Vibration Management Plan

Epping to Thornleigh Third Track Alliance

ETT ALLIANCE

Vibration Management Plan

Document Control

Title Construction Vibration Management Plan (VMP)

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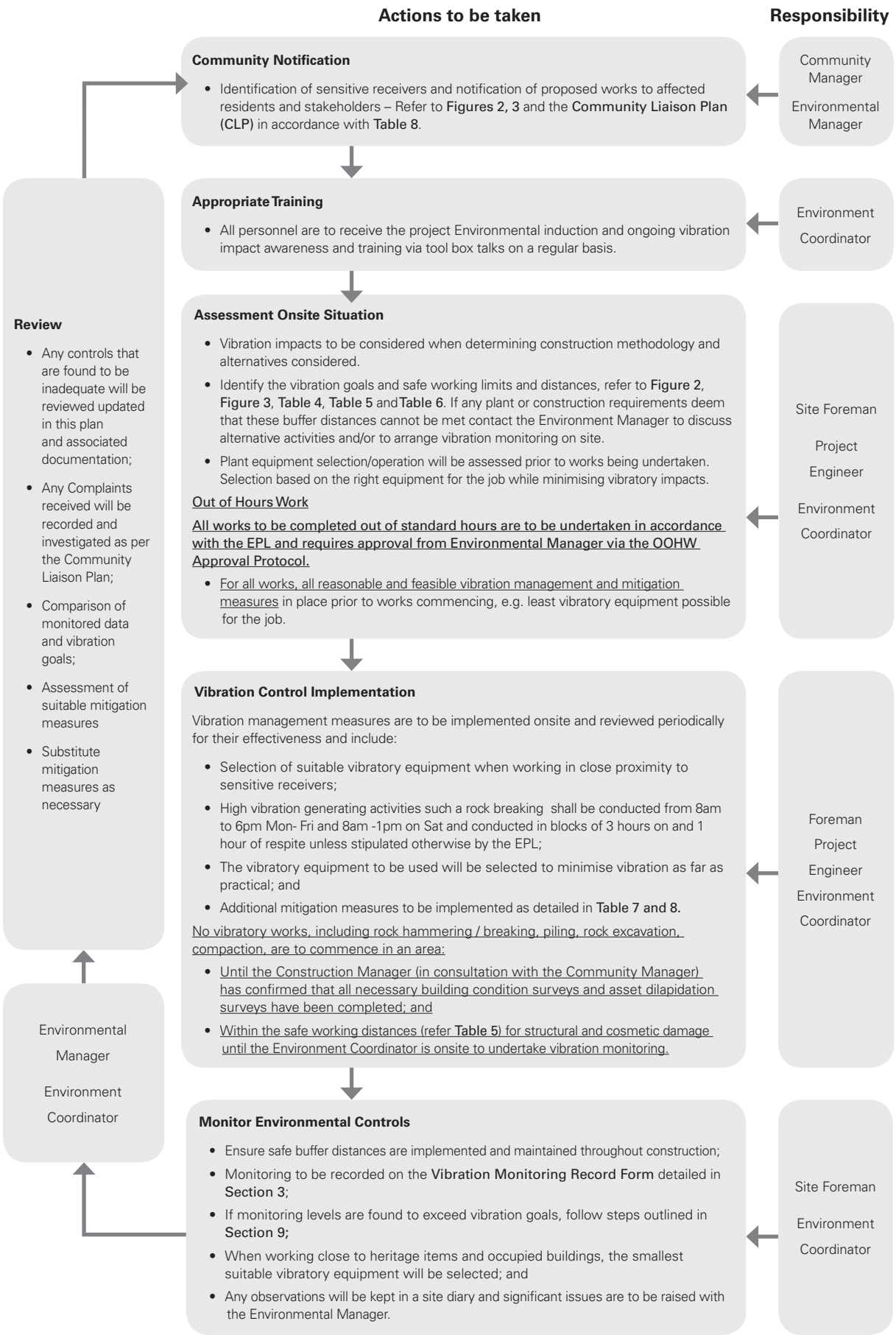
Details of Revisions

Rev	Date	Description
0	15/05/2013	Initial document submission for TPD review
1	22/05/2013	Edits following TPD / ER review
2	6/06/2013	Updated to reflect draft CoA
3	25/6/2013	Updated to reflect final draft CoA and edited following TPD / EMR review
4	2/07/2013	Edits following TPD / ER review
5	22/07/2013	Updated to reflect Project Determination
6	29/08/2013	Compiled following stakeholder review Compiled for DP&I review and approval
7	18/10/2013	Updated following DP&I comments Initial for Construction
8	24/02/2014	Removal of procedures to central location
9	15/03/2015	Annual review, and updated for Organisation Chart. Incorporate document design changes in-line with Web Content Accessibility Guidelines (WCAG).
10	03/03/2016	Annual review, and updated for Organisation Chart. Finalised document design changes in-line with Web Content Accessibility Guidelines (WCAG).

Contents

Figure 1 – Construction Vibration Management Process



1 Objective

- To implement measures to ensure that impacts from vibration generating activities are minimised during construction and to comply with the Vibration component of the Condition of Approval (CoA) **Condition E34(b) - Construction Noise and Vibration Management Plan, TfNSW Standard Requirements TSR E1 – Environmental Management and TfNSW Construction Noise Strategy 2012 (TfNSW CNS) and the Project EPL** as applicable to ETTT works.
- This Plan forms part of the overall Project Construction Environmental Management Plan (CEMP) and addresses the specific CoA, REMMs and other applicable conditions relating to the management of noise related impacts during construction.
- Development of the Construction Vibration Management Plan will be in consultation with the NSW Environmental Protection Authority (EPA).
- Noise impacts and proposed management are described in the Construction Noise Management Plan.
- Control of vibration related impacts on heritage items are further developed in the Construction Heritage Management Plan.
- Vibratory impacts associated with rock fracturing and blasting will be detailed within a corresponding Blast Management Plan (if these options are pursued).

2 Legislation, Licences, Standards, Planning Instruments and Guidelines

- Table 1 below details the legislation, licences, standards, planning instruments and guidelines considered during development of this Plan.

