APPENDIX B3

Construction Noise and Vibration Management Plan

Early Works – Wave 1&3 (part)

Woolgoolga to Ballina

Pacific Highway Upgrade

SEPTEMBER 2015

Document control

File name	RMS00031-110 B3 CNVMP_3.0.docx
Report name	Woolgoolga to Ballina Construction Noise and Vibration Management Plan
Revision number	3.0 (Greenhill Cutting addition)

Plan approved by:

[signed]	*[signed]*	*[signed]*
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Revision history

Revision	Date	Description	Approval
This document supersedes *'RMS00031-2429-9000 Appendix B3 CNVMP'*			
1.0	17/08/2015	First Controlled issue	Rob Blyth
2.0	03/09/2015	Final Submission	Rob Blyth
3.0	13/10/2015	Greenhill Cutting Addition	Rob Blyth

Distribution of controlled copies

Copy no.	Issued to	Version
1	Dean Gregory	1.0
2	Dean Gregory	2.0
3	Jeff Boylan	3.0
4		
5		

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Glossary / Abbreviations

CEMP	Construction Environmental Management Plan
CoA	Condition of Approval
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DECC	Department of Environment and Climate Change (now EPA)
EIS	Environmental Impact Statement
EMS	Environmental management system
Environmental aspect	Defined by AS/NZS ISO 14001:2004 as an element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Defined by AS/NZS ISO 14001:2004 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
Environmental objective	Defined by AS/NZS ISO 14001:2004 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2004 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
ER	Environmental Representative
ERG	Environmental Review Group
EWMS	Environmental Work Method Statements
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements..
Golding	Golding Contractors Pty Ltd
$L_{Aeq\ (15min)}$	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.

$L_{A\ (max)}$	the A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
LGA	Local government area
NML	noise management levels
OEH	Office of Environment and Heritage
SPIR	Submission / Preferred Infrastructure Report
RBL	The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
RMS	Roads and Maritime Services
Secretary	Secretary of the Department of Planning and Environment
SWP	Sound Power Level
SPL	Sound Pressure Level

1 Introduction

1.1 Context

This Construction Noise and Vibration Management Plan (CNVMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for the Early Works - Wave 1 and part of Wave 3 Project, which is part of the upgrade of the Pacific Highway between Woolgoolga and Ballina (the Project).

This CNVMP has been prepared to address the requirements of the Minister's Conditions of Approval (CoA) and the mitigation measures listed in the Pacific Highway Upgrade Woolgoolga to Ballina Environmental Impact Statement (EIS), the Project Specifications and applicable legislation.

This Plan has been prepared for Wave 1 and 3 (part) of the Project which broadly includes:

- Ground treatment and preparatory earthworks (soft soils treatments) between approximate STN 83400 and 91200.
- Excavation of material taken from a highway cutting at Tyndale (at approximate STN 69000 to 69500) for the soft soil treatments.
- Excavation of material taken from highway cuttings North of McIntyres Lane, Gulmarrad (at approximate STN 77500 to 78400) for the soft soil treatments.
- Excavation of material south of McIntyres Lane, Gulmarrad - Greenhills cutting (at approximate STN 76000 to 77075) for the soft soil treatments. McIntyres Lane would be widened to support truck movements from this cutting.
- Relocation of utility services at various locations throughout STN 67200 to 95100.
- Establishment and operation of site ancillary facilities at approximate STN 90700.

These works are located within Sections 4 and 5 of the Approved Project.

1.2 Background

The Pacific Highway Upgrade Woolgoolga to Ballina EIS (RMS 2012) assessed noise and vibration impacts on sensitive receivers and structures from construction of the Project.

As part of EIS development, a construction and operational noise and vibration assessment was prepared to satisfy the Director General Requirements (DGRs) issued by Planning and Infrastructure. The noise and vibration assessment was included in the EIS as Working Paper: Noise and Vibration.

The EIS concluded that there will be some noise and vibration impacts during construction and the extent will vary depending on the type of activity in progress and the proximity to sensitive receivers.

Additional management measures were provided within the *Woolgoolga to Ballina Submissions / Preferred Infrastructure Report Nov 2013*, with applicable management measures from that report included as part of this CNVMP.

1.3 Environmental management systems overview

The overall Environmental Management System for the Project is described in the Construction Environmental Management Plan (CEMP).

The CNVMP is part of the Golding environmental management framework for the Project, as described in Section 4.1 of the CEMP. This Plan has been developed in accordance with the requirements of CoA D26 (a).

Management measures identified in this Plan will be incorporated into site or activity specific Environmental Work Method Statements (EWMS). EWMS will be developed and signed off by environment and management representatives prior to associated works and construction personnel will be required to undertake works in accordance with the identified requirements and associated mitigation measures.

Used together, the CEMP, strategies, procedures and EWMS form management guides that clearly identify required environmental management actions for reference by Golding personnel and contractors.

The review and document control processes for this Plan are described in Section 1.6 and Chapter 10 of the CEMP.

2 Purpose and objectives

2.1 Purpose

The purpose of this Plan is to describe how Golding proposes to manage potential noise and vibration impacts during construction of the Project.

The management of noise and vibration impacts in this Plan is based on the assessment undertaken as part of the EIS. The assessment in the EIS considered the following guidelines and standards:

- Environmental Criteria for Road Traffic Noise (ECRTN) (EPA 1999).
- NSW Industrial Noise Policy (EPA 2000).
- RTA Environmental Noise Management Manual (ENMM) (RTA 2001).
- Interim Construction Noise Guideline (ICNG) (DECC 2009).
- Assessing Vibration: A Technical Guideline (DEC 2006).
- British Standard 7385: Part 2 ““Evaluation and measurement of vibration in buildings”.
- Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990) Australian and New Zealand Environment and Conservation Council (ANZECC).
- Australian Standard AS2187.2-2006: “Explosives – Storage, Transport and Use”.

2.2 Objectives

The key objective of the CNVMP is to ensure that impacts to the local community and the built environment from noise and vibration are minimised. Specific objectives include:

- Identifying sensitive receivers and ensure appropriate environmental controls and procedures are implemented during construction activities.
- Minimising potential adverse noise and vibration impacts to environment and community.
- Managing impacts if they occur through a systematic analysis of mitigation strategies.
- Ensure appropriate measures are implemented to address the relevant CoA outlined in Table 3.1 and the mitigation measures detailed in the EIS.
- Ensure appropriate measures are implemented to comply with all relevant legislation and other requirements as described in Section 3.1 and Section 3.4 of this Plan.

2.3 Targets

Targets have been established for the management of noise and vibration impacts during the Project to ensure:

- Full compliance with the relevant legislative requirements and CoA.
- Implement feasible and reasonable noise mitigation measures with the aim of achieving the construction noise management levels detailed in the lnterim Construction Noise Guideline (DECC, 2009).
- That blasting activities are only undertaken at designated times and remain within established/agreed criteria.
- Complaints from the community and stakeholders are minimised.

3 Environmental requirements

3.1 Relevant legislation and guidelines

3.1.1 Legislation

Legislation relevant to noise and vibration management includes:

- *Protection of the Environment Operations Act 1997* (POEO Act).
- *Protection of the Environment Operations (Noise Control) Regulation 2008*.

Relevant provisions of the above legislation are explained in the register of legal and other requirements included in Appendix A1 of the CEMP.

3.1.2 Guidelines

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

- RMS QA Specification G36 – Environmental Protection (Management System).
- Environmental Criteria for Road Traffic Noise (ECRTN) (EPA 1999).
- NSW Industrial Noise Policy (EPA 2000).
- RTA Environmental Noise Management Manual (ENMM) (RTA 2001a).
- Interim Construction Noise Guideline (ICNG) (DECC 2009).
- Assessing Vibration: A Technical Guideline (DEC 2006).
- British Standard 7385: Part 2 “Evaluation and measurement of vibration in buildings”.
- German DIN 4150: Part 3 – 1999 Effects of Vibration on Structure (DIN 1999).
- Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990) Australian and New Zealand Environment and Conservation Council (ANZECC).
- Australian Standard AS2187.2-2006: “Explosives – Storage, Transport and Use”.

3.2 Minister’s Conditions of Approval

The CoA relevant to this Plan are listed Table 3-1. A cross reference is also included to indicate where the condition is addressed in this Plan or other project management documents.

Table 3-1 Conditions of Approval relevant to noise and vibration

CoA No.	Condition Requirements	Document Reference
	Construction Noise	
B14	The SSI shall be constructed with the aim of achieving the construction noise management levels detailed in the *Interim Construction Noise Guideline* (DECCW, 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 *Note:* *The Interim Construction Noise Guideline identifies ‘particularly annoying’ activities that require the addition of 5dB(A) to the predicted level before comparing to the construction NML.*	This plan Section 5

CoA No.	Condition Requirements	Document Reference
B15	Construction activities associated with the SSI shall be undertaken during the following standard construction hours: (a) 7:00am to 6:00pm Monday to Friday, inclusive; and (b) 8:00am to 5:00pm Saturday; and (c) at no time on Sunday or public holidays.	This plan Appendix C
B16	Construction works outside of the standard construction hours identified in condition B15 may be undertaken in the following circumstances: (a) construction works that generate noise that is: (i) no more than 5 dB(A) above rating background level at any residence in accordance with the *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009); and (ii) no more than the noise management levels specified in Table 3 of the *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009) at other sensitive receivers*;* or (b) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or (c) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or (d) between 6.00am and 7.00am and 6.00pm and 7.00pm Monday to Friday (except public holidays) in sparsely populated areas (these construction hours may be reviewed and/or revoked by the Director General in consultation with the EPA in the case of unresolved noise complaints); or (e) low noise impact activities and work as follows: (i) between 6.00am and 7.00am Monday to Friday; and/or (ii) between 6.00pm and 7.00pm Monday to Friday; or (f) works approved through an EPL; or (g) works approved by a Construction Environment Management Plan or Construction Noise and Vibration Management Plan for the SSI	This plan Appendix C
B17	Construction activities which cannot be undertaken during the standard construction hours for technical or other justifiable reasons (Out of Hours work) may be permitted outside the construction hours specified in condition B15 with the approval of the Environmental Representative. Out of Hours work shall be undertaken in accordance with an approved Construction Environment Management Plan or Construction Noise and Vibration Management Plan for the SSI, where that plan provides a process for the consideration of Out of Hours work. This consideration includes: (a) process for obtaining the Environmental Representative's approval for Out of Hours work; (b) details of the nature and need for activities to be conducted during the varied construction hours; (c) justifies the varied construction hours in accordance with the *Interim Construction Noise Guideline* (DECCW, 2009); (d) provides evidence that consultation with potentially affected receivers and notification of the relevant council has been undertaken, that the issues raised have been addressed and all feasible and reasonable mitigation measures have been put in place; and (e) provides evidence of consultation with the EPA on the proposed variation in standard construction hours.	This plan Appendix C
B18	Construction activities resulting in impulsive or tonal noise emission (such as rock breaking, rock hammering, pile driving) shall only be undertaken: (a) between the hours of 8:00am to 5:00pm Monday to Friday; (b) between the hours of 8:00am to 1:00pm Saturday; and	This plan Section 7

CoA No.	Condition Requirements	Document Reference
	(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. The works subject to this condition may be undertaken in sparsely populated areas within the construction hours specified in condition B15.	
B19	The Applicant shall, where feasible and reasonable, limit high noise impact activities and work to the mid-morning and mid-afternoon periods, except in sparsely populated areas.	This plan Section 5
	Construction Vibration	
B20	The SSI shall be constructed with the aim of achieving the following construction vibration goals: (a) for structural damage to heritage structures, the vibration limits set out in the German Standard *DIN 4150-3: Structural Vibration – Part 3 Effects of vibration on structures*; (b) for damage to other buildings and/or structures, the vibration limits set out in the British Standard *BS 7385-1:1990 – Evaluation and measurement of vibration in buildings* (and referenced in Australian Standard 2187.2 – 2006 *Explosives – Storage and use – Use of explosives*). Guide for measurement of vibration and evaluation of their effects on buildings; and (c) for human exposure, the acceptable vibration values set out in *Assessing Vibration: A Technical Guideline* (Department of Environment and Conservation, 2006).	This plan Section 5.4
B21	Blasting associated with the SSI shall only be undertaken during the following hours: (a) 9:00am to 5:00pm, Monday to Friday, inclusive; (b) 9:00am to 1:00pm on Saturday; and (c) at no time on Sunday or public holidays. Blasting outside the above hours and in accordance with the standard construction hours where: (i) no sensitive receivers in sparsely populated areas would be impacted by blasting; or (ii) an agreement has been made with receivers within 200 metres of the blast zone to permit blasting in accordance with the standard construction hours. This condition does not apply in the event of a direction from the NSW Police Force or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.	Appendix B
B22	The Applicant shall ensure that Airblast overpressure generated by blasting associated with the SSI shall not exceed the criteria specified in Table 1 when measured at the most affected residence or other sensitive receiver. **Table 1 - Airblast overpressure limits for human comfort** **Receiver** | **Type of blasting operations** | **Airblast Overpressure Limit** | | 115 dBL for 95% of blasts per year	This plan Appendix B

CoA No.	Condition Requirements			Document Reference
	Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	120 dBL maximum limit	
	Sensitive site	Blasting operations lasting less than 12 months or less than 20 blasts in total	120 dBL for 95% of blasts per year	
			125 dBL maximum limit	
	Occupied non-sensitive sites, such as factories and commercial premises	All blasting	125 dBL maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation	

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.
Source – Table J5.4(A) – AS 2187.2 – 2006

B23 The Applicant shall ensure that Ground vibration generated by blasting associated with the SSI shall not exceed the criteria specified in Table 2 and Table 3 when measured at the most affected residence or other sensitive receiver.

This plan Appendix B

Table 2 – Ground vibration limits for human comfort

Receiver	Type of blasting operations	Peak component particle velocity (mm/s)
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	5 mm/s for 95% of blasts per year
		10 mm/s maximum limit
Sensitive site	Blasting operations lasting less than 12 months or less than 20 blasts in total	10 mm/s maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	25 mm/s maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.
Source – Table J4.5(A) – AS 2187.2 – 2006.

Table 3 – Ground vibration limits for control of damage to structures

Receiver	Type of blasting operations	Peak component particle velocity (mm/s)	
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction [1]		15 mm/s 4 Hz to 15 Hz, except for heritage structures where a frequency dependent vibration criteria would be determined in accordance with AS 2187.2 – 2006.	20 mm/s 15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings [2]	All blasting	50 mm/s at 4 Hz and above	
Unreinforced or light framed structure. Residential or light commercial type building [2]	All blasting	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Unoccupied structures of reinforced concrete or steel construction	All blasting	100 mm/s maximum, where agreed with the structure owner.	
Infrastructure service structures, such as pipelines, powerlines, cables and reservoirs.	All blasting	Limits to be determined by structural design methodology in consultation with the infrastructure service provider.	

Source:
1 - Table J4.5(B) – AS 2187.2 – 2006.
2 - Table J4.4.2.1 – AS 2187.2 – 2006 (BS 7385-2).

B24	The blasting criteria specified in conditions B22 and/or B23 may be increased where the Applicant has obtained the written agreement of the relevant landowner to increase the criteria. In obtaining the agreement the Applicant shall make available to the landowner: (a) details of the proposed blasting program and justification for the proposed increase to blasting criteria including alternatives considered (where relevant); (b) the environmental impacts of the increased blast limits on the surrounding environment and most affected residences or other sensitive receivers including, but not limited to noise, vibration and air quality and any risk to surrounding utilities, services or other structures; and (c) the blast management and mitigation measures, and monitoring procedures to be implemented to monitor blasting impacts. The Applicant shall provide a copy of the written agreement to the Director General and the EPA, including details of the consultation undertaken (with clear identification of proposed blast limits and potential property impacts) prior to commencing blasting at the increased limits. Unless otherwise agreed by the Secretary, the following exclusions apply to the application of this condition: (a) Any agreements reached may be terminated by the landowner at any time should concerns about the increased blasting limits be unresolved. Should an agreement be terminated by a landowner, the Applicant shall not exceed the	This plan Appendix B

CoA No.	Condition Requirements	Document Reference
	criteria specified in conditions B22 and/or B23 for future blasting at that receiver. (b) The blasting limit agreed to under any agreement for an occupied residential building can at no time exceed a maximum Peak Particle Velocity vibration level of 25 mm/s or maximum Airblast Overpressure level of 125 dBL.	
B25	Wherever feasible and reasonable, piling activities shall be undertaken using quieter construction methods, such as bored piles or vibrated piles rather than impact or percussion piling methods.	Not applicable
B26	Prior to the use of the dynamic compaction construction method, the Applicant shall undertake an assessment of vibration generated by dynamic compaction on nearby sensitive receivers. Feasible and reasonable mitigation measures shall be implemented to minimise vibration impacts.	This plan Section 5.4
B27	During construction, affected educational institutions shall be consulted and reasonable steps taken to ensure that noise generating construction works in the vicinity of affected buildings are not timetabled during examination periods where practicable, unless other reasonable arrangements to the affected institutions are made at no cost to the affected institution.	This plan Section 8
D10	Prior to the commencement of construction, the Applicant shall undertake a land use survey to identify areas that are sensitive to construction vibration and construction ground-borne noise impacts. The results of the survey shall be incorporated into the Construction Noise and Vibration Management Plan	This plan Section 5.2
D11	The Applicant shall prepare a review of the operational noise mitigation measures proposed to be implemented for the SSI, within six months of commencing construction, unless otherwise agreed by the Secretary. The review shall be prepared in consultation with the EPA, to the satisfaction of the Secretary. The review may be submitted in stages to suit the staged construction of the SSI and shall: a) confirm the operational noise predictions of the SSI based on detailed design. This operational noise assessment shall be based on an appropriately calibrated noise model (which has incorporated additional noise monitoring, where necessary for calibration purposes); b) review the suitability of the operational noise mitigation measures identified in the documents listed in condition A2. The review shall take into account the detailed design of the SSI and, where feasible and reasonable, and where necessary, refine the proposed measures with the objective of meeting the criteria outlined in the NSW Road Noise Policy (Department of Environment, Climate Change and Water, 2011), based on the operational noise performance of the SSI predicted under (a) above; and c) where necessary, investigate additional feasible and reasonable noise mitigation measures to achieve the criteria outlined in the NSW Road Noise Policy (DECCW, 2011).	Operational Noise Review
D26 (a)	As part of the Construction Environmental Management Plan for the SSI, the Applicant shall prepare and implement: a) a **Construction Noise and Vibration Management Plan** to detail how construction noise and vibration impacts will be minimised and managed. The Plan shall be developed in consultation with the EPA and shall be consistent with the guidelines contained in the *Interim Construction Noise Guidelines* (DECC, 2009) and shall include, but not necessarily be limited to: (i) identification of sensitive receivers and relevant construction noise and vibration goals applicable to the SSI stipulated in this approval;	This plan All Sections

CoA No.	Condition Requirements	Document Reference
	(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; (iii) identification of feasible and reasonable measures proposed to be implemented to minimise and manage construction noise and vibration impacts (including construction traffic noise impacts); (iv) 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); and (v) a description of how the effectiveness of these actions and 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; (vi) an out-of-hours work (OOHW) protocol for the assessment, management and approval of works outside of standard construction hours as defined in condition B15 including a risk assessment process under which the Environmental Representative may approve out-of-hour construction activities. The OOHW protocol shall detail standard assessment, mitigation and notification requirements for high and low risk out-of-hour works, consultation procedures with the EPA, the relevant council and affected landowners; (i) procedures for notifying sensitive receivers of construction activities that are likely to affect their noise and vibration amenity, as well as procedures for dealing with and responding to noise complaints; (vii) a program for construction noise and vibration monitoring clearly indicating monitoring frequency, location, how the results of this monitoring would be recorded and, procedures to be followed where exceedences of relevant noise and vibration goals are detected; and (viii) mechanisms for the monitoring, review and amendment of this plan.	

4 Existing environment

4.1 Sensitive receivers

The Project extends from the Coffs Harbour local government area (LGA) in the south to Ballina LGA in the north and comprises regional urban communities such as Grafton and Maclean as well as smaller rural communities including Corindi, Tucabia, Ulmarra, Harwood, New Italy, Woodburn, Broadwater and Wardell. There are large portions of the study area that are comprised of national park, state forest and nature reserves, along with rural and agricultural land uses.

The noise and vibration assessment identified and considered potential noise impacts for each individual dwelling along the 155 kilometre alignment and within 600 metres either side of the new or existing road centre line (the study area). A total of 507 residences are located within Sections 4 and 5. A breakdown of residences within each project section is as follows:

- Section 4: 266 residential receivers (of which 12 are to be acquired) and five commercial/ non-residential receivers.
- Section 5: 241 residential receivers (of which seven are to be acquired) and two commercial / non-residential receivers.

The locations of the noise sensitive receivers potentially affected by the Wave 1 and 3 (part) early works are included in the Sensitive Area Plans found in Appendix A5 of the CEMP.

4.2 Ambient noise

Noise monitoring was conducted as part of the EIS in 2011 and 2012. The monitoring was undertaken to provide background noise levels and, among other purposes, to establish appropriate construction noise assessment criteria. Locations were selected to be representative of receivers that would experience a noise impact from the existing highway or from the Project (see Appendix A5 of the CEMP for monitoring locations).

A summary of the noise monitoring results is provided in Table 4-1. The receivers within the vicinity of the Wave 1 and 3 (part) early works are R842 (Section 4), R1396 (Section 5) and R1438 (Section 5). The relevant unattended monitoring data for these three receivers, taken from the EIS Working Paper, is included in Appendix D.

Table 4-1 Ambient noise monitoring results (dbA)

Location	Day			Night		
	L_{Amax}	L_{Aeq}	RBL	L_{Amax}	L_{Aeq}	RBL
Section 4						
R842*	71.5	65.6	47	74.1	65	
R849	75.1	65.9	44	76.9	64.9	
S4_1	68.2	60		70.4	58.9	
R892	83.9	67.1	43	84.3	66.4	
R1026	75.8	61.7	44	75.5	59.8	

Location	Day			Night		
	L_{Amax}	L_{Aeq}	RBL	L_{Amax}	L_{Aeq}	RBL
R1080	79.5	57.6	43	76.1	50.1	
Section 5						
R1331	76.6	59.3	48	75.2	58.6	
R1396*	82.2	57.4	44	78.3	55.1	
R1438*	87.2	72.3	45	87.6	71.4	
R1461	73.3	53.3	37	60.4	45.5	
R1471	69.1	57.7	43	69.8	58.1	
R1523	58.9	48.1	36	57.7	52.5	

* Receivers closest to the Wave 1 and 3 (part) early works.

5 Noise and vibration criteria for NSW

The EPA recommends management levels and goals when assessing construction noise and vibration. These are outlined in:

- Interim Construction Noise Guideline (ICNG).
- Assessing Vibration: a technical guideline.
- The ANZECC Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration.

