

Sydney Metro North West

Design and Construction of Surface
and Viaduct Civil Works



Construction Noise & Vibration Management Plan

NWRLSVC-ISJ-SVC-PM-PLN-120201

Revision 11.0

29 May 2017

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



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Document Revision History

Doc No NWRLSVC-ISJ-SVC-PM-PLN-120201

Revision	Description	Prepared by	Reviewed by	Approved by	Date
1.0	Initial Draft Plan	AN/WSP	Steve Fermio	Sam Turnbull	31-March-14
2.0	Revised in response to TfNSW comments	WSP	Steve Fermio	Sam Turnbull	13-May-14
3.0	Revised in response to Department of Planning and Environment comments	WSP	Steve Fermio	Graeme Tait	26-June-14
4.0	Revised in response to TfNSW comments	WSP	S Fermio pp Neville Hattingh	Graeme Tait	26-Aug-14
5.0	Appendix B amended	R Pollard	S Fermio	Graeme Tait	29-Sep-14
6.0	Amended Appendix B added [retracted]		S Fermio	Graeme Tait	14-Nov-14
6.0	Appendix B, F, H amended	R Pollard	S Fermio	Graeme Tait	21-Nov-14
7.0	Audit findings, EPA Licence variation	R Pollard	T Austin	G Tait	18-Mar-15
8.0	Amendments Section 5 & 7	D Malysiak	T Austin	Ian Stuart	23-Sep-15
9.0	Section 7 revised in response to TfNSW comments & updated Appendix B	D Malysiak	T Austin	Ian Stuart	27-Oct-15
10.0	General Update	J. Burgin	B. Tucker	G. Perdikaris	16 Dec 16
11.0	Update in response to TfNSW comments	J. Burgin	B. Tucker	G. Perdikaris	29 May 17
Signature					

Contents

ACRONYMS & GLOSSARY	4
INTRODUCTION	5
1 GOALS, OUTCOMES, KEY ISSUES	7
2 CONDITIONS OF APPROVAL REQUIREMENTS	11
Major Civil Construction Works – North West Rail Link (SSI-5100)	11
Stations, Rail Infrastructure and Systems – North West Rail Link (SSI-5414)	13
3 REVISED ENVIRONMENTAL MITIGATION MEASURES	17
Stage 1 Submissions Report (SSI-5100)	17
Stage 2 Submissions Report (SSI-5414)	17
4 PROJECT DEED, SWTC & CEMF REQUIREMENTS	18
Deed Requirements	18
SWTC Requirements	18
CEMF Requirements	18
5 LICENCE AND PERMIT REQUIREMENTS	20
EPA Licence [20454]	20
6 MITIGATION MEASURES	21
7 NOISE AND VIBRATION MONITORING REQUIREMENTS	25
7.1 NOISE AND VIBRATION COMPLAINTS – OVERVIEW OF COMPLAINTS AND ENQUIRIES PROCESS	32
8 TRAINING AND RESOURCES	33
9 REFERENCES AND REVISIONS	34
10 INCIDENT PLANNING AND RESPONSE	35
Appendix A. Summary of Relevant Construction Noise and Vibration Criteria	
Appendix B. Sensitive Receiver Locations and Noise Management Levels	
Appendix C. Key Noise and/or Vibration Generating Construction Activities	
Appendix D. Reasonable and Feasible Noise Reduction Measures	
Appendix E. Out of Hours Works Procedure	
Appendix F. Site Specific Construction Noise and Vibration Impact Statements	
Appendix G. Agency Consultation	
Appendix H. Noise Monitoring Form	

ACRONYMS & GLOSSARY

Ambient Level	Existing level of a phenomenon without the influence of construction activities
BMS	Impregilo S.p.A. (Australia) – Business Management System
CEMF	Construction Environmental Management Framework (Submissions Report, Section 3)
CEMP	Construction Environmental Management Plan
CNVIS	Construction Noise & Vibration Impact Statement
CNVS	Construction Noise & Vibration Strategy (Transport for NSW, 2012)
COA	Conditions of Approval
DP&E	Department of Planning and Environment
DP&I	Department of Planning and Infrastructure
Deed	Contract agreement between ISJV and TfNSW
EM	Environment Manager (ISJV)
Emission	A discharge of a substance (e.g. dust) into the environment
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	Environment Protection Authority
EPL	Environment Protection Licence
Incident	Any unplanned or undesired event which results in or has potential to result in injury, ill health, damage, to or loss of property, interruption to operations or environmental impairment. An incident also includes a near miss, breach of procedure, quality failure, injuries to employees, contractors or members of the public and any other statutorily reportable occurrence. Incidents are further defined in section 10 of this Plan.
ISJV	Impregilo S.p.A. (Australia) and Salini (Australia) Joint Venture / Principal Contractor
L_{Aeq}	Equivalent sound pressure level (dB)
Mitigation Measures	Measures employed to reduce (mitigate) an impact
POEO Act	Protection of the Environment Operations Act 1997
Pollution	The alteration of air, soil, or water as a result of human activities such that it is less suitable for any purpose for which it could be used in its natural state
REMM	Revised Environmental Mitigation Measures (Submissions Report, Section 7)
RMS	Roads and Maritime Service (formerly RTA)
ROL	Road Occupancy Licence
SMNW	Sydney Metro North-west
SSI	State Significant Infrastructure
SVC Works	Surface Viaducts and Civil Works, for the North West Rail Link Project
SWTC	Scope of Work and Technical Criteria
TfNSW	Transport for New South Wales

INTRODUCTION

The SMNW project is a key priority for the NSW Government. The SMNW will deliver a new high frequency single deck train system initially operating as a shuttle between Cudgegong Road and Chatswood. The project includes eight new stations, approximately 15.5km of tunnels from Epping to Bella Vista, a 4.5km elevated 'skytrain' (viaduct) between Bella Vista and Rouse Hill, and conversion of the Epping to Chatswood Rail Link to deliver high frequency rapid transit services.

Stations are planned at Cherrybrook, Castle Hill, Showground, Norwest, Bella Vista, Kellyville, Rouse Hill and Cudgegong Road. Bus, pedestrian, cycling and easy access facilities will be provided at all stations, with approximately 4000 'Park and Ride' spaces spread across five sites.

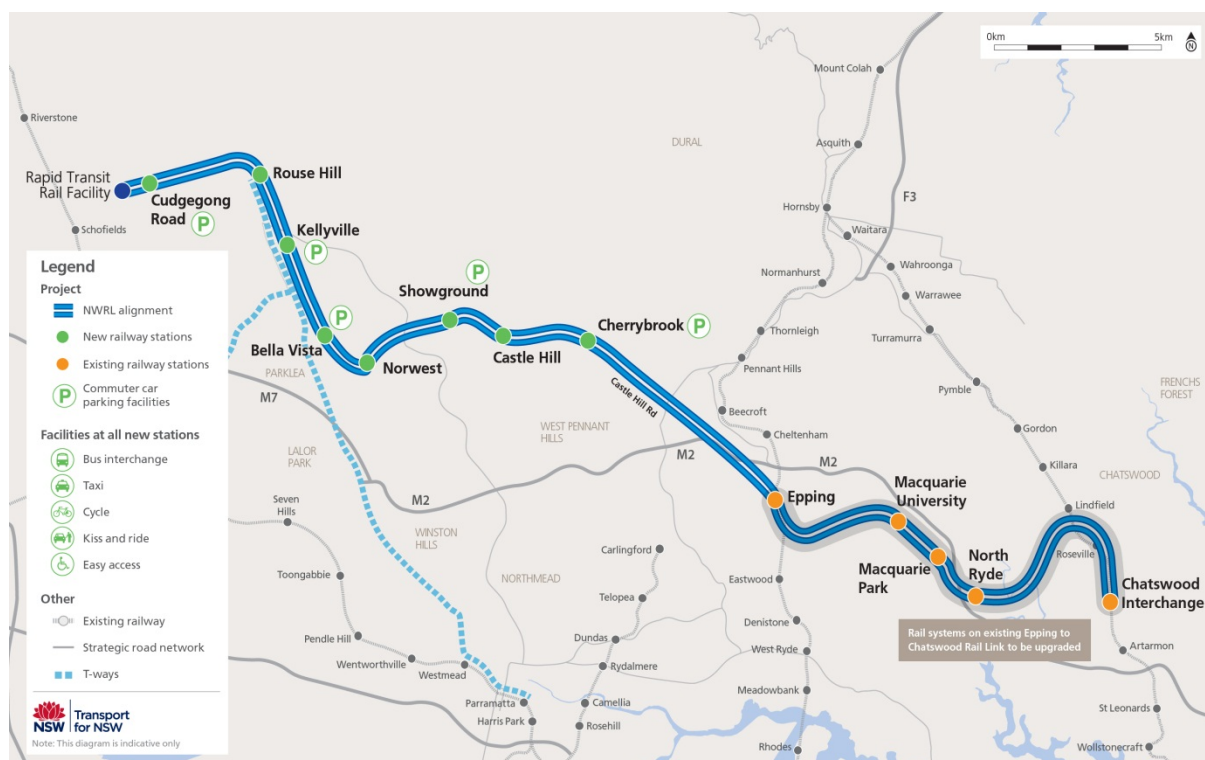


Figure 1: The North West Rail Link service alignment

The scope of the SVC Project works consists of the detailed design, construction and handover of the viaducts, bridges and associated civil works required for 6.3 km of the SMNW between Bella Vista and Cudgegong Road, and includes establishment and reinstatement of worksites, spoil removal and disposal and all required utility relocations and adjustments at construction worksites.

The 6.3 km of permanent infrastructure to be delivered includes:

- Approximately 4.5 km of viaduct between Balmoral Road and Rouse Hill Station including crossings over Memorial Avenue, Samantha Riley Drive, Windsor Road, Sanctuary Drive and White Hart Drive
- Bulk earthworks requirements including all cut, fill and embankments between Balmoral Road and Cudgegong Road
- A bridge over Windsor Road / Rouse Hill
- A bridge over Second Ponds Creek
- Allowance for station structures to be incorporated onto the viaduct at the Kellyville and Rouse Hill station sites

- Adjustments to existing infrastructure and roads within the construction site and / or otherwise affected by ISJV activities
- Safe, secure personnel access / egress into site areas including necessary temporary support services and site facilities, with hoardings, fencing and so on around worksites to be left in place upon completion
- Construction traffic and transport management including temporary and permanent traffic management works
- Removal of all temporary work and site facilities not otherwise required for handover to subsequent contractors.

Activities associated with the temporary and SVC Contractor works required in order to complete construction include:

- Safe, secure personnel access / egress into site areas including necessary temporary support services and site facilities, with hoardings, fencing and the like around work sites to be left in place upon completion
- Construction traffic and transport management including temporary and permanent traffic management works
- Removal of all temporary work and site facilities not otherwise required for handover to subsequent contractors
- Construction of temporary T-way car parking at Rouse Hill and Kellyville
- Construction, removal and transportation of the gantry along the SVC construction zone
- Temporary changes to site personnel access/egress
- Signage, fencing and hoarding
- Construction environmental management activities
- Construction traffic management activities
- Interface and communications within SVC Contractor team and across SMNW team
- Stakeholder liaison activities
- Adherence to SMNW protocols and procedures.

Sections 2 to 5 of this plan reproduce input requirements in the Conditions of Approvals (COA), Submissions Reports, Project Deed, Scope of Work and Technical Requirements and SMNW Construction Environmental Management Framework. The 'Reference' column of the tables indicates the paragraph taken from the respective input document, while the 'ISJV Reference' indicates where these items have been addressed in this plan.

Sections 6 to 10 of this plan sets out the measures proposed to be implemented on the Project to address the requirements identified in Sections 2 to 5 and to mitigate and control the impact of noise and vibration generated during the construction of the Project.

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



1 GOALS, OUTCOMES, KEY ISSUES

Scope	<p>This Construction Noise & Vibration Management Plan has been prepared to manage noise and vibration impacts during construction of the Surface Viaducts and Civil (SVC) Works component of the North West Rail Link. The scope of this Plan includes construction sites along the 6.3 km above ground section of the route between Balmoral Road to Cudgegong Road, which is a combination of viaduct, embankment, at grade and cutting.</p> <p>This plan is based on identified environmental aspects and noise and vibration impacts from construction activities in each of the SVC construction sites and relevant guidelines and standards to be achieved.</p> <p>This plan forms part of the Impregilo S.p.A. (Australia) and Salini (Australia) Joint Venture (ISJV) Business Management System and should be read in conjunction with plans shown in Figure 2.</p>
Goals	<p>Noise & Vibration (Construction Environmental Management Framework (CEMF) Section 9.1):</p> <ul style="list-style-type: none">• Minimise unreasonable noise and vibration impacts on residents and businesses• Avoid structural damage to buildings or heritage items as a result of construction vibration• Undertake active community consultation• Maintain positive, cooperative relationships with schools, childcare centres, local residents and building owners.
Intended Outcomes	<ul style="list-style-type: none">• Achieve construction noise limits, noise management levels and vibration guideline levels and where these cannot be achieved, implement all reasonable and feasible mitigation measures to minimise the impacts of noise and vibration on sensitive receivers• Undertake noise and vibration monitoring as required• Minimise construction noise and vibration impacts through pro-active and reactive implementation of mitigation measures• Gain the trust of the local community and affected stakeholders.
Key Issues and Sensitive Areas	<p>Key Noise Generating Activities</p> <ul style="list-style-type: none">• Concreting, utilising concrete trucks and concrete vibrators• Placement of pre-cast viaduct sections using semitrailer delivery and gantry cranes <p>Out of Hours Works</p> <p>Out of hours works will be required throughout construction. Out of hours work will be required to:</p> <ul style="list-style-type: none">• Reduce impacts on T-Way bus operations and commuter traffic flow during peak hour of pre cast segment movements from offsite pre cast yard to project corridor locations• Facilitate delivery of oversize plant & equipment in accordance with RMS/Police requirements• Finish off concrete work to avoid having to remove unfinished (hardened) concrete. <p>Anticipated activities and out of hours works associated with the above include:</p> <ul style="list-style-type: none">• Transport of segments from the precast yard to the site 12am – 5am

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



- Erection of precast segments to the gantry when crossing roads & T – Way 10pm – 7am
- Operation of the gantry (moving between piers, moving segments etc.) 6am – 7am and 6pm – 10pm
- Completion of late running concrete pours 6pm – 10pm Mon – Fri and Saturday afternoon 1pm – 6pm
- Work on RMS or Council roads in accordance with the relevant Road Occupancy Licence (ROL) between 10pm – 7am
- Deliveries to site for oversize items 10pm – 7am
- Deliveries to site of containers 10pm – 7am
- Service relocations / diversions where the service provider requires them to be done out of hours.

Sensitive Areas

- Residential and commercial areas to the east and west of the project alignment between Memorial Avenue and Balmoral Road, Bella Vista
- In vicinity of proposed Kellyville Station near Sam Riley Drive
 - Residences on Bridget Place north
 - Residences on Landy Place east
 - Residences on Arnold Avenue east
 - Residences on Folkstone Terrace west
 - Residential on Old Windsor Road to the south west
- In vicinity of proposed Rouse Hill Station
 - Commercial area (GPT Shopping Centre) adjacent and north
 - Active recreation to the south east
 - Residential south and south east, north and north west
 - Cemetery to the south (Castlebrook)
- Other areas surrounding the alignment
 - Residences to the south/west of Windsor Road
 - Sharrock Avenue
 - Emmanuel Terrace
 - Rothwell Circuit
 - Rory Court
 - Meldon Place
 - Kentwell Cres
 - Roxburgh Cres
 - Castleford Terrace
 - Bentwood Terrace
 - Miller Way
 - Farrier Way
 - Kilbenny Street
 - Waterford Street
 - Schofields Road
 - Corral Caravan Park (Corral Drive, Harold Drive)
 - John XXIII Catholic School

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



	<ul style="list-style-type: none"> Restaurants and Car Wash facility west of Windsor Road, opposite Balmoral Road
Statutory Requirements	<p><i>Protection of the Environment Operations Act 1997 (NSW) (POEO Act)</i></p> <p>The POEO Act is the key piece of environment protection legislation, and regulates activities via:</p> <ul style="list-style-type: none"> environment protection licencing, as per Schedule 1 regulation of scheduled and non-scheduled activities environmental protection offences and penalties establishment of a general duty to notify of environmental harm. <p><i>Protection of the Environment Operations (Noise Control) Regulation 2008 (NSW)</i></p> <p>This regulation controls noise emissions from vehicles and vessels, and provides for inspection and testing of noise emissions.</p> <p><i>Interim Construction Noise Guidelines, DECCW 2009</i></p> <p>Deals with the assessment of noise from construction activities and advises on best practice approaches to minimise noise impacts. It is aimed at managing noise from construction works regulated by the EPA, and is used to set statutory conditions in licences or other regulatory instruments.</p> <p><i>Assessing vibration: A Technical Guideline, DECC 2006</i></p> <p>This document is based on guidelines contained in BS 6472-1992. BS 6472-1992 presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. It does not address motion sickness, occupational vibration, blasting vibration effects or vibration-induced damage to buildings or structures.</p>
Relationship to Other Plans	<p>This plan interfaces most directly with the following management plans:</p> <ul style="list-style-type: none"> Construction Plan Construction Environmental Management Plan Monitoring & Protection Plan Construction Compound & Ancillary Facilities Management Plan Community Liaison Implementation Plan Construction Heritage Management Plan Construction Noise & Vibration Impact Statements (CNVIS) <p>The relationship between this plan and the other ISJV management plans is shown in Figure 2.</p>
Environmental Aspects & Impacts	<p>Refer to environmental aspects and impacts identified in CEMP Appendix E (Environmental Risk Assessment, extract of Project Wide Risk Assessment).</p>
Licence & Permit Requirements	<p>The requirements of the EPL for SVC works will be included in Section 5 of this Plan when the EPL is issued. These requirements will be updated with each relevant licence variation issued by EPA.</p>

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works

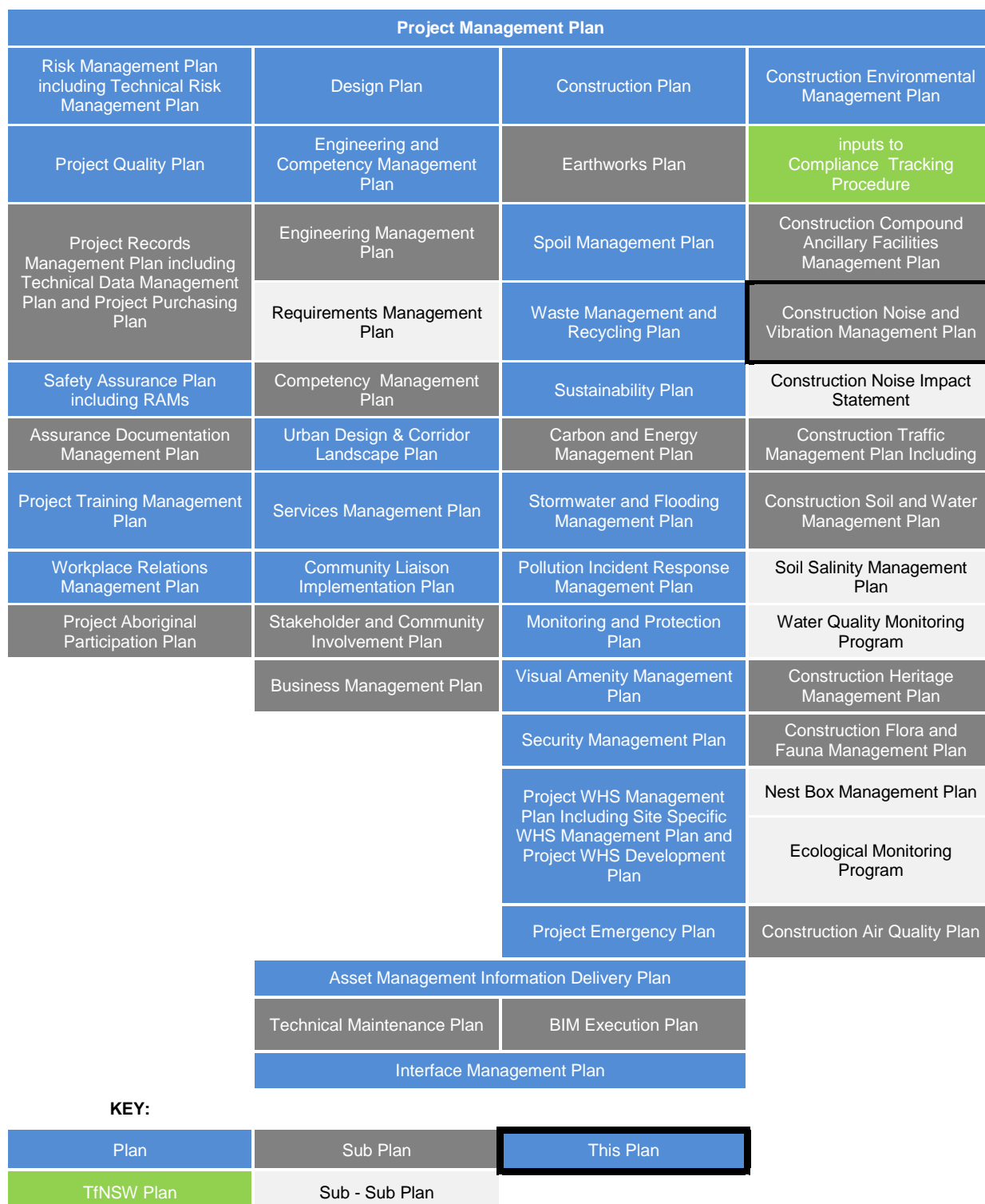


Figure 2 – Hierarchy of SVC Management Plans

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



2 CONDITIONS OF APPROVAL REQUIREMENTS

Major Civil Construction Works – North West Rail Link (SSI-5100)