Table 1: Legislation, Licences, Standards, Planning Instruments and Guidelines Applicable to the Project

Legislation / Licences	Standards & Guidelines	Planning Instruments
• NSW *Protection of the Environment Operations Act, 1997*	• *TfNSW Standard Requirements TSR E1 – Environmental Management*	• Project Planning Approval Date: 17 July 2013
• Project EPL No. 20287	• Construction Vibration (damage limits) German Standard DIN 4150 Part 3-1999 *Structural Vibration in Buildings – Effects on Structures*	• Epping to Thornleigh Environmental Impact Statement
	• Assessing Vibration – A technical guideline (DECC February 2006)	• Epping to Thornleigh Submissions Report and REMMs
	• *TfNSW Construction Noise Strategy 2012* (TfNSW CNS)	

- A vibration management compliance tracking sheet is provided in Annexure A.

3 Supporting Procedures, Forms, Checklists and Registers

- Tools that are used to support the implementation of this Plan are detailed within **Table 2** below.

Table 2: Supporting Procedures, Forms, Checklists and Registers Applicable to the Project

Procedure	Form	Checklist	Register
• Out of Hours Works Approval Protocol	• EPL Variation Exempt OOH Works Approval Form		• Register Of Out of Hours Work Applications
	• EPA Licence Variation Application Form		
	• Out of Hours Application Form		
	• Vibration Monitoring Record Form		
• Supporting documentation below can be found in the CEMP			
• Weekly Environmental Inspection Procedure	• Environmental Inspection Actions Form	• Weekly Environmental Inspection Checklist	
	• Stop Work Report Form		

- The supporting documents applicable to the management of vibration are provided separately on the TfNSW Website and on the Alliance's "Our Way" database.

4 Process

- Prior to and during construction, the management of vibration impacts will follow the process presented in **Figure 1.**

5 Management

- The induction will include details on vibration management whilst working on site.
- Ongoing vibration impact awareness and mitigation training will be implemented at regular intervals through the construction phase of the project.
- In accordance with CoA E2, except as permitted by an EPL, activities resulting in impulsive or tonal noise emission shall only be undertaken:
  - ☐ between the hours of 8:00 am to 6:00 pm Monday to Friday;
  - ☐ between the hours of 8:00 am to 1:00 pm Saturday; and
  - ☐ in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block.
  - ☐ 'Continuous' includes any period during which there is less than a one hour respite between ceasing and recommencing any of the work that is the subject of this condition.
- Approval to work outside of the specified hours as presented within the Construction Noise Management Plan will follow the process presented in the **Out of Hours Works Approval Protocol.**
- All out of hours works will be tracked on the **Register Of Out of Hours Work Applications.**
- High vibration generating activities will only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block.
- To minimise potential cumulative impacts, no more than four consecutive nights of high noise and/or vibration generating work will be undertaken over any seven day period, unless otherwise approved by the relevant authority or the project's EPL. Subsequent detail regarding management of potential cumulative impacts including responsibilities for implementation is provided in **Table 7** and includes implementation of respite periods for activities resulting in high vibration emissions and coordinating Project works with other major project's (SSI;s) in the area.
- Where reasonable and feasible vibration generating plant and equipment will be scheduled at less sensitive time periods.
- A list of indicative construction key vibration generating activities and the affected catchment areas are identified in **Table 3.** The location of nearby sensitive receivers is detailed within **Figure 2** and nearby heritage items are detailed within **Figure 3.** Heritage item identification and management is further detailed within the Project's **Construction Heritage Management Plan.**
- The vibration criteria in relation to surface structures are adopted from the German Standard DIN 4150 Part 3-1999 Structural Vibration in Buildings – Effects on Structures (GS DIN 4150) are shown in **Table 4**. The environmental coordinator in consultation with the foreman and project engineers will assess the location of vibratory works for compliance with the vibratory goals provided in **Table 4** and the safe working distances shown in **Table 5.**
- Levels prescribed for human response are significantly lower than for those for structural damage. Preferred and maximum vibration levels for human comfort are shown in **Table 6.** Vibratory work likely to exceed on these guidance levels will be undertaken in continuous blocks of three hours, with an hour of respite unless otherwise approved in the EPL.
- If vibratory works are necessary within the safe working distance for cosmetic damage or adjacent to heritage structures, vibration monitoring will be undertaken at the time of the works to determine compliance with relevant standards.
- A list of measures to minimise vibration impacts that will be implemented where reasonable and feasible on the project are identified in **Table 7, Table 8** and in **Assessing Vibration (DECC 2006).** Measures to minimise

potential vibration impacts to heritage listed items / properties such as Devlins Creek Causeway (as per REMM P.3 and P.8) are detailed within the Project's **Construction Heritage Management Plan.**

- To effectively minimise construction vibration , the following process will be undertaken in order of priority:
  - ☐ early consultation with nearby sensitive receivers;
  - ☐ controlling vibration at the source;
  - ☐ controlling the transmission of vibration ;and
  - ☐ Controlling vibration at the receiver.
- Nearby sensitive receivers are to be notified and consulted with regarding vibration activities that are within the safe working distances in accordance with the Alliance's **Community Liaison Plan.** This will involve but not limited to letter box drops, project specific respite offers, phone calls and specific notifications.
- Stakeholders will be provided with the contact details for inquiries (1800 684 490) and complaints (1800 775 465). They will also be notified of works in accordance with the **Community Liaison Plan.**
- In addition to the requirements set out in this plan, the relevant conditions set out in the project EPL also apply.

6 Goals

- Where possible, the project will be constructed with the aim of achieving the construction vibration guideline values detailed within Table 4 and 6.
- Sensitive receivers and heritage item locations are identified in Figure 2 and Figure 3 respectively.
- All works operated within safe working distances are to be monitored and amended to assist in complying with vibration goals if they are exceeded.