Relevant elements of these documents are summaries and discussed in this Chapter.

5.1 Construction noise and assessment objectives

The DECC Interim Construction Noise Guideline (ICNG, July 2009) provides guidelines for the assessment and management of construction noise. The ICNG focuses on applying a range of work practices to minimise construction noise impacts rather than focusing on achieving numeric noise levels.

The main objectives of the ICNG are to:

- Identify and minimise noise from construction works.
- Focus on applying all 'feasible' and 'reasonable' work practices to minimise construction noise impacts.
- Encourage construction during the recommended standard hours only, unless approval is given for works that cannot be undertaken during these hours.
- Reduce time spent dealing with complaints at the project implementation stage.
- Provide flexibility in selecting site-specific feasible and reasonable work practices to minimise noise impacts.

5.2 Quantitative noise assessment criteria

Construction noise assessment goals presented in the ICNG are referenced to noise management levels for residential, sensitive land uses and commercial/ industrial premises.

Residential premises

Table 5-1 sets out management levels for noise at residences and how they are to be applied.

In Table 5-1 the rating background level (RBL) is used when determining the management level. The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy (EPA, 2000).

As a guide, the difference between the internal noise level and the external noise level is typically 10dB with windows open for adequate ventilation.

Table 5-1 Noise at residents using quantitative assessment

Time of day	Management Level $L_{Aeq\ (15\ min)}$ *	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: – 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.

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Other land uses

Other sensitive land uses, such as schools, typically find noise from construction to be disruptive when the properties are being used (such as during school times). Table 5-2 presents management levels for noise at other sensitive land uses based on the principle that the characteristic activities for each of these land uses should not be unduly disturbed. Consultation should be undertaken with noise sensitive land use occupants likely to be affected by noise from the works to schedule the project's work hours to achieve a reasonable noise outcome.

Internal noise levels are assessed at the centre of the occupied room. External noise levels are assessed at the most affected point within 50 metres of the area boundary. Where internal

noise levels cannot be measured, external noise levels may be used. A conservative estimate of the difference between internal and external noise levels is 10dB for buildings other than residences. Some buildings may achieve greater performance, such as where windows are fixed (that is, cannot be opened). The management levels in Table 5-2 are 5dB above the corresponding road traffic noise levels in the Environmental Criteria for Road Traffic Noise (EPA 1999) (and the 'maximum' levels in the NSW Industrial Noise Policy (EPA 2000) for commercial and industrial uses) to account for the variable and short-term nature of construction noise.

Table 5-2 Noise at sensitive land uses (non-residents) using quantitative assessment

Land use	Noise assessment location	Noise management level ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Hospitals and operating theatres		
Places of worship		
Active recreation areas[1]	External	65
Passive recreation areas[2]	External	60
Community centres	Dependent on intended use	Maximum internal levels recommended in AS2107 for specific use
Industrial premises	External	75
Office, retail outlets	External	70
Other noise sensitive businesses	Investigation to determine suitable noise levels on project-by-project basis	

Notes:

1. Active recreation areas are characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion.
2. Passive recreation areas are characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion (eg. reading, meditation).

5.3 Adopted project noise management levels

Based on measured noise levels described in Section 4.2, the project-specific construction noise objectives for each representative monitoring location have been determined and are presented in Table **5-3**. The receivers closest to the Wave 1 and 3 (part) early works include R842, R1396 and R1438 and are highlighted in Table 5-3. This information is taken from EIS Working Paper: Noise and Vibration. Considering the possibility of works outside standard construction hours additional management levels for these times are also included in the construction noise objectives.

Sections 4 and 5 have each been split into six noise catchment areas (NCAs). Each NCA represents a typical background noise environment. This is based on noise levels measured across the project. The areas are based on a buffer located either side of the project, as follows:

- Catchment 'a': 400–600 metres east of the project centreline

- Catchment ‘b’: 200–400 metres east of the project centreline
- Catchment ‘c’: 0–200 metres east of the project centreline
- Catchment ‘d’:0–200 metres west of the project centreline
- Catchment ‘e’:200–400 metres west of the project centreline
- Catchment ‘f’: 400–600 metres west of the project centreline

Noise management levels have been determined for each NCA for both standard hours and night-time / out of hours. Where measurements were taken at more than one location within the NCA, the lowest measurements were used to establish the noise management levels. All receivers within a NCA are assigned the same NMLs.

Table 5-3 **Project-specific construction noise objectives**

Location	Setback from existing highway	Noise catchment area	Standard hours (7am-6pm)		Morning shoulder (6am-7am)		Evening shoulder (6pm-7pm)	
	m		RBL dB(A)	NML dB(A)	RBL dB(A)	NML dB(A)	RBL dB(A)	NML dB(A)
Section 4								
R1080	411	4-a	43	53	45	55	46	56
R823		4-b	35	45	40	50	42	52
R865		4-b	42	52	44	54	44	54
R1026	51	4-c	44	54	42	52	50	60
R892	34	4-d	43	53	44	54	47	57
R842*	58	4-e	47	57	51	61	51	61
R903		4-e	47	57	50	60	52	62
R849	47	4-f	44	54	44	54	45	55
Section 5								
R1523	490	5-a	36	47	42	52	40	50
R1256		5-b	46	56	46	56	47	57
R1331	69	5-c	48	58	48	58	49	59
R1471	109	5-c	43	53	44	54	46	56
R1396*	141	5-d	44	54	43	53	44	54
R1438*	16	5-d	45	55	45	55	44	54
R1283		5-e	45	55	46	56	47	57
R1457		5-f	36	46	40	50	42	52
R1461	460	5-f	37	47	40	50	42	52

* Receivers closest to the Wave 1 and 3 (part) early works.

In accordance with the ICNG, the maximum noise assessment to determine the potential for sleep disturbance as a result of the construction works was undertaken as part of the EIS Working Paper: Noise and Vibration. Although the ICNG does not specifically provide criteria for assessing maximum noise events, methods within the NSW Road Noise Policy specify:

- Maximum noise levels below 50-55dB(A) are unlikely to cause an awakening from a sleep state
- One or two noise events per night with maximum noise levels of 65-70dB(A) are not likely to affect the health and wellbeing significantly.

5.4 Vibration criteria

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

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

Vibration criteria relating to human comfort that are applicable to this project are taken from the DEC (2006) document Assessing Vibration – A Technical Guideline and include the following.

- Continuous vibration – from uninterrupted sources (see Table 5-4).
- Impulsive vibration – up to three instances of sudden impact eg dropping heavy items, per monitoring period (see Table 5-5).
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (see Table 5-6).

Two standards by which building damage from construction-induced vibration are commonly assessed include:

- British Standard 7385: Part 2-1993 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration (BSI 1993)
- German DIN 4150: Part 3 – 1999 Effects of Vibration on Structure (DIN 1999).

The German standard provides the most stringent criteria and will be used in this CNVMP. The DIN guideline values for peak particle velocity (mm/s) measured at the foundation of the building are summarised in Table 5-7. The criteria are frequency dependent and specific to particular categories of structure.

Table 5-4 Continuous vibration acceleration criteria (m/s^2) 1-80Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
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	0.04	0.029	0.080	0.058

Table 5-5 Impulsive vibration acceleration criteria (m/s^2) 1-80Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
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

Table 5-6 Intermittent vibration impacts criteria (m/s^2) 1-80Hz

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Table 5-7 Structural damage criteria

Type of Structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz*	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

* For frequencies above 100Hz, at least the values specified in this column shall be applied.

5.5 Blast criteria

Guidelines documented in the ANZECC "Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration" has been used to establish goals for assessing blast air-blast overpressure and ground vibration.

(CoA B22) Airblast overpressure generated by blasting associated with the SSI shall not exceed the criteria specified in Table 5-8 when measured at the most affected residence or other sensitive receiver.

A summary of the noise monitoring results is provided in Table 4-1.

Table 5-8 Airblast overpressure limits for human comfort

Receiver	Type of blasting operations	Airblast Overpressure Limit
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	115 dBL for 95% of blasts per year
		120 dBL maximum limit
Sensitive site	Blasting operations lasting less than 12 months or less than 20 blasts in total	120 dBL for 95% of blasts per year
		125 dBL maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	125 dBL maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.
Source – Table J5.4(A) – AS 2187.2 – 2006

(CoA B23) Ground vibration generated by blasting associated with the SSI shall not exceed the criteria specified in Table 2 and Table 3 when measured at the most affected residence or other sensitive receiver.

Table 5-9 Ground vibration limits for human comfort

Receiver	Type of blasting operations	Peak component particle velocity (mm/s)
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	5 mm/s for 95% of blasts per year
		10 mm/s maximum limit
Sensitive site	Blasting operations lasting less than 12 months or less than 20 blasts in total	10 mm/s maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	25 mm/s maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.
Source – Table J4.5(A) – AS 2187.2 – 2006.

Table 5-10 Ground vibration limits for control of damage to structures

Receiver	Type of blasting operations	Peak component particle velocity (mm/s)	
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction [1]		15 mm/s 4 Hz to 15 Hz, except for heritage structures where a frequency dependent vibration criteria would be determined in accordance with AS 2187.2 – 2006.	20 mm/s 15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings [2]	All blasting	50 mm/s at 4 Hz and above	
Unreinforced or light framed structure. Residential or light commercial type building [2]	All blasting	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Unoccupied structures of reinforced concrete or steel construction	All blasting	100 mm/s maximum, where agreed with the structure owner.	
Infrastructure service structures, such as pipelines, powerlines, cables and reservoirs.	All blasting	Limits to be determined by structural design methodology in consultation with the infrastructure service provider.	

Source:
1 - Table J4.5(B) – AS 2187.2 – 2006.
2 - Table J4.4.2.1 – AS 2187.2 – 2006 (BS 7385-2).

For assessment of air-blast overpressure the DECC/ANZECC guidelines recommend measurement at any sensitive receiver at least 3.5 metres from building or structure, and ground vibration measured at any point on the noise sensitive site at least the longest dimension of the foundations of a building or structure away from the building or structure.

The blasting criteria specified in CoA B22 and/or CoA B23 may be increased where the Applicant has obtained the written agreement of the relevant landowner to increase the criteria, in accordance with CoA B24.

6 Environmental aspects and impacts

6.1 Environmental aspects

The Project will involve a range of activities incorporating various heavy machinery, plant and equipment that will operate in a number of locations across the Project. In order to assess the level of potential impact on noise and vibration sensitive receivers, the broad categories of construction activity likely to interact with these receivers are identified below:

- Site establishment and ancillary facilities.
- Clearing and grubbing.
- Demolition.
- Earthworks and drainage.
- Drilling and blasting.
- Material processing (crushing and screening).
- Road furnishing.

6.2 Impacts

The potential for noise and vibration impacts on sensitive receivers or structures will depend on a number of factors. Typically these might include:

- The type of equipment in use.
- The number of equipment simultaneously in use.
- Ground condition.
- Topography and other physical barriers.
- Proximity to sensitive receivers.
- The condition of sensitive receivers.
- Hours/duration of construction works.
- Proximity of heavy traffic areas such as the highway.

Relevant aspects and the potential for related impacts have been considered in a risk assessment at Section 3.4 and Appendix A2 of the CEMP.

Noise and vibration impacts attributable to the Project are anticipated. Chapter 8 provides a suite of mitigation measures that will be implemented to avoid or minimise impacts on the receiving community and/or built environment.

7 Construction noise and vibration assessment

A range of plant and equipment will be required to undertake activities associated with the Project. A summary of anticipated construction scenarios and predicted noise levels are provided below. This information will be used to determine potential impacts on the receiving community. An adaptive management approach will be applied to the implementation of mitigation measures to minimise impacts on the community.

Appendix C, Out of Hours Works Procedure, describes the process to obtain approval for audible works outside of the approved house for construction activities. Approval for Out of Hours Work is required from the Environmental Representative in accordance with CoA B17. A minimum of 2 weeks is required for notification to the Principal about upcoming Out of Hours Works.

7.1 Construction activities

Table 7-1 provides a summary of construction scenarios, and associated plant and equipment required for the works. Plant and equipment may be used in isolation or simultaneously. Appendix A provides a list of equipment and a correlating sound pressure level and the predicted noise impacts for each construction scenario are summarised in Section 7.2.

Table 7-1 Construction scenarios and associated plant and equipment

Scenario reference no.	Construction scenario	Typical plant and equipment required
A	Site enabling works (soft soil treatments)	2 x Excavator (30 tonne) 1 x Dozer (20 tonnes) 18 x Product truck (4 axle, 25 tonne) 2 x Vibratory compactor (12 tonne) 1 x Padfoot compactor 1 x Grader (25 tonne) 1 x Smooth barrel roller (18 tonne) 1 x Water cart
B	Formation, clearing and mulching	2 x Excavator (30 tonne) 1 x Dozer (20 tonnes) 18 x Product truck (4 axle, 25 tonne) 2 x Vibratory compactor (12 tonne) 1 x Padfoot compactor 1 x Grader (25 tonne) 1 x Smooth barrel roller (18 tonne) 1 x Water cart 1 x Mulcher 1 x Chipper
C	Earthworks	2 x Excavator (30 tonne)

		2 x Dozer (20 tonnes) 18 x Product truck (4 axle, 25 tonne) 2 x Vibratory compactor (12 tonne) 1 x Padfoot compactor 1 x Grader (25 tonne) 1 x Smooth barrel roller (18 tonne) 1 x Water cart 1 x Backhoe 2 x Front end loader 1 x Rock Breaker (Crusher)
D	Site compound (incl. plant workshop)	1 x Product truck (4 axle, 25 tonne) 1 x Front end loader 2 x Fork lift trucks 3 x Powered hand tools Office vehicles

An indicative schedule for the construction works for the key noise and vibration activities is provided in Appendix F.

7.2 Construction noise impacts

7.2.1 General construction

Table 7-2 to 7-4 provide a summary of predicted noise impacts from each related construction scenario. The noise management level (NML) thresholds for each noise catchment area have also been provided (refer to Table 5-3). Predicted noise levels for each construction scenario have been derived by calculating the combined noise output from the sound power levels of each piece of equipment listed in Appendix A. Appendix E lists the predicted noise levels at each receiver for each construction scenario potentially affected by the Wave 1 and 2 (part) early works. This information has been summarised in the tables below to determine the number of receivers within each noise catchment area that are predicted to experience noise levels that exceed the NML and also to identify any receivers that would be classified as highly noise affected.

'Soft soil treatments' will only occur in the Section 5 portion of the Project, while 'formation, clearing and grubbing' and 'earthworks' will occur in both the Section 4 and 5 portions. 'Formation, clearing and grubbing' and 'earthworks' will occur in the two cutting locations within the Section 4 (Ch 69000 to 69500 and Ch 77500 to 78500). Therefore, only the receivers located in proximity to these sites are included in Tables 7-3 and 7-4.

Table 7-2 Noise impact – soft soil treatments

Noise catchment area	Total number of receivers	Standard hours NML dB(A)	Maximum predicted noise level dB(A)	No. receivers exceeding NML	No. receivers highly noise affected*
5-a	70	37	39	2	0
5-b	66	56	39	0	0
5-c	30	53	40	0	0
5-d	37	53	40	0	0
5-e	28	55	40	0	0
5-f	12	46	39	0	0

* Highly noise affected is considered to be greater than 75 dB(A)

Table 7-3 Noise impact – formation, clearing and mulching

Noise catchment area	Total number of receivers	Standard hours NML dB(A)	Maximum predicted noise level dB(A)	No. receivers exceeding NML	No. receivers highly noise affected*
4-a	1	45	45	1	0
4-b	3	45	53	2	0
4-c	1	52	55	1	0
4-d	5	53	58	4	0
4-e	4	57	51	0	0
4-f	3	54	46	0	0
5-a	70	37	47	68	0
5-b	66	56	56	1	0
5-c	30	53	74	23	0
5-d	37	53	68	30	0
5-e	28	55	56	7	0
5-f	12	46	46	2	0

* Highly noise affected is considered to be greater than 75 dB(A)

Table 7-4 Noise impact – earthworks

Noise catchment area	Total number of receivers	Standard hours NML dB(A)	Maximum predicted noise level dB(A)	No. receivers exceeding NML	No. receivers highly noise affected*
4-a	1	45	50	1	0

4-b	3	45	58	3	0
4-c	1	52	60	1	0
4-d	5	53	63	5	0
4-e	4	57	56	0	0
4-f	3	54	51	0	0
5-a	70	37	52	68	0
5-b	66	56	61	16	0
5-c	30	53	79	23	2
5-d	37	53	73	31	0
5-e	28	55	61	23	0
5-f	12	46	51	11	0

* Highly noise affected is considered to be greater than 75 dB(A)

Table 7-2 indicates that only two receivers in NCA 5-a within Section 5 are predicted to experience noise levels that exceed the NML as a result of soft soil treatment works.

Table 7-3 indicates that most or all of the receivers in NCAs 4-a, 4-b, 4-c, 4-d, 5-a, 5-c and 5-d are predicted to experience noise levels that exceed the relevant NML as a result of formation, clearing and mulching works. None of the receivers in NCAs 4-e and 4-f, and only a handful of those in NCAs 5-b, 5-e and 5-f, are predicted to experience noise levels above the relevant NML.

Table 7-4 indicates that most or all of the receivers in NCAs 4-a, 4-b, 4-c, 4-d, 5-a, 5-c, 5-d, 5-e and 5-f are predicted to experience noise levels that exceed the relevant NML as a result of earthworks. None of the receivers in NCAs 4-e and 4-f, and less than a quarter of those in NCAs 5-b, are predicted to experience noise levels above the relevant NML.

As stated in the EIS Working Paper: Noise and Vibration, the impacts summarised in the above tables are representative of the worst case 15 minute period of each activity and daily noise levels are predicted to be lower. The predictions also assume that all plant listed in Table 7-1 for each scenario is operating simultaneously and at the shortest separation distance to each receiver. In reality, plant will be spread across the work site and the separation distances will vary.

Section 8 details reasonable and feasible mitigation measures to address the fact that numerous receivers are predicted to be exposed to noise levels that exceed the relevant NML.

There are no receivers that would be classified as highly noise affected due to soft soil treatment works or formation, clearing and mulching works. However, there are two receivers (1441 and 1427) that would be classified as highly noise affected due to earthworks operations. Receiver 1427 is the United service station at Ch 88400. Receiver 1441 is a residential house on the eastern side of the existing Pacific Highway at Ch 89600, which has been purchased by RMS and vacated. As such, no additional noise mitigation measures are required for these receivers.

Minimal out of hours work is to be undertaken during the Project and the likely noise impacts are deemed to be minor. An Out of Hours Works Assessment will be submitted to RMS for approval prior to undertaking any works outside the standard working hours.

7.2.2 Compound operation (including access)

The Project will require a main site compound, which will accommodate a range of activities, plant and equipment including, but not limited to:

- Office accommodation.
- Staff amenities.
- Light vehicle parking and access.
- A plant and equipment maintenance workshop.
- Material and chemical storage.
- Equipment storage.
- Material storage.

The main site compound will be located on the south-western side of the Chatsworth Road / Pacific Highway intersection at Ch 90700. There is only one sensitive receiver located within 600 m of this location. This receiver is approximately 550 m to the east of the compound site on the bend of Serpentine Channel North Bank Road, adjacent to Serpentine Channel. This receiver was not assessed in the EIS Working Paper: Noise and Vibration. As such, predicted noise levels from the compound operation are not available. However, it is reasonable to assume that the noise impacts of the main site compound at this receiver will be minimal due to the large separation distance and the fact that the existing Pacific Highway is located between the compound site and the receiver.

Vibration impacts from the operation of the compound are not anticipated.

7.3 Construction vibration and blasting assessment

The Sensitive Area Plans, CEMP Attachment A5, identify noise/vibration sensitive receivers and additional assessment will be made according to upcoming site activities, managed through the EWMS.

7.3.1 Vibration assessment

Table 7-5 list vibration intensive plant likely to be used during construction and provides predicted ground vibration levels at various distances from the plant. The vibration levels are indicative only and will vary depending on the particular item of plant and geotechnical conditions.

Table 7-5 Typical plant vibration levels

Activity	Typical Ground Vibration Level
Vibratory rollers	*Up to 1.5 mm/s at distances of 25 m* *Higher levels could occur at closer distances; however, no damage would be expected for any building at distances greater than approximately 12 m (for a medium to heavy roller)*
Hydraulic rock breakers	*4.50 mm/s at 5 m*

(levels typical of a large rock breaker operating in hard sandstone)	*1.30 mm/s at 10 m* *0.4 mm/s at 20 m* *0.10 mm/s at 50 m*
Compactor	*20 mm/s at distances of approximately 5 m, 2 mm/s at distances of 15 m. At distances greater than 30 m, vibration is usually below 0.3 mm/s*
Pile driving/removal	*1 to 3 mm/s at distances of 25 m to 50 m depending on soil conditions and the energy of the pile driving hammer* *These levels are well below the threshold of any possibility of damage to structures in the vicinity of these works. At closer distances to the piling operations, some compaction of loose fill would occur due to vibratory effects*
Bulldozers	*1 to 2 mm/s at distances of approximately 5 m. At distances greater than 20 m, vibration is usually below 0.2 mm/s*
Air track drill	*4 to 5 mm/s at a distance of approximately 5 m, and 1.5 mm/s at 10 m. At distances greater than 25 m, vibration is usually below 0.6 mm/s, and at 50 m or more, vibration is usually below 0.1 mm/s*
Truck traffic (over normal (smooth) road surfaces)	*0.01 to 0.2 mm/s at the footings of buildings located 10 to 20 m from a roadway*
Truck traffic (over irregular surfaces)	*0.1 to 2.0 mm/s at the footings of buildings located 10 m to 20 m from a roadway*

The construction activities likely to produce the main sources of vibration are rock hammering and blasting. Blasting is assessed in Section 7.3.2.

The locations of rock hammering/breaking are not easily identified; therefore a qualitative assessment was undertaken in the EIS Working Paper: Noise and Vibration to identify the distances at which an impact is likely to occur (refer Table 7.6).

Table 7-6 Generic vibration impact associated with rock hammering/breaking

Activity	Separation distance from receiver/metres		
	Low Risk	Medium Risk	High Risk
Structural damage	>20	10-20	<10
Human comfort	>40	30-40	<30

7.3.2 Blasting assessment

Blasting may be required to remove rock outcrops. Blast holes will be drilled and filled with an explosive charge and detonated with the aid of primers and detonators. Impacts associated with blasting normally relate to air blast overpressure and ground vibration.

Potential vibration and air blast overpressure impacts generated through blasting will be managed primarily through a site and blast-specific assessment in conjunction with preliminary

small scale testing conducted at each proposed blast site prior to the commencement of full scale blasting. Further assessment of potential blasting impacts is discussed in this Blast Management Program contained in Appendix B.