No.	Ref.	Relevant Requirement	ISJV Reference
1.	E11	Prior to construction, a detailed land use survey to identify potentially critical areas that are sensitive to construction vibration and construction ground-borne noise impacts, shall be undertaken. The results of the survey shall be incorporated into the Construction Noise and Vibration Management Plan (condition E45 (b)).	Section 6, NV1
2.	E12	Construction activities associated with the SSI shall be undertaken during the following standard construction hours: <ul style="list-style-type: none"> a) 7:00am to 6:00pm Mondays to Fridays, inclusive; and b) 8:00am to 1:00pm Saturdays; c) at no time on Sundays or public holidays. 	Section 6, NV3
3.	E14	Except as permitted by an EPL, activities resulting in impulsive or tonal noise emissions shall only be undertaken: <ul style="list-style-type: none"> (a) between the hours of 8:00 am to 5:00 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 the subject of this condition.	Section 6, NV4 Appendix E Section 5, EPL 20454
4.	E15	Notwithstanding conditions E12 to E14, construction activities outside of the prescribed construction hours may be undertaken in any of the following circumstances: <ul style="list-style-type: none"> (a) construction works that generate air-borne noise that is: <ul style="list-style-type: none"> (i) no more than 5 dB(A) above rating background level at any residence in accordance with the <i>Interim Construction Noise Guideline</i> (DECC, 2009); (ii) no more than noise management levels specified in Table 3 of the <i>Interim Construction Noise Guideline</i> at other sensitive receivers; (b) 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 <i>Assessing Vibration: a technical guideline</i> (DEC, 2006); (c) 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 <i>Assessing Vibration: a technical guideline</i>; (d) where a negotiated agreement has been reached with affected receivers, where prescribed noise and vibration levels cannot be achieved; (e) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; 	Section 6, NV5 Appendix E

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



No.	Ref.	Relevant Requirement	ISJV Reference
		(f) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; and (g) works approved through an EPL, including for works identified in an out of hours procedure.	
5.	E16	In relation to construction hours, including for standard and out of hours activities, the SSI shall be constructed to comply with an EPL applying to the SSI, including all relevant noise mitigation and management measures. In the event of a dispute between the Proponent (including its contractors) and the EPA, in relation to construction hours, either party may refer the matter to the Director-General for resolution.	Section 6 Appendix E
6.	E18	The SSI shall be constructed with the aim of achieving the construction noise management levels detailed in the <i>Interim Construction Noise Guideline</i> (DECC, 2009). All feasible and reasonable noise mitigation measures shall be implemented and any activities that could exceed the construction noise management levels shall be identified and managed in accordance with the Construction Noise and Vibration Management Plan (condition E46(b)). Note: The <i>Interim Construction Noise Guideline</i> identifies 'particularly annoying' activities that require the addition of 5dB(A) to the predicted level before comparing to the construction Noise Management Levels.	Section 6, NV2 Appendix A Appendix B
7.	E19	The SSI shall be constructed with the aim of achieving the following construction vibration goals: (a) for structural damage, vibration limits set out in German Standard <i>DIN 4150-3: Structural Vibration - effects of vibration on structures</i> ; (b) for human exposure, the acceptable vibration values set out in the <i>Environmental Noise Management Assessing Vibration: A Technical Guideline</i> (Department of Environment and Conservation, 2006).	Appendix A
8.	E22	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.	Section 6, NV11
9.	E23	The Proponent shall consult with potentially-affected community, religious, educational institutions and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) to ensure that noise generating construction works in the vicinity of the receivers are not timetabled during sensitive periods, unless appropriate other arrangements are made.	Community Liaison Implementation Plan NV17, NV18, NV19
10.	E24	During construction, Proponents of other 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.	Community Liaison Implementation Plan NV17, NV18, NV19
11.	E46(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 <i>Interim Construction Noise Guidelines</i> (DECC, 2009). The plan shall be developed in consultation with the EPA and shall include, but not be limited to:	This Plan Appendix G
		(i) identification of sensitive receivers and relevant construction noise and vibration goals applicable to the SSI stipulated in this approval;	Appendices 1, 2
		(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 construction scenarios, including at ancillary facilities) that have the potential to generate noise and/or vibration impacts on surrounding sensitive receivers, particularly residential areas;	Section 2.4 CEMP Appendix C

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



No.	Ref.	Relevant Requirement	ISJV Reference
		(iii) identification of feasible and reasonable measures proposed to be implemented to minimise and manage construction noise impacts (including construction traffic noise impacts), including, but not limited to, acoustic enclosures, erection of noise walls (hoardings), respite periods and the limiting of truck movements during night periods;	Section 6 Appendix D
		(iv) 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, and pre-and post-construction dilapidation surveys of sensitive structures where blasting and/ or vibration is likely to result in damage to buildings and structures (including surveys being undertaken immediately following a monitored exceedance of the criteria);	Section 6 Appendix D Monitoring & Protection Plan
		(v) detailing tunnelling and associated activities described in condition E13 including associated impacts, management, mitigation measures;	Not applicable to SVC works
		(vi) if blasting is required, an assessment of the potential noise and vibration impacts, and a strategy to minimise and manage those impacts, including preparation of an appropriate community information program;	Not applicable to SVC works
		(vii) 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 noncompliance would be rectified; and .	Section 7
		(viii) mechanisms for the monitoring, review and amendment of this plan.	Section 9

Stations, Rail Infrastructure and Systems – North West Rail Link (SSI-5414)

No.	Ref.	Relevant Requirement	ISJV Reference
12.	C15	Prior to construction of the SSI, a detailed land use survey to identify potentially critical areas that are sensitive to construction and operational noise (air and ground borne) and vibration impacts, shall be undertaken having regard to the type of land use. The results of the survey shall be incorporated into the Construction Noise and Vibration Management Plan (condition E34(b)) and the Operational Noise and Vibration Review (condition C20). The land survey, prepared to meet condition E11 of State significant Infrastructure Approval SSI 5100, may be revised, if necessary and resubmitted.	Section 6, NV1
13.	C16	Rail line components of the SSI shall be designed and operated with the objective of not exceeding the airborne and ground-borne noise trigger levels at existing development, at each stage of the SSI, as presented in the Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects (DECC and DP&E, 2007). In particular, final viaduct design shall incorporate feasible & reasonable methods & materials that will reduce radiated noise from the structure. For the purpose of this condition, existing development includes all development that at the date of this approval, has been carried out in the vicinity of the rail corridor and any such development approved prior to the determination of this SSI, but only to the extent that the location of sensitive receivers is known.	Not applicable to this stage of SVC works

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



No.	Ref.	Relevant Requirement	ISJV Reference
14.	E12	Construction activities associated with the SSI shall be undertaken during the following standard construction hours: (a) 7:00am to 6:00pm Mondays to Fridays, inclusive; and (b) 8:00am to 1:00pm Saturdays; (c) at no time on Sundays or public holidays.	Section 6, NV3
15.	E14	Except as permitted by an EPL, activities resulting in impulsive or tonal noise emissions shall only be undertaken: (a) between the hours of 8:00 am to 5:00 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 the subject of this condition.	Section 6, NV4 Appendix E
16.	E15	Notwithstanding conditions E12 to E14, construction activities outside of the prescribed construction hours may be undertaken in any of the following circumstances: (a) construction works that generate air-borne noise that is: (i) no more than 5 dB(A) above rating background level at any residence in accordance with the ICNG; (ii) no more than the noise management levels specified in Table 3 of the ICNG at other sensitive receivers; (b) 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); (c) 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); (d) where a negotiated agreement has been reached with affected receivers, where prescribed noise and vibration levels cannot be achieved; (e) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; (f) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; and (g) works approved through an EPL, including for works identified in an out of hours procedure.	Section 6, NV4 Appendix E
17.	E16	In relation to construction hours, including for standard and out of hours activities, the SSI shall be constructed to comply with an EPL applying to the SSI, including all relevant noise mitigation and management measures. In the event of a dispute between the Proponent (including its contractors) and the EPA, in relation to construction hours, either party may refer the matter to the Director-General for resolution.	Section 6 Appendix E
18.	E18	The SSI shall be constructed with the aim of achieving the construction noise management levels detailed in the ICNG. All feasible and reasonable noise mitigation measures shall be implemented and any activities that could exceed the construction noise management levels shall be identified and managed in accordance with the Construction Noise and Vibration Management Plan (E34(b)). Note: The <i>Interim Construction Noise Guideline</i> identifies 'particularly annoying' activities that require the addition of 5dB(A) to the predicted level before comparing to the construction Noise Management Levels.	Section 6 Appendix D

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



No.	Ref.	Relevant Requirement	ISJV Reference
19.	E19	The SSI shall be constructed with the aim of achieving the following construction vibration goals: (a) for structural damage, vibration limits set out in German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures; (b) for human exposure, the acceptable vibration values set out in the Assessing Vibration: a Technical Guideline (DEC, 2006). Where vibration levels exceed the acceptable vibration dose values, feasible and reasonable mitigation measures shall be considered.	Appendix A
20.	E21	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.	Section 6, NV11
21.	E22	The Proponent shall identify and consult with potentially-affected community, religious, educational institutions and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) and where feasible and reasonable ensure that noise generating construction works in the vicinity of the receivers are not timetabled during sensitive periods, unless appropriate other arrangements are made.	Community Liaison Implementation Plan NV17, NV18, NV19
22.	E23	During construction, Proponents of other 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.	Community Liaison Implementation Plan NV17, NV18, NV19
23.	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 Interim Construction Noise Guidelines (DECC, 2009) and Assessing Vibration: a technical guide (DEC, 2006). The plan shall be developed in consultation with the EPA and shall include, but not be limited to:	This Plan Appendix G
		(i) identification of work areas, site compounds and access points;	Appendix D
		(ii) identification of sensitive receivers and relevant construction noise & vibration goals applicable to the SSI stipulated in this approval;	Appendices 1, 2
		(iii) details of construction activities and an indicative schedule for construction works, including the identification of key noise and/or vibration generating construction activities (based on representative construction scenarios, including at ancillary facilities) that have the potential to generate noise and/or vibration impacts on surrounding sensitive receivers, particularly residential areas;	Appendix C
		(iv) identification of feasible and reasonable measures proposed to be implemented to minimise and manage construction noise impacts (including construction traffic noise impacts), including, but not limited to, acoustic enclosures, erection of noise walls (hoardings), respite periods and the limiting of truck movements during night periods;	Section 6 Appendix D
		(v) 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, and pre- and post- construction dilapidation surveys of sensitive structures where blasting and/or vibration is likely to result in damage to buildings and structures (including surveys being undertaken immediately following a monitored exceedance of the criteria);	Section 6 Appendix D
		(vi) if blasting is required, an assessment of the potential noise and vibration impacts, and a strategy to minimise and manage those impacts, including preparation of an appropriate community information program;	Not applicable to SVC works

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



No.	Ref.	Relevant Requirement	ISJV Reference
		(vii) 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	Section 7
		(viii) mechanisms for the monitoring, review and amendment of this plan.	Section 9

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



3 REVISED ENVIRONMENTAL MITIGATION MEASURES

Stage 1 Submissions Report (SSI-5100)

No.	Original Ref.	Relevant Requirement	ISJV Reference
24.	NV1	Noise and vibration mitigation measures described in the Construction Noise and Vibration Strategy would be implemented (refer Appendix E of Technical Paper 2).	Section 6 Appendix D
25.	NV5	3m high noise barriers (site hoardings) would be constructed around the perimeter of construction sites.	Section 6

Stage 2 Submissions Report (SSI-5414)

No.	Original Ref.	Relevant Requirement	ISJV Reference
26.	NV1	Noise and vibration mitigation measures described in the Construction Noise and Vibration Strategy would be implemented (refer Appendix J of Technical Paper 3 of EIS 2).	Section 6 Appendix D
27.	NV5	Three metre high noise barriers (site hoardings) would be constructed around the perimeter of construction sites.	Section 6
28.	NV7	Three metre high noise barriers (site hoardings) would be constructed at Bella Vista Station site on the north and eastern side of the main construction site and to the west of the station box.	Not applicable to SVC works
29.	NV16	Noise attenuation measures would be implemented where reasonable and feasible on tunnel ventilation equipment and other items of fixed plant (e.g. pumps, water treatment plant, diesel generators) that would be required to operate on a 24 hour per day, seven day per week basis in support of the underground works (e.g. ventilation fan enclosures and silencers, and additional enclosures and silencers for diesel generating equipment). At each site, the combined L_{Aeq} noise from the operation of this equipment would aim to not exceed the rating background level at nearest residential receivers.	Not applicable to SVC works

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



4 PROJECT DEED, SWTC & CEMF REQUIREMENTS

Deed Requirements

No.	Original Ref.	Relevant Requirement	ISJV Reference
30.	7.3(a)	(viii) prevent nuisance and unreasonable noise, vibration and disturbance (except to the extent such nuisance, noise, vibration and disturbance is a direct and unavoidable result of carrying out and completing the SVC Contractor's Activities in accordance with this deed) and comply with the requirements of Authorities.	Section 6 Appendix D

SWTC Requirements

No.	Original Ref.	Relevant Requirement	ISJV Reference
31.	App 24.4, (g)(ii)	The Construction Environmental Management Plan must include, as sub-plans, the following plans that are required by the Project Planning Approvals: <ul style="list-style-type: none">Construction Noise and Vibration Management Plan;	This CNVMP

CEMF Requirements

No.	Original Ref.	Relevant Requirement	ISJV Reference
32.	9.1(a)	The following noise and vibration management objectives will apply to the construction of the project: <ul style="list-style-type: none">i. Minimise unreasonable noise and vibration impacts on residents and businesses.ii. Avoid structural damage to buildings or heritage items as a result of construction vibration.iii. Undertake active community consultation.iv. Maintain positive, cooperative relationships with schools, childcare centres, local residents and building owners.	Section 1
33.	9.2(a)	SMNW Principal Contractors will develop and implement a Construction Noise and Vibration Management Plan for their scope of works. The Construction Noise and Vibration Management Plan will include as a minimum: <ul style="list-style-type: none">i. The noise and vibration mitigation measures as detailed in the environmental approval documentation and the SMNW Construction Noise and Vibration Strategy (CNVS).ii. The requirements of any applicable EPL conditions.iii. Site plans or maps indicating locations of sensitive receivers, and key noise and vibration controls.iv. Pre-construction compliance requirements and hold points.v. The responsibilities of key project personnel with respect to the implementation of the plan.	Section 6 Appendix D Section 5 Appendix B Section 6, NV23 Sections 6, 7, 8, 10

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



No.	Original Ref.	Relevant Requirement	ISJV Reference
		vi. Noise monitoring requirements.	Section 7
		vii. Compliance record generation and management.	Section 7
		viii. Community consultation requirements.	Community Liaison Implementation Plan
		ix. An Out of Hours Works Procedure applicable to all construction methods and sites (refer to the CNVS).	Appendix E
34.	9.2(b)	Detailed <i>Construction Noise and Vibration Impact Statements</i> will be prepared for major noise-intensive construction sites and/or activities, to ensure the adequacy of the noise and vibration mitigation measures for the actual design and construction methods. Specifically Construction Noise and Vibration Impact Statements will be prepared for: <ul style="list-style-type: none"> i. The construction activities to be undertaken outside of standard construction hours. ii. Tunnelling works. iii. Works proposed to be undertaken outside of standard construction hours 	Section 6, NV2 Appendix E, F
35.	9.2(c)	Noise and vibration monitoring would be undertaken for construction as specified in the CNVS and the EPL.	Section 7
36.	9.2(d)	The following compliance records would be kept by the SMNW Contractor: <ul style="list-style-type: none"> i. Records of noise and vibration monitoring results against appropriate NMLs and vibration criteria. ii. Records of community enquiries and complaints, and the Contractor's response. 	Section 7
37.	9.3	All feasible and reasonable mitigation measures would be implemented in accordance with the CNVS. Examples of noise and vibration mitigation measures include: <ul style="list-style-type: none"> • Construction hours will be in accordance with the working hours specified in section 5.1. • Hoarding and enclosures will be implemented where required to minimise airborne noise impacts. The layout of construction sites will aim to minimise airborne noise impacts to surrounding receivers. 	Section 6 Appendix D



5 LICENCE AND PERMIT REQUIREMENTS

Refer to Current EPL 20454 on the ISJV website (<http://www.isjv.com.au/environmental-management/environmental-protection-licence-epl/>)

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



6 MITIGATION MEASURES

This section outlines required mitigation based on approval conditions and actual planned construction locations and techniques. The numbered NV references in this table are the revised ISJV references, not the original NV references listed in input documents. Reference to “entire project” covers all locations over the SVC contract period.

ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
General							
NV1.	<i>Monitoring and Protection Plan</i> to include undertaking of dilapidation surveys at public utilities, structures, and buildings that are sensitive to construction vibration and construction ground-borne noise impacts.	■	■	As per minimum distances listed in ISJV BMS MSP22S Noise & Vibration (Environmental)	COA SSI-5100 E11, COA SSI-5414 C15 ISJV BMS MSP22S Noise & Vibration (Environmental)	Construction Manager	Prior to construction
NV2.	Prepare <i>Construction Noise and Vibration Impact Statements</i> (CNVIS) for construction activities to be undertaken outside standard construction hours (Appendix F)		■	Entire project	REMM SSI-5100 NV15 CEMF 9.2(b)	Noise & Vibration Specialist	Throughout construction
Hours of work							
NV3.	Ensure that construction activities are only undertaken between 7am and 6pm Monday - Friday, and 8am to 1pm Saturday unless otherwise approved. To be included in Project Induction and Pre Start Briefings, Toolbox Talks etc. IND		■	Entire project	COA SSI-5100 E12, COA SSI-5414 E12	Environment Manager Construction Manager All personnel	Throughout construction
NV4.	Ensure that activities resulting in impulsive or tonal noise are only undertaken: (a) between 8am to 5pm Monday to Friday; (b) between 8am to 1pm Saturday; and (c) in continuous (less than a one hour respite between ceasing and recommencing) blocks not exceeding three hours each with a minimum respite of not less than one hour between each block. To be included in Pre Starts & Work Method Statement for relevant activities. IND		■	Entire project	COA SSI-5100 E14, COA SSI-5414 E14	Environment Manager Construction Manager All personnel	Throughout construction

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
NV5.	All requests for Out of Hours Work are to be assessed by the Environment Manager using process outlined in Appendix E. IND		■	Entire project	COA SSI-5100 E15, COA SSI-5414 E15, CEMF 9.2(a)(ix)	Environment Manager Construction Manager	Throughout construction
Construction							
NV6.	All fixed plant at the work sites are to be appropriately selected and, where required, fitted with silencers, acoustical enclosures and other noise attenuation measures (refer to Appendix A for table of appropriate noise level limits).	■	■	Entire project	REMM SSI-5414 NV16 CNVS Section 3.1	Site Supervisor Environment Coordinator	Throughout construction
NV7.	Plant Inspection Checklist (NWRLSVC-ISJ-SVC-HS-FRM-090318) will be completed for all plant entering site, which includes noise emissions (refer to Appendix A for table of appropriate noise level limits).		■	Entire project		Plant Inspection Manager	Throughout construction
NV8.	Structures to be used to shield residential & other sensitive receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.	■	■	Entire project	CNVS Section 3.1	Site Engineer Environment Coordinator	Throughout construction
NV9.	Work sites to be configured to avoid or minimise truck reversing, and ensure vehicles enter and exit work sites in a forward direction where possible.	■	■	Entire project	CNVS Section 3.1	Project Engineers	Throughout construction
NV10.	Noisy plant and equipment to be positioned as far apart as is practicable from each other and whether orientation and location of the plant can reduce noise impacts at sensitive receivers.	■	■	Entire project	ISJV BMS MSP22S Noise & Vibration (Environmental)	Project Engineers	Throughout construction
NV11.	Public address systems will not be used, except in emergencies.	■	■	Entire project	CNVS Section 3.1	Safety Manager	Throughout construction
NV12.	Bored piles will be used. Where this is not possible due to ground conditions other non-percussive piling techniques will be implemented where practicable. If impact piling is required, limit noise impact using measures such as limiting hours of operation, lowering the height of hammers, shielding by construction equipment or acoustic shrouding, or resilient dollies.		■	Entire project	COA SSI-5100 E22, COA SSI-5414 E21, CNVS Section 3.1	Construction Manager Project Engineers	Throughout construction

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
NV13.	Low-vibration generating equipment / vibration dampeners or alternative construction methodology will be sought to ensure relevant vibration criteria is achieved.		■	Entire project	COA SSI-5414 E34(v)	Environmental Manager Construction Manager Site Supervisors	Throughout construction
NV14.	Pre and post dilapidation surveys will be conducted of sensitive structures where vibration is likely to result in damage to buildings or structures.		■	Entire project	COA SSI-5414 E34(v)	Environmental Manager Construction Manager Site Supervisors	Throughout construction
NV15.	All noise controls identified in this plan will be installed as early as is practical prior to the relevant stage of construction.		■	Entire project	Best practice	Environment Manager	Throughout construction
NV16.	Non-tonal and / or automatically adjusting reversing alarms will be installed on all vehicles and mobile plant regularly used on site IND		■	Entire project	ISJV BMS MSP22S Noise & Vibration (Environmental)	Project Engineers Site Supervisor Environment Coordinator	Throughout construction. All hours
NV17.	Minimise vehicles and plant idling when not in use. IND		■	Entire project	ISJV BMS MSP22S Noise & Vibration (Environmental)	Site Supervisor	Throughout construction
NV18.	Equipment will be inspected and repaired if needed, such as defective mufflers, tightening/correction of rattling parts and components and repair of leakages in compressed airlines.		■	Entire project	ISJV BMS MSP31 Plant & Equipment	Project Engineers	Throughout construction
NV19.	Vibration producing equipment will be used in accordance with the separation distances in Appendix A.		■	Entire project	ISJV BMS MSP22S Noise & Vibration (Environmental)	Project Engineers Environment Manager	Throughout construction
NV20.	Appropriate buffer distances will be enforced, as per CNVIS or monitoring requirements, for vibration intensive works. Movement of the crawler crane shall be outside the 2 m exclusion zone from the No-Go Heritage Area of the		■	Entire Project	COA SSI-5414 E34(v)	Environment Manager	Throughout construction

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
	White Hart Inn so as to reduce vibration limits to those specified in the Construction Heritage Management Plan				Environmental Control Map Zone 5	Site Supervisors	
Communication							
NV21.	The community will be informed of project progress via letterbox drop, website, 24/7 Community Information Line, and email distribution list		■	Entire project	Community Liaison Implementation Plan.	Community Relations Manager	As required
NV22.	Residents and potentially affected stakeholders will be notified of planned out-of-hours works and deliveries in accordance with the Community Liaison Implementation Plan.		■	Entire project	Community Liaison Implementation Plan.	Community Relations Manager	As required
NV23.	Where noise levels are predicted to exceed the relevant Noise Management Levels in Table 6 (Appendix B) as identified in the relevant CNVIS, the mitigation measures outlined in Tables 10 & 11, Appendix D, will be implemented (commensurate with the predicted level of exceedance).		■	Entire project	Table 1, Appendix D	Environment Manager Community Relations Manager	Throughout construction
EPL							
NV24.	Any additional measures required by the SVC Works EPL are to be implemented as required.	■	■	Entire project	EPL	Environment Manager	As required

7 NOISE AND VIBRATION MONITORING REQUIREMENTS

This section outlines the frequency, actions and guidelines / standards for noise and vibration monitoring and appropriate actions in the event of noncompliance.