7 Monitoring

- Vibration monitoring would be initially carried out at nearby structures within the safe working distances for cosmetic damage (**Table 4** and **5**) as a result of vibration intensive construction activities, where the vibration levels are greater than the recommended values for human comfort (**Table 6**), in response to complaints and in accordance with relevant EPL conditions.
- Monitoring for the effects of vibration on historic buildings and structures where works occur within the safe working distances will be undertaken (**Table 5**) with the objective of achieving the criteria detailed within **Table 4** in accordance with German Standard DIN 4150 Part 3-1999 **Structural Vibration in Buildings – Effects on Structures.**
- Vibration monitoring would also be carried out as required by the EPL.

8 Reporting

- Vibration monitoring will be recorded on the **Vibration Monitoring Form.**
- All monitoring required by the EPL will be posted on the Leighton Contractors website as holder of the EPL (www.leightoncontractors.com.au).
- In response to complaints a detailed report will be provided to the complainant.
- Further reporting will be in line with Section 8.4 of the Construction Environmental Management Plan (CEMP).

9 Incidents and Non-Conformances

- Where nominated vibration exceed goals, works are to be amended to assist in complying with vibration goals and the following actions undertaken:
  - ☐ Confirm that monitored levels are not being contaminated by other vibration sources;
  - ☐ Confirm that all reasonable and feasible measures have been implemented;
  - ☐ Confirm if the exceedance is due to an uncharacteristically vibratory piece of equipment;
  - ☐ Identify if equipment can be swapped out for another piece of equipment or alternative equipment or plant(without putting the possession at risk if identified in a possession);
  - ☐ Ensure that learning's form the above are fed back into the vibration modelling assessment process.

» Incidents will be managed as outlined within Section 9 of the CEMP.

10 Review

- A management review of the CEMP will be undertaken to ensure its continuing suitability, adequacy and effectiveness. Reviews will include assessing opportunities for improvement and the need for changes to the system, including the environmental policy and environmental objectives and targets. The management reviews will occur:
  - » On an annual basis to ensure its continuing effectiveness;
  - » Within 1 month following a major (Class 1) incident
  - » Where an audit recommends a review
  - » Where there are repeat non conformances and these are not closed out within the agreed timeframe
  - » As otherwise determined by the Environmental Manage

Table 3: Key Vibration Generating Activities and Affected Areas

Key Vibration Generating Activities	Indicative Plant / Equipment	Location of works	Indicative dates for works
Ancillary facilities and construction compounds	Generators; Excavators with varied attachments; Front end loaders; Franna crane; Dump trucks; Semi-trailers.	As detailed within the **Construction Compound and Ancillary Facilities Management Plan**	Throughout construction period 2013 - 2016
Embankment construction and temporary works	D9 dozer; 20 t excavator; Vibratory roller	NCA02, NCA04, NCA05, NCA07, NCA08,	October 2013-December 2014
Access Roads	D9 dozer; 20 t excavator; Vibratory roller	NCA04, NCA05, NCA07, NCA08, NCA09	October 2013- January 2014
Piling works for OHW bases and civil structures	Piling rigs	NCA01,NC02,NC03,NCA04, NC05, NCA06, NCA07,NCA08, NCA09	June 2014- July 2016
Bridge and viaduct construction	30 t excavator; Vibrating pad compactors.	NCA01, NCA02	June 2014- July 2016
Bridge Strengthening	30 t excavator	NCA04, NCA06, NCA08,	June 2014- July 2016
Bulk excavation works	D11 and D10 dozers with rippers; 30 t excavator with jack hammer; 20 t excavator rock fracturing chemicals	NCA03,NCA04, NCA05, NCA06, NCA07, NCA08,	June 2015-July 2016
Retaining walls	D9 dozer; 20 t excavator; Small crane; Vibratory roller	NCA02, NCA04, NCA05, NCA07, NCA08	June 2015- July 2016
Drainage Works (Culverts)	30t excavator with jack hammer; Small vibratory rollers; Sheet piling; Vibratory pad compactors; 30t excavators;	NCA02, NCA03, NCA04, NCA05, NCA06, NCA07, NCA08, NCA09	June 2015- July 2016
Track and turnout	Turnout tamper; Vibratory roller	NCA01, NCA09, NCA10	June 2015- July 2016
Track Laying (Plain line and TRMs)	Excavator with varied attachments; Vibratory roller; Tamper	NCA01, NCA02, NCA03, NCA06, NCA07, NCA08, NCA09, NCA10	June 2015- July 2016
Station works	20t excavator with jack hammer; Vibratory rollers	NCA04, NCA06, NCA08,	December 2015- July 2016

Table 4: Vibration Velocity Guide Values – Short Term Vibration on Structures (mm/s) to Avoid Cosmetic Damage

Building Type	Vibration at the foundation at a frequency of			Vibration at horizontal plane of highest floor at all frequencies
	1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz	
Buildings used for commercial purposes, industrial buildings and buildings of a similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. heritage listed buildings / structures)	3	3 to 8	8 to 10	8

(Source: *Construction Vibration (damage limits) German Standard DIN 4150 Part 3-1999 Structural Vibration in Buildings – Effects on Structures*)

Table 5: Safe Working Distances for Common Plant / Equipment to Comply with Cosmetic Damage Criteria

Operation	Frequency of vibration (Hz)	Peak Vibration Level (mm/s) at Given Distance					
		5m	10m	20m	30m	40m	50m
Light rock hammer	30-60	0.2	0.06	0.02	0.01	0.01	0.01
Heavy rock hammer	30-60	5	1.5	0.5	0.2	0.15	0.1
Vibratory Roller	~30 Hz	7	3	1.05	0.55	0.35	0.3
Rock saw	45-90	0.75	0.5	0.3	0.2	0.16	0.14
Bored piling	30-60	0.4	0.2	0.1	0.07	0.05	0.04
Rock drill (estimate)	18-60	1.1	0.5	0.2	0.1	0.05	0.04

(Source: *Construction Vibration (damage limits) German Standard DIN 4150 Part 3-1999 Structural Vibration in Buildings – Effects on Structures*)