8 Environmental control measures

A range of environmental requirements and control measures are identified in the various environmental documents, including the EIS, Submissions / Preferred Infrastructure Report, Conditions of Approval and RMS documents. Specific measures and requirements to address impacts from noise and vibration are outlined in Table 8-1 Noise and vibration management and mitigation measures

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Table 8-1 Noise and vibration management and mitigation measures

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
GENERAL					
NV1	Training will be provided to all project personnel, including relevant sub-contractors on noise and vibration requirements from this plan through inductions, toolboxes and targeted awareness training. Noise and vibration training requirements will be as per Section 9.2 of this plan.	Project Inductions	Pre-construction, construction	Environmental Site Representative	G36, Section 9.2
NV2	Work compounds, parking areas, equipment and material stockpile sites will be positioned away from noise-sensitive locations in accordance with the criteria in Section 3.7.2 and Appendix A2 of the CEMP, and Appendix I of the CSWQMP.		Construction	Environmental Site Representative	G36
NV3	Site entry and exit points will be located as far as possible from sensitive receivers, taking into account the importance of safe access.		Construction	Foreman	Submissions / PIR(CNV3)
NV4	Truck routes to and from the worksite will be via major roads where possible, in accordance with the Construction Traffic Management Plan.		Construction	Superintendent	Submissions / PIR (CNV9)
NV5	Operational noise mitigation measures eg at property treatments, noise mounds, will be installed as early as possible during construction.		Construction	Construction Manager	G36
NV6	Where piling, hydraulic hammering or dynamic compaction is proposed within 50 metres of any structure or service, a building condition survey would be conducted and preliminary vibration monitoring undertaken by a qualified contractor.	Sub-contractor as required	Construction	Construction Manager	Submissions / PIR (CNV15)
NV7	Where piling, hydraulic hammering or dynamic compaction is proposed within 50 metres of any heritage structure or potentially structurally unsound service, a building condition survey would be conducted and preliminary	Sub-contractor as required	Construction	Construction Manager	Submissions / PIR (CNV16)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	vibration monitoring undertaken by a qualified contractor. A follow-up survey would be conducted in response to any vibration complaints.				
NV8	Prior to the use of the dynamic compaction construction method, the Applicant shall undertake an assessment of vibration generated by dynamic compaction on nearby sensitive receivers. Feasible and reasonable mitigation measures shall be implemented to minimise vibration impacts.		Construction	Construction Manager	CoA B26
PLANT AND EQUIPMENT					
NV9	Where feasible and reasonable noisy equipment and/or construction processes will be substituted by alternative low noise emitting equipment and/or construction process. For example; (CoA B25) where feasible and reasonable, piling activities shall be undertaken using quieter construction methods, such as bored piles or vibrated piles rather than impact or percussion piling methods.		Construction	Foreman	G36, Submissions / PIR (CNV5, CNV 9 and CNV 14) CoA B25
NV10	Static noise sources, such as generators, pumps and lighting towers, will be located as far as possible from sensitive receivers. Place screening or enclosures around fixed plant under regular operation that may impact upon noise sensitive receivers. The use of temporary noise shielding will be determined following community consultation.		Construction	Foreman	G36, Submissions / PIR (CNV11 and CNV12)
NV11	Undertake saw-cutting operations wherever possible to minimise noise impacts		Construction	Foreman	G36
NV12	Plant or machinery will not be permitted to 'warm-up' before the nominated working hours.	Induction	Construction	Operators	Submissions / PIR (CNV8)
NV13	Switching off engines when equipment is not in use for extended periods (ie 30 minutes).	Induction	Construction	Operators	G36
NV14	Unless required for technical reasons, undertake high noise generating work (such as use of a concrete saw or hydraulic hammer) during the day, or early in the evening		Construction	Foreman	G36

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	if required to be undertaken at night; avoiding short sharp sounds from impacts during night work to minimise sleep disturbance to neighbouring residents.				
NV15	Manually adjustable or ambient noise sensitive or 'quacker' type reversing alarms on plant and/or flashing lights will be used at night.		Construction	Superintendent	G36, Submissions / PIR (CNV6)
NV16	Where possible, maintenance work on construction plant will be undertaken away from noise sensitive receivers.		Construction	Foreman	G36
NV17	All construction plant and equipment used on the site will be, in addition to other relevant requirements: • Fitted with properly maintained noise suppression devices in accordance with the manufacturer's specifications. • Maintained in an efficient condition. • Operated in a proper and efficient manner		Construction	Superintendent	G36, Submissions / PIR Submissions / PIR (CNV4)
NV18	Loading and unloading will be carried out as far as practical away from sensitive receivers.		Construction	Foreman	Good practice
NV19	Truck movements will be kept to a minimum, ie that trucks are sufficiently utilised for each trip.		Construction	Foreman	Good practice
NV20	Trucks will not queue up outside residential properties. No trucks will arrive on site or be permitted to queue near sensitive receivers prior to the 7.00 am start time unless required by road safety considerations.		Construction	Foreman	Good practice
NV21	Noisy plant working simultaneously close together will be avoided to the greatest extent practical adjacent to noise affected sensitive receivers.		Construction	Foreman	Good practice
NV22	Whenever practical, at the end of shifts, excavation and/or ripping plant will be taken from their work areas and left overnight away from the immediate vicinity of sensitive receivers. Warming up of the plant will then be conducted away from such receivers.		Construction	Foreman	Good practice

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
NV23	Truck drivers will limit compression braking as far as practicable.		Construction	Operators	Good practice
NV24	Where possible, noise generating equipment will be strategically positioned to take advantage of natural screening from geographical features or other structures to reduce the transmission of noise between work sites and receiver locations.		Construction	Foreman	Good practice
NV25	Appropriately sized equipment would be selected in order to minimise vibration emissions, where required.		Construction	Foreman	Submissions / PIR (CNV17)
CONSTRUCTION HOURS					
NV26	Construction works associated with the Project, other than blasting, will only be undertaken during the following hours: • 7:00am to 6:00pm Mondays to Fridays, inclusive; and • 8:00am to 5:00pm Saturdays; and • at no time on Sundays or public holidays. Unless otherwise assessed and justified in the CEMP or this Plan.		Construction	Construction Manager	CoA B15
NV27	Works outside of the construction hours identified in CoA B15 will only be undertaken in the following circumstances: a) works that generate noise that is (i) no more than 5 dB(A) above rating background level at any residence in accordance with the Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009); and (ii) no more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009) at other sensitive receivers; or b) for delivery of materials required outside these hours by the Police or other authorities for safety reasons; or		Construction	Construction Manager	CoA B16

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	c) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or d) between 6.00am and 7.00am and 6.00pm and 7.00pm Monday to Friday (except public holidays) in sparsely populated areas (these construction hours may be reviewed and/or revoked by the Director General in consultation with the EPA in the case of unresolved noise complaints); or e) low noise impact activities and work as follows: (i) between 6.00am and 7.00am Monday to Friday; and/or (ii) between 6.00pm and 7.00pm Monday to Friday; f) works approved through an EPL or g) works approved by a Construction Environment Management Plan or Construction Noise and Vibration Management Plan for the SSI in accordance with CoA B19.				
NV28	The Applicant shall, where feasible and reasonable, limit high noise impact activities and work to the mid -morning and mid-afternoon periods, except in sparsely populated areas. Rock breaking, rock hammering, sheet piling, pile driving and any similar activity will be scheduled only between the hours of 9am to 12pm and 2pm to 5pm, Monday to Friday; and 9am to 12pm, Saturday except where works are to be undertaken outside proposed construction hours as outlined above. These activities, if undertaken in continuous blocks and where there is an impact on a sensitive receiver, must not exceed 3-hours in duration, particularly if work extends outside the standard construction hours. A minimum respite period of 1 hour shall be scheduled before activities recommence.		Construction	Construction Manager	CoA B19, Submissions / PIR (CNV2)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
NV29	Construction activities resulting in impulsive or tonal noise emission (such as rock breaking, rock hammering, pile driving) shall only be undertaken: (a) between the hours of 8:00am to 5:00pm Monday to Friday; (b) between the hours of 8:00am to 1:00pm 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.* *The works subject to this condition may be undertaken in sparsely populated areas within the construction hours specified in condition CoA B15.*		Construction	Foreman	Submissions / PIR (CNV2) CoA B18
NV30	Any proposal to undertake works outside of the standard working hours identified in CoA B15 will be subject to CoA B17 and the processes and assessment requirement contained in the out of hours works procedure (see Appendix C).		Construction	Construction Manager	CoA B17
NV31	Affected receivers would be consulted prior to the commencement of out of hours work.	Community Consultation	Construction	Communications Manager	Submissions / PIR (CNV1)
NV32	Affected educational institutions shall be consulted and reasonable steps taken to ensure that noise generating construction works in the vicinity of affected buildings are not timetabled during examination periods where practicable, unless other reasonable arrangements to the affected institutions are made at no cost to the affected institution.		Construction	Construction Manager	CoA B27
BLAST MANAGEMENT					

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
NV33	Blasting will be undertaken in accordance with the blast management plan provided in Appendix B.		Construction	Foreman	Submissions / PIR (CNV18)
NV34	Where sensitive receivers are located close to the blast site, a series of trials will be undertaken at a reduced scale to determine site-specific blast response characteristics, in order to define allowable blast sizes to occur within the criteria.		Construction	Foreman	Submissions / PIR (CNV19)
NV35	Controlled blasting activities will only be undertaken between the hours of: a) 9am to 5pm, Monday to Friday b) 9am to 1pm, Saturday; and c) at no time on Sunday or public holidays Blasting may occur in accordance with the construction hours specified in CoA B15 where no sensitive receivers would be impacted by blasting in sparsely populated areas or that an agreement has been made with receivers within 200 metres of the blast zone to permit blasting in accordance with the construction hours specified in CoA B15. Where the blast management plan has identified potential impacts on sensitive receivers, these hours will be subject to change. *This condition does not apply in the event of a direction from the NSW Police Force or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.*		Construction	Construction Manager	Submissions / PIR (CNV20) CoA B21
NV36	A minimum of 24 hours' notice will be provided to all residences located within 500 metres of any blast, including an indication of blasting times and a contact name and telephone number.	Community Consultation	Construction	Communications Manager	EIS (CNV21)
NV37	Monitoring of overpressure and vibration levels will be undertaken for each blast at the potentially most affected receivers.	Sub-consultant as required	Construction	Foreman	EIS (CNV22)
NV38	A building condition survey will be undertaken for all buildings located within 500 metres of the proposed	Sub-consultant as required	Construction	Construction Manager	EIS (CNV23)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	blasting area prior to the start of blasting and any damage occurring from the blasting rectified at no cost to the property owner.				
NV39	Should blasting be required within 200 metres of the water reservoirs at the Lang Hill borrow source, a dilapidation or preconstruction condition survey will be undertaken before blasting work commences in consultation with Richmond Valley Council and Rous Water.		Construction	Construction Manager	Submission / PIR (CNV24)
NV40	The maximum instantaneous charge (MIC) will be reduced to the lowest possible level by the use of delays, reduced diameter holes, and/or deck loading.		Construction	Foreman	Submissions / PIR (CNV25)
NV41	Adequate stemming will be provided and exposed detonating cord will be eliminated (by covering with at least 300 millimetres of quarry dust or road base).		Construction	Foreman	Submissions / PIR (CNV26)
NV42	Secondary blasting will be eliminated. (A rock breaker or drop hammer will be used instead of popping). Effort will be made to eliminate the need for toe shots (eg by better control of drill patterns).		Construction	Foreman	Submissions / PIR (CNV27)
NV43	Weather conditions at the time of the blast will be assessed. Blasting will be avoided where possible during heavy cloud cover and/or if a strong wind is blowing towards residences. Days of severe temperature inversion will be avoided where possible or, (if not possible) blasting would occur between 11am and 1pm.		Construction	Foreman	Submissions / PIR (CNV28)
NV44	Strict control will be exercised over the spacing and orientation of all blast drill holes. Holes will be spaced in such a manner that the explosive force is just sufficient to break the stone to the required size.		Construction	Foreman	Submissions / PIR (CNV29)
NV45	Controlled blasting times will be determined in consideration of site-specific conditions and in consultation with affected residents and take place, where possible, when impacts are likely to be the least intrusive (eg all blasts would be fired at a set time acceptable to		Construction	Foreman	Submissions / PIR (CNV30)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	residents and preferably when the background noise is highest).				
CONSULTATION AND COMPLAINTS MANAGEMENT					
NV46	Residents / sensitive receivers will be notified of construction activities that are likely to affect their noise and vibration amenity in accordance with the Community Communications Strategy. Information provided will include: (i) The types of activities to be undertaken. (ii) The timing of activities including expected start and finish. (iii) The location of activities. (iv) Details of the community information line and how to make an enquiry and/or complaint	Community consultation	Pre-construction / Construction	Communications Manager	Submissions / PIR (CNV31)
NV47	Affected receivers will be consulted prior to the commencement of out of hours work.	Community consultation	Construction	Superintendent / Communications Manager	Submissions / PIR (CNV1)
NV48	Circumstances may arise during construction where works outside of standard construction hours are essential and sensitive receivers are assessed to be highly noise affected (ie experience noise levels greater than 75 dBA). Where this is the case, opportunities to minimise impacts on highly noise effected receivers, including the provision of alternative accommodation, would be considered in consultation with those affected receiver(s).		Construction	Communications Manager	Good practice
NV49	All complaints received will be managed in accordance with the Community Communications Strategy.		Construction	Communications Manager	Submissions / PIR (CNV7)
NV50	Where it has been identified as necessary (eg in response to community complaints), noise monitoring will be undertaken to check that noise mitigation measures are effective.		Construction	Construction Manager / Communications Manager	Submissions / PIR (CNV10)
SURVEY, MONITORING AND REPORTING					

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
NV51	Initial noise monitoring of plant and equipment will be undertaken to ensure the noise performance levels predicted in this CNVMP are being met.		Pre-construction / Construction	Environmental Officer / Noise Specialist	Good practice
NV52	Noise and vibration monitoring will be undertaken in accordance with Section 9.3. The program for construction noise and vibration monitoring indicates monitoring frequency, location, how the results of this monitoring are recorded and, procedures that are followed where significant exceedances of relevant noise and vibration goals are detected.		Construction	Environmental Officer / Noise Specialist	Submissions / PIR (CNV13)
NV53	Building Condition Inspections for each public utility, structure and building will be carried out where: (i) Blasting operations are within 500 metres or the distance at which the calculated 95th percentile Peak Velocity of ground vibration from the proposed blast is 2 mm/s, whichever is the greater. (ii) Pile driving activities are within 250 metres or the distance at which the calculated 95th percentile Peak Velocity of ground vibration from the proposed pile driving is 2 mm/s, whichever is the greater (iii) Other vibration causing activities where the distance at which the calculated 95th percentile Peak Velocity of ground vibration is 2 mm/s.	Sub-consultant as required	Pre-construction / Construction	Project Engineer	G36
NV54	The Building Condition Inspection report will include as a minimum: (i) Floor plan of the subject building. (ii) Record site details - age, construction, site slope and provision for drainage, presence of trees. (iii) Type of defects and their positions and extents on the floor plan. (iv) Photograph of external view and photograph of all defects of significance (especially if of concern to the owner), or typical examples of say, hairline plaster cornice cracks.	Sub-consultant as required	Pre-construction / Construction	Project Engineer	G36

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	(v) How doors sit in the jambs - out of line may indicate foundation settlement. (vi) External signs of reactive clay foundation soil, e.g. lifting of slabs, uneven kerbing.				
NV55	All complaints, including those related to property damage, will be managed in accordance with the RMS Complaints and Enquiries Procedure – see section 6.3.2 of the CEMP.		Construction	Communications Manager	Good practice

9 Compliance management

9.1 Roles and responsibilities

The Golding Project Team's organisational structure and overall roles and responsibilities are outlined in Section 4.2 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Chapter 8 of this Plan.

9.2 Training

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

- Existence and requirements of this sub-plan.
- Relevant legislation.
- Normal construction hours.
- The process for seeking approval for out of hours works, including consultation.
- Location of noise sensitive areas.
- Complaints reporting.
- General noise and vibration management measures.
- Specific responsibilities to minimise impacts on the community and built environment from noise and vibration associated with the works.

Further details regarding staff induction and training are outlined in Section 5 of the CEMP.

9.3 Inspections and monitoring

Weekly and other routine inspections by Environmental Officers, RMS, ERG representatives and ER will occur throughout construction. Detail on the nature and frequency of these inspections are documented in Section 8.2 of the CEMP.

Noise and vibration monitoring will also occur routinely for the duration of the Project. Monitoring will be undertaken by an Acoustic Consultant or the Environmental Officer during the construction phase of the Project.

9.3.1 Noise monitoring

The following noise monitoring will be undertaken:

- Periodic noise monitoring at nominated sensitive receiver locations (refer to section 4.1 of this plan) to determine the effectiveness of mitigation measures against predicted impacts.
- Where complaints are received, additional noise monitoring may be undertaken at sensitive receivers to determine if the actual construction noise generated exceeds the predicted 'worst case' construction noise levels identified in Section 7.2 of this Plan.
- Noise monitoring may be carried out for the purpose of refining construction methods or techniques to minimise noise.
- Ongoing spot checks of noise intensive plant and equipment will be undertaken throughout construction to ensure compliance with manufactures specifications.

Where actual noise levels are found to exceed the predicted worst case levels, the source of excessive noise generations will be identified, and any additional feasible and reasonable measures available will be implemented to either reduce noise emissions or reduce the impacts on receivers.

Details of site activity and equipment usage will be noted during construction noise monitoring.

Acoustic instrumentation employed in the noise monitoring surveys will comply with the requirements of AS1259.2-1990 Acoustics – Sound Level Meters, Part 2: Integrating – Averaging and carry appropriate NATA (or manufacturer) calibration certificates.

Within six months of commencing construction, the applicant shall, in consultation with the EPA, prepare to the satisfaction of the Director General, a review of the operational noise mitigation measures proposed to be implemented for the SSI. The review may be submitted in stages to suit the staged construction of the SSI. This Operational Noise Review is to be completed in accordance with CoA D11.

9.3.2 Vibration monitoring

The following vibration monitoring will be undertaken:

- For the protection of buildings, monitoring will be carried out at the commencement of vibratory compaction work within 50 metres of buildings to ensure that safe vibration levels specified in Section 7.3.1 are not exceeded and to confirm safe working distances.
- When vibration intensive activities are required, vibration monitoring will be carried out within the established buffer zones, or where there is considered to be a risk that levels may exceed the relevant structural damage goals.
- Vibration monitoring may be carried out in response to complaints, exceedances, or for the purpose of refining construction methods or techniques to minimise vibrations.
- Vibration monitoring will continue throughout construction, where appropriate, at nominated sensitive receiver locations to determine the effectiveness of mitigation strategies.

Where vibration is found to exceed safe levels, impacts will be avoided by changing work methods and/or equipment, or through the provision of building protection measures where possible. In the event a complaint relating to property damage is received, an inspection of the property would be undertaken and an interim building condition survey prepared.

Vibration monitoring will be carried out with the aim of achieving the following construction vibration goals (CoA B20):

a) for structural damage to heritage structures, the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration – Part 3 Effects of vibration on structures;

b) for damage to other buildings and/or structures, the vibration limits set out in the British Standard BS 7385-1:1990 – Evaluation and measurement of vibration in buildings (and referenced in Australian Standard 2187.2 – 2006 Explosives – Storage and use – Use of explosives). Guide for measurement of vibration and evaluation of their effects on buildings; and

c) for human exposure, the acceptable vibration values set out in Assessing Vibration: A Technical Guideline (Department of Environment and Conservation, 2006).

9.4 Non-conformances

Non-conformances in general will be dealt with and documented in accordance with Section 8.6 of the CEMP.

9.5 Complaints

Complaints will be recorded in accordance with the Community Communications Strategy (CCS). Information to be recorded will include location of complainant, time/s of occurrence of alleged noise or vibration impacts (including nature of impact particularly with respect to vibration), perceived source, prevailing weather conditions and similar details that could be utilised to assist in the investigation of the complaint. All resident complaints will be responded to in a timely manner and action taken recorded in accordance with the CCS.

9.6 Auditing

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

Audit requirements are detailed in Section 8.3 of the CEMP.

9.7 Reporting

Reporting requirements and responsibilities are documented in Section 8.3 of the CEMP.

Specific reports prepared in response to noise and vibration monitoring will capture detail including, but not limited, to:

- The locations and description of monitoring undertaken.
- A tabulation of results (eg for noise including L_{MAX}, L_{10}, L_{90} and L_{Aeq} noise levels) together with notes identifying the principle sources and operations.
- Summary of any measurements exceeding the nominated criteria, and descriptions of the plant or operations causing these exceedances.
- Detail of any corrective actions and confirmation of their successful implementation.

10 Review and improvement

10.1 Continuous improvement

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

The continuous improvement process will be designed to:

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

10.2 Update and amendment

The processes described in Section 8 and Section 9 of the CEMP may result in the need to update or revise this Plan. This will occur as needed.

Only the Environment Manager, or delegate, has the authority to change any of the environmental management documentation.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure – refer to Section 10.2 of the CEMP.

Appendix A
Plant and equipment sound power levels

Proposed equipment and associated sound power levels

Activity	Plant noise source	LAeq Sound power level dB(A)	
Site enabling works (soft soil treatments)	2 x Excavator – 30 tonne 2 x Dozer – 20 tonne 18 x Product truck – 4 axle, 25t 2 x Vibratory compactor – 12 tonne 1 x front end loaders 1 x Padfoot compactor 2 x Grader – 25 tonne 1 x Smooth barrel roller – 18 tonne 2 x Water cart – extracting water	103 103 108 112 114 107 114 107 107	Modelled as single point source at shortest separation to receivers taking account of plant operating duration.
Formation, clearing and mulch	2 x excavator – 30 tonne 1 x dozer – 20 tonne 18 x product truck – 4 axle, 25 tonne 2 x vibratory compactor – 12 tonne 1 x padfoot compactor 1 x grader – 25 tonne 1 x smooth barrel roller – 18 tonne 1 x water cart – extracting water	103 103 108 112 107 114 107 107	Modelled as single point source at 25 metre intervals along the project with highest level at each receiver reported, taking account of plant operating duration.
Earthworks	2 x excavators (30 tonne) 2 x dozers (20 tonne) 18 x product trucks – 4 axle (25 tonne) 2 x vibratory compactors (12 tonne) 1 x padfoot compactor 1 x grader (25 tonne) 1 x smooth barrel roller (18 tonne) 1 x watercart (to extract water) 1 x backhoe 2 x front end loaders	103 103 108 112 107 114 107 107 110 114	Modelled as single point source at 25-metre intervals along the project with highest level at each receiver reported, taking account of plant operating duration.
Ancillary sites – stockpiles	1 x excavator (30 tonne) 1 x dozer (20 tonne) 2 x product trucks – 4 axle (25 tonne) 1 x watercart (water bowser) 1 x backhoe 2 x front-end loaders	103 103 108 107 110 114	Modelled as an area source from sum of all sound power of all plant operating, taking account of plant operating duration.