Detail	Frequency	Standards	Reporting	Action if non-complying	Responsibility
Attended noise monitoring <ul style="list-style-type: none"> during any out of hours works to assess compliance with EPL or E15 as required by any CNVIS in response to a community complaint where required by EPA/DP&I, to refine construction methods to minimise noise, to differentiate between construction noise sources and other sources (eg. road traffic), to assess internal construction noise levels at commercial premises, if needed, or as needed during site establishment. 	<p>As required, at selected sensitive receivers to active construction areas during construction to determine compliance with noise management levels.</p> <p>As required by EPL.</p> <p>If required as part of any audit of noise mitigation measures in accordance with audit schedule (section 6 of CEMP).</p>	<p>AS 1055</p> <p>AS 2436</p> <p>EPA Guidelines</p> <p>SMNW Construction Noise and Vibration Strategy</p>	<p>MSF22S-2 Noise Monitoring Form</p>	<p>Suspend OOHW (if being carried out)</p> <p>Seek professional acoustic input if necessary.</p> <p>Determine appropriate corrective/preventative actions before recommencing any relevant activities</p> <p>Amend this plan or other relevant procedures as appropriate.</p> <p>Review reasonable and feasible noise mitigation measures applying to daytime works if NMLs not achieved.</p>	<p>Environment Manager</p> <p>Noise & Vibration Specialist (if required)</p>
Attended vibration monitoring <ul style="list-style-type: none"> at relevant sensitive receiver locations identified in Monitoring & Protection Plan during any out of hours works to assess compliance with EPL or E15 as required by any CNVIS in response to a complaint from community where required by EPA/DP&I, to refine construction methods to minimise vibration, to differentiate between construction vibration sources and other sources (eg. road traffic), to assess internal construction vibration levels at heritage, commercial and residential premises, if 	<p>As specified or required</p> <p>Before any vibration intensive works within safe working distance identified for affected receivers.</p> <p>Initial two weeks of significant vibratory activity.</p> <p>Frequency to be reassessed following data interpretation.</p> <p>As required for changes in works or complaints.</p>	<p>Goals in Appendix A</p> <p>EPA guidelines</p> <p>BS 6472</p> <p>DIN 4150</p> <p>BS 7385</p>	<p>Vibration monitoring report</p>	<p>Cease relevant activities, and/or implement additional measures.</p> <p>Seek professional vibration input if required</p> <p>Determine appropriate corrective/preventative actions before recommencing any relevant activities.</p> <p>Amend Monitoring & Protection Plan, this plan or other relevant procedures, as appropriate.</p>	<p>Environment Manager</p> <p>Noise & Vibration Specialist</p>

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



Detail	Frequency	Standards	Reporting	Action if non-complying	Responsibility
needed, or • as needed during site establishment.					
Construction equipment monitoring to assess compliance with appropriate noise limits, and to allow any increase in noise levels to be detected and addressed.	If equipment is perceived as being noisy or noisier than other similar equipment, or in response to complaints.	Construction Noise & Vibration Strategy - Maximum Allowable Noise Levels for Construction Equipment (Appendix A, Table 3)		Assess equipment and undertake remedial action such as repair, noise-proofing, redeployment or removal.	Environment Co-ordinator Noise Specialist (if required)
Integrity of any site hoarding.	Weekly.	Hoarding intact	MSF43-2 Environmental Inspection Checklist	Construction Manager to repair or replace	Environment Co-ordinator

Construction Noise and Vibration Impact Statements

A Construction Noise and Vibration Impact Statement (CNVIS) will be prepared for all major noise-intensive construction activities and for any proposed out of hours works as required under the Environment Protection Licence (EPL) for the Project and consistent with the requirements of CoA E15(g). The type of CNVIS assessment will depend on the scale of the works and the likely noise and vibration impacts. For small scale works with minimal impact on sensitive receivers and duration of less than 3 weeks, a qualitative assessment will be completed. For large scale works with a duration greater than 3 weeks and is adjacent to sensitive receivers, a quantitative assessment will be completed. The CNVIS will identify any monitoring requirements and locations to represent the noise sensitive receivers surrounding the worksite. These locations would be used for monitoring needed to quantify the noise and vibration impacts to the areas near the construction sites. More information regarding the preliminary approach and content for the construction noise and vibration impact assessments is provided in Appendix F.

Where qualitative CNVIS assessments need to be completed, rough noise level calculations will be included to support any qualitative assessment and ISJV will seek approval from the Environmental Management Representative prior to the commencement of construction activities.

An assessment of revised noise background levels was commissioned by ISJV to capture the significant changes to noise environments at several locations along the alignment (Appendix B). All new CNVIS (after September 2015) will use the revised current background noise levels provided in Appendix B, while existing CNVIS (prior to September 2015) will remain unchanged.

As a result of Environment Protection Licence variations, including the requirement for quantitative CNVIS assessment for all out of hours work regardless of duration, the preliminary assessment provided by WSP Buildings in Appendix F has been updated in the table below to cover this licence requirement. The table also covers any changes in work components and main noise generating activities that wasn't identified during the pre-construction phase.

Updated assessment and proposal for CNVIS for SVC activities:

Work Component	Main noise generating activities	Duration of works: Over 3 weeks per location?	Out of Hours Work (OOHW)?	Type of CNVIS Proposed
Access road construction	Site clearing / grading	N	N	Qualitative

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



Work Component	Main noise generating activities	Duration of works: Over 3 weeks per location?	Out of Hours Work (OOHW)?	Type of CNVIS Proposed
	Rolling / compacting			
Piling Construction	Piling Rig Generators Concrete Pouring	N	N	Quantitative
Pile Cap Construction	Concrete pouring General working with light tools (hammering, etc) Vehicular movements	Not always	N	Quantitative
Site & compound establishment	Loading / unloading of cabins, etc General light tool use	N	N	Qualitative
Samantha Riley Drive Commuter Car Park	Grader, watercart, excavator, bogie tipper, vibratory roller, delivery trucks and trailers	N	N	Qualitative
Gantry Crane Assembly	Gantry element lifting Welding activities Grinding and welding activities	Y	Y	Quantitative
Balmoral Road Compound Hardstand Removal Works	Hydraulic hammer, excavator, truck and dog	Y	N	Quantitative
Deck Erection (General Viaduct)	Lifting of segments into position on Gantry Crane General working with light tools (hammering, etc) Vehicular movements Fixing & tensioning of segments Segment delivery	Y	Y	Quantitative
Deck Erection (Road Crossings)	Lifting of segments into position on Gantry Crane General working with light tools (hammering, etc) Vehicular movements Fixing & tensioning of segments Segment delivery	Not always	Y	Quantitative
Windsor Road Bridge Construction	Piling Rig Generators Concrete pouring Lifting of segments into position Construction & demolition of temporary piers General working with light tools (hammering, etc)	Y	Y	Quantitative

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



Work Component	Main noise generating activities	Duration of works: Over 3 weeks per location?	Out of Hours Work (OOHW)?	Type of CNVIS Proposed
	Vehicular movements Tower installation Segment delivery Fins Cables			
Services Connections (General)	Cutting of road asphalt	N	N	Qualitative
Services Connections (OOHW)	Cutting of road asphalt	N	Y	Quantitative
Parapet Fixing (OOHW)	Lifting of segments into position on Gantry Crane General working with light tools (hammering, etc) Vehicular movements Fixing & tensioning of segments	Not always	Y	Quantitative
Segment Transportation	Truck movements on major transport routes	Y	Y	Quantitative
Segment Demolition	Excavator with hydraulic hammer, franna, EWP, scissor lift	Y	Y	Quantitative
General Roadworks	Water pressure truck, powered hand tools, linemarking trucks, raised reflective pavement marker trolley, lighting towers, semi trailer with Hi-Ab, Hiab truck, EWP, demolition saw, excavator with hydraulic hammer, tipper trucks, profiler, paver, bobcat sweeper, asphalt trucks, roller	Y	Y	Quantitative
Knights Quarry Hammering and Backfill	Excavators, trucks,	Y	N	Quantitative

Construction Noise Monitoring Procedure

The following procedure is to be followed:

- Refer to CNVIS to identify monitoring locations. Monitoring should be undertaken during periods of light wind (< 5 m/s) and no rain.
- Ensure the sound level meter (SLM) is calibrated correctly.
- Set-up the SLM on a tripod with the windscreen on the microphone.
- Monitoring should be conducted for a minimum period of 15 minutes in each location. In accordance with AS 1055.2, the following information should be recorded:
 - a. Date and time of measurement
 - b. Details of the measurement positions, instrumentation used and types of analysis made
 - c. Weather conditions during the measurements (wind direction, wind velocity, relative humidity, temperature, rain)
 - d. Description of the noise being investigated as well as operating conditions of the sound source(s) under investigation
 - e. Noise due to other sources during the measurement period

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



- f. Results and interpretation (including L_{Aeq} value)
- g. Associated observations.

In order to interpret the results, the personnel conducting the measurement should distinguish between construction noise and other audible noises in the area that are unrelated to construction activities. They should note the most dominant noise source and estimate the noise contribution from construction activities if possible. Significant extraneous noise levels may be excluded from the measurement using 'pause' and / or 'back-erase' functions on the SLM.

Where it is possible to estimate construction noise levels, these are to be compared with the noise limits established in this document.

All field sheets will be stored on file. An example noise monitoring site sheet is provided in Appendix H to allow the operator to record relevant information on site and document the measured noise level after the noise measurements has been completed.

Noise measurements for individual construction activities

Noise measurements of specific construction equipment should be carried out in accordance with AS 2012.1. This is summarised as follows:

- Monitoring should be undertaken during periods of light wind (< 5 m/s) and no rain.
- At each microphone position, the A-weighted background noise should be at least 6 dB, and preferably more than 10 dB, below the noise levels generated by the equipment being measured. Corrections for background noise are provided in the standard.
- No signalling devices (e.g. reversing alarm) should be sounded during the measurements.
- A hemisphere should be used as the measurement surface. The radius is determined by the basic length of the equipment being measured (refer Figure 1). This length excludes major attachments (e.g. dozer buckets). The radius should be:
 - a) 4 m where the basic length is less than 1.5 m
 - b) 10 m where the basic length is between 1.5 m and 4 m
 - c) 16 m where the basic length is greater than 4 m.

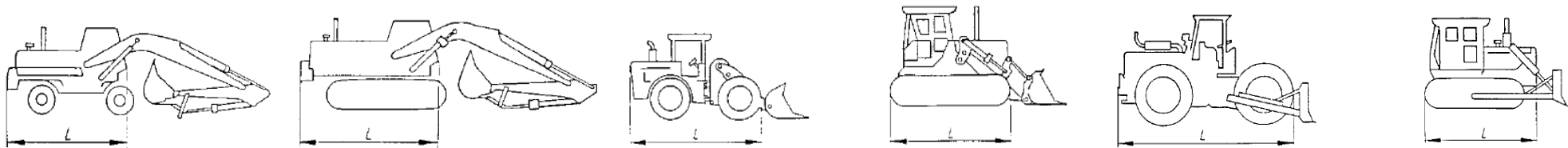


Figure 1 - AS 2012.1 equipment length references (loader / excavator / dozer)

- Six measurements should be taken at positions distributed around the determined hemisphere.
- A minimum of three measurements at each microphone position will be conducted during the equipment's stabilised operating mode, each measurement being between 15 – 30 seconds. The following information should be recorded:
 - a) Machinery under test (manufacturer, model number, power rating, specified speed)
 - b) Instrumentation (type, serial number, manufacturer, calibration date)
 - c) Test environment (description of test site, meteorological conditions)
 - d) Acoustic data (microphone locations, measurements levels)

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



- The formulae presented in AS 2012.1 should then be used to calculate the sound power level of the equipment being tested.

Vibration monitoring

The following procedure is to be followed:

- Siting: Ensure good coupling with the ground. The sensor should be placed on a level, solid surface (e.g. concrete). The sensor should be placed at the location where vibration is a concern
- Field notes: Record the time, place, and conditions under which monitoring were performed.

Actions in the event of noise monitoring non-conformance

The following measures will be undertaken in the event of the measured noise level during construction stage monitoring exceeding the nominated criteria:

Early Warning Level (< 3dB below criteria)

The following actions shall be undertaken should a measurement be within 3dB below the nominated criteria:

- Monitoring operative to investigate primary source(s) of noise
- Monitoring operative to inform Noise / Vibration Specialist (within 24 hours of measurement) and provide details of measurements for further analysis in order to reduce risk of future exceedance.
- Noise / Vibration Specialist to investigate the measured levels and the likelihood of the criteria being exceeded. If requested by Noise / Vibration Specialist, additional investigatory measurements undertaken, as necessary, to supplement the monitoring results.

Marginal Exceedance (< 3dB above criteria)

- Monitoring operative to investigate primary source(s) of noise
- Monitoring operative to discuss with foreman any reasonable and feasible mitigation measures to implement with immediate effect. This may include:
 - Introduction of localised screening / barriers
 - Reduction in duration of use of equipment
- Monitoring operative to undertake investigatory measurement(s) at set distance(s) from primary source(s) as described above.
- Monitoring operative to inform Noise / Vibration Specialist and provide details of monitoring & investigative measurements for further analysis (within 24 hours of measurement)
- Noise / Vibration Specialist to review and assess if future exceedances are likely (within 24 hours of receiving data). If these are likely:
 - Noise / Vibration Specialist to liaise with Managing Contractor to agree mitigation measures to be adopted in all future works. This assessment should consider all reasonable and feasible mitigation measures that could be explored (as per TfNSW's Construction Noise & Vibration Strategy, 2012)
 - Noise / Vibration Specialist to revise CNIS for works to include updated mitigation measures.

Minor Exceedance (3-5dB above criteria)

As Marginal Exceedance (Section 2.2), plus:

- Should complaints be received, Community Manager to engage with the complainant subject to exceeded levels. This should entail:
 - Ensuring the sensitive receivers are made aware of the source of noise and necessity of works
 - Ensuring the sensitive receivers are made aware of the duration for which the exceeded levels are likely
- Environment Manager to arrange further noise monitoring measurements, as required, repeating the processes above should exceedances continue.
- Note that if 'Minor Exceedances' (3-5 dB above criteria) continue to occur at the same sensitive receptor(s) for more than three (3) consecutive measurements, the exceedance shall be treated as a 'Significant Exceedance' (see Section 2.4).

Significant Exceedance (>5dB above criteria)

As Marginal Exceedance (Section 2.2), plus:

- Should complaints be received, Community Manager to engage with the complainant subject to exceeded levels. This should entail:

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



- Ensuring the sensitive receivers are made aware of the source of the and necessity of works
- Ensuring the sensitive receivers are made aware of the duration for which the exceeded levels are likely
- Discussion with the most affected sensitive receivers and requesting feedback on their opinion of the levels and impacts this has had
- Addressing any impacts raised as part of the above, where reasonable and feasible
- In the event that absolute level reductions are not possible through reasonable and feasible mitigation measures, discuss with the most affected noise sensitive receivers any compensation that may be offered (such as hotel accommodation for OOWH works, etc)
- Environment Manager to arrange further noise monitoring measurements, as required, repeating the processes above should exceedances continue.

7.1 NOISE AND VIBRATION COMPLAINTS – OVERVIEW OF COMPLAINTS AND ENQUIRIES PROCESS

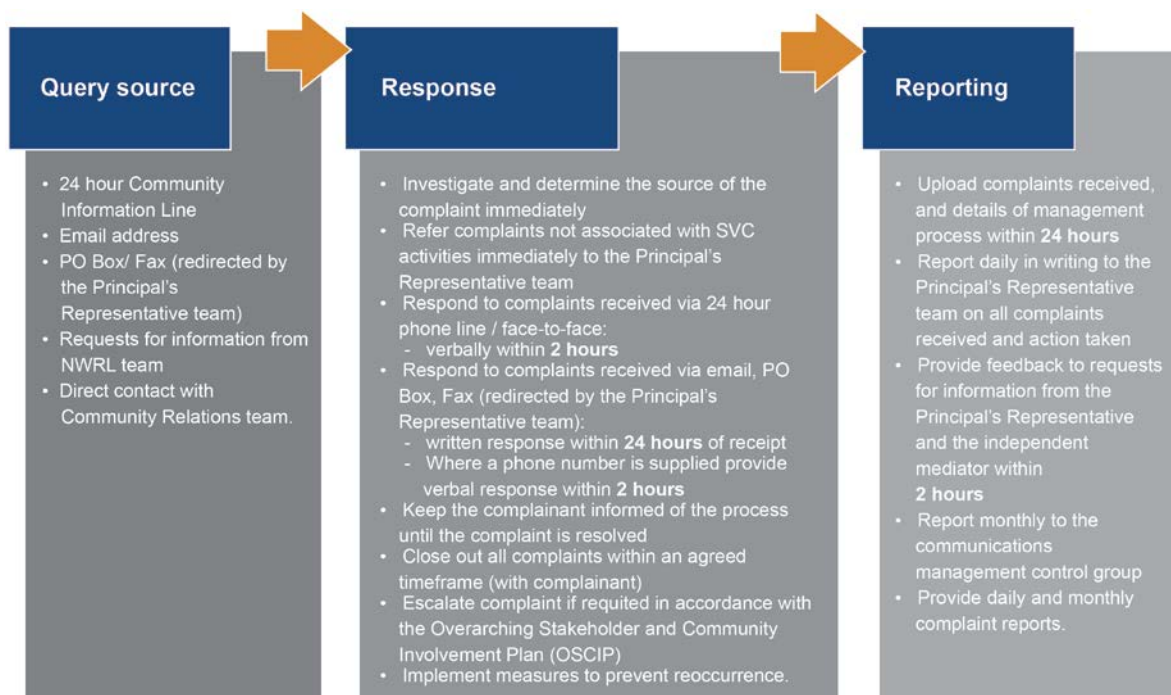
As per Community Liaison Implementation Plan (CLIP), Appendix 2 ISJV commits to manage all complaints and enquiries associated with the SVC in accordance with the requirements of SCL-05 Construction Complaints Management System.

Complaints include any interaction with a community member or stakeholder who expresses dissatisfaction with the project, policies, contractor's services, staff members, actions or proposed actions during the project.

The key requirement of the Project Deed, as outlined in SCL-05 Construction Complaints Management System, is the establishment of a Complaints Management System consistent with ISO 10002 (formerly AS 4269 *Complaints handling*) prior to the commencement of early works. The system will be maintained for the duration of construction activities.

Figure A2-1 below provides a summary overview of the process for managing complaints and enquiries for the SVC works.

Figure A2-1: Overview of management process for complaints and enquiries



8 TRAINING AND RESOURCES

Training

Inductions will address:

- Matters identified by the term “**IND**” (“Induction”) in the mitigation measures section.

Site Inductions are recorded in the Projects’ on-line system (Damstra), checked with MSF15-7 Induction Assessment Form and maintained in Damstra. The MSF15-6 Site Induction Form and MSR15-3 Site Induction Register have been superseded by Damstra even though a lot of the information requirements from these documents have been retained in Damstra. Specific noise and vibration requirements for each work area will also be raised each work day as part of the daily prestart assessment procedure and be recorded on a SEA Card (MSF22-6).

Pre start & Toolbox talks to be conducted on:

- Working hours allowed, including any approved out of hours works and specific mitigation measures to be applied
- Results of noise and vibration monitoring
- Complaints or authority directions.

Resources

- Calibrated sound level meters
- Calibrated vibration meter (to be supplied and operated by a vibration specialist)
- Bureau of Meteorology weather information
- Environmental Manager, Environmental Co-ordinators
- Noise & Vibration Specialist.