Table 6: Preferred and Maximum Vibration Levels for Human Comfort

Location	Assessment Period	Vibration Goals			
		Preferred values		Maximum Values	
Continuous Vibration		Z axis	X &Y axis	Z axis	X &Y axis
Critical Areas	Day or Night time	0.005m/s^2	0.0036m/s^2	0.010m/s^2	0.0072m/s^2
Residences	Daytime	0.010m/s^2	0.0071m/s^2	0.020m/s^2	0.014m/s^2
	Night time	0.007m/s^2	0.005m/s^2	0.014m/s^2	0.010m/s^2
Offices, Schools, educational intuitions and places of worship	Day or Night time	0.020m/s^2	0.014m/s^2	0.040m/s^2	0.028m/s^2
Workshops	Day or Night time	0.040m/s^2	0.029m/s^2	0.080m/s^2	0.058m/s^2
Impulsive Vibration		Z axis	X &Y axis	Z axis	X &Y axis
Critical Areas	Day or Night time	0.005m/s^2	0.0036m/s^2	0.010m/s^2	0.0072m/s^2
Residences	Daytime	0.30m/s^2	0.21m/s^2	0.60m/s^2	0.42m/s^2
	Night time	0.10m/s^2	0.071m/s^2	0.20m/s^2	0.14m/s^2

Location	Assessment Period	Vibration Goals			
		Preferred values		Maximum Values	
Continuous Vibration		Z axis	X &Y axis	Z axis	X &Y axis
Offices, Schools, educational intuitions and places of worship	Day or Night-time	0.64m/s^2	0.46m/s^2	1.28m/s^2	0.92m/s^2
Workshops	Day or Night time	0.64m/s^2	0.46m/	1.28m/s^2	0.92m/s^2
Intermittent Vibration		X,Y & Z axis		X,Y & Z axis	
Critical Areas	Day or Night time	0.10m/s$^{1.75}$		0.20m/s$^{1.75}$	
Residences	Daytime	0.20m/s$^{1.75}$		0.40m/s$^{1.75}$	
	Night time	0.13m/s$^{1.75}$		0.26m/s$^{1.75}$	
Offices, Schools, educational intuitions and places of worship	Night time	0.40m/s$^{1.75}$		0.80m/s$^{1.75}$	
Workshops	Day or Night time	0.80m/s$^{1.75}$		1.60m/s$^{1.75}$	

(Source: *TfNSW CNS* and *DECC's Assessing Vibration: a technical guideline, 2006*)

Figure 2: Project Area and Sensitive Receivers Map

Figure 9.1 Noise catchment areas, non-residential sensitive areas and noise and vibration monitoring locations

Note: Indicative only, subject to detailed design.

Figure 3: Project Area and Heritage Item Location Map

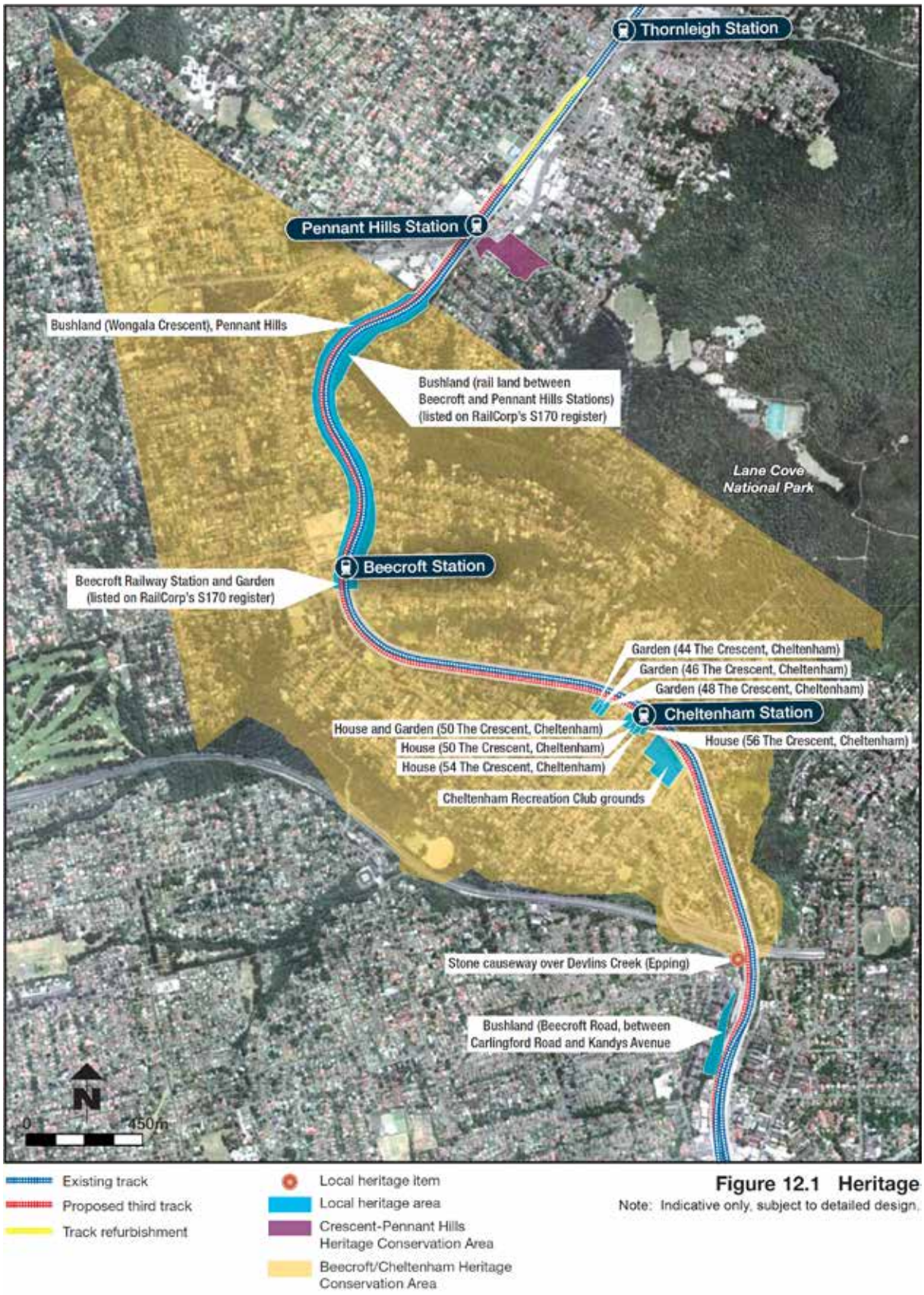


Figure 12.1 Heritage

Note: Indicative only, subject to detailed design.