Appendix B
Blast management plan

Blast Management Plan

Purpose: The purpose of this document is to provide for the blast management and mitigation measures, and monitoring procedures to be implemented to monitor blasting impacts

Document Attributes	
Element	Project Management
Knowledge Area	Project SHE Management
Owner	Project Manager
Custodian	Project Engineer
Document ID	RMS00031-111

BLAST MANAGEMENT PLAN
Early Works – Wave 1&3 (part)
Woolgoolga to Ballina
Pacific Highway Upgrade

The current controlled .pdf version of this plan is located in the Golding network at Public\Library\Management Plans. All printed copies of this Management Plan are to be considered uncontrolled and should be validated with the Project Manager before use.

Effective from	Details of Revision	Approved By Owner	Document Review Number
This document supersedes *'RMS00031-012 BMP'*			
17 August 15	First Controlled Issue	Project Manager Rob Blyth	RMS00031-DRE-032

Holder Number	Holder Name	Holder Position Title	Company Name
546	Rob Blyth	Project Manager	Golding Contractors Pty Ltd
565	Dean Gregory	Principal's Authorised Delegate	Roads and Maritime Services (RMS)

The current controlled version of this document is located in the GMS. All other printed copies of this document are to be considered uncontrolled and should be validated against the current controlled version on the Golding Intranet before use.

Contents

Attachments

1. Project Description

This blast management plan forms part of the Construction Noise and Vibration Management Plan (Appendix B3 of the CEMP) for the Early Works - Wave 1 and part of Wave 3 Project, which is part of the upgrade of the Pacific Highway between Woolgoolga and Ballina (the Project).

Wave 1 and 3 (part) of the Project broadly includes:

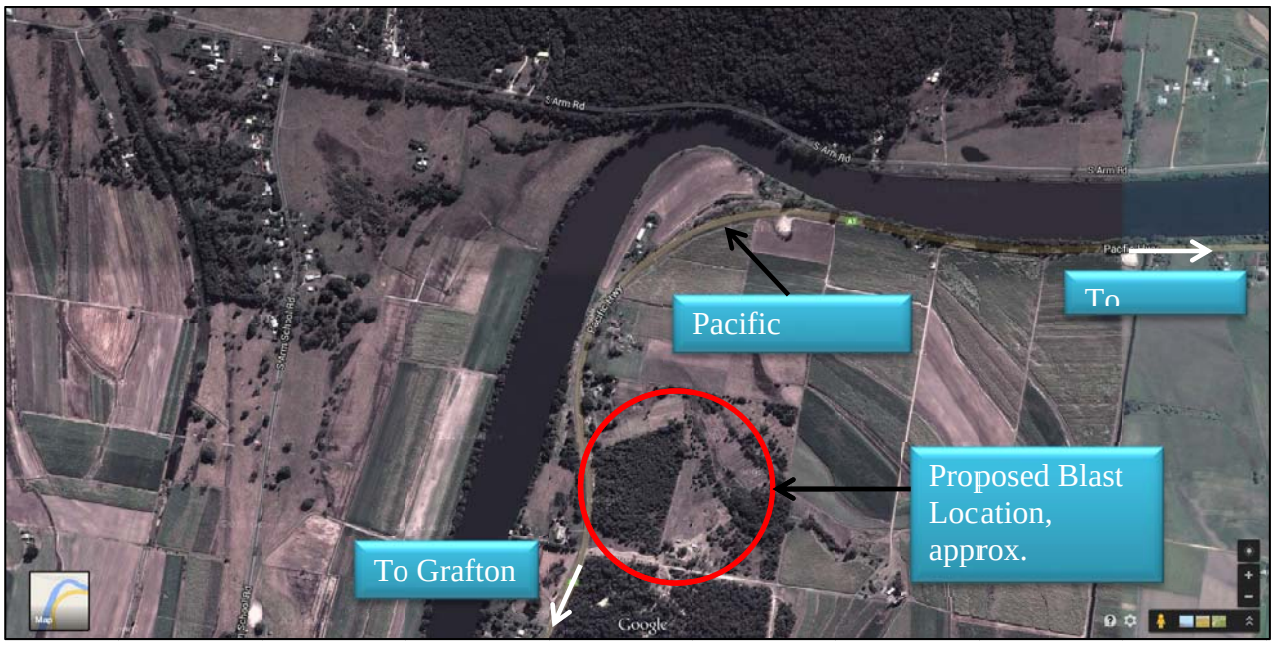
- Ground treatment and preparatory earthworks (soft soils treatments) between approximate STN 83400 and 91200.
- Excavation of material taken from a highway cutting at Tyndale (at approximate STN 69000 to 69500) for the soft soil treatments.
- Excavation of material taken from highway cuttings North of McIntyres Lane, Gulmarrad (at approximate STN 77500 to 78400) for the soft soil treatments.
- Relocation of utility services at various locations throughout STN 67200 to 95100.

These works are located within Sections 4 and 5 of the Approved Project.

The contract allows for embankment material required for these soft soil treatment sites to come from a highway cutting at Tyndale (Figure 1-1), with initial import of drainage rock from external sources to commence early works to commence.

Appendix A5 Sensitive Area Plans, provides information on receivers sensitive to noise and vibration.

Figure 1-1 Tyndale Cutting Location



2. Introduction

2.1. Purpose

Material is required to be excavated from the Tyndale cutting under the contract for construction purposes, this cutting consists of both rippable and non-rippable material.

Blasting is the most cost and time effective method of fragmenting and breaking hard rock to enable excavation and further processing. In order to determine the level of rock formation and to analyse the impact of blasting to sensitive receivers, rock mapping and Site Law Investigations will be undertaken. The following works will be conducted as part of the rock mapping scope:

- Field monitoring of controlled drilling operations within identified rock cuttings
- Develop a model of the identified rock cuttings including geotechnical data and surrounding area
- Conduct control seismic blasting within selected drilled holes
- Evaluate blasting results and undertake a statistical regression analysis of recorded data. This evaluation will help determine the vibration transmission characteristics of the geology surrounding the identified rock cuttings and enable a greater accuracy in shot design, higher levels of control of vibration and overpressure.

Once the excess 'free dig' or 'rippable' material has been removed to within 1-2m above the rock layer, blast patterns will be set out on the rock surface and drilling will commence with hydraulic drill rigs. Drilling will be carried out to the approved blast design for each blast.

Once drilling has been completed, the blast holes will be accurately loaded with down line detonators and the calculated weight of explosives. The explosive product is then confined within the blast hole by stemming of the remainder of the hole with 10mm – 12mm aggregate.

The blast holes will be connected with surface delay detonators as detailed in the approved blast timing. This will ensure that only one blast hole detonates at an instant and the maximum instantaneous charge (MIC) permitted to comply with project vibration limits is achieved.

2.2. Scope

The drilling and blasting scope includes the following works:

- Rock mapping and Site Law Investigation
- Preparation of blast design, Safe Work Method statement (SWMS) and application for relevant permits and notifications
- Drilling in accordance with approved blast design
- Implementation of blast controls as per approved SWMS
- Monitoring and recording blasts
- Supply, transport, load and conduct blasting in accordance with approved blast design and SWM
- Pre- and post blast inspections.

3. Minister's Conditions of Approval

There are a number of Conditions of Approval (CoA) that relate to blasting associated with the construction of the HW10 Highway Upgrade – Woolgoolga to Ballina - Early Works - Wave 1 and 3 (part) – (Tyndale to Chatsworth road). These CoA set limits for:

- airblast overpressure
- Peak particle velocity
- blast hours
- blasting frequency
- blasting near infrastructure.

Details of these CoA's are described in the project Construction Noise and Vibration Management Plan(CNVMP).

The Environment Protection Licence (EPL) issued for the project includes conditions relevant to blasting. The CoA also set limits for:

- airblast overpressure
- vibration velocity
- monitoring requirements.

4. Hazards and Risks

4.1. Flyrock

Controlling the risk of flyrock is a primary focus when designing and implementing blasts on site. Blast designs are completed for every blast to ensure that the explosive is correctly proportioned to the rock type and the explosive energy upon detonation is contained within the rock mass.

- Contributing blast parameters that can lead to a flyrock event are:
- Insufficient stemming length
- Incorrect stemming type / particle size
- Insufficient front
- Weak rock seams or broken ground
- Overloaded blast hole
- Powder Factor too high
- Excessive ground water

Drillers will record any geological features encountered while drilling the blast holes on the drill sheet and these records will be used to adjust explosive quantities as required i.e. holes where broken ground or seams are encountered will be down loaded to ensure that the explosive gases do not cause weak rock to be ejected from these areas.

Every blast will be recorded by video to ensure that reviews of blast performance and trends of potential flyrock incidents are identified and refinements made for future blasts.

4.2. Vibration management

All blasting on site will cause ground vibration to be emitted from the blast area. The level of vibration will be controlled by adjusting the amount of explosive that is detonated at any instant or MIC.

Site relationships between the distance to the receiver and the MIC will be established for each blast site based on conservative trial blast results and vibration results obtained and analysed during further blast operations. This will enable vibration calculations to be completed prior to blasting, to ensure compliance with the project vibration limit.

Vibration impacts will be managed through the measures contained within the project CNVMP.

4.3. Noise management

Each blast will generate noise that, depending on location and proximity to residents, will be audible. The CoA has set maximum noise criteria that have to be met by all construction activities associated with construction of the project.

There is the potential for noise from blasting that is predicted to exceed these levels if the blasts are not managed properly. Any noise impacts will be managed through the measures contained within the project CNVMP.

4.4. Sedimentation management

Any blasts required for construction in close proximity to existing natural drainage lines and watercourses, presents the risk of blast material ending up in waterways.

This will be managed through the implementation of the controls proposed in the area/activity specific Erosion & Sediment Control Plan (ESCP) prior to the commencement of blasting. Controls will also be checked after each blast to ensure that they do not require maintenance or replacement prior to the next blast in that area.

Further controls will include water diversions on site to ensure any material from the blast makes its way into construction basins instead of natural watercourses.

4.5. Air blast management

Air blast is the pressure wave produced by the blast and transmitted through the atmosphere. High Air blasts are a result of explosive gases venting from the blast i.e. a flyrock event will most likely be an air blast exceedance.

Weather conditions may also contribute to the air blast result from a blast. Blasting will be avoided, where possible, during heavy cloud and/or strong wind blowing in the direction of nearby residences. Another measure is to increase the stemming length to avoid exceedance.

4.6. Free face – fall from heights

Blasting to a free face will assist with fragmentation and excavation by allowing maximum swell to the blasted rock. Blasting to a free face will also assist with vibration levels as the rock has more relief and ability to move, therefore dissipating vibration.

When a free face is exposed for blasting, the safety risk that requires controlling is the potential for workers to fall from heights. To control this risk on the project, all access into the area will be restricted and delineation fencing, bunds and signage will be erected to control entry into the area.

4.7. Explosives on site

Explosives will not be stored on site. During loading of the blast, explosive products are to be kept in the explosive delivering vehicle until they are required. It is important that detonators or explosive product is not carelessly placed on the ground during loading as there is the potential that it is lost and will remain a risk of detonation following the blast.

The shot firer will ensure that only the required explosives are placed at each hole to be loaded and the quantity checked against the blast design to ensure that all explosives are accounted for.

4.8. Excavation of blasted rock

Following each blast, the shot firer will inspect all surface detonators and the movement of the blasted rock to determine that all explosives have detonated prior to giving the 'All-clear' call. Any plant operators involved in excavating the shot rock will be inducted into the excavation of shot rock safe work method statement to ensure they are familiar with the explosive products and the protocols to follow if they discover any explosives.

The Blast Plan and SHEWM will detail the process to be followed for dealing with misfires and excavated explosive materials.

4.9. Services

All services and utilities will be positively identified prior to any drilling and blasting works commencing. An Excavation and Penetration Permit will be prepared for each section of works, in which all personnel working within the area will be briefed and toolboxed on, in accordance with Golding protocols.

5. Control Measures

The following control measure will be applied to control and mitigate the potential hazards and risk associated with the blasting activities.

5.1. SWMS

Prior to any works commencing, an approved Safe Work Method Statement (SWMS) will be developed for all drill and blast activities. In so far as is reasonably practicable Engineering Controls or better ('Above the Line' controls) will be implemented to reduce or mitigate the risks associated with this activity.

The SWMS shall specifically address the following hazards and risk:

- Fly rock control

- Stemming of blast holes
- Restricted access and access control
- Radio usage
- Misfires
- Clearance signals
- Blast guards
- Blasting guidelines
- Storage and transport of explosives
- Live services and utilities

Prior to commencing with drilling and blasting works, the requirements of the SWMS and relevant permits required will be communicated to all personnel involved in the drill and blast activities.

The SWMS is a live document and will be updated as and when any changes to the activity or working environment is encountered. Any changes will be communicated to all personnel involved in the blasting activities.

5.2. Permit controls

The following permits are required in accordance with Golding Contractors Procedures:

- Excavation and Penetration Permit – for all drilling activities
- All blasting permits required from Authorities, will be obtained by the blasting contractor and submitted to Golding prior to any blasting occurring.

The controls and management processes identified in each of these Permits will be strictly adhered to.

5.3. Implementation of control measures

In order to safely control the blasting activities and to execute the controls stated in the SWMS, the following measures will be implemented. These measures and procedures are in line with the Golding requirements for managing safety and health of workers and members of the public in relation to drill and blast activities.

5.3.1. Responsible person

The following roles have been appointed to implement the control measures and to manage the safety of the drill and blast operations:

Shot firer (Authorised Person)

Name: TBA

Qualification:

Responsibilities: Ensuring the safety of blasting works by carrying out best practice blast designs, blast hole loading, stemming, tie-in and initiation of each blast.

Blast Coordinator

Name: TBA

Qualification:

Responsibilities: Coordinating the blast and site personnel for each blast. This includes establishing blast clearance zone, setting site blast guards and traffic controllers; completing clearance runs blast clearance forms.

Safety Coordinator

Name: TBA

Responsibilities: Ensuring that the blasting works are performed safely and in accordance with the safe work method statement.

Environmental Site Representative (ESR)

Name: See contacts of CEMP

Responsibilities: Review blast designs to ensure vibration and air blast limits have been accurately calculated to ensure compliance with licence limits for each blast.

5.3.2. Blast Plan

Prior to commencing with any blasting activities, the blasting contractor will develop and submit a Blast Plan for approval. The Blast Plan will describe the design of the blast necessary for the task and include the matter required in AS 2187.2 Explosives – Storage and use. The Blast Plan will include as a minimum the following information:

- Clearly define responsibilities of supervision, survey crews, drill crews and any other personnel involved in the blasting activity
- Details the controls that conform with the requirements of the specific safety, health and environmental legislation, codes of practice, standards, OFSC audit criteria (where applicable) and Golding Safety procedures relevant to the drill and blasting activities
- Access and egress for the types of equipment involved
- Layout, signage and barriers of the exclusion zones, which also indicates location of blast guards during the blasting operation
- Layout of the blast including the drilling pattern and hole depths
- Drilling procedure
- Explosive type/quantity, firing equipment and method
- Procedures for loading and charging
- Detonation sequence/effective charge mass per delay (MIC) ‘powder factor’
- Misfire procedure
- Storage and transport controls in accordance with jurisdictional legislation , standards and codes
- Identifies the controls to prevent noise exposure to workers and prevent impact on the public
- Surface conditions, e.g. drainage, surface water, mud, loose material etc
- Hole conditions, e.g. water, mud, cuttings infill, hole collapse / slumping
- Controls to manage dust

- Identifies protective systems to be implemented on the project site to prevent person or plant being impacted by debris
- Identifies requirement to perform relevant investigations of structures and / or ground stability before using explosives, and after blasting at each site.
- The impact blasting will have on adjoining structures and public areas
- The emergency response rescue plan
- The Blast Plan will also define the methods on how the controls are to be communicated to relevant personnel, such as inductions, pre-start meetings and toolbox meetings

One Blast Plan may relate to multiple proposed uses of explosives if it is intended that they occur simultaneously.

5.3.3. Exclusion zone

Prior to any drilling or blasting activities, suitable demarcation of the drill and blast work area will be put in place. Physical barriers and appropriate warning signage will be installed to create an effective exclusion zone.

The exclusion zone will be such that it:

- Does not grant access to unauthorised personnel in the area whilst drilling or blasting activities are in progress
- All access points into the exclusion zone can be closed off by the use of blast guards, prior to a blast being undertaken.

The drill and blast contractor will be responsible for the implementation and maintenance of the exclusion zone. A layout of each exclusion zone forms part of the Blast Plan. The exclusion zone will include on site and off site areas as required. The community manager will consult with residential premises that require evacuation to ensure minimal disruption

5.3.4. Post blast inspection

After the blast has taken place and prior to any person entering the blast site, the authorised shot firer will inspect the area and give an ALL CLEAR signal. The Blast Plan will specify time periods for close inspection of the blast area and also detail time periods for inspection following any apparent misfire.

Specific procedures stated in the Blast Plan will specify how misfires will be managed. The procedure will comply with the requirements of AS 2187.2 Explosives – Storage and use, and will address the following:

- Location of misfire either during the post blast inspection or during excavation
- Isolation of the area to prevent unauthorised or accidental access
- Recovery of misfires with particular emphasis on risk identification and establishment of specific procedures when required
- Process for rendering materials harmless
- Reporting requirements including statutory obligations

- Investigation procedures to identify cause and corrective actions

5.3.5. Blast recording

Blast monitoring will be carried out for each blast. Blasts will be designed and monitored to ensure conformance with the project limits for vibration and airblast overpressure as outlined in the CNVMP and the project Environmental Protection Licence (EPL). Blast monitoring will be carried out at the nominated sensitive receivers and locations designated in the Blast Plan, and information captured in the blasting records.

Blast records will be maintained for each shot to assist in planning future blast and to record information that may be required in the event of an incident. Blast information will be recorded by the blasting contractor in an approved format and will include:

- General blast information:
  - Date, time and location (e.g. mine, pit / bench / seam)
  - Type of blast (e.g. pre-split, overburden, cast blast)
  - Environmental conditions (e.g. weather, wind strength and direction)
- Blast details:
  - A plan or sketch of the blast
  - Burden spacing
  - Face/bench height
  - Blast hole diameter
  - Hole depths, angles, subgrade
  - Presence and depth of water
  - Charge details of every hole (including type and quantity of detonators, primers, explosive charge, decks etc.)
  - Initiation sequence and delays
  - Maximum charge weight per delay
  - Stemming (type and depth)
- Monitoring:
  - Person / company conducting monitoring
  - Equipment (including calibration details if required)
  - Settings of monitoring equipment
  - Location of monitors (distance from blasts and sensitive receivers etc.)
  - Scaled distance (m/kg)
  - Measured ground vibration (mm/sec)
  - Airblast (dB)
- Any other information or comments concerning the blast e.g. flyrock, misfires, breaches of procedure rifling etc.

6. Explosives Management

There will be no storage of explosive on site other than on the day of loading. The explosives will be kept in the licensed explosive delivery vehicle until required for loading into blast holes. Explosives material will be under the instruction of the shotfirer.

Transport of explosives will be by a licensed explosives supplier on the day of each blast. Transport will be carried out in accordance with relevant legislation and Australian Standard AS2187. (AS2187.2 Section 4.4 and Australian Code for the Transport of Explosives buy Road and Rail – 3rd Edition, Sections 7.3.2 (6) and (7)).

7. Emergency Preparedness and Response

Before starting any drilling and blasting works, an appropriate documented Emergency Response Rescue Plan and first aid procedure will be completed. This will form part of the Blast Plan deliverable. The emergency response plan and equipment will routinely be tested to verify their adequacy.

This drill and blast Emergency Response Rescue Plan will be incorporated as part of the overall Emergency Control Plan for the site.

8. Work Procedures

This section details how drilling and blasting operations will be carried out on the project. The objective is to outline the procedures that must be followed to ensure the safety of all personnel that may be affected by the blasting operations.

The following sections outline:

- Notifications required
- Precondition surveys
- Blast objectives
- Trial blast
- Blast design
- Drilling and blasting on site
- Traffic control during blasting operation

8.1. Notifications

8.1.1. Community

Golding will be responsible for all community notifications and communications in accordance with Table 10 of this document.

8.1.2. Regulators / Local Authorities

The drill and blast contractor will be responsible to apply for and gain all required permits and approvals from the relevant Regulators and Authorities, within the required timeframes. No blast will occur without the relevant permit approvals and notification periods as required by the Authorities.

The Environment Protection Licence (EPL) issued by the NSW EPA includes conditions relevant to blasting activites.

8.1.3. Construction Teams

Leading up to a blast, the site teams will be briefed and toolboxed on the specific location and controls of the blast. The sequence stated in the Blast Warning Checklist will be followed for each blast, which details radio protocol, notifications and alarms prior, during and after a blast.

Blast times and locations will be displayed on notice boards at the entrance to the site and other prominent locations on the Project. The blast notice boards will be updated at least one full shift (12 hours) in advance of a blast. Firing times will only be approved by the Golding Project Manager or delegated person, who will be appointed as per Section 5.3.1 Responsible Personnel.

8.2. Precondition Surveys

All properties and utilities within 500m of the blast area are required to have a precondition report. Where precondition reports have been completed the names and locations of the properties will be listed in Table 8-1.

Table 8-1: Properties that have precondition surveys

Name	Address

8.3. Blast Objectives

Blast designs for project blasting will be developed to ensure the following critical outcomes are achieved:

- Flyrock is not produced from the blast
- Vibration and Airblast Limits are not exceeded
- Damage to batters is prevented
- Required fragmentation of shot rock is achieved
- No community complaints.

Blast videos are an important tool in reviewing the flyrock potential of blasts. The face and crest of the blasts must be captured in the video to determine if there is any explosive energy that was not contained within the rock mass. This information will then be used when completing future blast designs to control the risk of flyrock.

Vibration and airblast will be recorded on the blast monitors set out for each blast. The blast monitors will provide the wave form trace of Peak Particle Velocity (PPV). This information will be analysed to refine the site constants used in calculating the expected blast vibration and airblast levels. Small scale trial blasts with a conservative MIC will be carried out to establish these site constants prior to the commencement of production blasting.

Excavation of blasted rock will show the batter profile produced from the blast. Where the design includes for batters shallower than 1H: 1V, a standoff distance to the batter will be required, along with final trimming with an excavator and rock hammer. Alternatively 'over blasting' can be undertaken and an appropriate batter treatment undertaken.