9 REFERENCES AND REVISIONS

Related Documents
TfNSW/SLR Consulting (2012) EIS 1, Section 10: Noise and Vibration – Construction.
TfNSW/SLR Consulting (2012) EIS 1 Technical Paper 2 – North West Rail Link: Noise and Vibration Technical Paper for Major Civil Construction Works (ref: NWRL-10046-R-NO-00005-v2.0-Major Civil NV).
TfNSW/SLR Consulting (2012) North West Rail Link - Additional Background Noise Logging (ref: NWRL-10046-R-NO-00028-v1.0-Extra Noise Logging).
TfNSW/SLR Consulting (2012) North West Rail Link Construction Noise and Vibration Strategy.
ISJV Management System - MSP22S Noise & Vibration (Environmental) Risk Management Procedure.
References
DECCW (2009) NSW Interim Construction Noise Guideline.
DECC (2006) NSW Assessing Vibration – a technical guideline.
DECCW (2011) NSW Road Noise Policy.
Transport for NSW (2012) Construction Noise Strategy 7TP-ST-157/2.0 (CNS).
AS1055: Acoustics – Description and measurement of environmental noise.
AS2012: Acoustics – Measurement of airborne noise emitted by earth moving machinery: Stationary test condition – Determination of compliance with limits for exterior noise.
AS2436: Guide to Noise Control on Construction, Maintenance and Demolition Sites.
AS4349.1: Inspection of Buildings.
German Standard DIN4150-1999 Structural vibration Part 3: Effects of vibration on Structures.
British Standard BS6472:1992 Guide to evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz).
British Standard BS7385-2:1993 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration.
Revision, Control & Amendment
Revisions to this plan will be approved in accordance with the process outlined in section 4 of the CEMP.
Document control and amendment will be in accordance with MSP18 'Document and Data Control'.

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



10 INCIDENT PLANNING AND RESPONSE

Incident Planning & Response			
<p>Environmental incidents will be reported immediately as per ISJV's SVC Incident Management Procedure (MSP42) to a Site Supervisor who will contact either the Project Manager, or Environmental Manager. All incidents will be investigated and appropriate actions taken to address the issue.</p> <p>Incidents involving noise would typically involve a complaint from the community, notification by a regulatory authority or non-compliance with an approval or EPA licence condition. These and other typical noise incidents and appropriate responses are detailed in the table below.</p>			
No.	Situation	Response	Responsibility
1	Works occurring outside standard hours without approval or appropriate notification to community/authorities	<p>Immediately cease work where safe to do so. Notify authorities if required under licence/approval condition and enter details in TfNSW compliance register as required.</p> <p>Undertake investigation / assessment of incident to determine corrective/preventative actions.</p> <p>Apply for approval using Appendix E process if works still required.</p>	<p>Construction Manager</p> <p>Environment Manager</p>
2	Malfunction of equipment used for tasks causing excessive noise / vibration emissions	Cease activities under direction of the Environment Manager or Construction Manager. Notify relevant staff, and organise use of appropriate equipment to complete task.	Construction Manager
3	Noise or vibration causing community complaint	Community complaints are to be managed in accordance with the Complaints Management System (Appendix 2 of the <i>Community Liaison Implementation Plan</i>).	Community Relations Manager
4	Vibration causing structural damage	<p>It is noted that the vibration thresholds for structural damage are far higher than those for human perception. The procedure for any vibration intensive works involve the establishment of safe working distances prior to the commencement of work, and the monitoring of sensitive structures during the works so that the work can be stopped before any structural damage limits are exceeded.</p> <p>In the case where monitoring shows excessive vibration levels, cease activities causing vibration under direction of the Environment Manager or Construction Manager. Notify relevant staff according to the Site Specific Emergency Response Sub Plan. If appropriate, evacuate any occupants of buildings with due consideration to safety, and secure the area to prevent unauthorised access.</p> <p>Undertake a structural assessment and compare results with any previous condition survey. If any damage is associated with construction, implement rectification works or agree compensation.</p>	Construction Manager
5	Noise causing disturbance for site workers	Cease activities causing disturbance under direction of the Environment Manager or Construction Manager. Conduct assessment of noise exposure in accordance with worksite Health and Safety Regulations. Implement buffer zones for hearing protection where necessary.	Construction Manager

Appendix A. Summary of Relevant Construction Noise and Vibration Criteria

Air-borne noise guidelines

Project Planning Approval Condition E18 stipulates that the *Interim Construction Noise Guideline* (ICNG, DECC, 2009) be used to establish the construction noise management levels. Table 2 from the ICNG has been replicated in Table 1 below displaying the noise management levels and how they are to be applied.

Table 1 – ICNG Noise management levels at residential receivers

Time of day	Management level $L_{Aeq}(15min)$	How to apply
Recommended standard hours: - Monday to Friday 7am to 6pm - Saturday 8am to 1pm - No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq}(15min)$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noise activities can occur, taking into account: <ul style="list-style-type: none"> • times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Table 2 provides noise management levels for other sensitive land uses based on the ICNG.

Table 2 - Noise management levels at sensitive land uses

Land use	Noise management level $L_{Aeq}(15min)$ *	Where objective applies
Cinema space	35	Internal noise level**
Classrooms at schools and other educational institutions	45	Internal noise level
Hospital wards and operating theatres	45	Internal noise level
Places of worship	45	Internal noise level
Community centres – municipal buildings	50	Internal noise level**
Active recreation areas	65	External noise level
Passive recreation areas	60	External noise level
Commercial premises (including offices and retail outlets)	70	External noise level
Industrial premises	75	External noise level

Note: *These levels apply during periods where the premises are in use.

**Based on maximum internal levels as provided in AS2107.

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



Similarly to residential receivers, a highly noise affected objective of 75 dB(A) applies for other noise sensitive land uses.

Sleep disturbance guidelines

Section 4.3 of the *ICNG* discusses methodology for managing sleep disturbance at residences. Where construction works are expected to be carried out over more than two consecutive nights, a sleep disturbance assessment should analyse the expected maximum noise events – their forecast level and the magnitude/frequency that maximum noise events are expected to exceed the RBL. Additional guidance regarding potential sleep disturbance is then recommended from the NSW *Environmental Criteria for Road Traffic Noise* (ECRTN, EPA, 1999).

Appendix B of the *ECRTN* concludes that:

- maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions, and
- one or two noise events per night, with maximum internal noise levels of 65-70 dB(A), are not likely to affect health and wellbeing significantly.

Any sleep disturbance assessments should cover the maximum noise level, and the extent and number of times that the maximum noise level exceeds the RBL.

Maximum plant and equipment noise level guidelines

All plant and equipment used for the SVC Works must have operating sound power / pressure levels less than or equal to those displayed in Table 3. This table replicates the information presented in Table 3.2 of the CNVS.

As discussed in the CNVS report, “the sound power level (SWL) represents the total noise output of the plant equipment. The SWL is normally used in computer noise models to predict the sound pressure levels (SPL) at nearby receivers. When undertaking site compliance measurements, it is normally the SPL that is measured at a specific distance (typically 7 m) from the plant or equipment.

Plant and equipment with SWLs higher than those presented in the table would be deemed to be emitting an excessive level of noise and should not be permitted to operate on construction sites.”

Table 3 - Maximum allowable noise levels for construction equipment

Equipment	Maximum allowable noise level, dB(A) - L_{Amax}	
	Sound power level (SWL) re: 1pW	Sound pressure level (SPL) at 7m
Excavator hammer	122	97
Excavator (approx. 3 tonne)	90	65
Excavator (approx. 6 tonne)	95	70
Excavator (approx. 10 tonne)	100	75
Excavator (approx. 20 tonne)	105	80
Excavator (approx. 30 tonne)	110	85
Excavator (approx. 40 tonne)	115	90
Skidsteer loaders (approx. ½ tonne)	107	82
Skidsteer loaders (approx. 1 tonne)	110	85
Dozer (equiv. CAT D8)	118	93
Dozer (equiv. CAT D9)	120	95
Dozer (equiv. CAT D10)	121	96
Backhoe / FE Loader	111	86
Dump truck (approx. 15 tonne)	108	83
Concrete truck	112	87

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



Equipment	Maximum allowable noise level, dB(A) - L _{Amax}	
	Sound power level (SWL) re: 1pW	Sound pressure level (SPL) at 7m
Concrete pump	109	84
Concrete vibrator	105	80
Bored piling rig	110	85
Scraper	110	85
Grader	110	85
Vibratory roller (approx. 10 tonne)	114	89
Vibratory pile driver	121	96
Impact piling rig	134	109
Compressor (approx. 600 CFM)	100	75
Compressor (approx. 1500 CFM)	105	80
Concrete saw	118	93
Jackhammer	113	88
Generator	104	79
Lighting tower	80	55
Flood lights	90	65
Cherry picker	102	77
Mobile crane	110	85

Ground-borne noise at residences

Ground-borne noise issues are not anticipated during the SVC works, and accordingly ground-borne noise guidelines are not considered further in this plan.

Chapter 10 of the Stage 1 EIS notes that:

“Ground-borne construction noise is not anticipated to be appreciable for the proposed surface construction works between Bella Vista Station and the Tallawong Stabling Facility on the basis that airborne noise levels would be more prominent than the ground-borne noise levels.

The majority of existing buildings and structures adjacent to the proposed rail alignment between Bella Vista Station and Tallawong Stabling Facility are located more than 50 m from the proposed viaduct, ensuring that vibration levels would remain below the safe vibration levels associated with minor cosmetic damage. At locations where existing buildings and structures are located closer to the proposed excavation works, attended vibration monitoring may be required to maintain vibration levels below the safe vibration levels.

Construction related road traffic noise guidelines

A quantitative assessment for the predicted noise impact due to the increase in traffic volumes will be prepared within each CNIS where traffic movements associated with the SVC Works are forecast to increase traffic noise by more than 2 dB for OOHV. This will occur when forecast traffic volumes increase existing traffic volumes by 1.6. The NSW Road Noise Policy will be used for guidance in setting noise goals in these instances, and the Application Notes for the NSW Industrial Noise Policy will provide guidance for assessment of sleep disturbance.

Construction vibration guidelines

Disturbance to building occupants

Condition of Approval E19(b) states that, “for human exposure, the acceptable vibration values set out in the Environmental Noise Management *Assessing Vibration: a technical guideline* (DECC, 2006)” should be achieved. Drawing guidance from British Standard BS 6472-1992 (since superseded by BS 6472-2008), this guideline provides criteria for evaluation of human exposure to vibration.

The guideline classifies vibration (and related effects) as continuous, impulsive, or intermittent. Table 4 presents the guidelines’ definition of each type of vibration along with the associated examples.

Table 4 - Types of vibration

Type of vibration	Definition	Example
Continuous vibration	Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time).	Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).
Impulsive vibration	A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds.	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.
Intermittent vibration	Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude.	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer this would be assessed against impulsive vibration criteria.

In applying vibration criteria, it is noted in the guideline that “vibration may enter the body along different orthogonal axes, i.e. x-axis (back to chest), y-axis (right side to left side), or z-axis (foot to head).” Figure 1 replicates Figure 2.1 from the guideline depicting these orthogonal axes. When assessing people in an upright position, vibration measured in the horizontal plane should be compared with x- and y-axis criteria. When assessing people in a lateral position, vibration measured in the horizontal plane should be compared with y- and z-axis criteria.

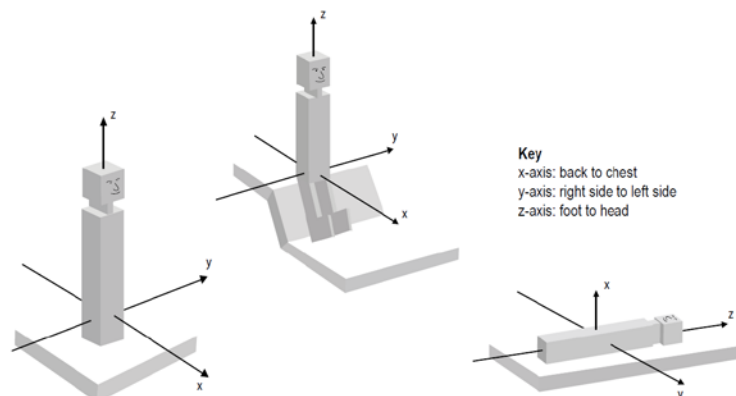


Figure 2 - Orthogonal axes for assessment of human exposure to vibration

(source: *Assessing Vibration: a technical guideline* [DECC, 2006])

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



The information provided in Table 2.2 and Table 2.4 of the guideline has been reproduced in Table 5. This provides criteria for preferred and maximum values for continuous, impulsive, and intermittent vibrations.

Table 5 - Preferred and maximum levels for human comfort

Location	Assessment period*	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration (weighted RMS acceleration, m/s ² , 1-80 Hz)					
Critical areas**	Day- or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions, and places of worship	Day- or night-time	0.020	0.014	0.040	0.028
Workshops	Day- or night-time	0.040	0.029	0.080	0.058
Impulsive vibration (weighted RMS acceleration, m/s ² , 1-80 Hz)					
Critical areas**	Day- or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions, and places of worship	Day- or night-time	0.64	0.46	1.28	0.92
Workshops	Day- or night-time	0.64	0.46	1.28	0.92
Intermittent vibration (Vibration Dose Values, m/s ^{1.75} , 1-80 Hz)					
Critical areas**	Day- or night-time	0.10		0.20	
Residences	Daytime	0.20		0.40	
	Night-time	0.13		0.26	
Offices, schools, educational institutions, and places of worship	Day- or night-time	0.40		0.80	
Workshops	Day- or night-time	0.80		1.60	

Note: *Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am.

**Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specified above. Stipulation of such criteria is outside the scope of their policy and other guidance documents (e.g. relevant standards) should be referred to. Source: BS 6472-1992.

Structural damage to buildings

To assess structural damage to buildings from vibrational energy, reference is made to:

- British Standard BS 7385: Part 2, which is referenced in the SMNW CNVS, and
- German Standard DIN 4150: Part 3, which is referenced in the Project Planning Approval Conditions.

There is not currently an Australian Standard that provides guidance for structural damage due to vibration.

British Standard BS 7385

The assessment of potential building damage from ground vibration has been guided by BS 7385-2 "evaluation and measurement of vibration in buildings". This standard categorises damage in terms of 'cosmetic', 'minor', or 'major', providing limits for each. The levels provided in the standard are shown in Table 6.

Table 6 - BS 7385 Structural damage criteria

Group	Type of structure	Peak component particle velocity, mm/s *		
		4Hz to 15Hz	15Hz to 40Hz	40Hz and above
1	Reinforced or framed structures Industrial or heavy commercial buildings	50		
2	Un-reinforced or light framed structures Residential or light commercial buildings	15 to 20**	20 to 50	50

Note: *Values referred to are at the base of the building, on the side of the building facing the source of vibration (where feasible).
**At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

These peak vibration limits are set so that the risk of 'cosmetic' damage is minimal. For 'minor' or 'major' vibrational damage to occur, the standard states that vibration magnitudes two times and four times (respectively) the values shown in Table 6 are necessary.

It is noted that these levels are 'safe limits' which relate to transient vibrations. They have been set at the lowest level above which damage has been credibly demonstrated. 'Cosmetic' damage is described as minor non-structural effects such as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks, and separation of partitions or intermediate walls from load bearing walls. Periods of continuous vibration may require reductions in these limits by up to half.

The standard outlines the sources of vibration it has considered as including; blasting, demolition, piling, ground treatments, compaction, construction equipment, tunnelling, road and rail traffic and industrial machinery.

German Standard DIN 4150

In accordance with Condition of Approval E19(a), German Standard DIN 4150 has also been used to set vibration limits for structural damage. DIN 4150 provides a recommendation for maximum allowable vibration levels to reduce the risk of structure damage.

The minimum 'safe limits' listed have been presented in Table 7 and are generally recognised as being conservative.

Table 7 - DIN 4150-3 Structural damage criteria

Group	Type of structure	Vibration velocity, mm/s			
		At foundation frequency of			Plane of floor uppermost storey
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz*	All frequencies
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use.	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 or 2 and have intrinsic values (e.g. buildings under a preservation order).	3	3 to 8	8 to 10	8

Note: *At frequencies above 100 Hz, the values given in this column may be used as minimum values.

Indicative minimum working distances

Further to the information provided in Section 6 of this report (NV1), Table 8 has been provided to help guide appropriate working distances for vibration intensive plant and equipment, from the SMNW Construction Noise Strategy. These values will minimise the risk of cosmetic damage and human discomfort. It is noted that the values provided for cosmetic damage must be complied with unless a site-specific assessment has been conducted.

Table 8 - Recommended minimum working distances for vibration intensive equipment

Plant item	Rating / description	Minimum working distance, m*	
		Cosmetic damage	Human response (complaints)**
Vibratory roller	< 50 kN (typically 1-2 tonnes)	5	15 to 20
	< 100 kN (typically 2-4 tonnes)	6	20
	< 200 kN (typically 4-6 tonnes)	12	40
	< 300 kN (typically 7-13 tonnes)	15	100
	< 300 kN (typically 13-18 tonnes)	20	100
	> 300 kN (typically > 18 tonnes)	25	100
Hydraulic hammer	300 kg (5-12 tonne excavator)	2	7
	900 kg (12-18 tonne excavator)	7	23
	1600 kg (18-34 tonne excavator)	22	73
Vibratory pile driver	Sheet piles	2 to 20	20
Pile boring	≤ 800 mm	2 (nominal)	-
Jackhammer	Hand held	1 (nominal)	Avoid contact with structure

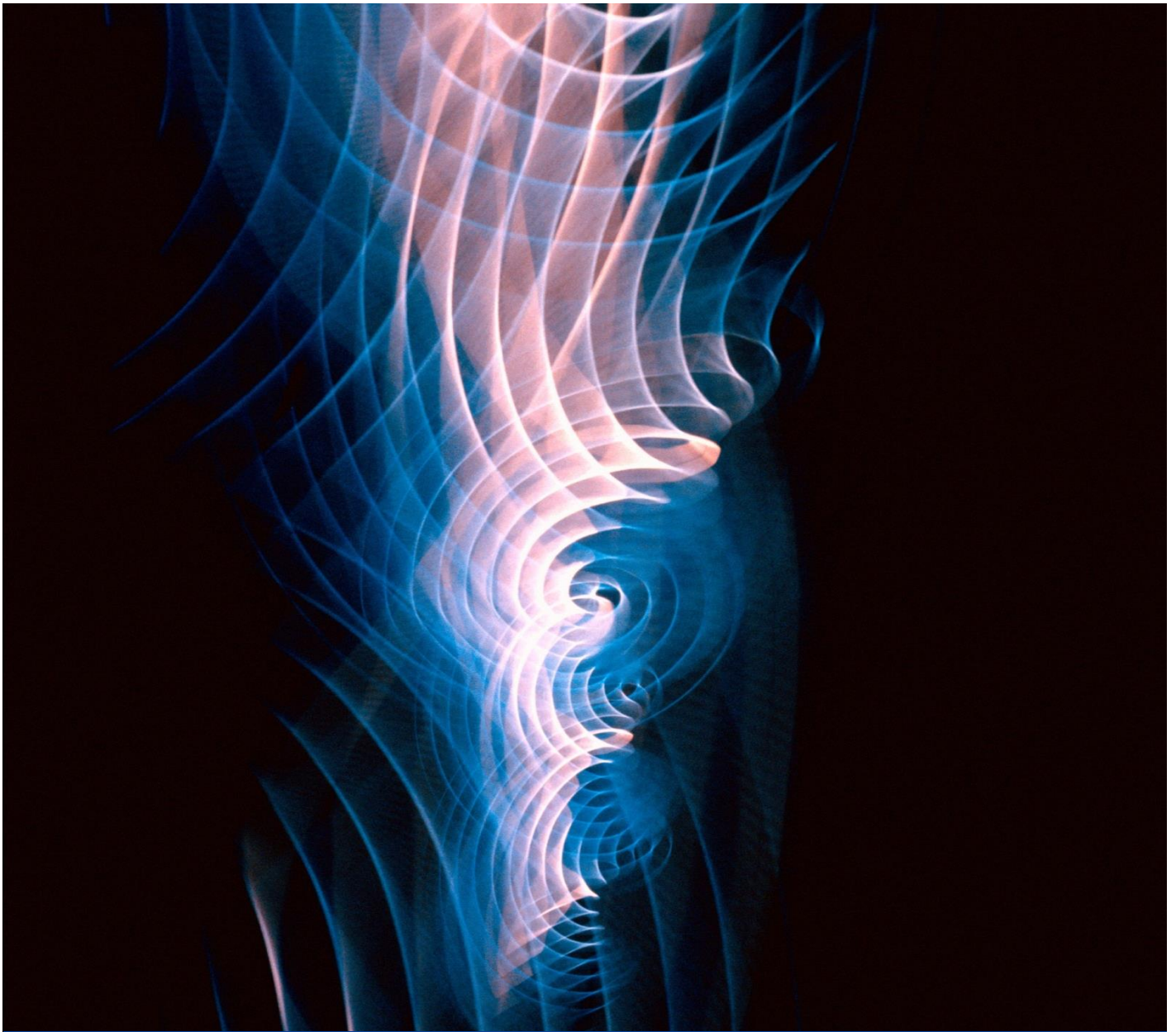
Note: *Stricter conditions may apply to heritage or other sensitive structures.

**These values relate to continuous vibration. The majority of construction activities produce intermittent vibration, in which case higher vibration levels are allowable over a shorter period of time.

The values contained in Table 8 are indicative only. Variations will occur depending on each specific site – depending on the item/s of plant in use and local geotechnical conditions. These values relate to typical structures and conditions. It is recommended that vibration monitoring be utilised to confirm the minimum working distances at specific sites.

Initial land surveys show that the majority of sensitive buildings are located a minimum of 50 m from the proposed worksites. Alternate construction methods may be required for works required in the proximity of sensitive structures, or in cases where the minimum working distances cannot be met.