Table 7: Mitigation Measures

No.	Requirement	Mitigation Measure	Timing	Responsibility	Tool
Consultation and Management Controls					
1.	TfNSW CNS 2	Consultation with sensitive receivers will be undertaken which may include but not limited to letter box drops, individual briefings, and notifications as per the Alliances' Community Liaison Plan (CLP).	Construction	Construction Manager/ Community Manager	CLP
2.	CoA E.11 REMMs M.5	Consultation will be undertaken with Our Lady Help of Christians Primary School, Cheltenham Girls High School, Beecroft Primary School and Arden Anglican School Preschool and Primary Campus prior to vibration generating works to ensure impacts are minimised during examination periods and/or other critical periods in the school calendar (where works are predicted to exceed the relevant construction noise management level for this receiver). Consultation with nearby childcare centres will also be undertaken to potentially avoid intense vibration works during rest periods at the centres.	Construction	Construction Manager/ Community Manager	CLP
3.	REMMs J.9 CoA E34 b) v)	Subject to landowner agreements, building condition surveys building surveys will be completed on the following buildings/ structures prior to proximate piling, excavation or bulk fill or any vibratory impact works including jack hammering and compaction (unless otherwise determined as not being adversely impacted by a qualified geotechnical engineer): all buildings/structures/roads within a plan distance of 50 metres from the edge of the works, all heritage listed buildings and other sensitive structures within 150 metres from the edge of the works and any damage to buildings, structures, lawns, trees, sheds, gardens etc. as a result of construction activity direct and indirect (i.e. including vibration and groundwater changes) shall be rectified at no cost to the owner(s). Surveys would be undertaken immediately following a monitored exceedance of the criteria.	Construction	Construction Manager/ Community Manager/ Environmental Manager	CLP / Building Condition Survey Reports/ Vibration monitoring Reports

No.	Requirement	Mitigation Measure	Timing	Responsibility	Tool
4.	REMMs M.4 TfNSW CNS 7	Where feasible and reasonable, work generating high vibration levels would be scheduled during less sensitive periods.	Construction	Site Foreman	Site Inductions / Toolbox Talks / Weekly Environmental Inspection Checklist
Source Controls					
5.	REMMs M.1	Vibration impacts will be considered when determining construction methodology and alternatives considered. This may include saw cutting prior to rock hammering to minimise potential vibration impacts.	Construction	Environmental Manager/ Construction Manager	Project Team Meetings
6.	CoA E.10 REMMs M.1 REMMs M.4 TfNSW CNS 9	Equipment selected will be the lowest vibration generating equipment when compared to alternatives and the most appropriate/ suitable choice of plant for the task. E.g. impact or percussion piling will be investigated to determine if quieter alternatives can be undertaken, such as bored piles or vibrated piles.	Construction	Environmental Manager/ Project Engineers / Site Foreman	Site Inductions / Toolbox Talks / Weekly Environmental Inspection Checklist / Work Method Plans
7.	CoA E.2 TfNSW CNS 8 REMMs M.4 REMMs W.1 W2	High Noise and vibration generating work activities such as rock breaking and piling shall only be conducted during 8am- 6pm Monday to Friday and between 8am and- 1pm on Saturday; and in continuous blocks of 3 hours on and one hour of respite; unless authorised in the EPL or OOHW approval. No more than four consecutive nights of high noise and/or vibration generating work will be undertaken over any seven day period, unless otherwise approved by the relevant authority. Where a cumulative vibratory impact is expected between the ETTT Alliance and the Northwest Rail Link, the ETTT will work with the North West Rail link to minimise cumulative vibratory impacts as they arise.	Construction	Project Engineer/ Site Foreman Environmental Manager	Site Inductions / Toolbox Talks / Weekly Environmental Inspection Checklist

No.	Requirement	Mitigation Measure	Timing	Responsibility	Tool
8.	CoA E.12 REMMs M.1	During construction, Proponents of other major construction works in the vicinity of the SSI shall be consulted, and reasonable steps taken to coordinate works to minimise impacts on, and maximise respite for affected sensitive receivers. Major Projects to be considered during construction includes the M2 Upgrade and North West Rail Link Projects.	Construction	Environmental Manager/ Project Engineers / Site Foreman	Site Inductions / Toolbox Talks/ Weekly Environmental Inspection Checklist
9.	REMMs M.1	All plant and equipment will be maintained in good working order and operated in an efficient manner.	Construction	Site Foreman/ Operators	Site Inductions / Toolbox Talks / Plant Pre-start Checklist / Observation
10.	TfNSW CNS 3 TfNSW CNS 4	All employees, contractors and subcontractors will receive an environmental induction. The induction will include but not limited to: • All relevant project specific and standard noise and vibration mitigation measures to be implemented on the site; • Relevant licence and approval conditions; • Permissible hours of work; • Any limitations on high vibration generating activities; • Location of nearest sensitive receivers and heritage buildings; • The importance of safe working distances and vibration goals; • Hours of work for high vibration generating activities • Environmental incident procedures.	Construction	Environment Manager / Site Foreman	Site Inductions / Toolbox Talks / Weekly Environmental Inspection Checklist
11.	REMMs M.4	Where reasonable and feasible, consecutive works with high vibration levels in the same locality would be minimised.	Construction	Environmental Manager / Project Engineers	Site Inductions / Toolbox Talks / Weekly Environmental Inspection Checklist

