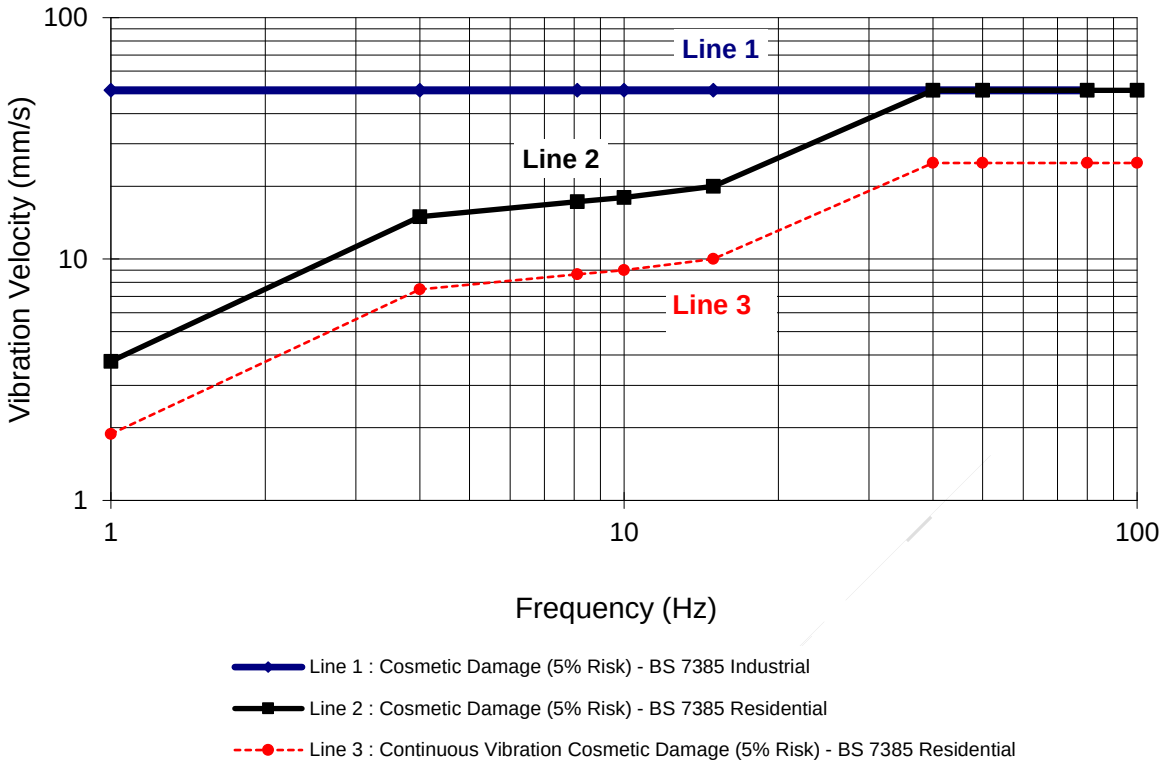
The BS 7385 Part 2-1993 sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect. Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (eg compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in **Table B1** and graphically in **Figure B1**.

Table B1 Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage

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

Figure B1 Graph of Transient Vibration Guide Values for Cosmetic Damage



BS 7385 Part 2-1993 goes on to state that cosmetic damage is possible at vibration magnitudes which are greater than twice those given in **Table B1**, and damage to a building structure may occur at values greater than four times the tabulated values. It is also noteworthy that extra to the guide values nominated in **Table B1**, the BS 7385 Part 2-1993 states that:

> *"Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK."*

Also that:

> *"A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive."*

BS 7385 Part 2-1993 states that the guide values in **Table B1** 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 (ie rock breaking or sheet piling) 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 B1** may need to be reduced by up to 50%.

For construction activities involving intermittent vibration sources such as rock breakers, piling rigs, vibratory rollers, excavators and the like, the predominant vibration energy occurs at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range). On this basis, a conservative vibration damage screening level per receiver type is given below:

- Unreinforced or light framed structures: **7.5 mm/s**.
- Reinforced or framed structures: **25.0 mm/s**

Vibration - Computer Rooms

Based on previous experience, SLR has found a peak particle velocity (ppv) criterion of 5 mm/s to be appropriate for computer room floors (based on vibration requirements for hard drives). If it is determined that more sensitive equipment is stored in these rooms, this criterion may need to be revised.

Vibration - Mechanical Plant

The criteria in **Table B2** are based on previous experience at port facilities.

Table E2Guideline Values for Vibration - Effect of Short Term Vibration on Mechanical Plant

Situation	Vibration Measured on Support Structure (ppv mm/s)
Mechanical Plant (ie conveyors, drive assemblies) **In Operation**	20
Mechanical Plant (ie conveyors, drive assemblies) **Not In Operation**	5

Vibration - Buried Pipework

The German Standard DIN 4150-3:1999 "*Structural Vibration Part 3: Effects of vibration in structures*" provides guideline values for evaluating the effect of vibration on buried pipework. The values are based on the assumption that pipes have been manufactured and laid using current technology. Additional considerations may be required at junctions. The recommended limits for short term vibration to ensure minimal risk of damage are presented numerically in **Table B3**.

Table B3 Guideline Values for Vibration - Effects of Short Term Vibration on Buried Pipework

Pipe Material	Vibration Measured on the Pipe[1] (ppv mm/s)
Steel (including welded pipes)	100
Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80
Masonry, plastic	50

Note 1: Mounting equipment directly onto pipes may not be possible. If the vibration source is not immediately next to the pipework, measurements can be made on the ground surface to obtain an estimate. Generally, this vibration level will be greater than the level measured directly on the pipework.

Vibration - Human Comfort

EPA's "*Assessing Vibration: A Technical Guideline*" (DEC 2006) is based on the information set out in British Standard 6472-1992 "*Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)*". This standard defines levels of building vibration associated with a "low probability of adverse comment" from occupants. The applicable levels for continuous daytime activities are shown in **Table B4**.

Table B4 Vibration Levels with "Low Probability of Adverse Comment" (1 Hz to 80 Hz)

Building Type	Peak Floor Vibration	Peak Floor Vibration (Z Vertical)
Residential	0.8 mm/s to 1.6 mm/s	0.3 mm/s to 0.6 mm/s
Commercial/Offices	1.6 mm/s	0.6 mm/s
Industrial/Workshops	3.2 mm/s	1.2 mm/s

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