Appendix B. Sensitive Receiver Locations and Noise Management Levels



UNITED
BY OUR
DIFFERENCE



SYDNEY METRO NORTH WEST

Background Noise Monitoring

18/09/2015

Quality Management

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
Remarks	Draft			
Date	18/09/15			
Prepared by	Chris Marsh			
Signature				
Checked by	Adrian White			
Signature				
Authorised by	Alex Campbell			
Signature				
Project number	ACG1401400			
Report number				
File reference				

Sydney Metro North West Noise Catchment Area Monitoring

18/09/2015

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Table of Contents

Executive Summary.....	5
1 Introduction	6
1.1 Project background.....	6
1.2 Site description	7
2 Previous noise measurements.....	9
3 Noise monitoring methodology.....	10
3.1 Existing construction noise	11
4 Results	13
5 Discussion.....	14
6 Revised noise management levels.....	17
7 Summary.....	18
Appendix A – Photographs of noise monitoring locations	19
Appendix B – Noise monitoring graphs.....	21

Executive Summary

WSP | Parsons Brinckerhoff (WSP | PB) has undertaken noise measurements to determine the Rating Background Levels (RBLs) at representative locations along the Sydney Metro North West (SMNW) project alignment. The RBLs inform assessment of construction noise at receivers potentially affected by the project.

Previous RBL measurements were conducted between 2005 and 2011 for the Environmental Impact Statement (EIS) for the project. Changes to the noise environment as a result of new residential and commercial developments and increased local traffic flows have occurred in the area since the EIS.

Following discussions between TfNSW and WSP | PB, new measurements were undertaken to establish updated RBLs.

The locations of the measurements was reviewed and measurements were relocated to provide noise levels representative of the potentially most affected receivers to the construction works.

In general the measured noise levels were higher than previously measured at measurement locations where significant development has occurred or for locations near roads.

The revised noise measurements were used to derive updated noise management levels for construction noise for the project.

1 Introduction

WSP | PB has been appointed to provide construction phase related noise and vibration advice to Impregilo Salini Joint Venture (ISJV) with regards to the Surface, Viaduct and Civil (SVC) package of the Sydney Metro North West (SMNW) project.

To manage potential impacts from these works, a Construction Noise and Vibration Management Plan (CNVMP) was submitted to Transport for New South Wales (TfNSW) which establishes parameters and framework for compliance with noise and vibration goals.

The CNVMP features background noise levels from noise catchment areas (NCAs) along the viaduct route, as determined in the 2011 SMNW Environmental Impact Statement. Background noise measurements for the EIS were obtained between 2005 and 2011.

Since then the noise environment around several locations has changed with new property developments and increased road traffic. Following discussions between TfNSW and WSP | PB, new measurements at revised locations were undertaken to determine current background noise levels.

1.1 Project background

The scope of the SVC Project works consists of the detailed design, construction and handover of the viaducts, bridges and associated civil works required for 6.3 km of the SMNW between Bella Vista and Cudgegong Road. The project includes establishment and reinstatement of worksites, spoil removal and disposal, and all required utility relocations and adjustments at construction worksites.

The 6.3 km of permanent infrastructure to be delivered includes:

- Approximately 4.5 km of viaduct between Balmoral Road and Rouse Hill Station including crossings over Memorial Avenue, Samantha Riley Drive, Windsor Road, Sanctuary Drive and White Hart Drive.
- Bulk earthworks requirements including all cut, fill and embankments between Balmoral Road and Cudgegong Road.
- A bridge over Windsor Road / Rouse Hill and another bridge over Second Ponds Creek.
- Allowance for station structures to be incorporated onto the viaduct at the Kellyville and Rouse Hill station sites.
- Adjustments to existing infrastructure and roads within the construction site and / or otherwise affected by ISJV activities.
- Safe, secure personnel access / egress into site areas including necessary temporary support services and site facilities, with hoardings, fencing and so on around worksites to be left in place upon completion.
- Construction traffic and transport management including temporary and permanent traffic management works.
- Removal of all temporary work and site facilities not otherwise required for handover to subsequent contractors.

A number of construction activities occur along the alignment at all times of the day, evening and night. The CNVIS requires noise impacts to be assessed which necessitates the collection of background noise data in order to set noise goals at sensitive receivers.

1.2 Site description

The SVC project extends from Old Windsor Road, Glenwood to Schofields Road, The Ponds. The alignment is shown in Figure 1.

Since the 2011 EIS, several new residential developments have been completed including a major development in The Ponds and other developments in the new Rouse Hill around Sanctuary Drive, Beaumont Hills and Balmoral Road release Area Kellyville.

In addition, Schofields Road has been redeveloped and widened. With the increase in residential and commercial developments in the region, road traffic levels are assumed to have increased.

The major noise source in the area is Windsor Road which is an arterial road. Other significant noise sources include sub-arterial roads; Sanctuary Drive, Commercial Road and Samantha Riley Drive.

The most significant commercial developments are at Rouse Hill Town Centre and Bella Vista with other land uses including Castlebrook Lawn Cemetery and isolated nature reserves.

Sensitive receivers, primarily medium density residential are located along the whole alignment with the majority being detached single and double storey dwellings. Multi-storey residential blocks are also present at Rouse Hill town centre and Kellyville Ridge.



2 Previous noise measurements

Previous noise measurements were undertaken between 2005 and 2011 as part of the EIS. The EIS divided receivers into 16 noise catchment areas (NCA). Each NCA contains receivers which are expected to have similar noise environments based on their distance from major noise sources and the proposed project.

Noise monitoring was conducted at one location in each NCA which was intended to be representative of receivers within that NCA. Figure 1 presents the 2011 EIS monitoring locations, highlighted in blue.

Table 1 presents the RBLs from the 2011 EIS.

Table 1 – 2011 EIS noise measurements

Noise measurement location	Measured noise level dBA					
	Daytime 7.00am to 6.00pm		Evening 6.00pm to 10.00pm		Night time 10.00pm to 7.00am	
	RBL	Leq(15min)	RBL	Leq(15min)	RBL	Leq(15min)
BG12	51	61	48	60	33	57
BG13	51	60	50	58	34	54
BG14	47	62	48	61	38	58
BG15	39	49	41	48	39	48
BG16	45	55	46	53	37	51
BG17	48	62	44	59	32	56
BG18	54	63	52	60	47	58
BG19	52	64	49	62	32	59
BG20	41	52	41	50	33	48
BG21	51	60	51	58	39	55
BG24	45	59	49	59	38	55

3 Noise monitoring methodology

A noise survey was conducted by WSP | PB in August and September 2015. Noise measurements made during this visit were conducted in general accordance with AS 1055 “*Acoustics – Description and Measurement of Environmental Noise Part 1: General Procedures*” and the requirements of the TfNSW *Construction Noise Strategy* (CNS) (TfNSW, 2013) which references the NSW *Industrial Noise Policy* (INP) (EPA, 2000).

The monitoring locations were selected to be representative of the 2011 EIS locations in most cases, allowing for site constraints including property access and equipment security. Some locations were relocated to be representative of the potentially most affected receivers relative to the construction works or changes in the local noise environment.

The following changes were made:

- BG11 was removed as the position is no longer representative of the SVC works.
- BG13 was relocated to represent the closest receivers to construction works.
- BG14 was relocated to represent the closest receivers to construction works.
- BG15 was not re-measured as it is influenced by existing construction works.
- BG16 was relocated to represent the closest receivers to construction works.
- BG17 was re-measured by WSP | PB in March 2015.
- BG19 was relocated to represent the closest receivers to construction works on Old Windsor Road.
- BG21 was relocated due to the excavation works at Knights Quarry. New location is considered representative of receivers previously represented by BG21.
- BG20 was relocated to represent the closest receivers to construction works on Old Windsor Road.
- BG24 was relocated to account for new receivers in The Ponds residential development.
- BG26 was added as a new location to represent receivers around Bentwood Terrace and Stanhope Gardens.

Figure 1 shows the location of the revised monitoring locations in green.

Weather conditions during the monitoring periods were predominantly dry and calm, with some light winds recorded. Where inclement weather or extraneous noise sources adversely affected the data, these periods were removed. The potential influence of existing construction noise is discussed further the Section 3.1.

Equipment was field calibrated using a Pulsar Model 105 acoustic calibrator before and after noise measurements with no drift in excess of ± 0.5 dBA noted. Noise monitoring equipment and the calibrator were in current National Association of Testing Authorities (NATA) calibration at the time of use. Equipment details and serial numbers are provided in Table 2.

Photographs of the noise monitoring locations are shown in Figure 3 in Appendix A.

Table 2 - Summary of acoustic testing equipment

Equipment description	Location	Manufacturer & Type No.	Serial No.
Sound level meter	BG12	ARL EL 316	16-707-005
Sound level meter	BG13	ARL EL 316	16-707-038
Sound level meter	BG14	ARL EL 316	16-707-042
Sound level meter	BG16	ARL EL 316	16-707-006
Sound level meter	BG18	ARL EL 316	16-306-037
Sound level meter	BG19	ARL EL 316	16-302-485 ⁽²⁾
Sound level meter	BG20	ARL EL 316	16-203-502
Sound level meter	BG21	ARL EL 316	16-302-490
Sound level meter	BG24	ARL EL 316	16-306-034
Sound level meter	BG26 ⁽¹⁾	ARL EL 316	16-707-007
Calibrator	All locations	Pulsar – Model 105	55041

Note: (1) BG26 refers to the new position behind 37 Bentwood Terrace, Stanhope

Note: (2) Additional measurements conducted at BG19 used an ARL 316 serial number 16-707-038.

3.1 Existing construction noise

The effects of existing construction activities were considered where they were located close to noise monitoring locations along the SVC package alignment. New RBLs should only be adopted where construction activities did not have a significant impact on the background levels during the measurement period.

Monitoring locations close to the current construction activities were BG14, BG20 and BG24. Table 3 presents a summary of the noise monitoring locations and a description of potential impacts from construction noise.

Table 3 - Summary of acoustic testing equipment

Noise measurement number and NCA location	Comments
BG12	No construction activity noted
BG13	No construction activity noted
BG14	Gantry crane assembly in area however no significant influence from construction noise noted.
BG15	No new measurements taken in August 2015 due to the proximity of the gantry crane to the catchment area. Previous RBL measurements are kept
BG16	No construction activity noted
BG17	Measurements conducted in March 2015 with no construction activity noted
BG18	No construction activity noted
BG19	No construction activity noted
BG20	Construction area between White Hart Drive and Sanctuary Drive, however no significant influence from construction noise noted.

Noise measurement number and NCA location	Comments
BG21	No construction activity noted
BG24	Noise logger was located close to the 97 Schofields Road compound. Measurements periods have been excluded where they have been affected by construction noise
BG26 ⁽¹⁾	No construction activity noted

Note: (1) BG26 refers to the new position behind 37 Bentwood Terrace, Stanhope

In Appendix B presents graphs of the noise monitoring data. Data for BG14, BG20 and BG24 has been examined for any potential impacts from construction noise

- BG14: The logger was located approximately 200m from the nearest section of the gantry crane and on the opposite side of Old Windsor Road. The measured noise data indicated that traffic noise from Old Windsor Road was dominant with no significant construction noise influence. Therefore the revised RBLs are considered valid.
- BG20: The noise logger was positioned approximately 400m from a viaduct construction area. Observations from site visits indicated that no major works were taking place during the measurements. Examination of the measured data also indicated no significant construction noise influence. Therefore the revised RBLs are considered valid.
- BG24: The logger was located the vicinity of the 97 Schofields Road compound, with the logger positioned on the opposite side of Schofields Road to the site entrance. The compound is occasionally used at night time, and truck movements to and from the site can occur frequently. Examination of the data indicated that the night period on Friday 14 August was influenced by construction noise and was excluded. The remaining data periods showed similar diurnal patterns and had consistent noise levels to the 2011 EIS measurements. As a result it is considered that the revised RBLs are valid.

4 Results

Noise measurements were processed according to produce average ambient equivalent continuous average noise levels ($L_{eq(15min)}$) and rating background levels (RBLs) as defined in INP as:

Rating Background Level (RBL) – the overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24hour period used for the assessment background level). The rating background level is the level used for assessment purposes. Where the rating background level is found to be less than 30dBA, then it is set to 30dBA.

Table 4 presents a summary of the noise measurements. Graphs of the noise monitoring results are presented in Appendix B.

At most locations, RBLs are highest during the daytime period and lowest during the night time period. Loggers positioned along Old Windsor Road have the highest $L_{eq(15min)}$ and RBL noise levels. Road traffic noise from Old Windsor Road and from distant sources was noted as the primary source of ambient and background noise at all locations.

Table 4 - WSP | PB 2015 noise measurements

Noise measurement location	Measured noise level dBA					
	Daytime 7.00am to 6.00pm		Evening 6.00pm to 10.00pm		Night time 10.00pm to 7.00am	
	RBL	$L_{eq(15min)}$	RBL	$L_{eq(15min)}$	RBL	$L_{eq(15min)}$
BG12	60	73	59	73	42	70
BG13	62	73	60	72	46	68
BG14	57	76	52	75	42	71
BG16⁽¹⁾	44	55	47	54	39	53
BG18	58	75	55	74	43	71
BG19⁽²⁾	60	75	55	74	37	70
BG20	51	63	50	62	40	58
BG21	51	69	49	65	39	62
BG24	52	65	48	62	38	59
BG26	52	70	52	69	40	65

Note: (1) Measured noise level is high during the evening than day. The INP Application Notes (EPA, 2013) states where this occurs, the evening RBL shall be set no higher than the day RBL.

Note: (2) Noise levels include measurements conducted between Monday 10 and Saturday 15 August 2015 and Wednesday 9 and Saturday 12 September 2015.

5 Discussion

Table 5 presents a comparison of RBLs measured for the EIS and in 2015.

Changes to the noise environment and monitoring locations detailed in Section 3 have caused background noise levels to increase at the measurements locations resulting in differences between the EIS 2011 and the 2015 measurements.

Measured noise levels at BG16 and BG21 are generally consistent with the 2011 EIS measurements, with a maximum variation of 2 dB. Measurements are therefore still considered valid for receivers within the vicinity of the previous and revised monitoring locations.

Noise levels at BG12, BG13 and BG20 show significant increases of around 10 dB during each day, evening and night period. This variation is likely due to the monitoring being conducted at locations much closer to Old Windsor Road and are therefore more exposed to road traffic noise without the same degree of shielding provided for the equivalent locations in the 2011 EIS. Locations were revised to provide RBLs representative of receivers facing Old Windsor Road.

Locations BG14 and BG19 show significant increases during the day of 8-10dB with lesser increases of 4-6dB during the evening and night period. This variation is likely due to a revision of locations to be representative of the potentially most affected receivers near Old Windsor Road.

Location BG24 shows a significantly higher RBLs during the day which is likely due to increased road traffic caused by significant residential development in The Ponds using Schofields Road.

BG18 shows a reduction in noise level during the night, however the 2015 noise level is consistent with other measured RBLs in the vicinity of Old Windsor Road is therefore considered valid.

For locations BG12 to BG24 and BG26 the 2015 monitoring results are proposed to be adopted for the project. Figure 2 presents the locations of the revised noise monitoring locations.

Table 5 – Comparison of 2011 EIS and 2015 monitoring

Noise measurement location	Measured noise level dBA								
	Daytime 7.00am to 6.00pm			Evening 6.00pm to 10.00pm			Night time 10.00pm to 7.00am		
	EIS RBL	2015 RBL	Difference	EIS RBL	2015 RBL	Difference	EIS RBL	2015 RBL	Difference
BG12	51	60	9	48	59	11	33	42	9
BG13	51	62	11	50	60	10	34	46	12
BG14	47	57	10	48	52	4	38	42	4
BG15⁽¹⁾	39	-	-	41	-	-	39	-	-
BG16	45	44	-1	46	47	1	37	39	2
BG17⁽²⁾	48	48	0	44	47	3	32	42	10
BG18	54	58	4	52	55	3	47	43	-4
BG19	52	60	8	49	55	6	32	37	5
BG20	41	51	10	41	50	9	33	40	7
BG21	51	51	0	51	49	-2	39	39	0
BG24	45	52	7	49	48	-1	38	38	0
BG26	-	52	-	-	52	-	-	40	-

Note: (1) Measurement at BG15 was not repeated.

Note: (2) Measurement was conducted in March 2015.



Figure 2 – Revised monitoring locations

6 Revised noise management levels

Noise management levels (NML) for the project are set according to the TfNSW Construction Noise Strategy. Updated NMLs have been developed based on the RBLs from revised monitoring.

Table 6 presents the 2015 RBL measurements and revised NMLs. BG11 is not included as it is no longer considered relevant for construction noise assessment as works are no longer taking place in the vicinity.

Table 6 – Updated NCA noise criteria

Noise measurement location	Year	Measured noise level dBA					
		Daytime 7:00am to 6:00pm		Evening 6:00pm to 10:00pm		Night time 10:00pm to 7:00am	
		RBL	NML	RBL	NML	RBL	NML
BG12	2015	60	70	59	64	42	47
BG13	2015	62	72	60	65	46	51
BG14	2015	57	67	52	57	42	47
BG15⁽¹⁾	2011	39	49	39	44	39	44
BG16⁽²⁾	2015	44	54	44	49	39	44
BG17⁽³⁾	2015	48	58	47	52	42	47
BG18	2015	58	68	55	60	43	48
BG19	2015	60	70	55	60	37	42
BG20	2015	51	61	50	55	40	45
BG21	2015	51	61	49	54	39	44
BG24	2015	52	62	48	53	38	43
BG26	2015	52	62	52	57	40	45

Note: (1) BG15 was measured in 2011

Note: (2) Measured noise level was higher during the evening than the day. In accordance with the INP Application Notes (EPA 2000), the evening RBL is set no higher than the day.

Note: (3) BG17 was measured in March 2015.

7 Summary

WSP | PB Acoustics performed noise monitoring at ten locations to provide updated background noise measurements to inform construction noise management levels for the Surface, Viaduct and Civil package of the Sydney Metro North West project.

Noise measurements were undertaken to provide updated noise levels to reflect changes to the noise environment as a result of residential, commercial and road traffic developments in the area since the 2011 Environmental Impact Statement. Monitoring locations were also revised to be representative of receivers closest to the construction works.

In general the measured noise levels were higher than previously measured. This is likely due to revised locations and increases in residential development and road traffic in the area.

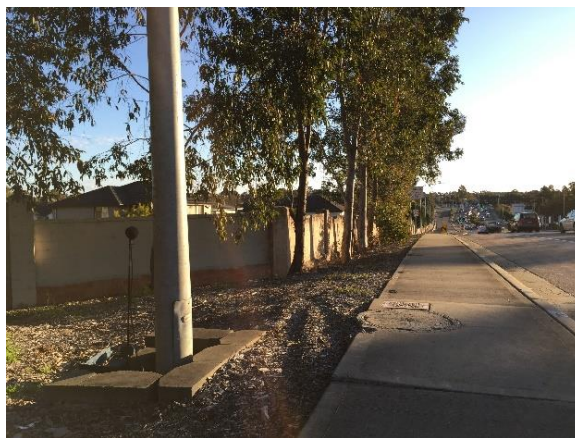
The revised noise measurements were used to derive updated noise management levels for construction noise for the project.

Appendix A – Photographs of noise monitoring locations

Photographs of the logging locations are shown in Figure 3 below.