No.	Requirement	Mitigation Measure	Timing	Responsibility	Tool
12.	REMMs M.4	Where reasonable and feasible, dampened rockbreakers and/ or 'city' rockbreakers would be used to minimise impacts associated with rockbreaking works.	Construction	Environmental Manager / Project Engineers	Site Inductions / Toolbox Talks / Weekly Environmental Inspection Checklist
Path Controls					
13.	REMMs M.1 REMMs M.4	Where reasonable and feasible the work generating high vibration levels will be located in areas with lower vibration impacts on sensitive receivers. Increased distances between the source of vibration and the receivers will minimise the effect of vibration on sensitive receivers.	Construction	Project Engineers / Site Foreman	Site Inductions / Toolbox Talks Weekly Environmental Inspection Checklist
Receiver Control					
14.	TfNSW CNS 5 TfNSW CNS 6	A vibration monitoring program will be carried out for the duration of the works in accordance with this Plan and any approval and licence conditions. Relevant record sheets to be completed following the monitoring as detailed in Section 3. Works are to be amended to assist in compliance with goals where exceedances are detected and assessed for suitable mitigation measures	Construction	Construction Manager/ Community Manager	CLP

No.	Requirement	Mitigation Measure	Timing	Responsibility	Tool
15.	CoA E25	Should potential for impact to properties be identified during construction, the following will be undertaken: • Vibration criteria identified within Tables 4 and 6 of this Plan will be followed and mitigation measures implemented to ensure that property damage (including cosmetic damage) will be avoided; • In agreement with the property owner, an independent property inspection will be undertaken by an appropriately qualified and experienced specialist in accordance with AS 4349.1 'Inspection of Buildings' and report on property features that may be affected by construction; • Property owners will advised of the scope and methodology for the inspection, and of the process for making a property damage claim where required; • A copy of the property inspection report will be provided to the owner of each property inspected and to the Director General upon request; • A register will be maintained of all properties inspected, indicating whether the owner accepted or refused the property inspection offer. A copy of the register will be provided to the Director General upon request; and • Reports advising on the risk of damage to properties shall be made available upon request to the Director General.	Construction	Environmental Manager / Community Manager / Construction Manager	Inspection Report

Table 8: Stakeholder Construction Vibration Management Strategy (TPD Construction Noise Strategy)

Time Period		Mitigation Measures Predicted vibration levels exceed maximum levels
Standard	Mon- Fri(7am-6pm)	M, LB
	Sat (8am-1pm)	
	Sun/Pub Hol (Nil)	
OOHW Period 1	Mon- Fri (6pm-10pm)	M,IB, LB, RO PC, SN
	Sat (7am-8am) & (1pm- 10pm)	
	Sun/Pub Hol (8am-6pm)	
OOHW Period 2	Mon-Fri (10pm-7am)	AA, M, IB, LB, PC, SN
	Sat (10pm-8am)	
	Sun/ Pub/Hol (6pm-7am)	

(Source: TfNSW CNS*)* Legend (AA= Alternative accommodation, M=Monitoring, IB= Individual briefings, LB= Letterbox drops, RO=Project specific respite offer, PC=Phone calls, SN=Specific Notifications

Annexure A – Construction Vibration Management Plan Compliance Tracking Sheet

Area	No.	Sub	Requirement	Where Addressed?
Construction Hours	E1.		Except as permitted by an EPL, construction activities associated with the SSI shall be undertaken during the following standard construction hours:	Construction Vibration Management Plan (VMP) Section 5 Management
		(a)	7:00am to 6:00pm Mondays to Fridays, inclusive; and	
		(b)	8:00am to 1:00pm Saturdays; and	
		(c)	at no time on Sundays or public holidays.	
	E2		Except as permitted by an EPL, high noise impact works and activities shall only be undertaken:	VMP Section 5: Management, Section, and Table 7: Mitigation Measures No. 7
		(a)	between the hours of 8:00 am to 6:00 pm Monday to Friday;	
		(b)	between the hours of 8:00 am to 1:00 pm Saturday; and	
		(c)	in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block.	
			For the purposes of this condition 'continuous' includes any period during which there is less than a one hour respite between ceasing and recommencing any of the work that is the subject of this condition.	
	E3		Notwithstanding conditions E1 to E2, construction activities outside of the prescribed construction hours may be undertaken in any of the following circumstances:	VMP Section 5 Management
		(a) (iii)	construction works that generate continuous or impulsive vibration values, measured at the most affected residence, that are no more than those for human exposure to vibration, specified for residences in Table 2.2 of *Assessing Vibration: a technical guideline* (DEC, 2006); and	
		(iv)	works that generate intermittent vibration values, measured at the most affected residence, that are no more than those for human exposure to vibration, specified for residences in Table 2.4 of *Assessing Vibration: a technical guideline* (DEC, 2006);	
		(b)	where a negotiated agreement has been reached with affected receivers, where the prescribed noise and vibration levels cannot be achieved.	
		(c)	for the delivery of material required outside these hours by the NSW Police Force or other authorities for safety reasons;	
		(d)	Where it is required in an emergency to avoid the loss of lives, property and / or to prevent environmental harm; and	
		(e)	works approved through an EPL, including for works identified in an out of hours procedure.	

<table>
<tr><th>Area</th><th>No.</th><th>Sub</th><th>Requirement</th><th>Where Addressed?</th></tr>
<tr><td></td><td></td><td></td><td>Notwithstanding the above, the Proponent shall limit construction outside of standard construction hours, particularly during the night time period, to the greatest extent practicable.</td><td></td></tr>
<tr><td rowspan="4">Construction Noise and Vibration</td><td rowspan="3">E5.</td><td></td><td>The SSI shall be constructed with the aim of achieving the following construction vibration goals:</td><td>VMP Section 6: Goals and Limits</td></tr>
<tr><td>(a)</td><td>for structural damage, the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures; and</td><td>VMP Section 6: Goals and Limits, Table 4 Vibration Velocity Guide Values and Table 5: Safe working distances</td></tr>
<tr><td>(b)</td><td>for human exposure, the acceptable vibration values set out in the Environmental Noise Management Assessing Vibration: A Technical Guideline (Department of Environment and Conservation, 2006).</td><td>VMP Section 6 Goals and Limits and Table 6 Preferred and maximum vibrations levels for human comfort</td></tr>
<tr><td>E6.</td><td></td><td>Except as permitted by an EPL, the airblast overpressure generated by blasting associated with the SSI shall not exceed the criteria specified in Table 1 when measured at the most affected residence or other sensitive receiver.
Table 1 - Airblast overpressure criteria
<table>
<tr><th>Airblast overpressure (dB(Lin Peak))</th><th>Allowable exceedance</th></tr>
<tr><td>115</td><td>5% of total number of blasts over a 12 month period</td></tr>
<tr><td>120</td><td>0%</td></tr>
</table></td><td>To be addressed in a corresponding management plan when blasting or rock fracturing activities are proposed. Referenced in VMP Section 1 Objective</td></tr>
<tr><td>E7.</td><td></td><td>Except as permitted by an EPL, the ground vibration generated by blasting associated with the SSI shall not exceed the criteria specified in Table 2 when measured at the most affected residence or other sensitive receiver.</td><td>To be addressed in a corresponding management plan when blasting or rock fracturing activities are proposed. Referenced in VMP Section 1 Objective</td></tr>
</table>