Observation of the blasted rock and excavation and crushing rates will determine the fragmentation. The fragmentation on the face and crest of the blast may be compromised in areas where residential properties are in close proximity due to the risk of flyrock and the airblast limit.

Community awareness of the blasting process will ensure that there are no unexpected disturbances as a result of blasting. The Community Relations Officer will remain in close contact with the local residents and feedback will be addressed as required.

8.3.1. Trial blast

Trial blasting will be carried out at each blasting location using the following methodology. A small controlled charge will be detonated in confined blast holes at the blast site, with monitors set to record the vibration. This charge will be approximately 20% of the charge calculated using the AS2187 Appendix J7.3 vibration equation, to comply with the vibration limit for nearby residences. Information captured during the trial blast will then be used in calculations to determine the site relationship between charge mass, distance and vibration level.

All information gathered during the trial blast exercise will then be used to update and or compile the Blast Design.

8.3.2. Blast design

Blast designs will be submitted to the Project Engineer by a qualified person representing the drill and blast subcontractor for every blast. The blast design will include the following information which will be submitted as Hold Points:

- Details of the quantity and type of explosive to be detonated
- The blasting pattern
- Measures to limit noise / airblast overpressure
- The calculated maximum instantaneous charge (MIC) of explosives to produce a vibration level below the allowable limit
- Location and time of blast
- Shotfirer name and copy of Licence
- Inspection following blast and procedure in the event of a miss-fire
- Methods for limiting and monitoring vibration

8.3.3. Drilling and blasting on site

Drilling on site

The drilling operation, and the hazards and risks associated with this activity will be controlled in an activity specific SWMS. The SWMS will identify and list controls for all hazards with working with the drill rig as well as the environment around the drilling operations.

Prior to commencing with any drilling on site, and in addition to the SWMS and legislative requirements, the following specific requirements will be put in place.

- Have available and utilise appropriate dust suppression equipment / methods so as to minimise the impact of dust upon personnel and the environment
- Ensure drill holes are capped / plugged if blasting is not imminent in order to prevent fauna deaths via entrapment and debris entering the hole.
- Each blast hole is to be inspected by the authorised person before insertion of the charge
- Handling, storage and changing of drill rods
- Recovery of broken/damaged rods or drill bits

Blasting schedule

The frequency of blasting in the cuttings will be dependent on the production of crushing and earthmoving plant. Where possible the previous blast will be removed prior to the following blast, to enable a free face for blasting. This will improve fragmentation and reduce vibration for each blast. If the previous blast cannot be totally removed, the face of the following blast may be exposed by excavating a trench at the rear of the blasted rock.

It is expected that blasting will occur approximately once a week. The days of the week will be determined by the drilling production, weather and quantity of shot rock remaining in the cut.

Golding shall obtain permission to blast from the Principal prior to every blast. This is a HOLD POINT

8.4. Traffic Control

Traffic control will be utilised when the Pacific Highway or local roads are within the evacuation area for a blast. Should the Pacific Highway or a local road require a stoppage, a Traffic Control Plan (TCP) will be issued for Hold Point release along with the Blast Plan for the specific area.

The expected stoppage time for traffic will be up to 5 minutes from the commencement of the warning signal to ALL CLEAR has been given to the blast guards and traffic controllers.

9. Documentation and Standards

The following documentation will form part of the drill and blast process as required by legislation, the relevant standards and this blast management plan:

- Excavation and Penetration Permit
- Explosive Permit
- Safe Work Method Statement (SWMS)
- Appointment of Authorised Person Form
- Blast Plan

- Golding Checklists
- Blast Design
- Work at Height Permit (where required)
- ERSED Plans
- Employee records to be maintained by the Blasting Contractor
- Hold Point release forms

The following standards will have relevance to the drilling and blasting activities:

- AS/NZS 1200 Pressure equipment
- AS/NZS 1768 Lightning protection
- AS 2187.1 Explosives – Storage, transport and use – Storage
- AS 2187.2 Explosives – Storage and use – use of Explosives
- AS 4326 The storage and handling of oxidizing agents
- Australian Code for the Transport of Explosives by Road and Rail (Third Edition 2009)

10. Hold Points

Table 10-1 sets out the hold points required to be submitted to the Principal for approval.

Table 10-1: Hold Points

Specification	Hold Point	Notice Required
G36 Cl 4.7	Building Condition Inspection Reports and Vibration and Air Blast Management Plan	10 Working days
R44 Cl 4.7.1	Submission of blasting procedure details. Submission of altered blasting procedure details.	Start of each blasting operation

11. Terms and Definitions

The following definitions and or abbreviations are used throughout this document

Terms Definitions and Abbreviations

Item	Description

Attachment A – Technical Assessments (tbc)

Attachment B - Vibration Analysis (tbc)

Attachment C – Permits and Checklists (tbc)

Attachment D – Standard Operating Procedures (SOPs) (tbc)

Appendix C

Out of hours works procedure

CONSTRUCTION PROCEDURE
OUT OF HOURS WORKS PROCEDURE

Purpose: This Procedure describes the process to obtain approval for audible works outside of the approved hours for construction activities.

Project No.:	RMS 00031	**Project Description:**	Pacific Highway Upgrade - Woolgoolga to Ballina Early Works – Wave 1 and Wave 3 (part)
Scope of Procedure	This Procedure applies to construction works outside the standard construction hours (MCoC B16) with the following exceptions: • Where the works do not cause construction noise to be audible at any sensitive receiver • Where the delivery of materials is required by police or other authorities for safety reasons; or • Where work is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm. The Environment Protection Licence (EPL) issued by the NSW EPA provide conditions relevant to the standard hours of work. This procedure does not apply to blasting as blasting is only permitted during the working hours specified in MCoA B21 (except in the event of a direction from police or other relevant authority for safety reasons), or to impulsive or tonal emissions as specified in MCoA B18. Refer to Figure 1 for the Out of Hours Works Procedure flow chart.		

Procedure

1. Out of Hours Work Assessment

Where audible out of hours work is required, an Out of Hours Work (OOHW) Assessment will be prepared by the Environmental Site Representative (ESR). As part of the preparation of the OOHW Assessment, the ESR will consult with the Environmental Representative (ER), Roads and Maritime Services' (RMS), Environment Protection Authority (EPA) and Clarence Valley Council (CVC) at least 2 weeks prior to the proposed work. Consultation will also be undertaken with affected receivers. Refer to Steps 2 to 6 for details on consultation requirements.

The OOHW Assessment will include:

- Details of the nature and justification for activities to be conducted during the varied construction hours;
- A noise impact assessment of predicted noise levels in each noise catchment area (NCA) with number of residents predicted to affected;
- Details of any additional proposed noise monitoring;
- Evidence that appropriate consultation with potentially affected sensitive receivers and notification of CVC has been undertaken;
- Evidence that all reasonable and feasible noise mitigation measures have been put in place; and
- Evidence of consultation with EPA on the proposed variation in construction hours.

2. EPA Consultation

The ESR will consult with EPA on the proposed variation in construction times. The consultation will include but not be limited to details on how Golding Contractors are meeting the requirements of MCoA B16, B17 and EPL Conditions.

3. Community Consultation

The ESR and Community Relations Manager (CRM) will undertake community consultation to inform the community of the proposed out of hours activities and mitigation measures to be implemented to obtain general community support. If there is opposition from the community for the proposed OOHW, then Golding Contractors will review and revise the proposed work program and mitigation measures based on community feedback and continue to work with the community to obtain

community support.

4. Community / Council Notification Preparation

The CRM in consultation with the relevant team members (i.e. ESR, Project Manager (PM) or Traffic Control Site Manager (TCSM)) will prepare written notifications for the community and CVC, outlining the works to be undertaken, date and location, and any likely impacts to the community.

5. Community / Council Notification Approval

Once the internal review process is completed, the draft notifications are forwarded to RMS for review.

The following timeframes apply:

Construction activity	Communication activity	When residents need to be notified	When Communication Team needs to have information
All activity outside standard construction hours			
	Letterbox notification	5 working days prior	11 working days prior to activity (1 for Golding, 5 for RMS /ER minor approval, 5 days resident notice)
	Individual letters	2 working days prior	3 working days prior to activity for a letter to a single individual (1 day for Golding, 2 days resident notice) 8 working days prior for letters to more than 1 individual (1 day for Golding, 5 days RMS, 2 days resident notice)
	Resident Doorknocks	48 hours prior	3 working days prior to activity (1 day Golding / ER, 48 hours resident notice)

6. Issue of Notification

Once approved, the CRM issues the letterbox notification to residents 5 days, individual letters 2 days and doorknocks 48 hours in advance of the proposed works. The type of consultation utilised will be determined by the CRM in consultation with the ESR/PM.

Details of the community notification will be provided to EPA, CVC and RMS at least 48 hours prior to the works commencing (email to the relevant officer).

7. Works Approval

Following completion of the appropriate consultation with potentially affected sensitive receivers, EPA, CVC and RMS, the OOHW Assessment will be finalised and submitted with the Out of Hours Work Approval to the ER for consideration and approval.

8. Record keeping

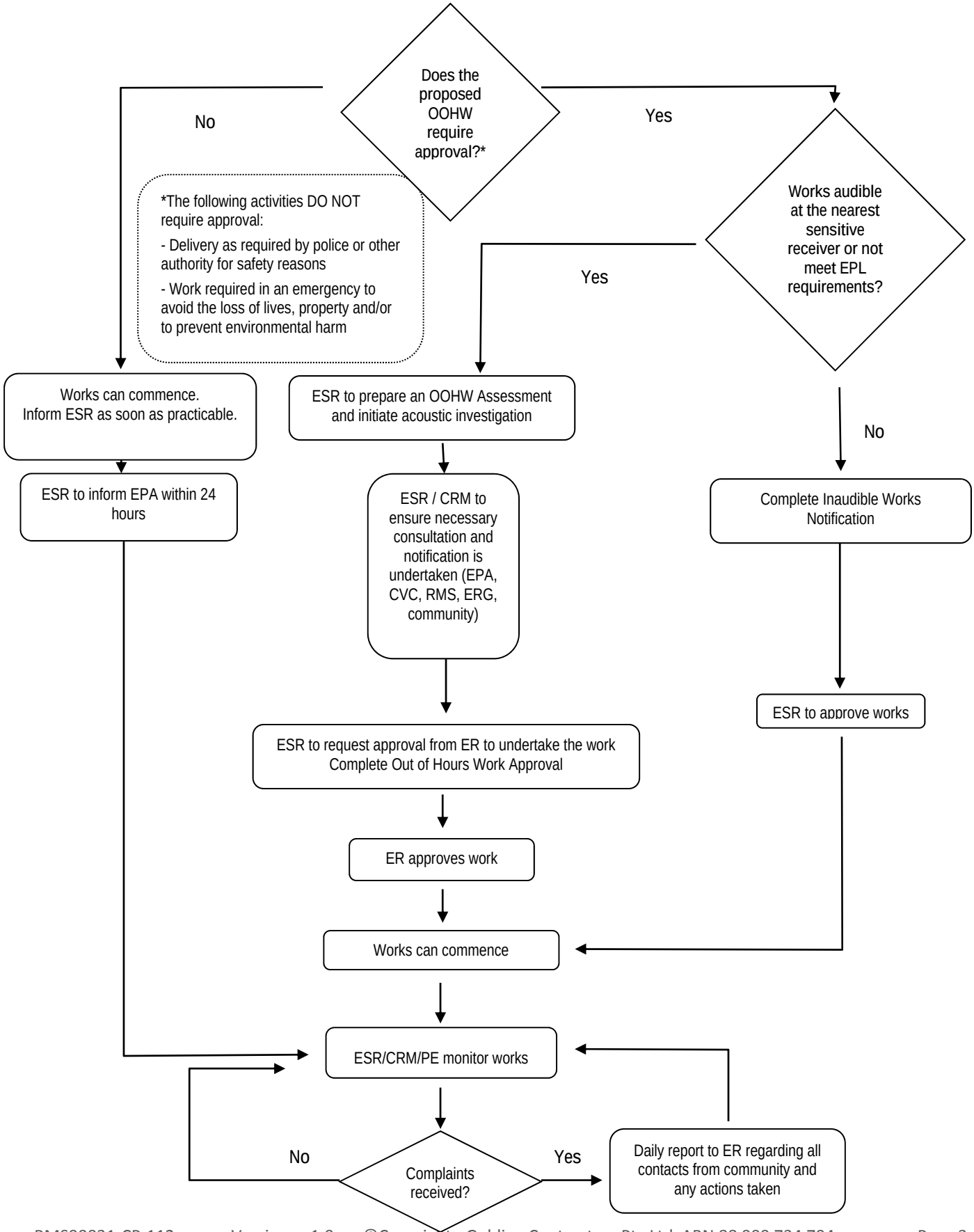
All notifications are registered and stored at the main compound during the project and appropriately archived at project completion.

9. Complaints

Any complaints received as a result of the works are to be managed in accordance with Section 6.3.2 of the CEMP.

CONSTRUCTION PROCEDURE
OUT OF HOURS WORKS PROCEDURE

Figure 1 Out of Hours Works Procedure Flow Chart



Appendix D
Unattended monitoring data

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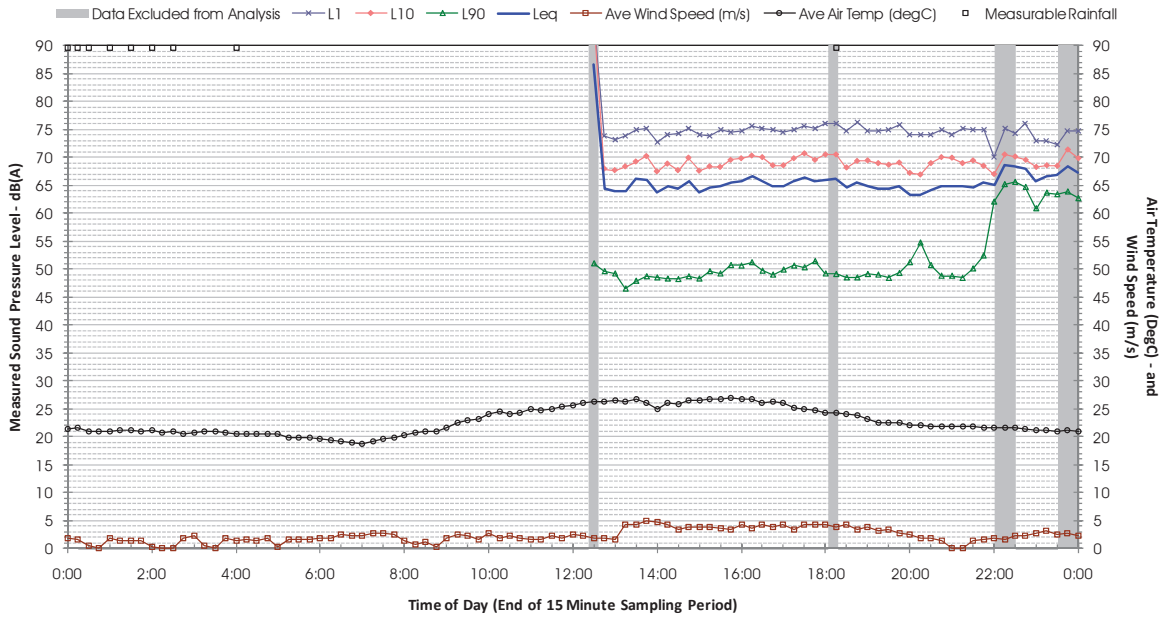
Wednesday 22 February 2012



Profile of Noise Environment - Noise Monitoring Location 842
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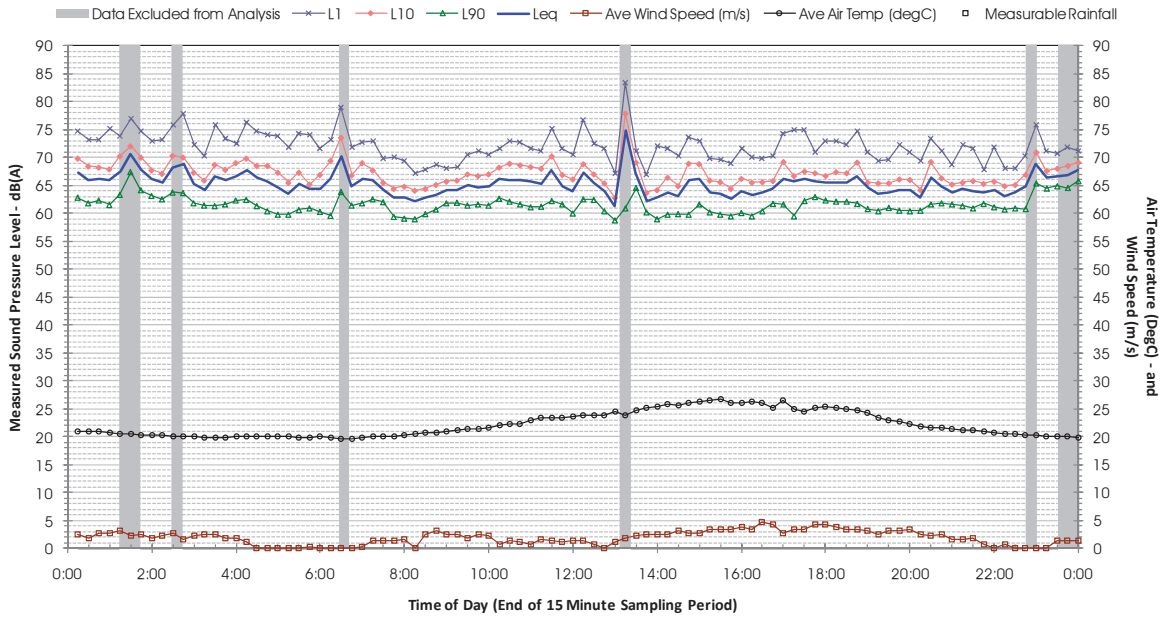

Profile of Noise Environment - Noise Monitoring Location 842
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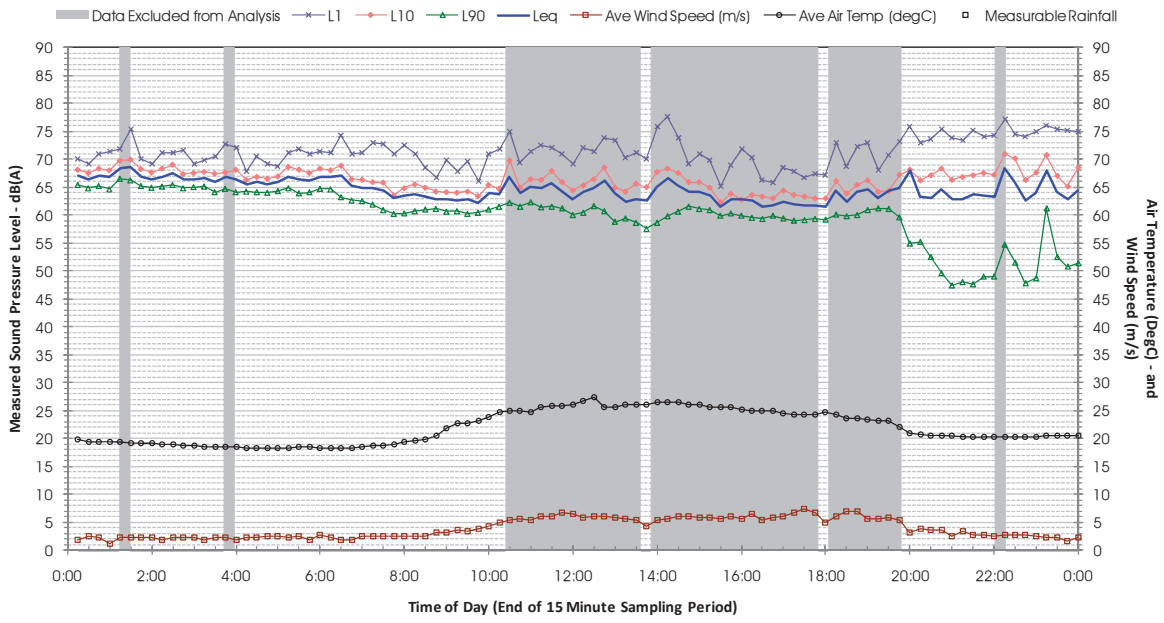

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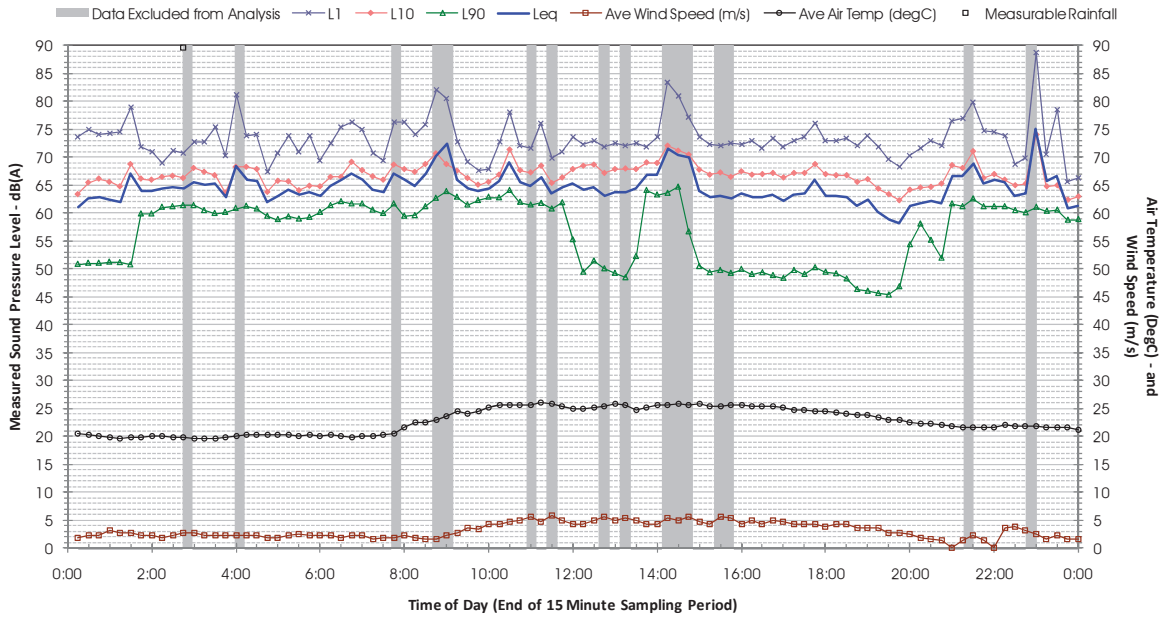