BG12



BG13



BG14



BG26



BG18



BG19



BG24



BG21



BG20

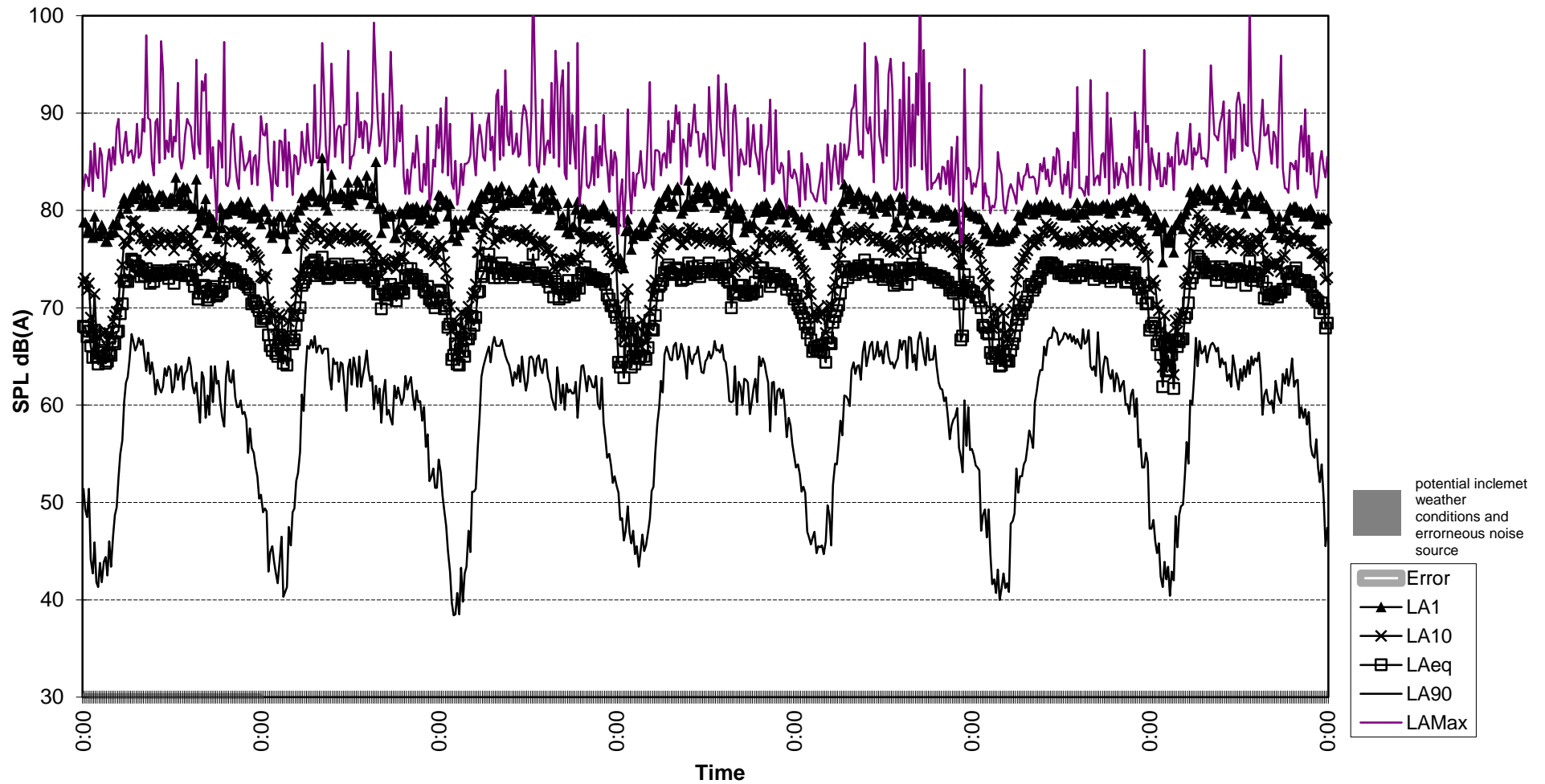


BG16

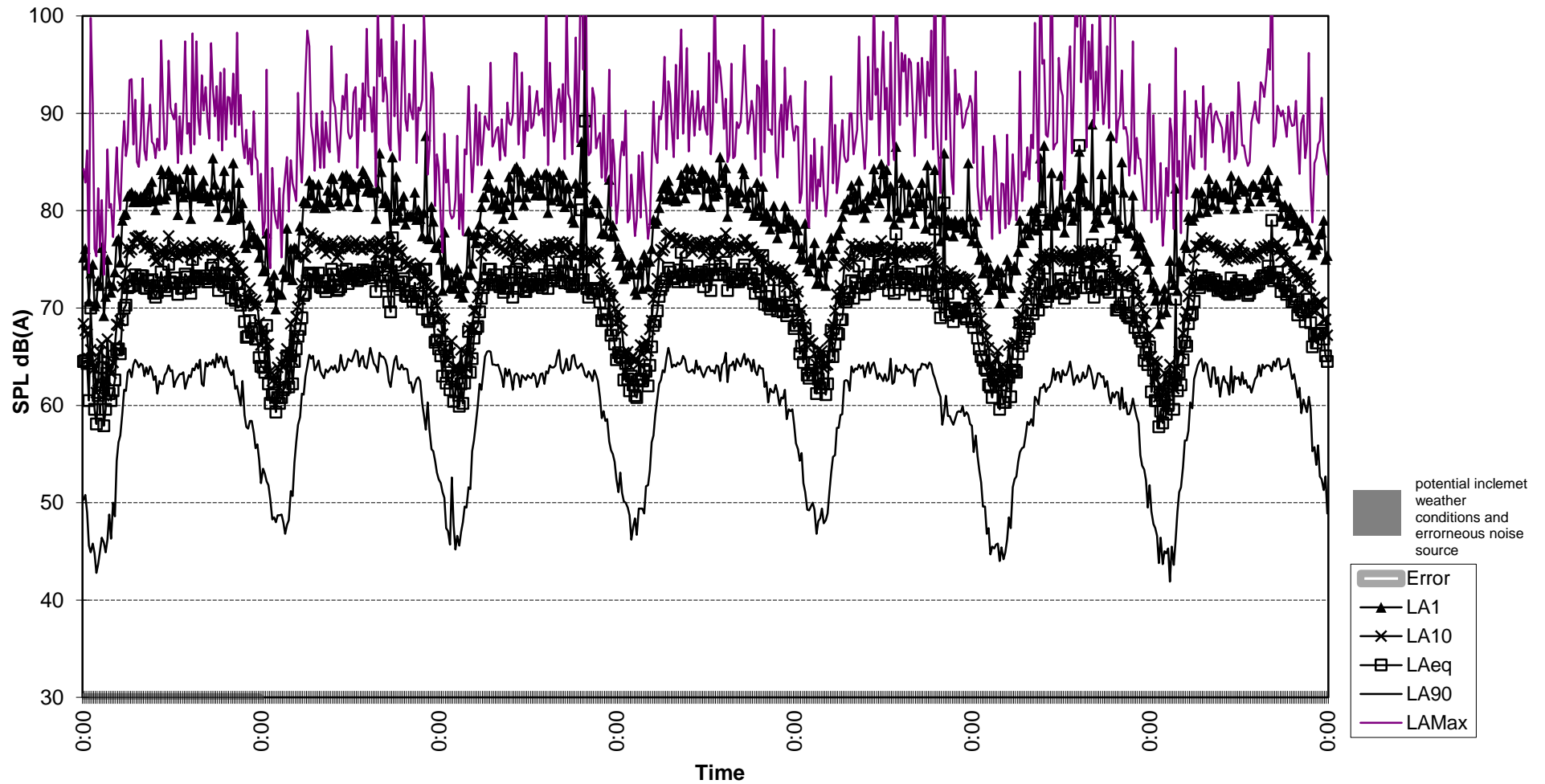
Figure 3 – Photographs of noise monitoring locations

Appendix B – Noise monitoring graphs

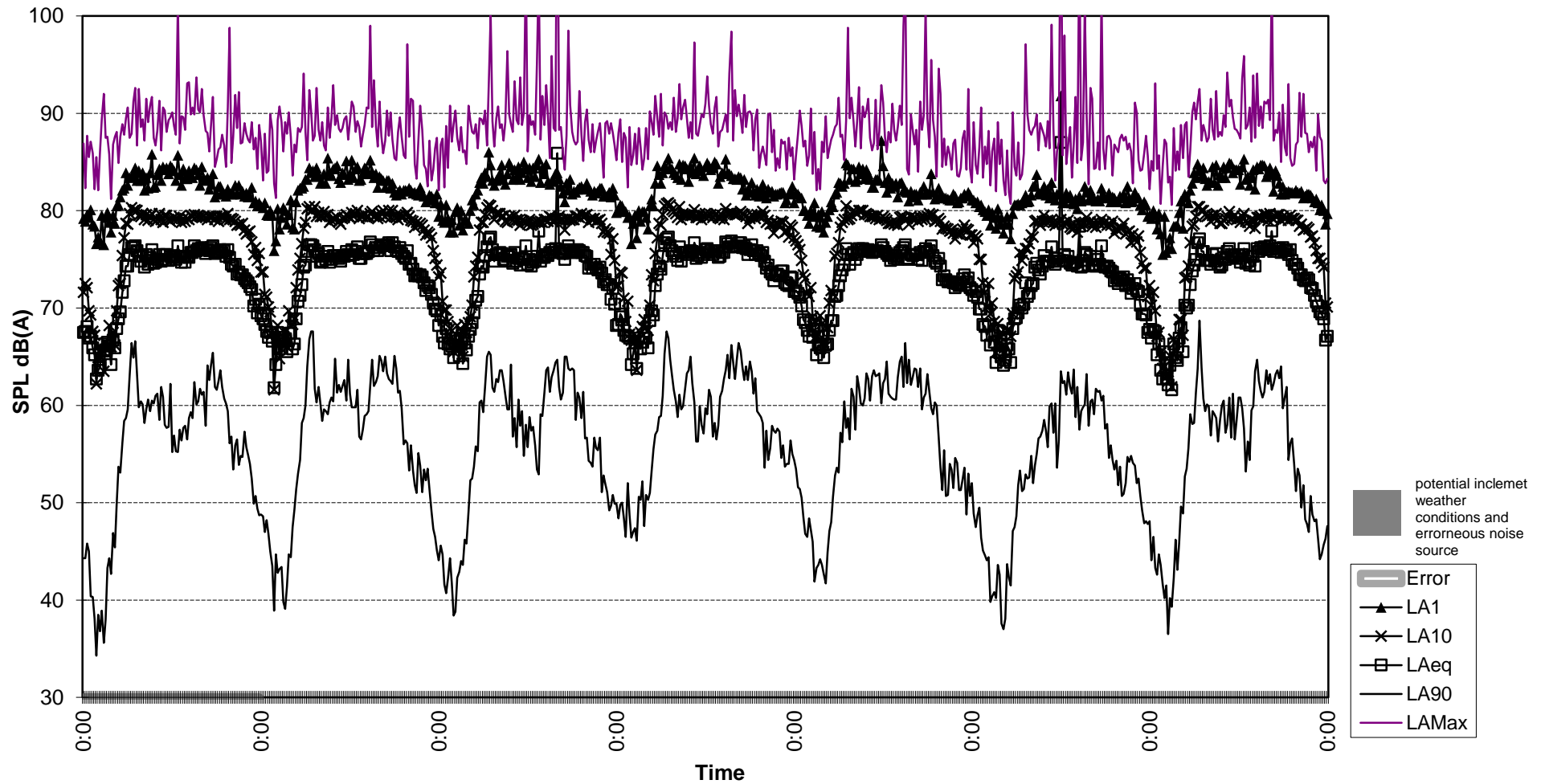
Site BG12 -
Measured Noise Levels - Tuesday 01/09/2015 - Monday 07/09/2015



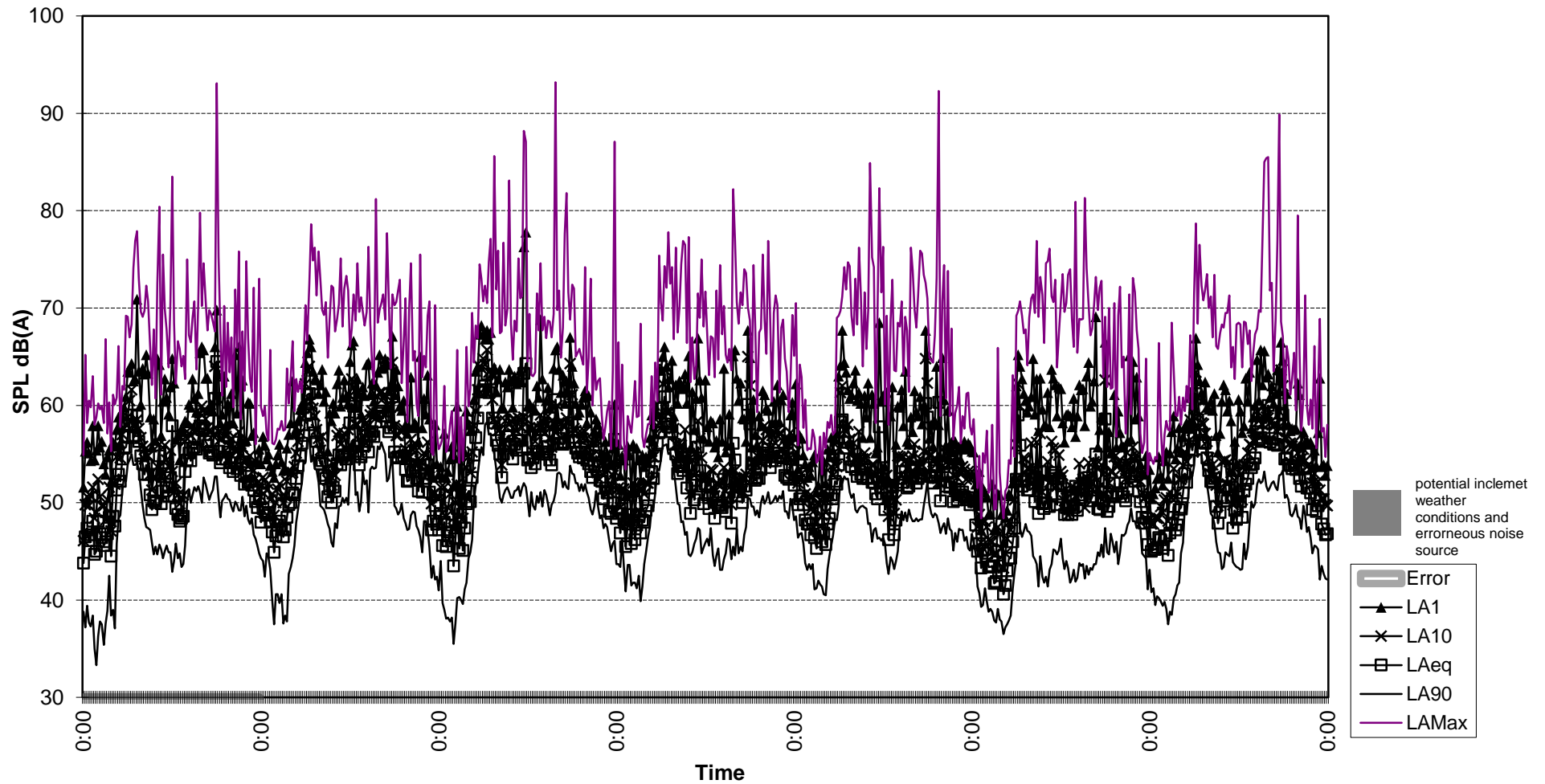
Site BG13 -
Measured Noise Levels - Tuesday 11/08/2015 - Monday 17/08/2015



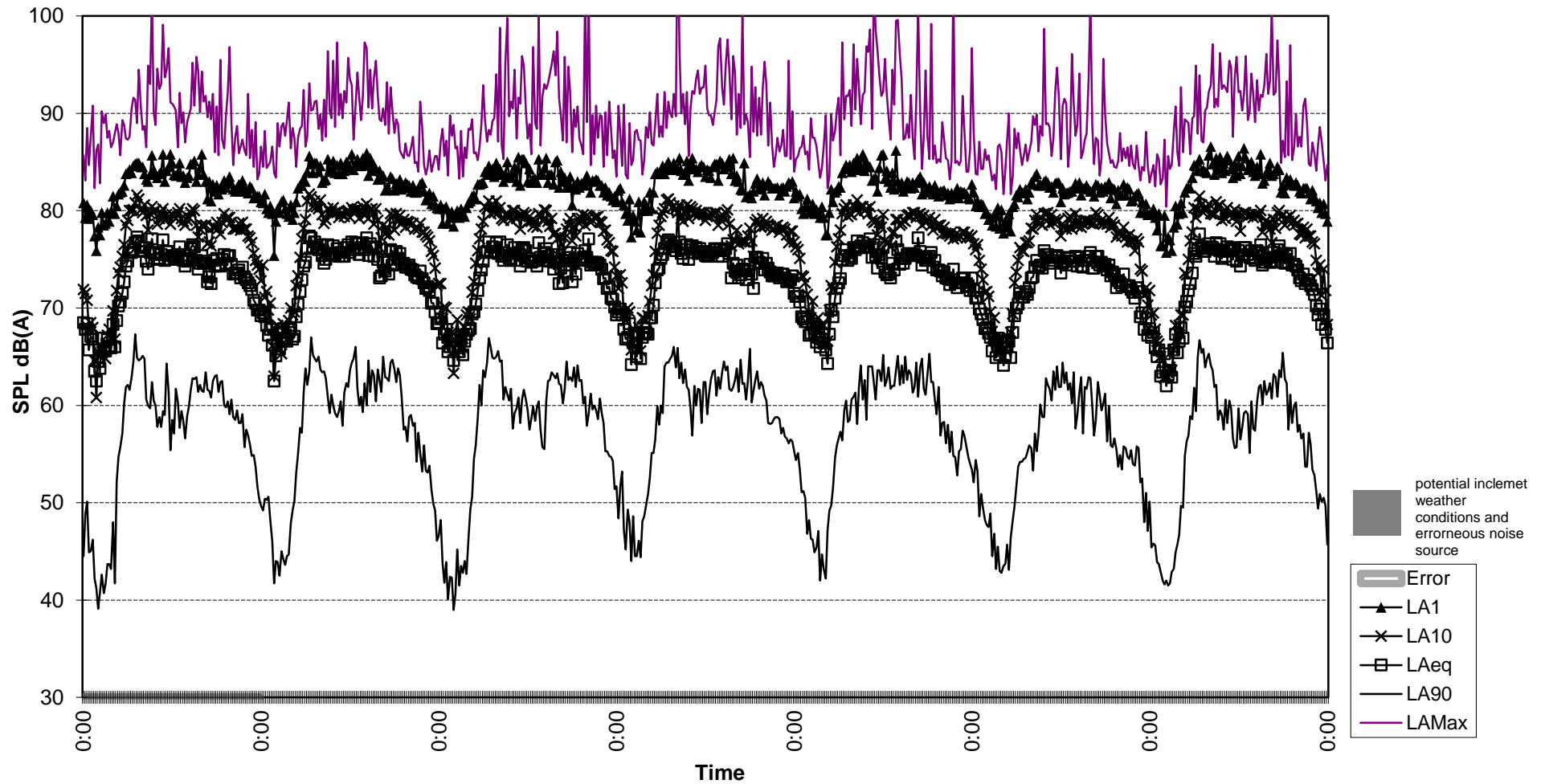
Site BG14 -
Measured Noise Levels - Tuesday 11/08/15 - Monday 17/08/2015



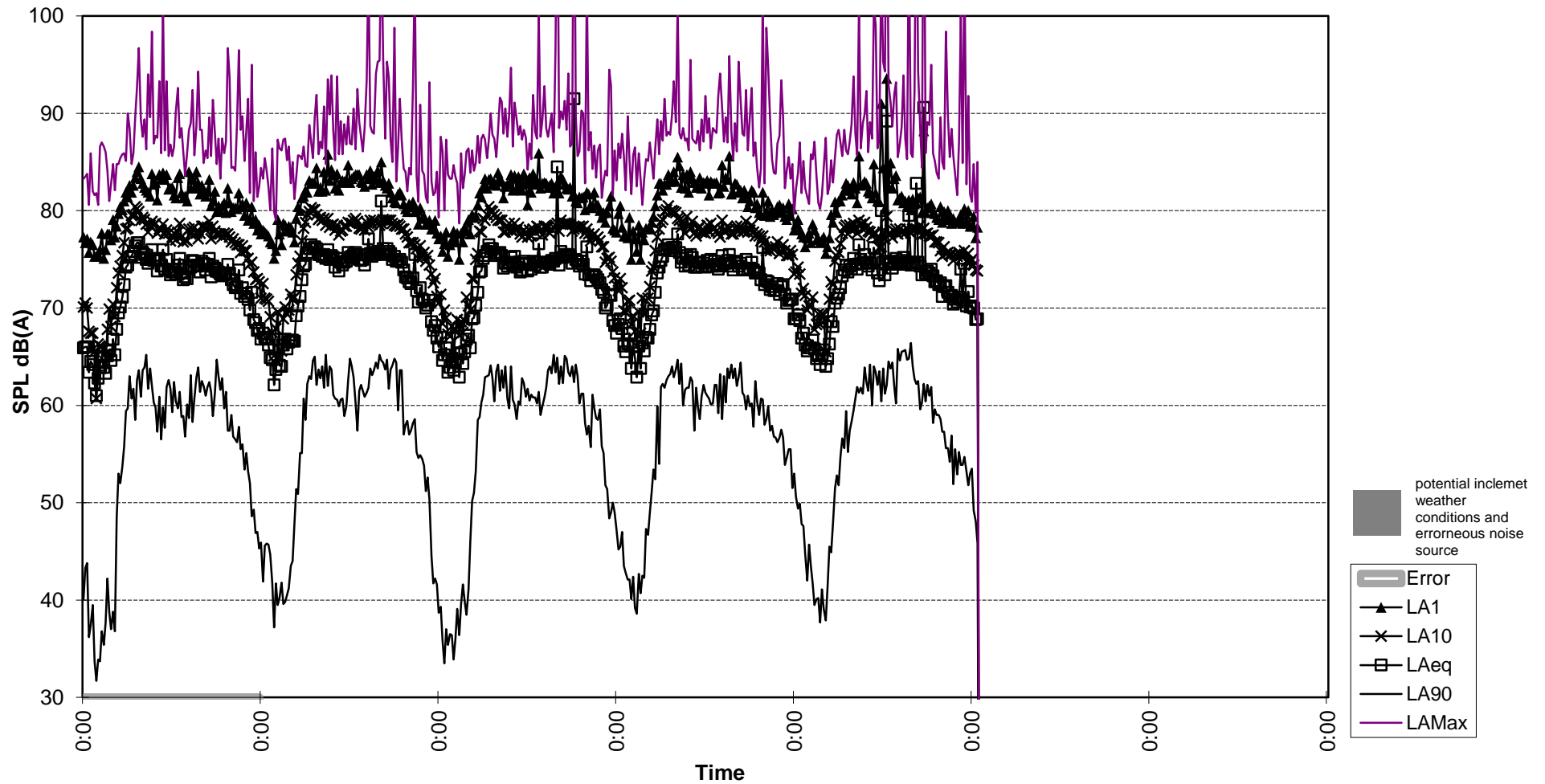
Site BG16 -
Measured Noise Levels - Tuesday 11/08/2015 - Monday 17/08/2015