<table>
<tr><th>Area</th><th>No.</th><th>Sub</th><th>Requirement</th><th>Where Addressed?</th></tr>
<tr><td>Construction Noise and Vibration</td><td></td><td></td><td>Table 2 – Peak particle velocity criteria
<table>
<tr><th>Receiver</th><th>Peak particle velocity (mm/s)</th><th>Allowable exceedance</th></tr>
<tr><td rowspan="2">Residence on privately owned land</td><td>5</td><td>5% of total number of blasts over a 12 month period</td></tr>
<tr><td>10</td><td>0%</td></tr>
<tr><td>Other sensitive receivers</td><td>5</td><td>0%</td></tr>
<tr><td>Historic heritage structures</td><td>3</td><td>0%</td></tr>
<tr><td>Public infrastructure</td><td>50</td><td>0%</td></tr>
</table></td><td></td></tr>
<tr><td></td><td>E8.</td><td></td><td>E8. Should blasting be required, the Proponent shall prepare a Blast Management Plan for the SSI, which shall:</td><td rowspan="10">To be addressed in a corresponding management plan when blasting or rock fracturing activities are proposed. Referenced in VMP Section 1 Objective</td></tr>
<tr><td></td><td></td><td>(a)</td><td>assess the potential noise and vibration impacts of the blasting activities and set criteria limits for airblast overpressure and ground vibration;</td></tr>
<tr><td></td><td></td><td>(b)</td><td>identify a strategy to minimise and manage blasting impacts including preparation of an appropriate community information program;</td></tr>
<tr><td></td><td></td><td>(c)</td><td>identification of feasible and reasonable procedures and mitigation measures to ensure relevant vibration and blasting criteria are achieved, including a suitable blast program, applicable buffer distances for vibration intensive works, use of low-vibration generating equipment/ vibration dampeners or alternative construction methodology;</td></tr>
<tr><td></td><td></td><td>(d)</td><td>include pre and post construction dilapidation surveys of property where blasting and/ or vibration may result in damage to buildings and structures (including surveys being undertaken immediately following a monitored exceedance of the criteria), consistent with condition E25. Any damage caused by blasting shall meet the requirements of condition E26;</td></tr>
<tr><td></td><td></td><td>(e)</td><td>include a monitoring program to enable modification of blast design where monitoring indicates impacts are greater than the criteria limits; and</td></tr>
<tr><td></td><td></td><td>(f)</td><td>identify a strategy for receiving, investigating and responding to complaints.</td></tr>
<tr><td></td><td></td><td></td><td>The methods contained in AS2187.2-2006 shall be utilised by the Proponent to manage blasting to minimise ground vibration and overpressure impacts.</td></tr>
<tr><td></td><td></td><td></td><td>The Plan shall form a component of the Construction Noise and Vibration Management Plan required by condition E34.</td></tr>
</table>

Area	No.	Sub	Requirement	Where Addressed?
Construction Noise and Vibration	E9.		For any section of construction where blasting is proposed, a series of initial trials at reduced scale shall be conducted prior to production blasting to determine site-specific blast response characteristics and to define allowable blast sizes to meet the airblast overpressure and ground vibration limits in this approval.	To be addressed in a corresponding management plan when blasting or rock fracturing activities are proposed. Referenced in VMP Section 1 Objective
	E10.		Wherever feasible and reasonable, piling activities shall be undertaken using quieter alternative methods than impact or percussion piling, such as bored piles or vibrated piles.	VMP Table 7 Mitigation measures No. 6
	E11.		The Proponent shall consult with potentially-affected community, religious, educational institutions and vibration-sensitive businesses and where reasonable and feasible schedule noise and vibration generating construction works in the vicinity of the receivers outside of sensitive periods, unless appropriate other arrangements are made.	VMP: Table 7: Mitigation measures No. 2.
	E12		During construction, Proponents of other major construction works in the vicinity of the SSI shall be consulted, and reasonable steps taken to coordinate works to minimise impacts on, and maximise respite for affected sensitive receivers.	VMP Table 7: Mitigation measures No. 8.
Impacts to Third Party Property and Structures	E25		The Proponent shall, prior to the commencement of construction for each part of the SSI that may impact on surrounding properties at risk from damage:	VMP Table 7: Mitigation measures No. 15.
		(a)	where agreed with the property owner, undertake independent inspections of these properties prior to construction in accordance with *AS 4349.1 'Inspection of Buildings'*. This inspection shall be undertaken by appropriately qualified and experienced persons, and report on property features that may be affected by construction;	
		(b)	contact the owners of all buildings on which property inspections are to be conducted before the inspection, or as otherwise agreed by the affected property owner, and advise of the scope and methodology for the inspection, and of the process for making a property damage claim;	
		(c)	provide a copy of the property inspection report to the owner of each property inspected prior to construction that could affect the property;	
		(d)	determine an appropriate property vibration criteria and management and protection measures to ensure that property damage (including cosmetic damage) will be avoided; and	