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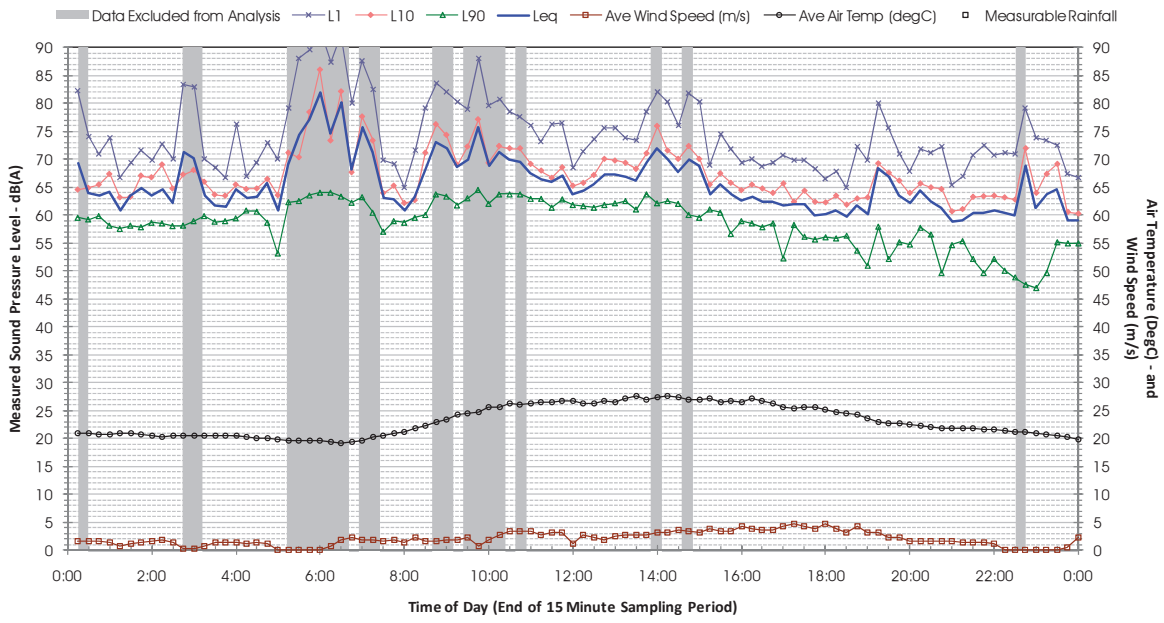

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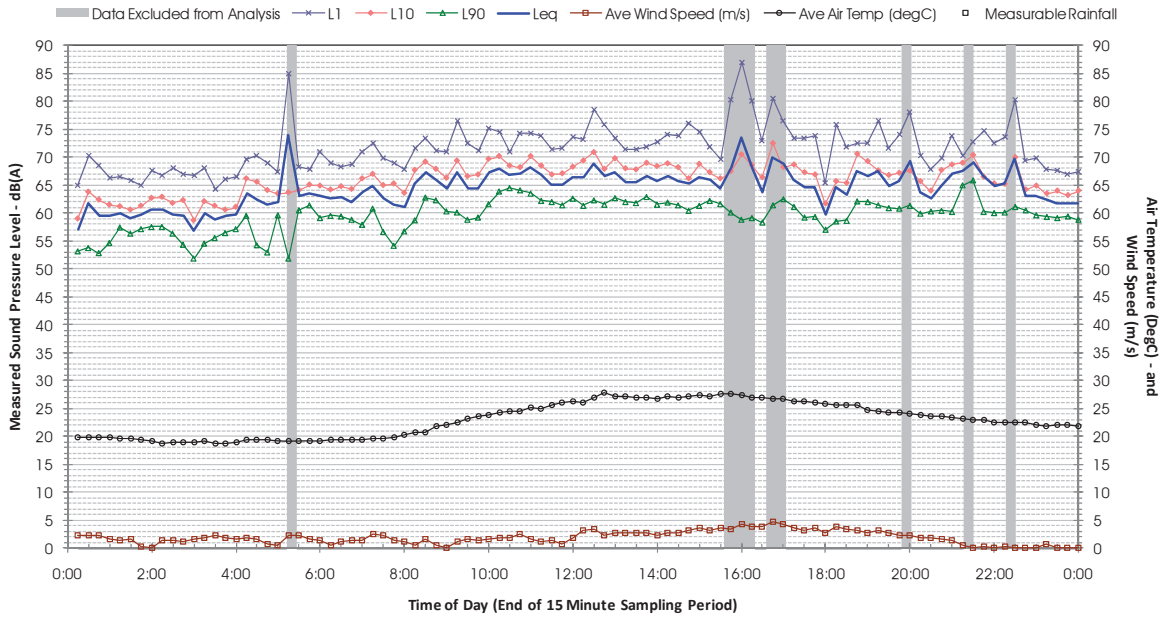

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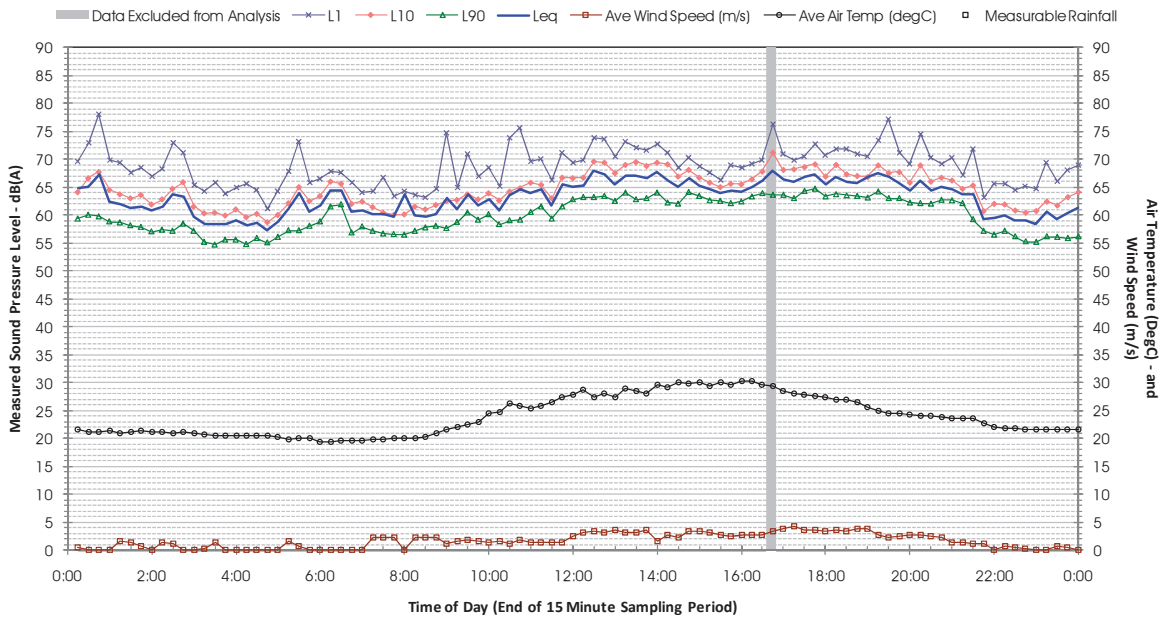

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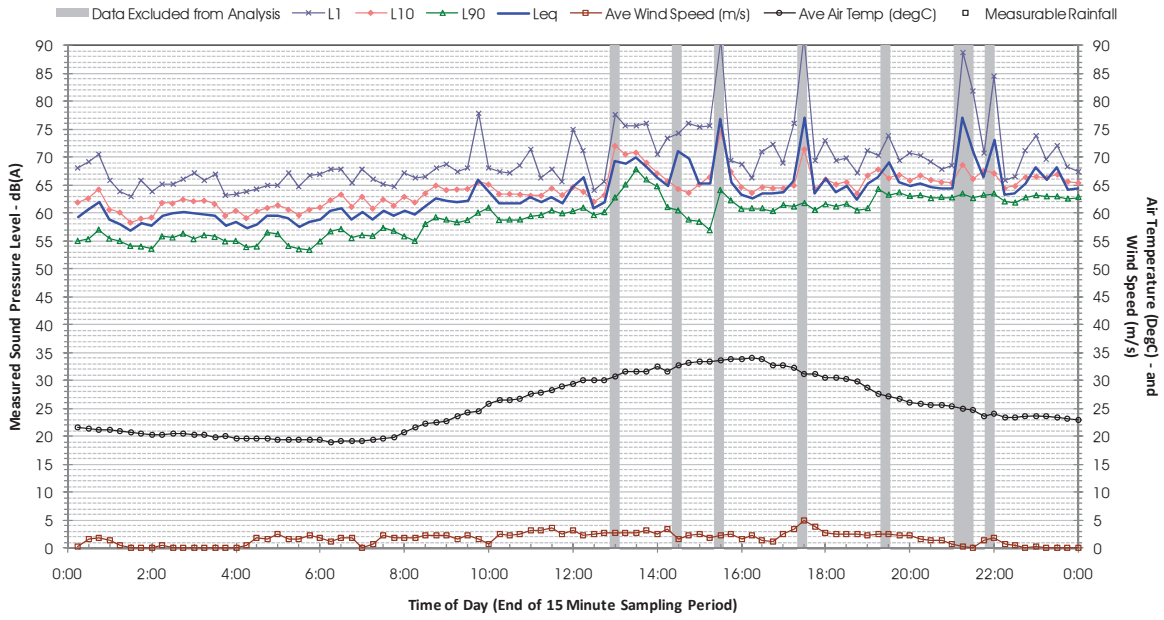

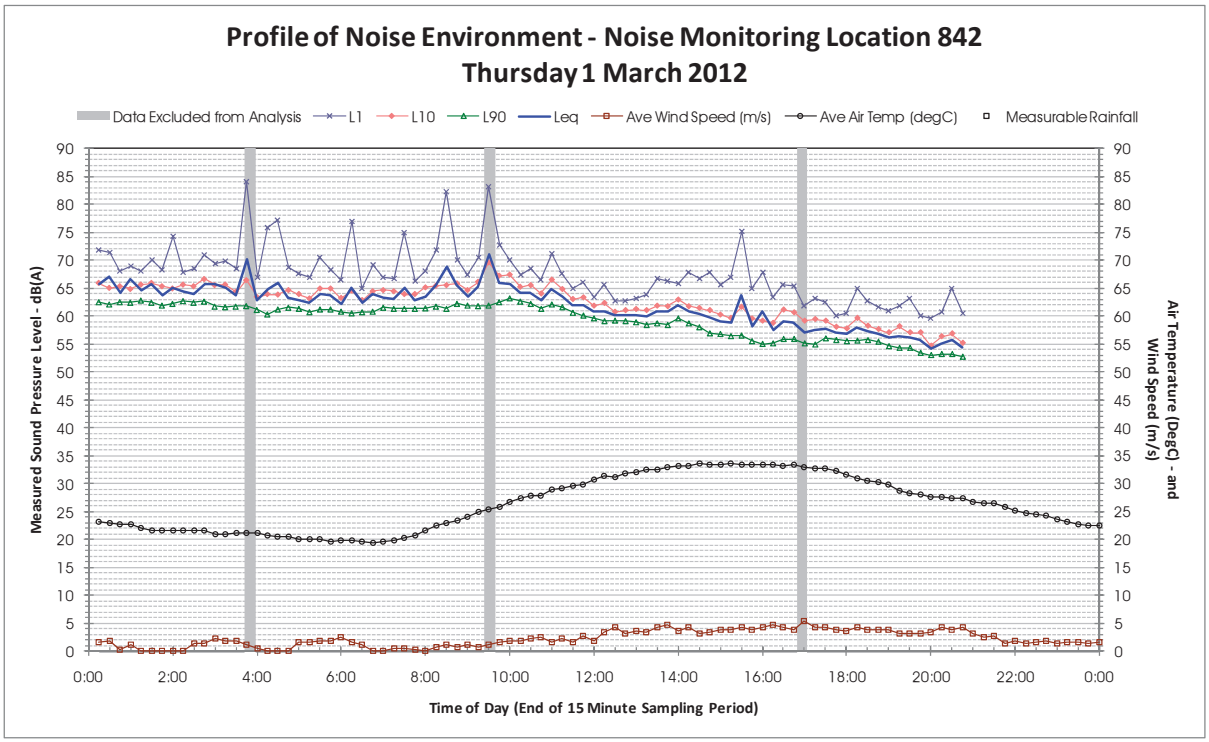
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Thursday 1 March 2012
Data Excluded from Analysis
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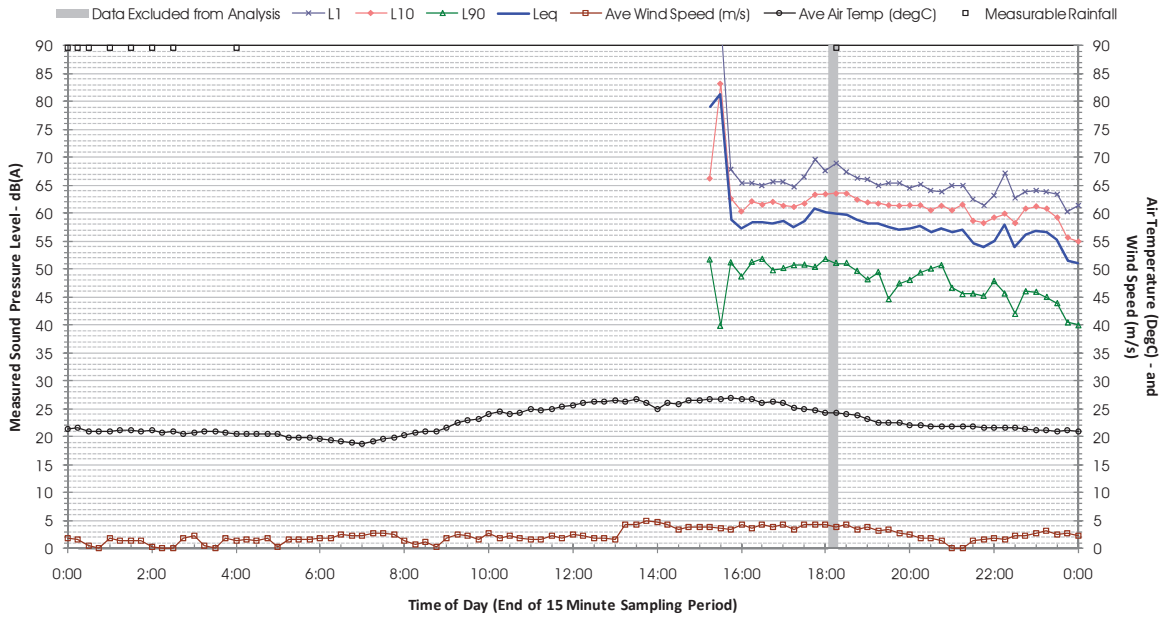
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

Profile of Noise Environment - Noise Monitoring Location 1396
Wednesday 22 February 2012



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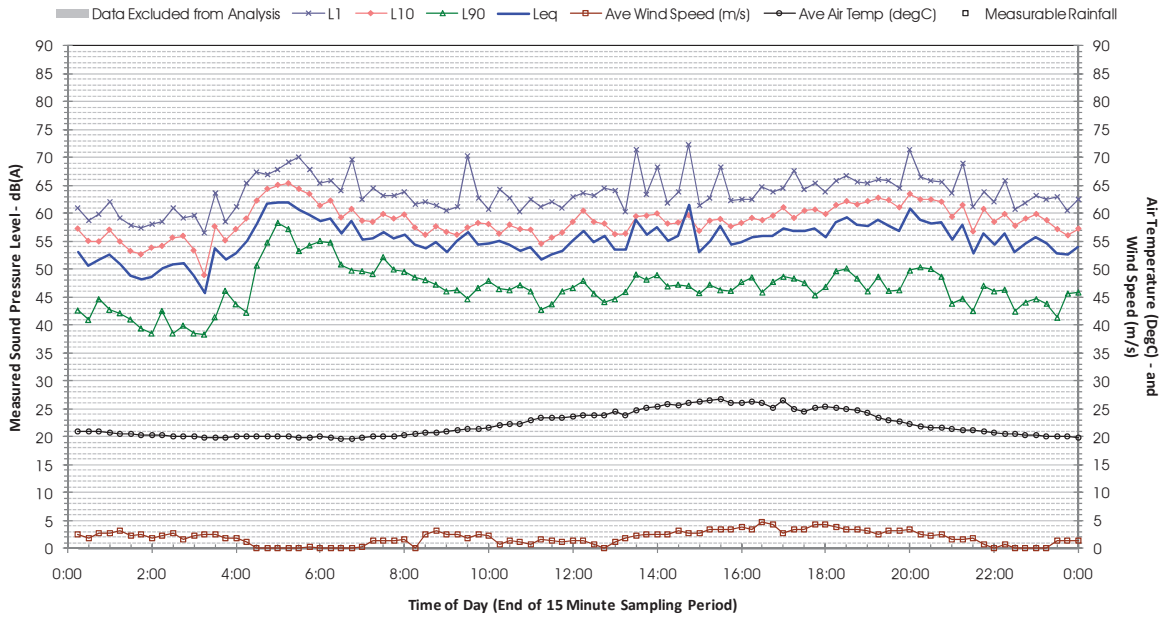

Profile of Noise Environment - Noise Monitoring Location 1396
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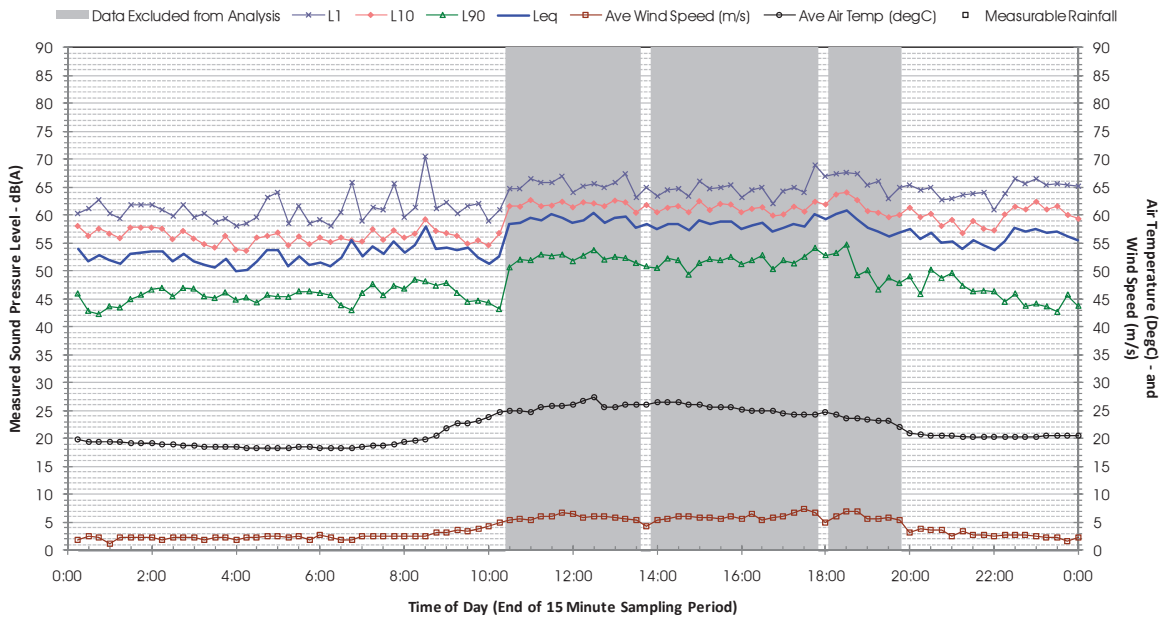
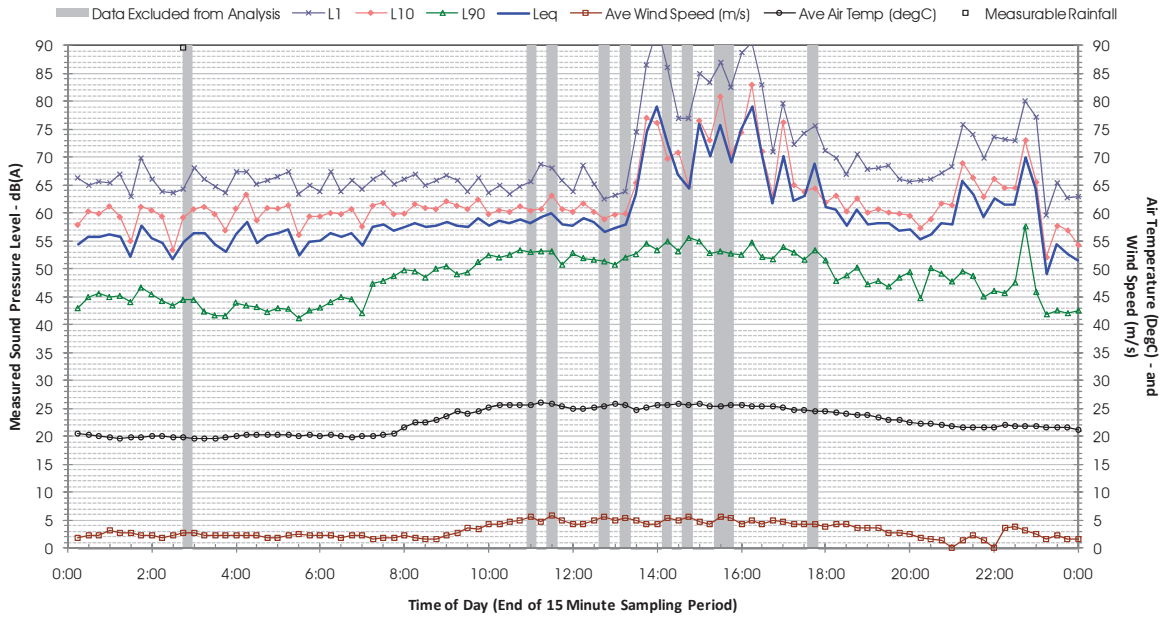
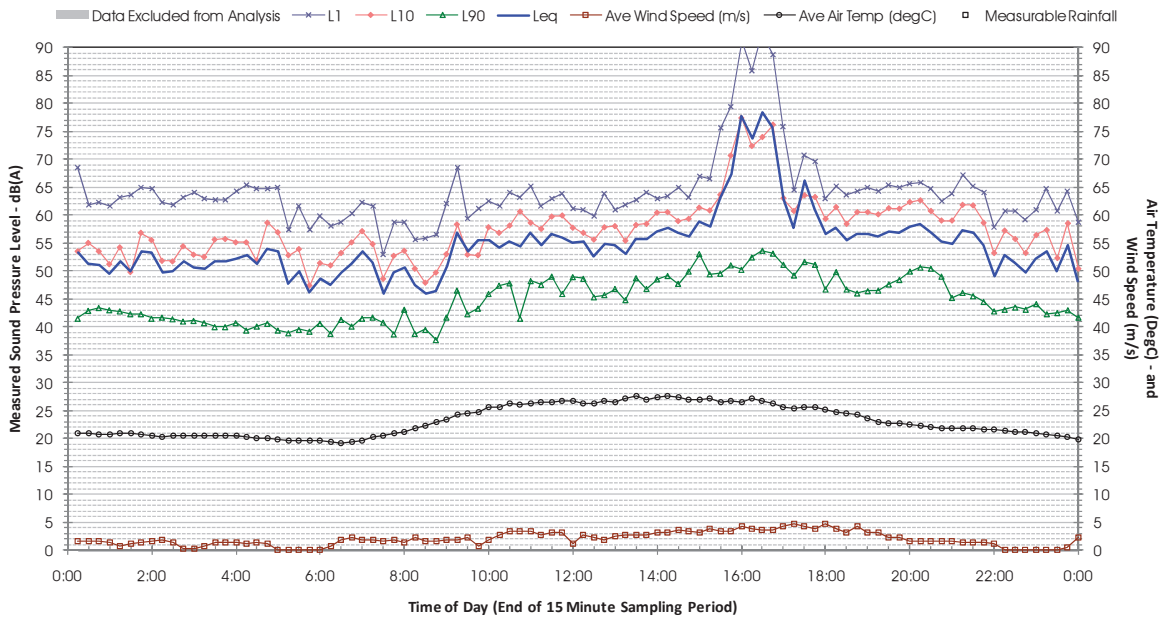