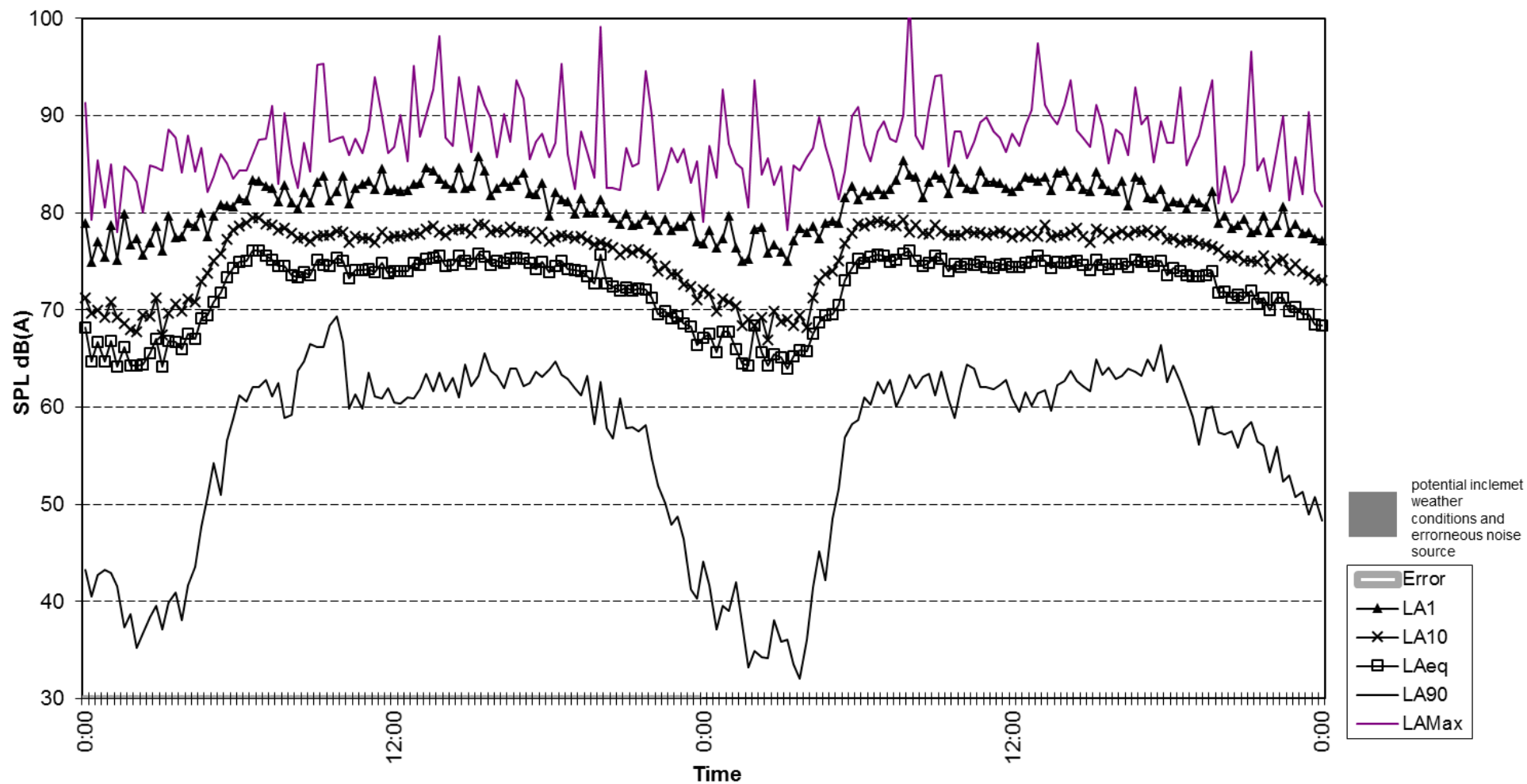
Site BG18 -
Measured Noise Levels - Tuesday 11/08/2015 - Monday 17/08/2015



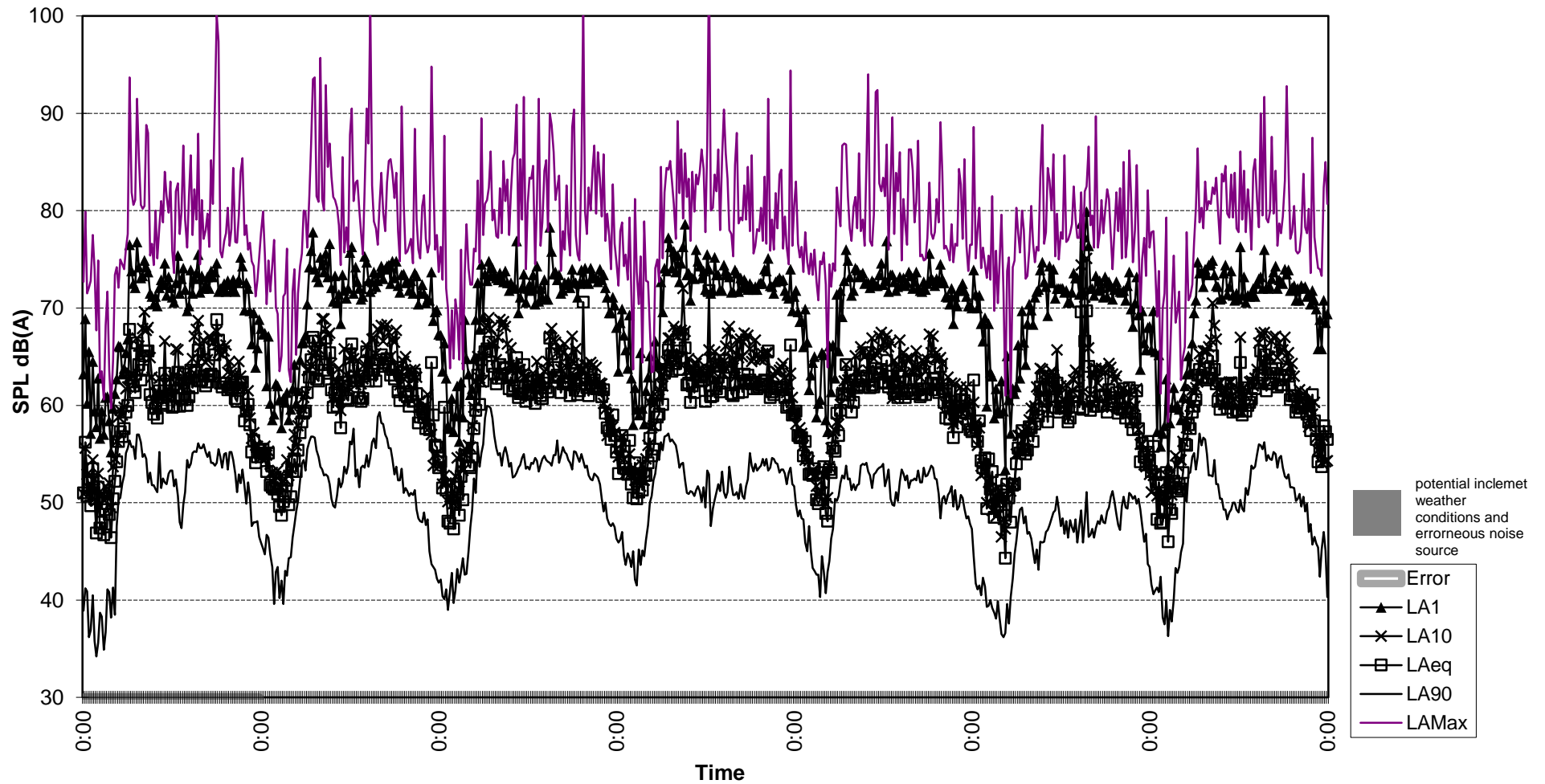
Site BG19 -
Measured Noise Levels - Tuesday 11/08/2015 - Monday 17/08/2015



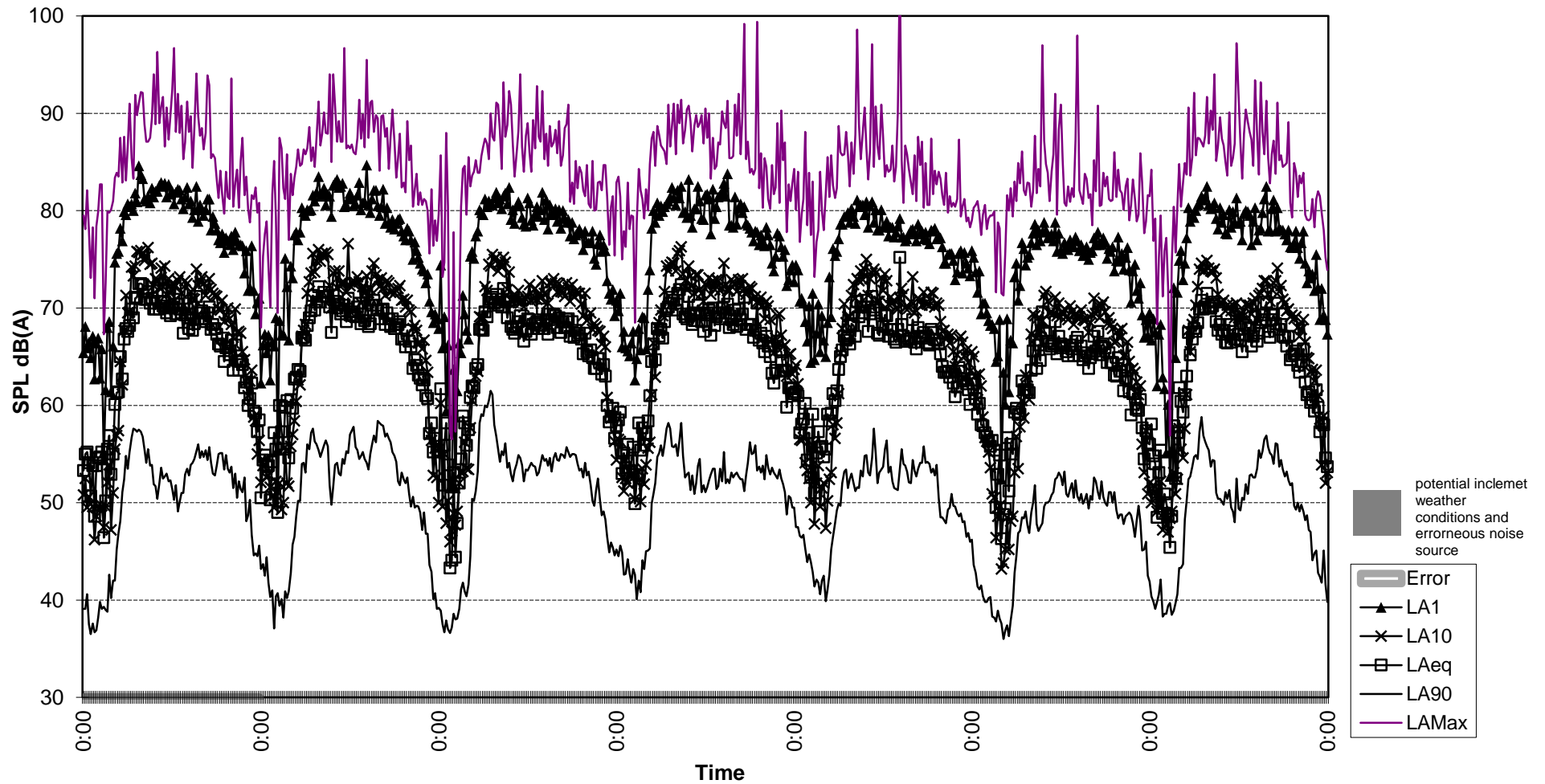
Site BG19 -
Measured Noise Levels - Thursday 10/09/2015 - Friday 11/09/2015



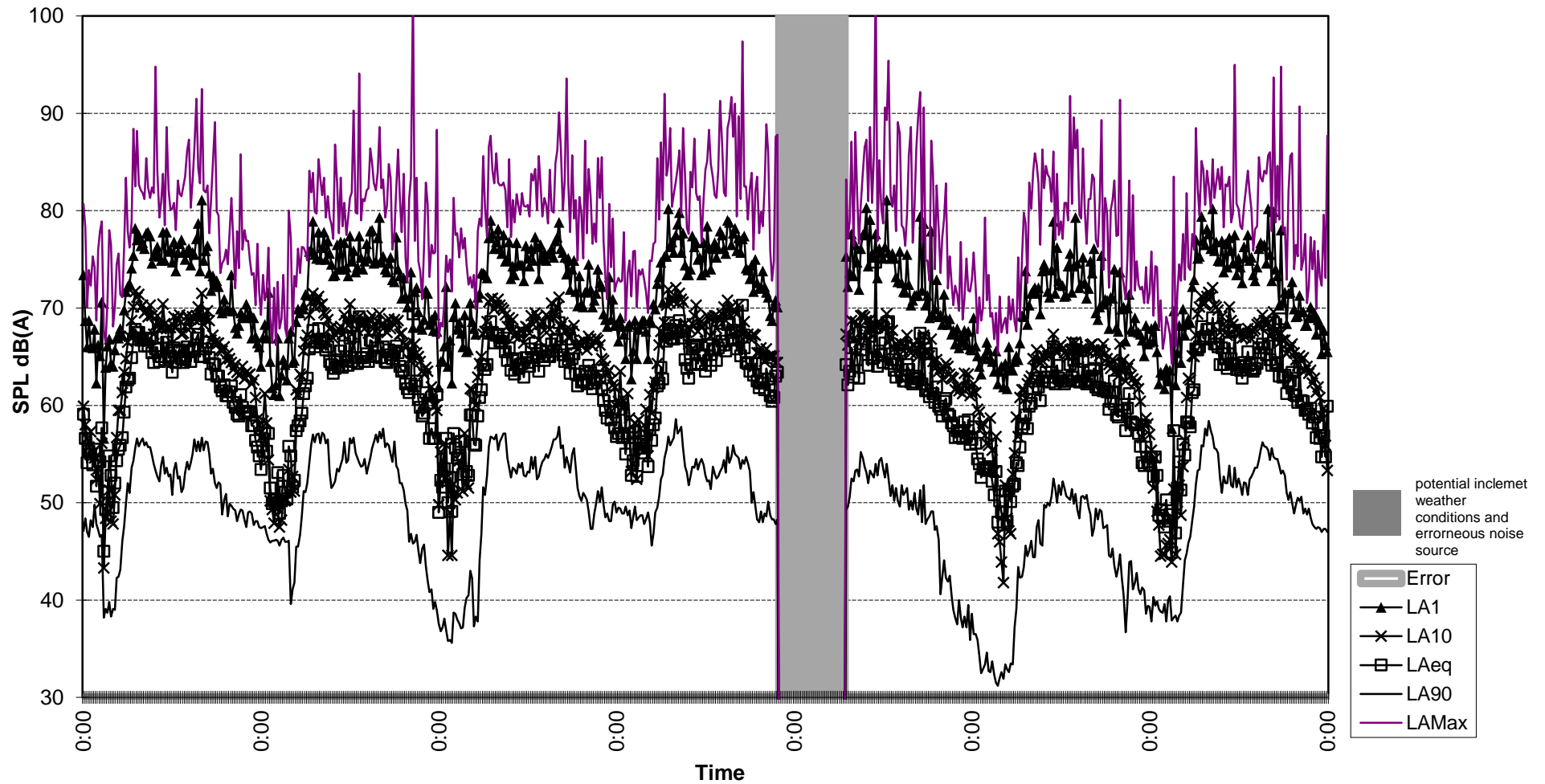
Site BG20 -
Measured Noise Levels - Tuesday 11/08/2015 to Monday 17/08/2015



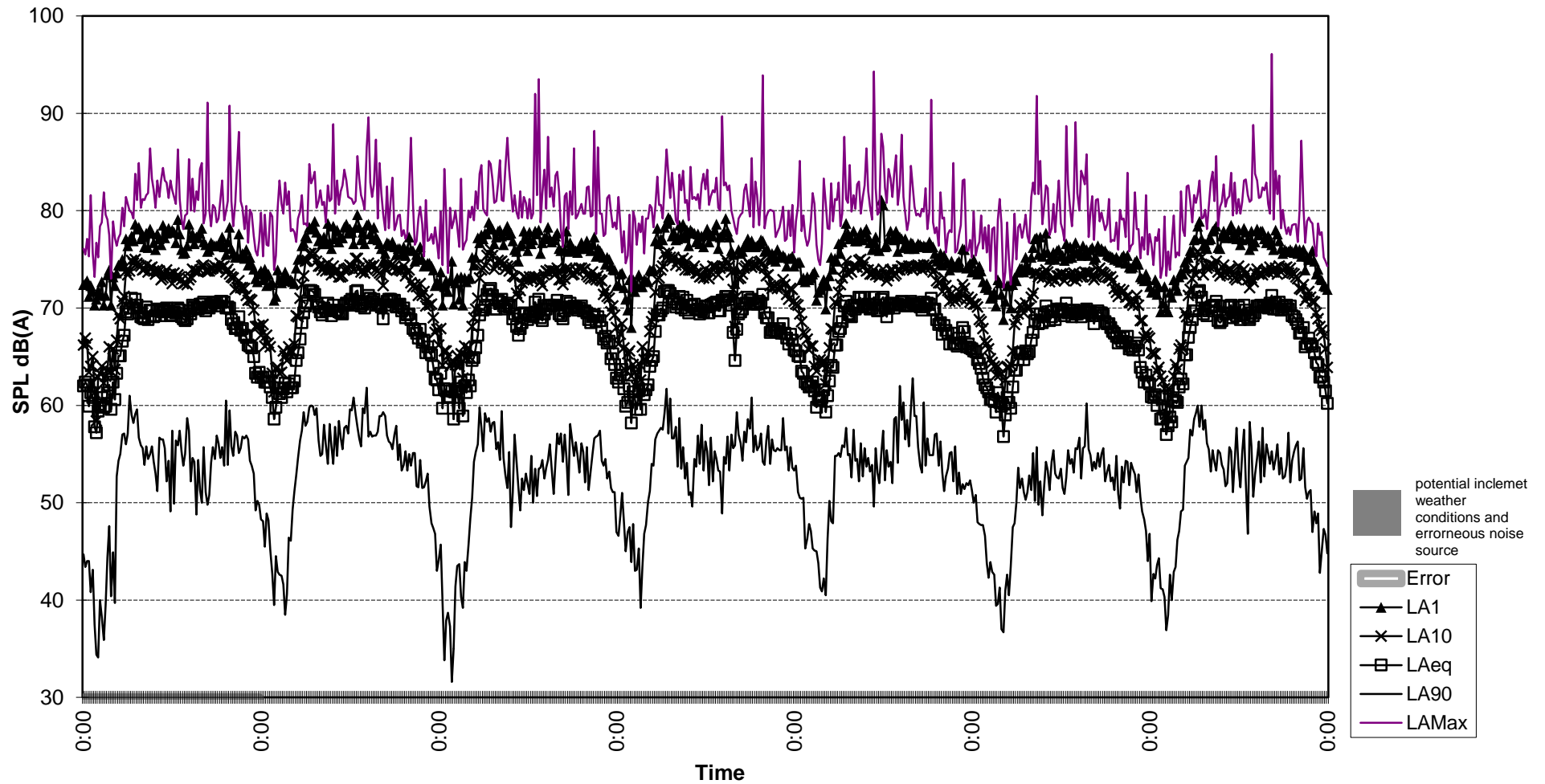
Site BG21 -
Measured Noise Levels - Tuesday 11/08/2015 - Monday 17/08/2015



Site BG24 -
Measured Noise Levels - Tuesday 11/08/2015 - Monday 17/08/2015



Site BG26 -
Measured Noise Levels - Tuesday 11/08/25 - Monday 17/08/2015



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Appendix C. Key Noise and/or Vibration Generating Construction Activities

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



Table 9 below has been extracted from the CEMP and indicates the planned SVC construction components, along with indicative commencement and completion dates for each component which may be subject to change due to delays in design development, modifications to design, wet weather impacts etc.

Table 9 - Indicative SVC Construction Schedule Summary

Work component	Main work activities	Contractor ¹	Planned start	Planned completion
Project – Portion 1	Portion 1 -Construction Viaduct and associated works from Memorial Ave to Cudgegong Rd.	ISJV	December 14	August 17
Segment Fabrication	Fabricate concrete Viaduct Segments for the Viaduct Structure at a rate of approximately 90 deck units per month over a 14 months period.	ISJV	January 15	January 17
Piling Construction	Construct piles from each end of the project working towards the middle. The production will use 1 piling rig for each end and they should each complete piles beneath 5 pier locations per month.	ISJV	August 14	July 16
Pile Cap Construction	Construct piles from each end of the project working towards the middle. The production will use 2 crews for each end and they should each complete pile caps beneath 4 to 5 pier locations per month.	Daracon	September 14	September 16
Deck Erection	Construct decks using two gantries. Commencing from each end of the project and working towards the middle. The production rate should achieve 4 to 5 decks per month from each end depending if they are constructed as Continuous decks or in Tandem (2 at a time).	ISJV	July 15	May 17
Pier 001 (Bella Vista End) to Pier 065	Construct piers from each end of the project working towards the middle. The production will use 2 crews for each end and they should each complete 4 to 5 piers per month.	Daracon	October 14	August 16
Pier 126 (Second Ponds Creek End) to Pier 066	Construct piers from each end of the project working towards the middle. The production will use 2 crews for each end and they should each complete 4 to 5 piers per month.	Daracon	October 14	April 16
Bella Vista Dive – Portion 2	Portion 2 - Construct the dive structure & associated overbridges between the Viaduct and Tunnel.	ISJV	January 16	April 17

* Indicative dates only. For more accurate data see the Construction 6 Week Look Ahead Schedule.

TSC works commenced in late 2013, and is expected to be completed in early 2017. Station construction, fitout, ventilation and precinct works are scheduled to commence in mid-2016, with trains operational in 2019.

Detailed assessment of construction noise and vibration impacts will be assessed through the preparation of Construction Noise and Vibration Impact Assessments for construction scenarios for major worksite / activities, based on the proposed construction methodologies, equipment and locations. More information regarding the approach and content for the construction noise and/or vibration impact assessments is provided in Appendix F.

Appendix D. Reasonable and Feasible Noise Reduction Measures

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



Standard Reasonable and Feasible noise reduction measures

Through all stages of the project there is a commitment to apply mitigation measures in an effort to achieve and maintain compliance with the relevant noise and vibration criteria. The following measures are identified as the *standard* reasonable and feasible measures for the SVC works and will be implemented wherever relevant.