Area	No.	Sub	Requirement	Where Addressed?
		(e)	maintain a register of all properties inspected by the Proponent, indicating whether the owner accepted or refused the property inspection offer, and provide a copy of the register to the Director General upon request.	
			Reports advising on the risk of damage to properties shall be made available upon request to the Director General.).	
Construction Environmental Management Plan	E33.		Prior to the commencement of construction, or as otherwise agreed by the Director General, the Proponent shall prepare and implement (following approval) a Construction Environmental Management Plan for the SSI. The Plan shall outline the environmental management practices and procedures that are to be followed during construction, and shall be prepared in consultation with the relevant government agencies and Council(s) in accordance with the *Guideline for the Preparation of Environmental Management Plans* (DIPNR, 2004). The Plan shall include, but not necessarily be limited to:	VMP Section 5: Management and Figure 1, Section 7: Monitoring
		(e)	details of how environmental performance would be managed and monitored to meet acceptable outcomes, including what actions will be taken to address identified potential adverse environmental impacts (including any impacts arising from the staging of the construction of the SSI). In particular, the following environmental performance issues shall be addressed in the Plan:	
		(iii)	noise and vibration;	
	E34.	(b)	a Construction Noise and Vibration Management Plan to detail how construction noise and vibration impacts will be minimised and managed. The Plan shall be consistent with the guidelines contained in the Interim Construction Noise Guidelines (DECC, 2009). The Plan shall be developed in consultation with the EPA and shall include, but not be limited to:	NMP & VMP
		(i)	identification of sensitive receivers and relevant construction noise and vibration goals applicable to the SSI stipulated in this approval;	VMP Figure 2 : Noise Catchment Area, and Sensitive receivers Map, Table 4 Vibration Velocity Guide Values and Table 6 Preferred and maximum vibrations levels for human comfort
		(ii)	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	VMP Table 1: Indicative schedule

Area		No.	Sub Requirement	Where Addressed?
Construction Environmental Management Plan	E34.		construction scenarios, including at ancillary facilities) that have the potential to generate noise and/or vibration impacts on surrounding sensitive receivers, particularly residential areas;	Indicative schedule of Construction works
		(iv)	a Blast Management Plan (condition E8), if relevant;	To be addressed in a corresponding Blast Management Plan when blasting or rock fracturing activities are proposed. Referenced in VMP Section 1 Objective
		(v)	identification of feasible and reasonable procedures and mitigation measures to ensure relevant vibration criteria are achieved, including applicable buffer distances for vibration intensive works, use of low-vibration generating equipment/ vibration dampeners or alternative construction methodology, and pre- and post- construction dilapidation surveys of sensitive structures where vibration is likely to result in damage to buildings and structures (including surveys being undertaken immediately following a monitored exceedance of the criteria);	VMP Table 4 Vibration Velocity Guide Values VMP Table 7 Mitigation Measures Blast Management Plan referenced in VMP Section 1 Objective
		(vi)	a description of how the effectiveness of mitigation and management measures would be monitored during the proposed works, clearly indicating how often this monitoring would be conducted, the locations where monitoring would take place, how the results of this monitoring would be recorded and reported, and, if any exceedance is detected, how any non-compliance would be rectified; and	VMP Section 7 Monitoring and Section 8 Reporting.
		(vii)	mechanisms for the monitoring, review and amendment of this plan.	VMP Section 10 Review .

Area	No.	Sub	Requirement	Where Addressed?
Noise and vibration	M.1		The construction noise and vibration management plan would take into consideration measures for reducing the source noise levels of construction equipment by construction planning and equipment selection where practicable.	NMP Table 6 Mitigation Measures No. 5, 6, 8, 11 and 14.
	M.2		The construction noise and vibration plan would specifically address the issue of construction traffic noise and identify measures to minimise construction traffic noise impacts.	NMP Table 6 Mitigation Measures No. 9-12
	M.3		Mitigation measures documented in the Transport for NSW Construction Noise Strategy would be adopted, as specified in section 7.2.6 of Technical Paper 2 – Noise and vibration. These measures may include, but not be limited to:	NMP Table 6 Mitigation Measures No. 1, 5, 11, 13-15, 22, 24
			- letter box drops and noise monitoring	
			- individual briefings, notifications respite periods, or where highly intrusive noise levels are anticipated alternative accommodation for specific construction activities would be considered	
			- use of localised acoustic hoarding around significant noise generating items of plant, where reasonable and feasible	
			- briefing of the work team in order to create awareness of the locality of sensitive receivers and the importance of minimising noise emissions	
			- planning the higher-noise activities and work near residential receivers to be undertaken predominantly during less sensitive periods, where reasonable and feasible	
			- ensuring spoil is placed and not dropped into awaiting trucks	
			- use of less noise-intensive equipment, where reasonable and feasible	
			- non-tonal reversing alarms fitted on construction vehicles.	
	M.5		Consultation would be undertaken with Our Lady Help of Christians Primary School, Cheltenham Girls High School, Beecroft Primary School and Arden Anglican School Preschool and Primary Campus prior to noise intensive works to ensure impacts are minimised during examination periods and/or other critical periods in the school calendar (where works are predicted to exceed the relevant construction noise management level for this receiver). Consultation with nearby childcare centres to be undertaken to potentially avoid noisy works during rest periods at the centres.	NMP Table 6 Mitigation Measures No.2
	M.6		*Consultation would be undertaken with the following sensitive receivers prior to noise intensive works to ensure impacts are minimised during the most sensitive activities at these receivers (where works are predicted to exceed the relevant construction noise management levels for these receivers):	NMP Table 6 Mitigation Measures No. 3

Area	No.	Sub	Requirement	Where Addressed?
			- Beecroft Community Centre	
			- Pennant Hills Library and Community Centre.	
			- Uniting Church Retirement Home (at Copeland Road, west of Beecroft Road)	
			- Beecroft Lawn Tennis Club	
			- Cheltenham Recreational Club	
			- The Beecroft Scout Hall.	
Cumulative issues	W.1		The potential cumulative construction impacts associated with the proposal would be further considered as the detailed design of the proposal is developed. Mitigation measures would be developed and implemented as appropriate during the construction of the proposal. Mitigation measures during construction of the proposal would include, but not be limited to: - preparation of the following sub-plans as part of the project CEMP to mitigate the following potential impacts:	NMP
			} noise and vibration management plan	