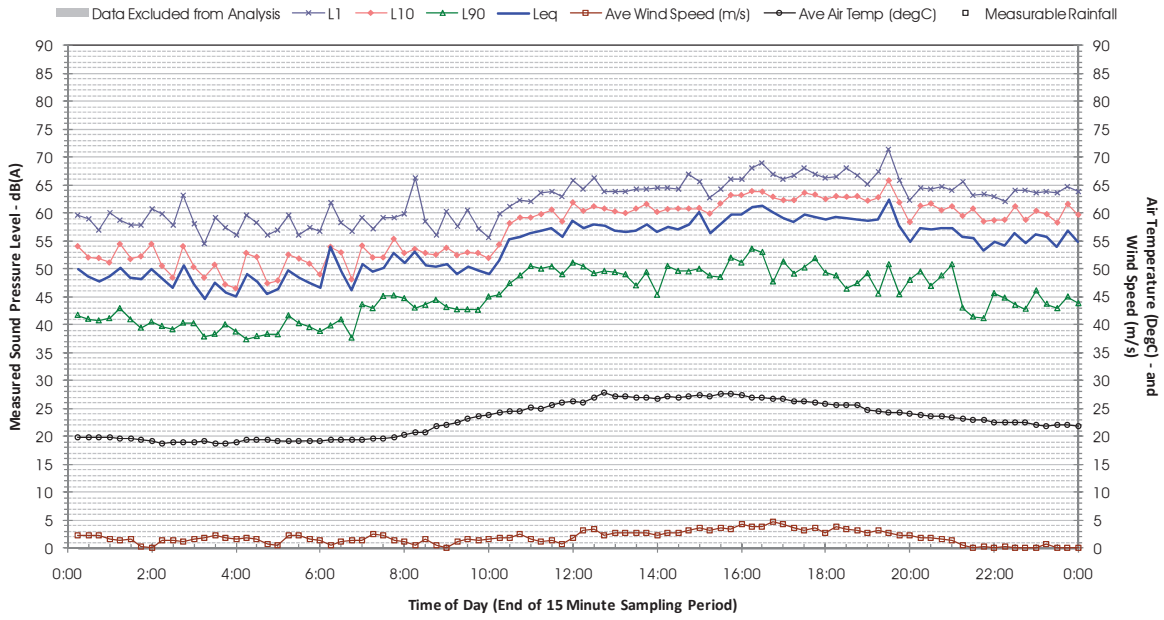
Profile of Noise Environment - Noise Monitoring Location 1396
Saturday 25 February 2012



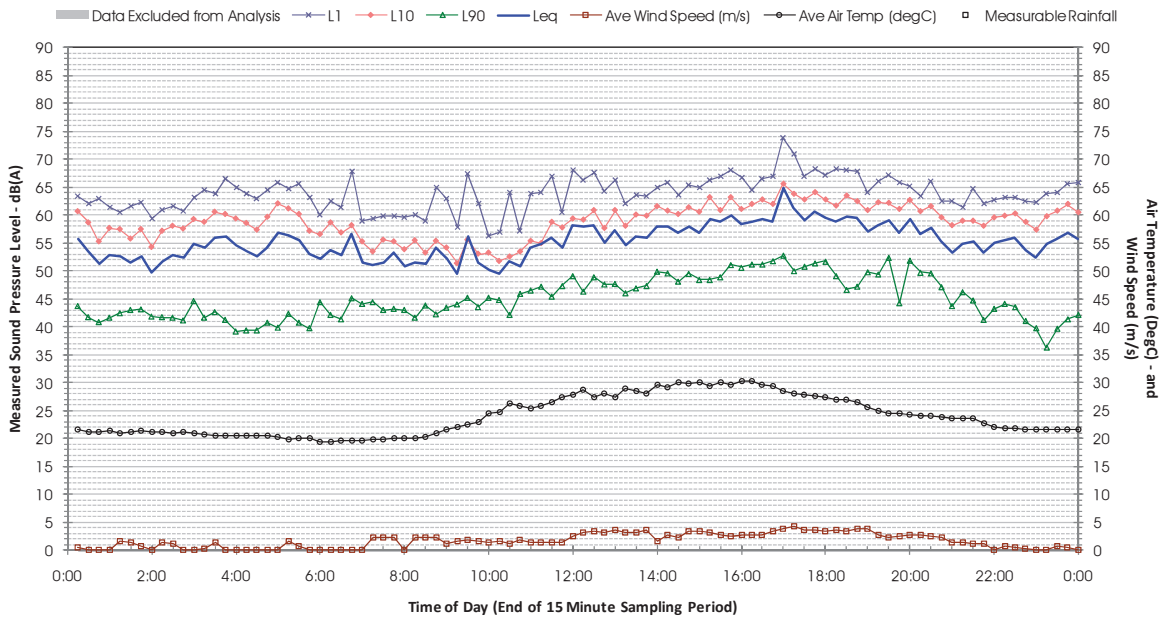
Profile of Noise Environment - Noise Monitoring Location 1396
Sunday 26 February 2012



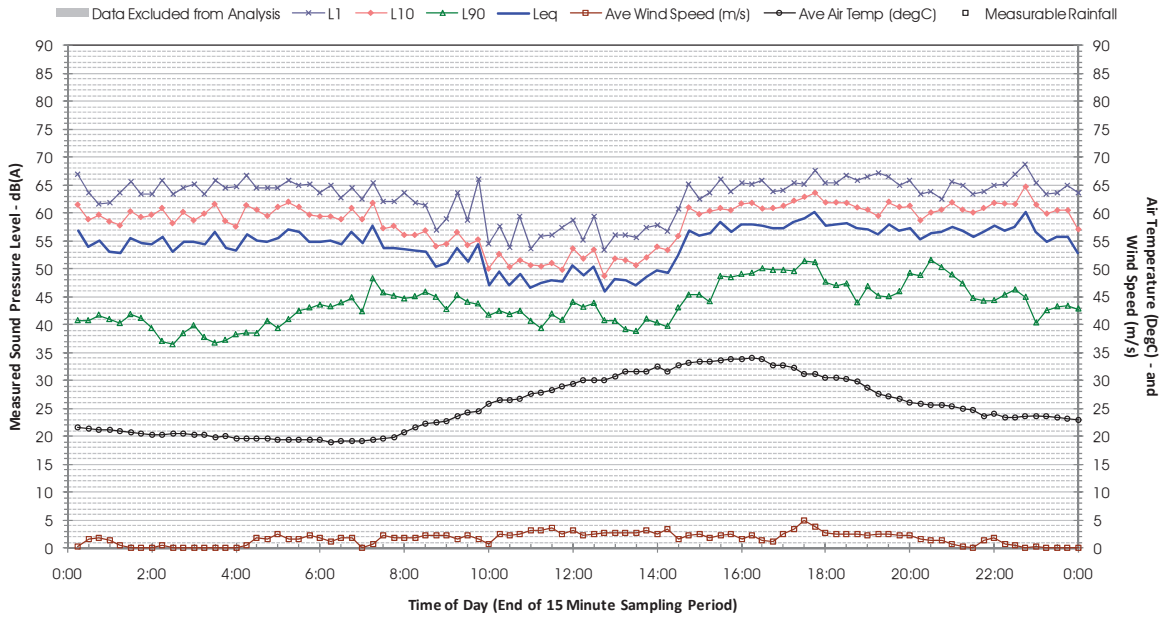
Profile of Noise Environment - Noise Monitoring Location 1396
Monday 27 February 2012



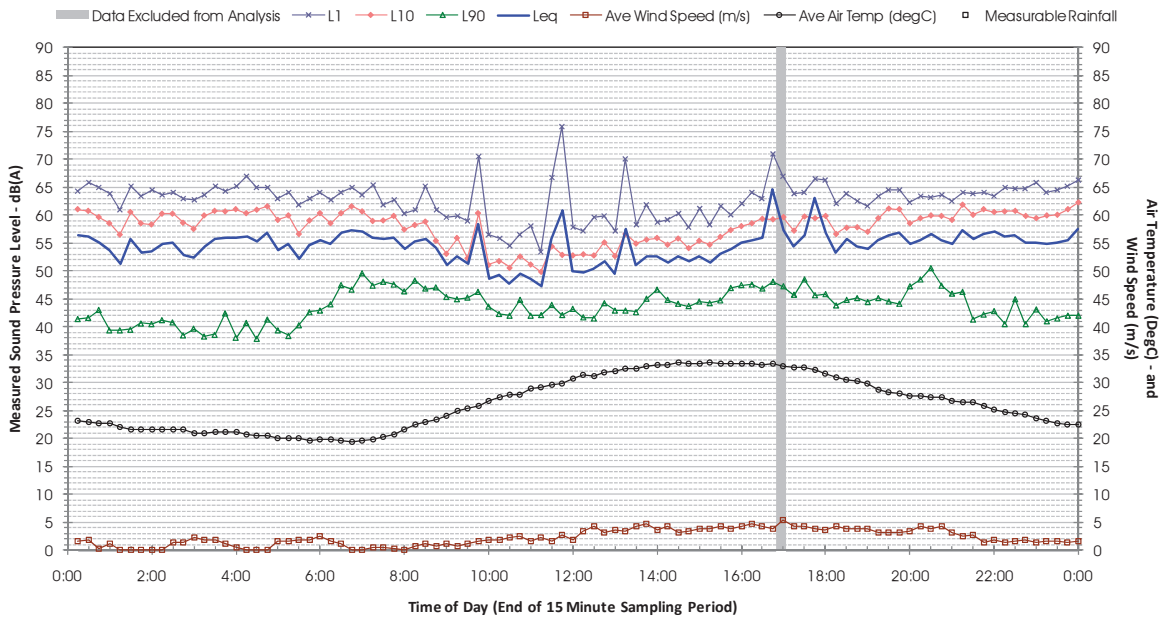
Profile of Noise Environment - Noise Monitoring Location 1396
Tuesday 28 February 2012



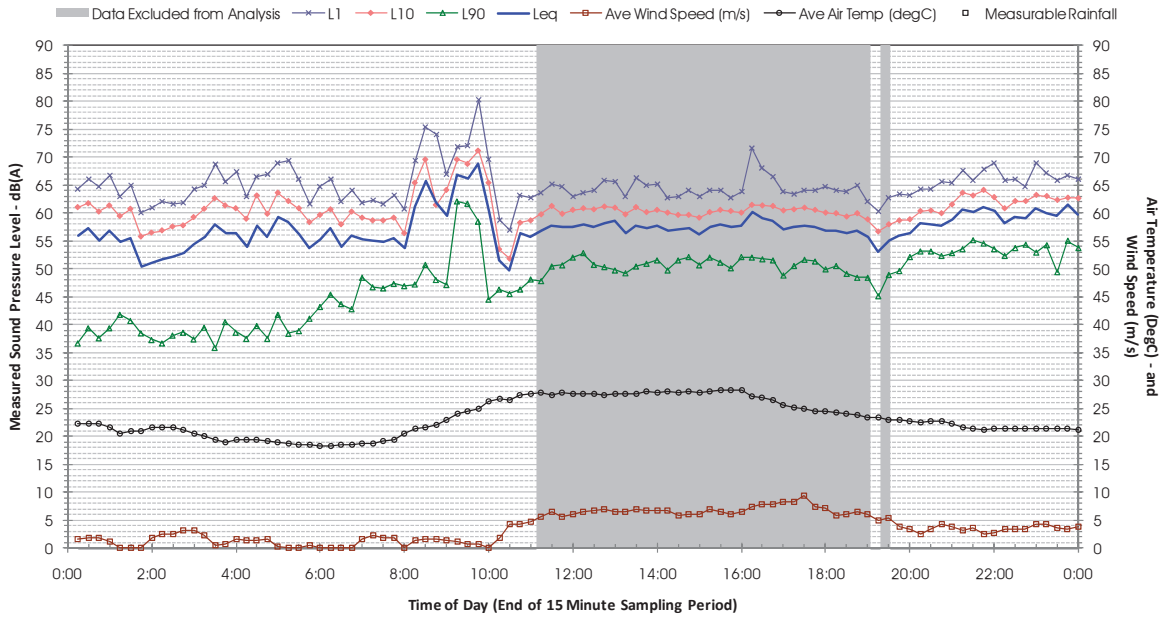
Profile of Noise Environment - Noise Monitoring Location 1396
Wednesday 29 February 2012



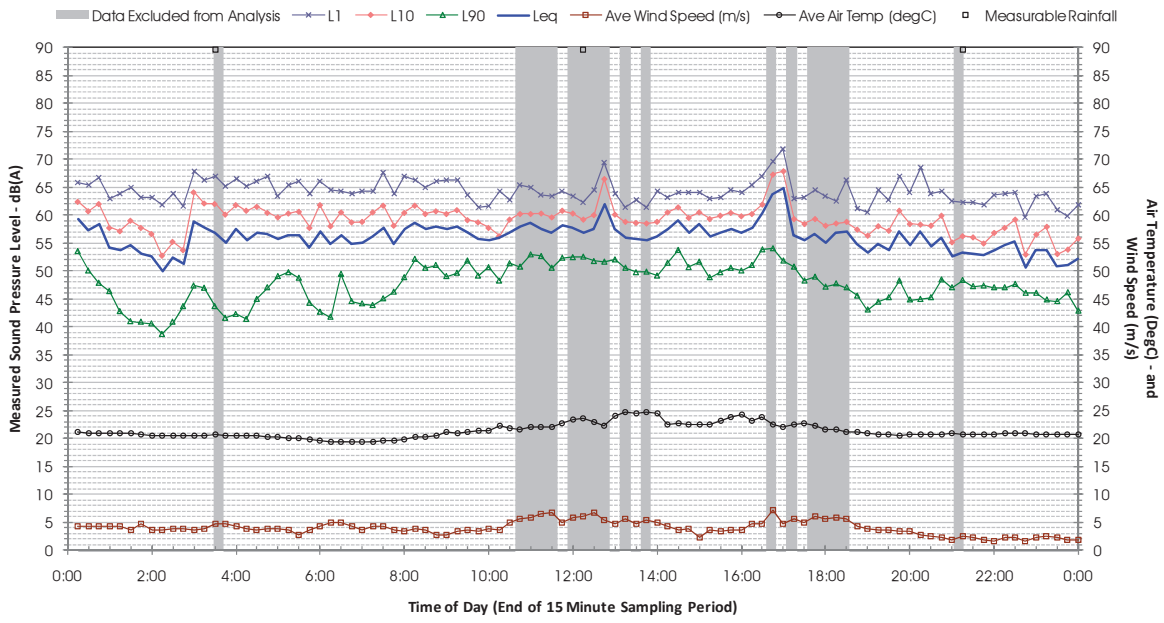
Profile of Noise Environment - Noise Monitoring Location 1396
Thursday 1 March 2012



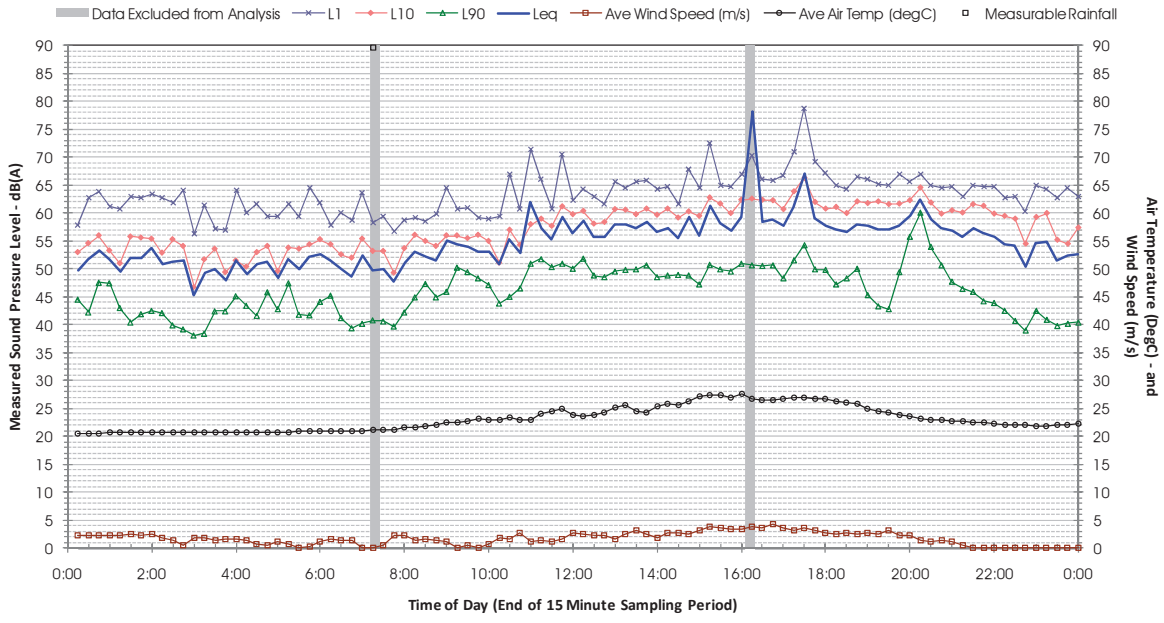
Profile of Noise Environment - Noise Monitoring Location 1396
Friday 2 March 2012



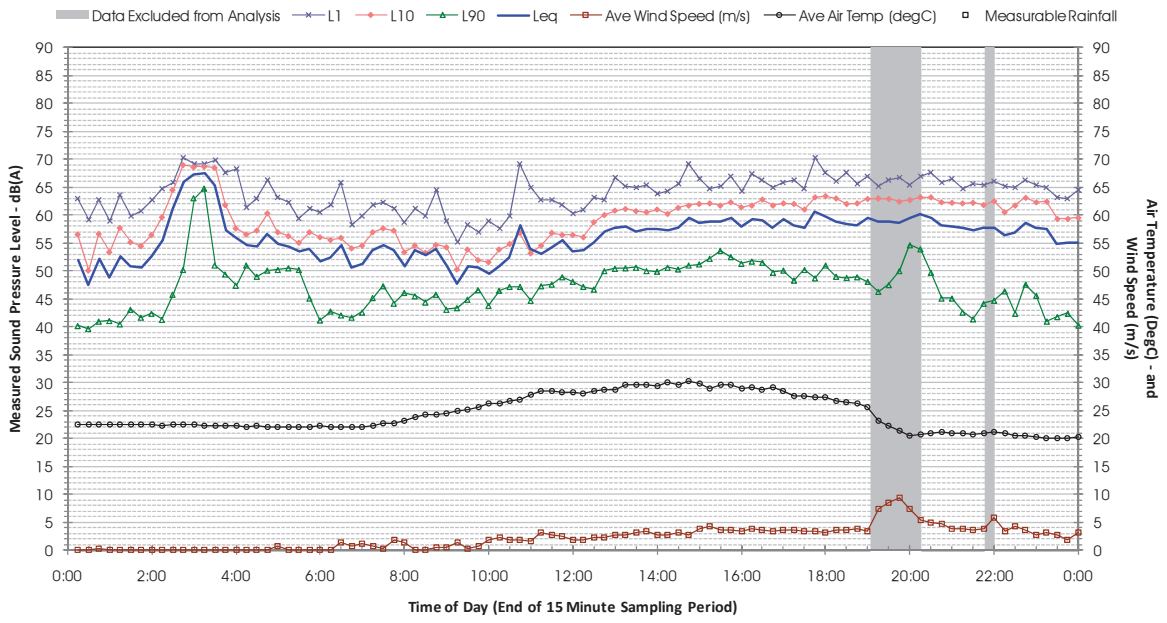
Profile of Noise Environment - Noise Monitoring Location 1396
Saturday 3 March 2012



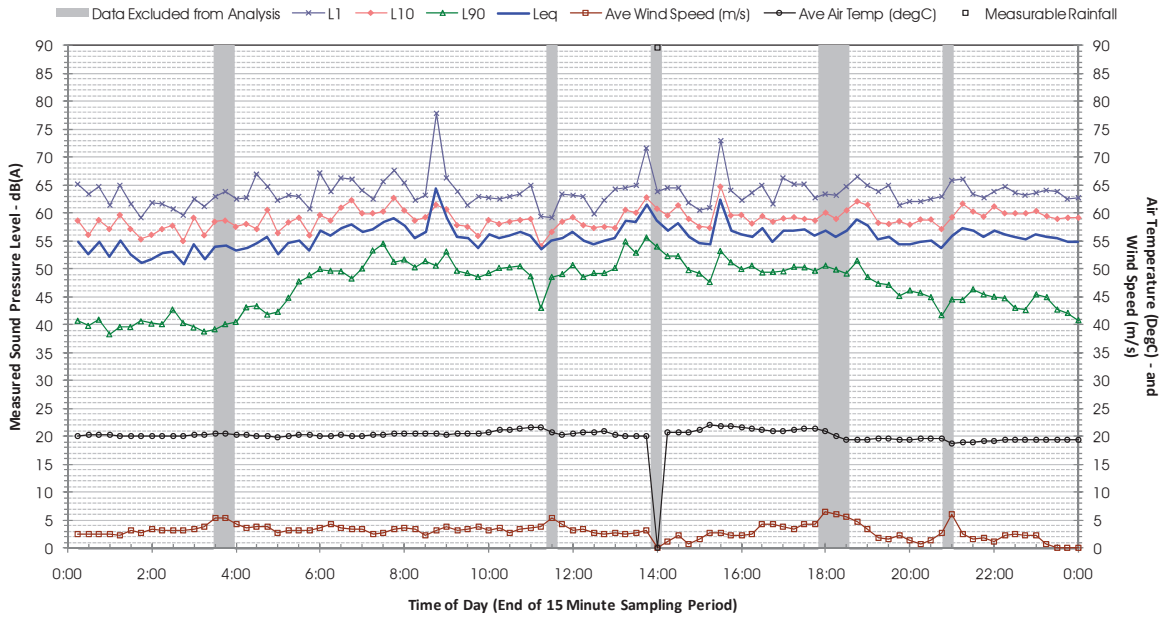
Profile of Noise Environment - Noise Monitoring Location 1396
Sunday 4 March 2012