Table 10 – Standard Noise Mitigation Measures for SVC (adapted from TfNSW CNVS)

Noise Reduction Measure (from TfNSW CNVS)	Measure type	Day or Night	Reasonable and feasible for SVC works?
In previous documents			
Encapsulate engine chambers and fit silencers to equipment. This typically provides 5dB attenuation, but can achieve attenuation up to 10dB(A).	Quiet equipment	Day & night	Yes – install on equipment operating long term on-site.
Minimise equipment use especially during off peak hours.	Procedure	Night	Yes – reduce equipment used whenever practical.
Use temporary barriers or berms to shield construction equipment. Examples include: Stacking containers around noisy equipment; Constructing a shield around operation equipment such as compressors.	Shielding	Day & night	Yes – provide hoardings around construction sites and barriers for pumps and static plant if needed.
Restricting times when noisy work is carried out (respite periods).	Procedure	Day	Yes – provide periods of relief when practical during noise intensive activities such as rock breaking.
Placement of work compounds, parking areas, equipment and material stockpile sites away from noise-sensitive locations.	Design	Day & night	Yes – separation distances for these facilities will be as far as possible from noise-sensitive receivers.
Where noise barriers/walls are to be constructed, program this as early as possible to reduce noise impacts on neighbouring residents.	Procedure		Yes – hoardings will be built at the commencement of construction.
Ensure that least noisy construction methods, vehicles, plant and equipment are used, and adopting alternative construction measures.	Quiet equipment		Yes – bored piling preferred. Otherwise generally not feasible due to specialised construction equipment required.
Consider alternatives to, or curtailing of reversing alarms.	Quiet equipment		Yes – non-tonal and / or automatically adjusting alarms for on-site equipment used at night time.
Prevent vehicles and plant queuing and idling outside construction hours.	Procedure		Yes – procedural.
Identify measures to be implemented to ensure that where movement alarms are fitted to vehicles, plant or equipment entering or operating on the site, such alarms are of a type that minimised noise at noise sensitive receivers.	Quiet equipment		Yes – non-tonal and / or automatically adjusting alarms.
Minimise use of impact piling techniques.	Quiet equipment / design	Day	Yes, bored piling preferred. Dependant on piling equipment used.
Based on current construction methods			
Silenced generators.	Quiet equipment	Day & night	Yes
Quiet compressors & pumps.	Quiet equipment		Yes
Notify community two days in advance of noisy or planned out of hours activities.	Procedure		Yes – as per CLIP or as agreed with TfNSW
Verification of noise model by monitoring.	Procedure		Yes, when required by CNVIS.

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



The TfNSW CNVS outlines requirements for *additional* management and mitigation measures to be applied in addition to the *standard* measures (Table 14) where necessary. These are based on predicted noise levels that exceed the measured rating background levels (RBLs). The relevant RBLs for the SVC project are provided in Table 6 of Appendix B. The *additional* measures are to be used in circumstances where – after the application of the *standard* mitigation measures (Table 14) – the construction noise and vibration levels are still predicted to exceed the noise or vibration objectives set out in CoA E15 and the EPL for the Project (*Table 11 has been reproduced from the TfNSW CNVS*).

NB: The implementation of any of these additional measures (if required) would be undertaken by the ISJV's Community Consultation Manager in consultation with TfNSW and in accordance with the processes outlined in the Community Liaison Implementation Plan.

Table 11 - Additional noise mitigation measures for SVC

Time period		L _{Aeq} (15min) noise level above background (RBL) qualitative assessment of noise levels*			
		0 to 10 dB(A) Noticeable	10 to 20 dB(A) Clearly audible	20 to 30 dB(A) Moderately intrusive	> 30 dB(A)
Standard	Mon-Fri (7am-6pm) Sat (8am-1pm) Sun/Pub (Nil)	-	-	LB, M	LB, M
OOHW Period 1	Mon-Fri (6pm-10pm) Sat (1pm-10pm) Sun/Pub (8am-6pm)	-	LB	M, LB	M, IB, LB, RO, PC, SN
OOHW Period 2	Mon-Fri (10pm-7am) Sat (10pm-8am) Sun/Pub (6pm-7am)	LB	M, LB	M, IB, LB, PC, SN	AA, M, IB, LB, PC, SN

- Note: *The following abbreviations have been used –
- AA: Alternative accommodation
 - M: Monitoring
 - IB: Individual briefings
 - LB: Letterbox drops
 - RO: Proposal specific respite offer
 - PC: Phone calls
 - SN: Specific notifications.

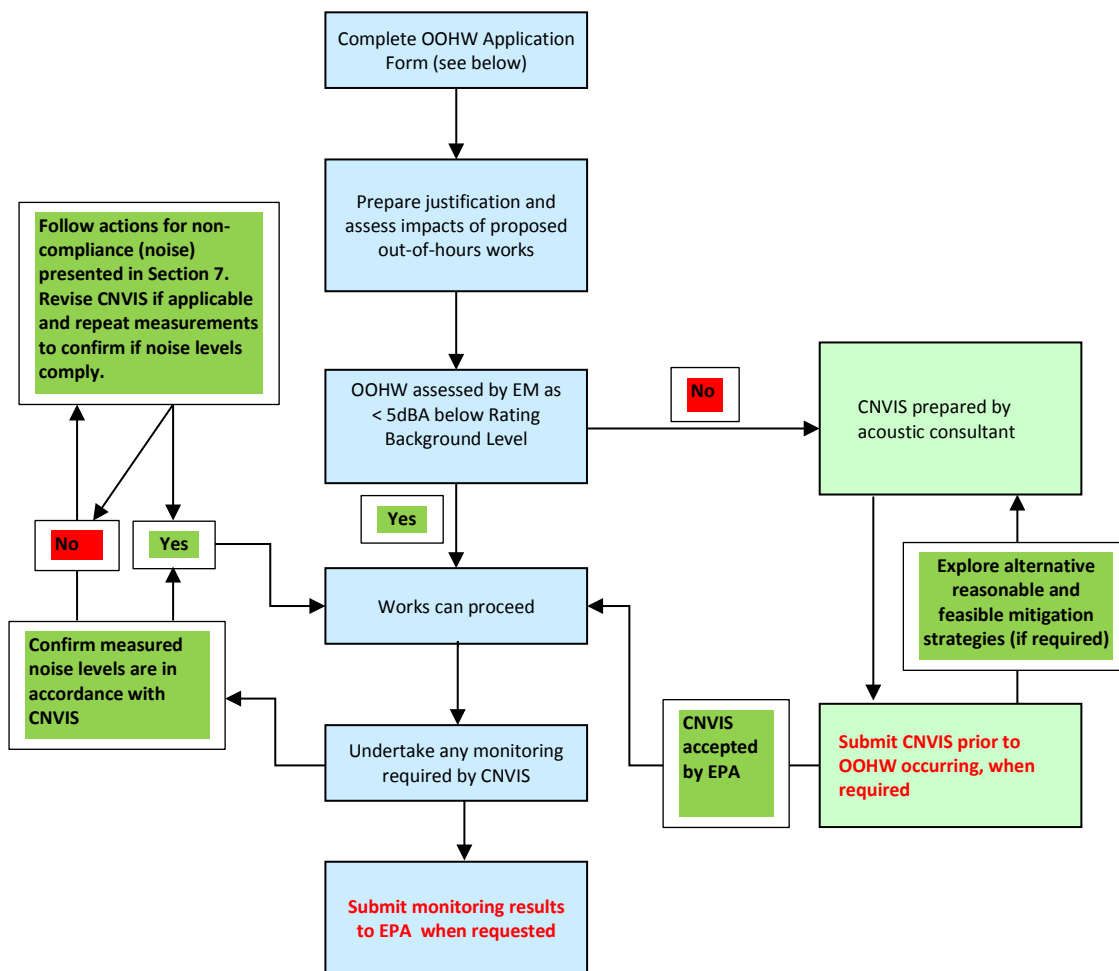
Appendix E. Out of Hours Works Procedure

SVC Out of Hours Works Procedure

Where construction planning identifies a need for OOHW that are outside of the standard construction hours (as specified in CoA E12 in the Planning Approvals and the Environment Protection Licence (EPL)) for the Project, the Environment Manager or Coordinator should be notified 4 weeks in advance of the OOHW. , ISJV will assess whether the proposed activities may be undertaken outside the standard construction hours consistent with the requirements of:

- Condition E15 of SSI-5100 and SSI-5414 COA;
- The EPL for the Project

Any CNVIS required to support the approval of OOHW must be submitted to the Environment Manager prior to any OOHW being undertaken to enable the assessment to be submitted to the EPA (if required).



OUT OF HOURS WORK REQUEST FORM

Management System Form



Project:

Date:

OHWR No:

Requested by:

Phone:

Date(s) of proposed work:

Time(s) of proposed work:

CNVIS No (IF APPLICABLE)

Location(s) of proposed Out of Hours Work (attach map/s or figure/s if required):

Description of proposed Out of Hours Work (including plant and equipment and sketch of location) and proposed noise mitigation measures (if required):

Qty	Plant Item	Make (Supplier)	Size	Sound Power Level LAeq	Percentage of use, comments	Operation Times		

Demonstrated need for Out of Hours Work (why must the works must be conducted out of hours)

\

OUT OF HOURS WORK REQUEST FORM

Management System Form



TO BE COMPLETED BY CHIEF PROJECT DIRECTOR

Chief Project Director confirmation:

Name:

Position:

Signature:

Date:

TO BE COMPLETED BY COMMUNITY MANAGER

What community consultation has been undertaken as per the CNVIS and EPA licence requirements?

EPA LICENCE REQUIREMENT (E1.3)

☐ Has the community been notified by letterbox drop or email not less than 5 days and not more than 14 days before the commencement of the proposed OOHW?

CNVIS REQUIREMENTS

- ☐ Is alternative accommodation required and if so, has it been offered?
- ☐ Are individual briefings or phone calls required and have these been provided?
- ☐ Is a specific respite offer required and has this been provided?
- ☐ Is a specific notification regarding this work required and has it been provided?

SVC No(s):

Details and Comments:

Approved By:

Name:

Position: **ISJV Community Manager or delegate**

Signature:

Date:

OUT OF HOURS WORK REQUEST FORM

Management System Form



Assessment against CoA E15 & EPL (tick as applicable)

TO BE COMPLETED BY ENVIRONMENT MANAGER

- ☐ Works assessed as likely to be no more than 5dBA above the Rating Background Level at any residence or no more than the noise management levels in Table 3 of the Interim Construction Noise Guideline (DECC 2009). Examples of works that **may** fall into this category could include (but may not be limited to):
- Use of hand tools (not including jack hammers)
 - Finishing off of concrete work using hand tools
 - Maintenance, refuelling of equipment
 - Inspections, surveys
 - Cleaning, painting
 - Light vehicle arrivals/departures
 - Office based activities
 - Activities within enclosed workshops
- ☐ Delivery of materials required outside these hours by the Police or other authorities for safety reasons
- ☐ Emergency work required to avoid the loss of lives or property, or to prevent environmental harm
- ☐ Agreement has been reached with potentially affected noise sensitive receivers, and written records of consultation agreements have been obtained (attached)
- ☐ Where a negotiated agreement has been reached with affected receivers, where the prescribed noise and vibration levels cannot be achieved
- ☐ Works in accordance with L4.7 {insert specific sub clause_____}
- ☐ 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)
- ☐ Construction 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)

Approval conditions / requirements TO BE COMPLETED BY ENVIRONMENT MANAGER

SPECIFIC MITIGATION MEASURES FOR THIS ACTIVITY

•

STANDARD MITIGATION MEASURES

- No shouting permitted
- Music or loud radios (other than radios used for 2 way personal communication) are to be used on site
- Workers are to minimise noise as much as possible to avoid disturbing residents
- All vehicles and plant to be fitted with non-tonal reversing alarms (quackers)
- Lights are to be directed so they do not impact on residents, and as far as possible on other road users
- No vehicles to be left idling near residential boundaries/driveways
- Minimal vehicles operational at once
- Lighting towers and plant to be turned off when not required
- *These requirements must be toolboxed to all personnel on site and a copy provided to ISJV's Environment Manager by close of business on the first working day following commencement of the works*

Approved By:

Name:

Position: **ISJV Environment Manager or delegate**

Signature:

Date:

NOTES

- **No OOHW can be undertaken until approved above.**

OUT OF HOURS WORK REQUEST FORM

Management System Form



A Construction Noise Impact Statement will need to be submitted to EPA if this application is not approved & OOHW are still required



Appendix F. Site Specific Construction Noise and Vibration Impact Statements

Consultants Advice - Acoustics

To	ISJV	DDN No.	AC003
Attention	Steve Fermio	Date	24/09/2014
From	A Campbell	Project No.	ACG1401400
Project	NWRL SVC	No. of pages	4
Subject	Recommended CNIS / CVIS Assessments		

A summary of the key activities that will be undertaken by ISJV as part of the SVC package are shown in Table 1 below.

Note that this table is considered a preliminary assessment at this stage as to what type of CNIS / CVIS (or CNVIS) is required. A case-by-case examination will be undertaken for each site based on the proximity to the nearest noise sensitive receiver and methodology noted in the NSW *Interim Construction Noise Guideline* (ICNG). This may inform the respective assessment changing from the ICNG Qualitative to Quantitative method (or vice-versa)

Table 1 – Assessment and proposal for CNIS / CVIS for SVC activities

Work component	Main noise generating activities	Duration of works: Over 3 weeks per location?	Out Of Hours Work (OOHW)?	Type of CNIS / CVIS Proposed
Segment Fabrication	Concrete batching Concrete vibrating Curing Movement of segments	Y	Y	None, activity will be conducted off-site in/on existing Precast facility in Industrial zone. Noise emissions covered by separate licence agreement.
Access road construction	Site clearing / grading Rolling / compacting	N	N	Qualitative
Piling Construction	Piling Rig Generators Concrete Pouring	Not always	N	Quantitative
Pile Cap Construction	Concrete pouring General working with light tools (hammering, etc) Vehicular movements	Not always	N	Quantitative

Work component	Main noise generating activities	Duration of works: Over 3 weeks per location?	Out Of Hours Work (OOHW)?	Type of CNIS / CVIS Proposed
Gantry Crane Erection	Loading / Unloading of sections General light tool use Lifting section in to place	N	N	Qualitative
Site & compound establishment	Loading / Unloading of cabins, etc General light tool use Lifting section in to place	N	N	Qualitative
Deck Erection (General Viaduct)	Lifting of segments in to position on Gantry Crane General working with light tools (hammering, etc) Vehicular movements Fixing & tensioning of segments	Not always	N	Qualitative if under 3 weeks Quantitative if over 3 weeks
Deck Erection (Road Crossings)	Lifting of segments in to position on Gantry Crane General working with light tools (hammering, etc) Vehicular movements Fixing & tensioning of segments	Not always	Y	Quantitative
Windsor Road Bridge Construction	Piling Rig Generators Concrete pouring Lifting of segments in to position Demolition of temporary piers General working with light tools (hammering, etc) Vehicular movements	Y	Y	Quantitative
Services Connections (General)	Cutting of road / asphalt	N	N	Qualitative
Services Connections (OOHW)	Cutting of road / asphalt	N	Y	Quantitative

Work component	Main noise generating activities	Duration of works: Over 3 weeks per location?	Out Of Hours Work (OOHW)?	Type of CNIS / CVIS Proposed
Parapet Fixing (General)	Lifting of segments in to position on Gantry Crane General working with light tools (hammering, etc) Vehicular movements Fixing & tensioning of segments	Not always	N	Qualitative if under 3 weeks Quantitative if over 3 weeks
Parapet Fixing (OOHW)	Lifting of segments in to position on Gantry Crane General working with light tools (hammering, etc) Vehicular movements Fixing & tensioning of segments	Not always	Y	Quantitative
Segment Transportation	Truck movements on major transport routes	Y	Y	Qualitative

Notes:

1) Any activity which places one of the following items of plant within the minimum working distances for human response in Table 8 of the CNVMP (repeated below) will trigger the requirement for a CVIS to be produced for the works (either Quantitative or Qualitative TBD)

Table 2 – reproduction of Table 8 from SVC CNVMP

Plant item	Rating / description	Minimum working distance, m*	
		Cosmetic damage	Human response (complaints)**
Vibratory roller	< 50 kN (typically 1-2 tonnes)	5	15 to 20
	< 100 kN (typically 2-4 tonnes)	6	20
	< 200 kN (typically 4-6 tonnes)	12	40
	< 300 kN (typically 7-13 tonnes)	15	100
	< 300 kN (typically 13-18 tonnes)	20	100
	> 300 kN (typically > 18 tonnes)	25	100
Hydraulic hammer	300 kg (5-12 tonne excavator)	2	7
	900 kg (12-18 tonne excavator)	7	23
	1600 kg (18-34 tonne excavator)	22	73
Vibratory pile driver	Sheet piles	2 to 20	20
Pile boring	≤ 800 mm	2 (nominal)	-
Jackhammer	Hand held	1 (nominal)	Avoid contact with structure

Note: *Stricter conditions may apply to heritage or other sensitive structures.
**These values relate to continuous vibration. The majority of construction activities produce intermittent vibration, in which case higher vibration levels are allowable over a shorter period of time.

WSP Acoustics

Appendix G. Agency Consultation

Construction Noise & Vibration Management Plan

Surface and Viaduct Civil Works



The EPA in its letter of 13 May 2014 advised that it had no comments on the CNVMP. See below



Our reference: DOC14/67813

Salini Impregilo
Suite 1 Level 7
100 Walker Street
North Sydney NSW 2060

Attention: Sam Turnbull

Dear Mr Turnbull,

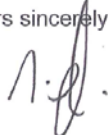
I refer to your letter of 7 April 2014 seeking input from the Environment Protection Authority (EPA) to the Environmental Management Plans for the Surface and Viaduct Civil Works section of the North West Rail Link.

Thank you for the opportunity to provide input to the management plans. The EPA does not generally comment on, approve or endorse environmental management plans. The EPA utilises a range of regulatory tools such as environment protection licences and pollution reduction programs to help achieve positive environmental outcomes.

Construction of the North West Rail Link project is licenced by the EPA under the *Protection of the Environment Operations Act 1997*. The environmental performance of the project's licence holders and sub-contractors is regulated through compliance with the relevant licences and legislation.

If you have any questions regarding this letter please contact Mark Jansons, Regional Operations Officer, EPA on (02) 9995 6829 or mark.jansons@epa.nsw.gov.au.

Yours sincerely

 13.05.2014

MARK HANEMANN
Unit Head Infrastructure
Environment Protection Authority

PO 668 Parramatta NSW 2124
Level 13, 10 Valentine Avenue Parramatta NSW 2150
Tel: (02) 9995 6801 Fax: (02) 9995 6900
ABN 43 692 285 758
www.epa.nsw.gov.au

Appendix H. Noise Monitoring Form

NOISE MEASUREMENT FORM

Management System Form



Project: NWRL SVC

NMF No.:

Test Location:

Date of test:

Time of test:

Duration of test:

Test Conducted by:

Position:

Construction activity:

Distance from monitoring location:

Field Conditions

Wind speed (km/h):

Temperature (deg C):

Wind direction:

Cloud cover (%):

Rain:

Relative humidity:

Intervening ground (e.g. hard/soft, flat/fenced):

Sound Level Meter data

SLM Make/ model/Serial Number: Svantek/971/39166

Last NATA calibration: 22/6/14

Calibrator make/ model/Serial Number: Svantek/SV31/38177

Last NATA calibration: 13/10/14

Field Calibration Results

Pre:

Post:

Meter File #

Test procedure : AS2659.1-1998: Guide to the use of sound measuring equipment - Portable sound Level Meters

Noise Measurement Results dB(A)

Measurement No.	1	2	Noise Criteria for location		
			Day:7am-6pm	Evening:6pm-10pm	Night :10pm-7am
L _{A01}					
L _{A10}					
L _{Aeq}					
L _{A90}					

Is construction noise audible?

Is extraneous noise present during measurement?

Is construction noise the dominant noise source?

Is construction noise continuous or intermittent?

Is construction noise noticeably tonal or impulsive?

(If noise source was noted as tonal or impulsive apply 5dB correction)

Is the measurement compliant with relevant criteria?

NOTES

- Measurements to be taken with 'A' weighting and 'Fast' response.
- Statistical descriptors to be recorded for 15 minute intervals.
- Instrumentation to be fitted with wind shields, and field calibrated prior to and after each measurement to correct drift.
- Measurements must be taken between 1.2m and 1.5m above the ground surface and be located 3.5m from any reflective structure.
- Measurements near buildings to be 1m from the façade.
- Noise instrumentation to comply with the requirements of AS 1259.2 – 1990. "Acoustics – Sound Level Meters, Part 2 – Integrating and Averaging" and carry appropriate NATA certification

NOISE MEASUREMENT FORM

Management System Form



Comments/Observations

Beaufort wind scale

Beaufort Number	Wind Speed km/h	Description	Land Conditions
0	0	Calm	Calm. Smoke rises vertically.
1	1 - 6	Light Air	Wind motion visible in smoke.
2	7 - 11	Light breeze	Wind felt on exposed skin. Leave rustle.
3	12 - 19	Gentle Breeze	Leaves and smaller twigs in constant motion
4	20 - 29	Moderate Breeze	Dust and loose paper raised. Small branches begin to move.
5	30 - 39	Fresh Breeze	Smaller trees sway.
6	40 - 50	Strong Breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult.
7	51 - 62	Near Gale	Whole trees in motion. Effort to walk against the wind.
8	63 - 75	Gale	Twigs broken from trees. Cars veer on road.
9	76 - 87	Strong Gale	Light structural damage.
10	88 - 102	Storm	Trees uprooted. Considerable structural damage.
11	103 - 117	Violent Storm	Widespread structural damage.
12	>117	Hurricane	Massive and widespread damage to structures.