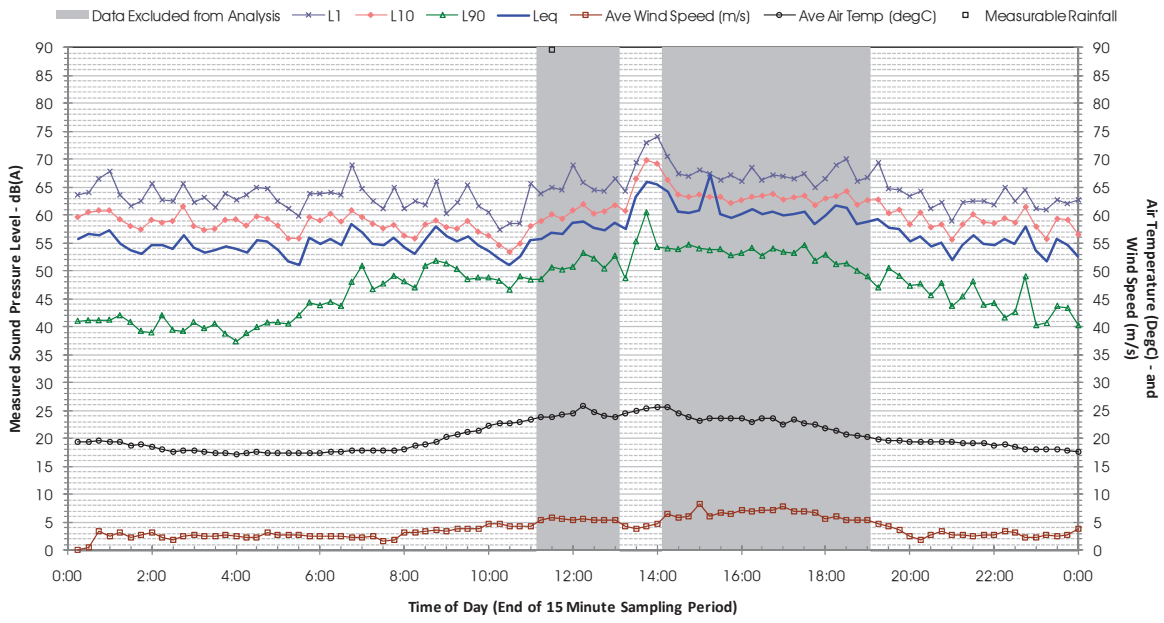
Profile of Noise Environment - Noise Monitoring Location 1396
Monday 5 March 2012



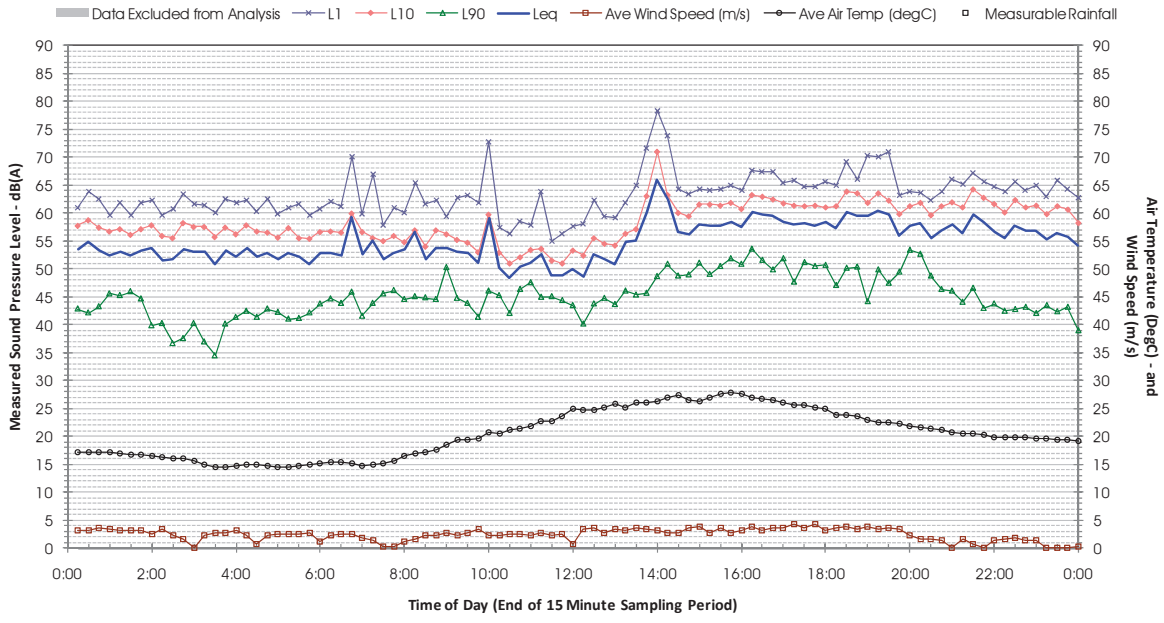
Profile of Noise Environment - Noise Monitoring Location 1396
Tuesday 6 March 2012



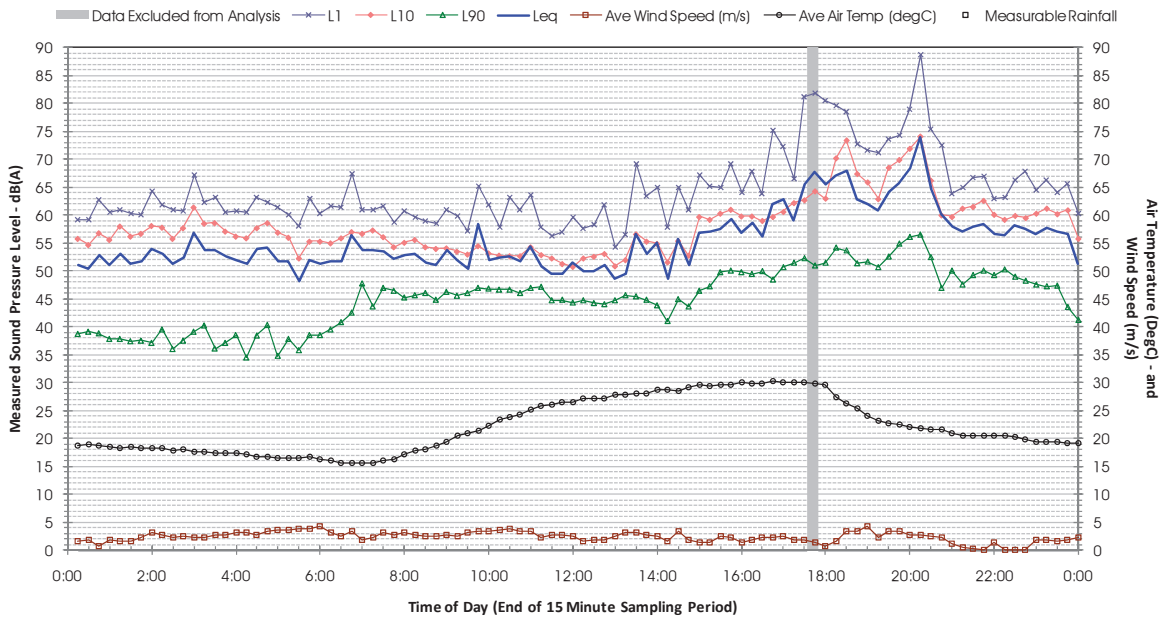
Profile of Noise Environment - Noise Monitoring Location 1396
Wednesday 7 March 2012



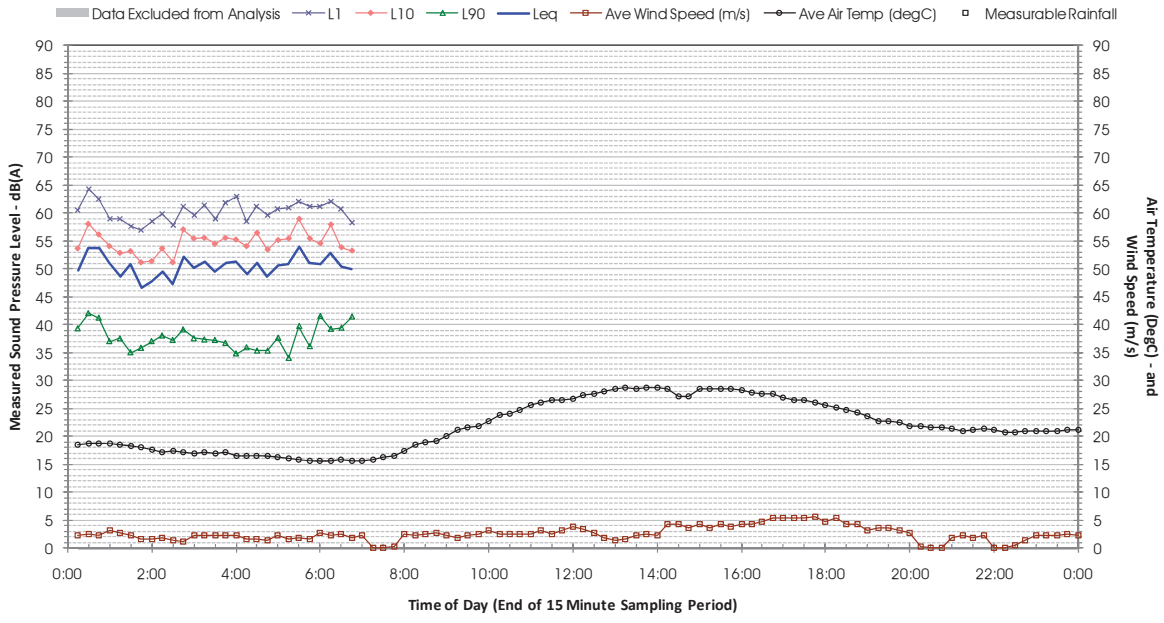
Profile of Noise Environment - Noise Monitoring Location 1396
Thursday 8 March 2012



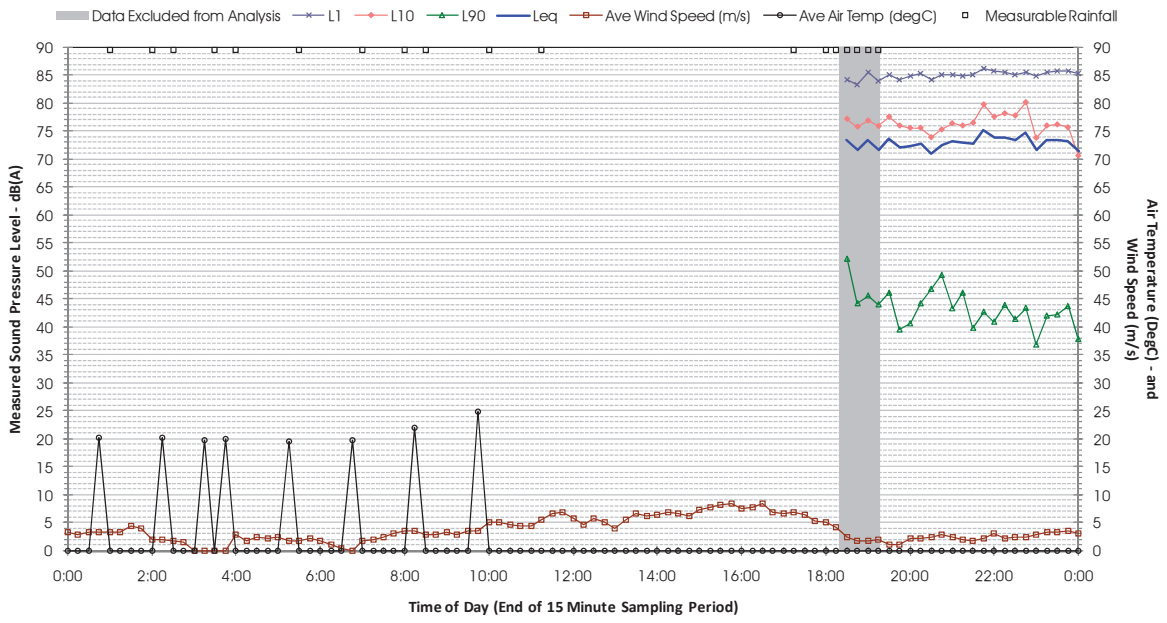
Profile of Noise Environment - Noise Monitoring Location 1396
Friday 9 March 2012



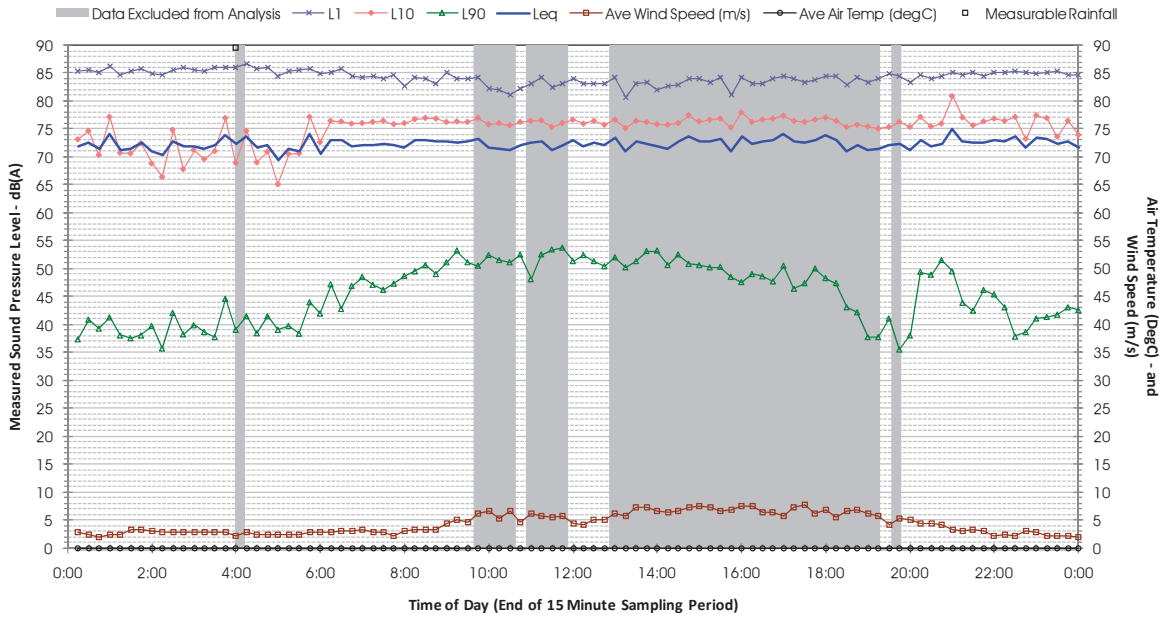
Profile of Noise Environment - Noise Monitoring Location 1396
Saturday 10 March 2012



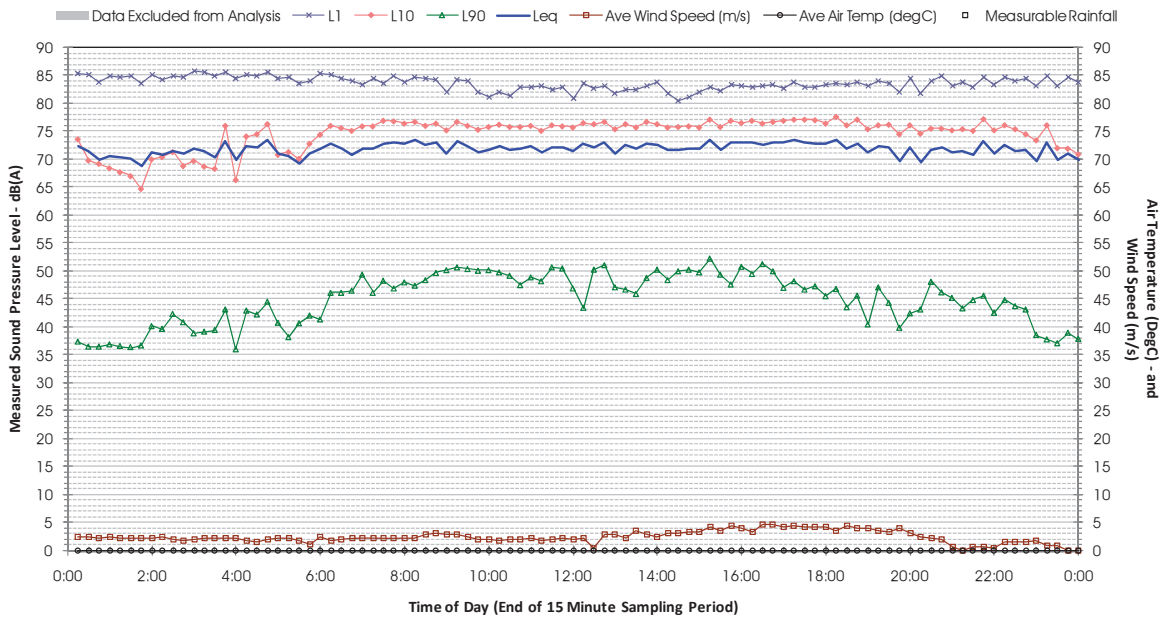
Profile of Noise Environment - Noise Monitoring Location 1438
Wednesday 8 February 2012



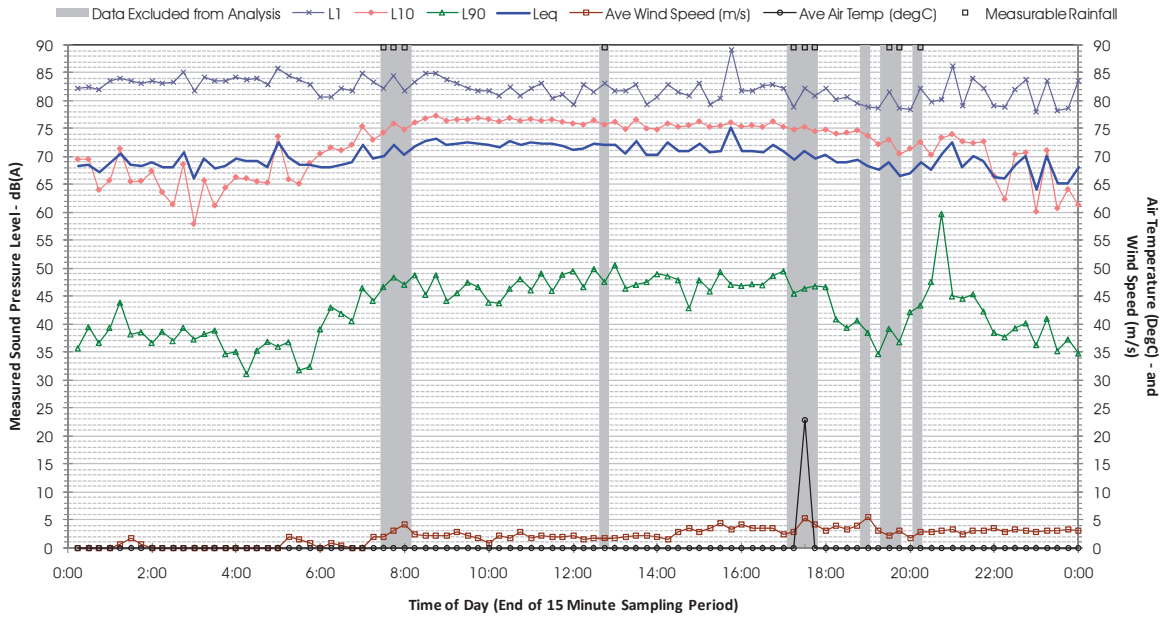
Profile of Noise Environment - Noise Monitoring Location 1438
Thursday 9 February 2012



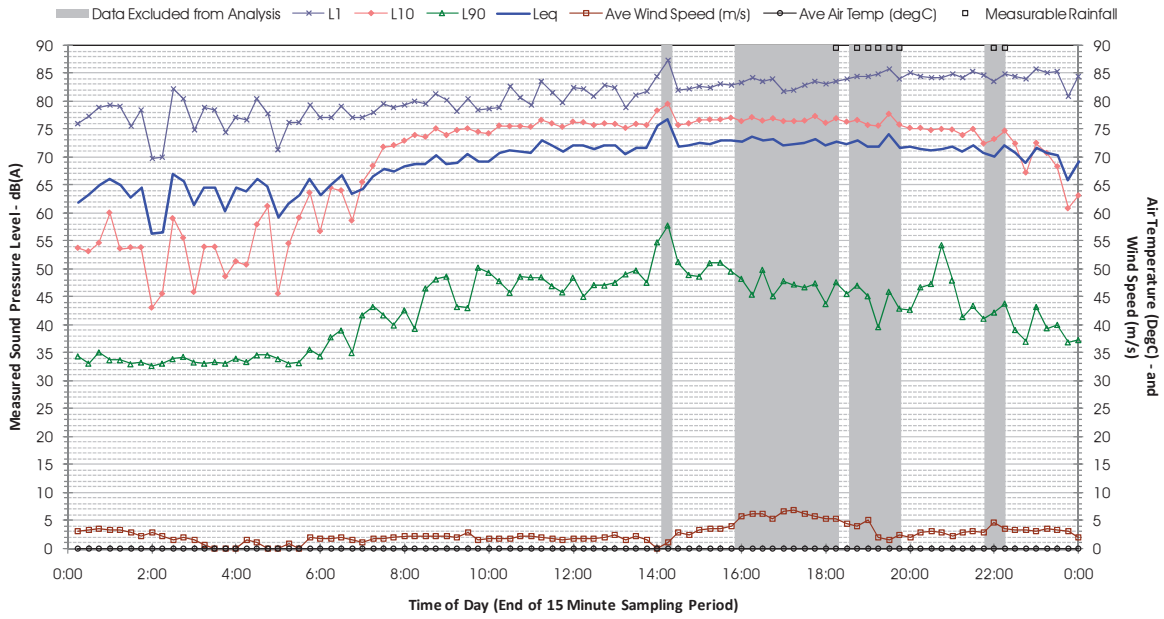
Profile of Noise Environment - Noise Monitoring Location 1438
Friday 10 February 2012



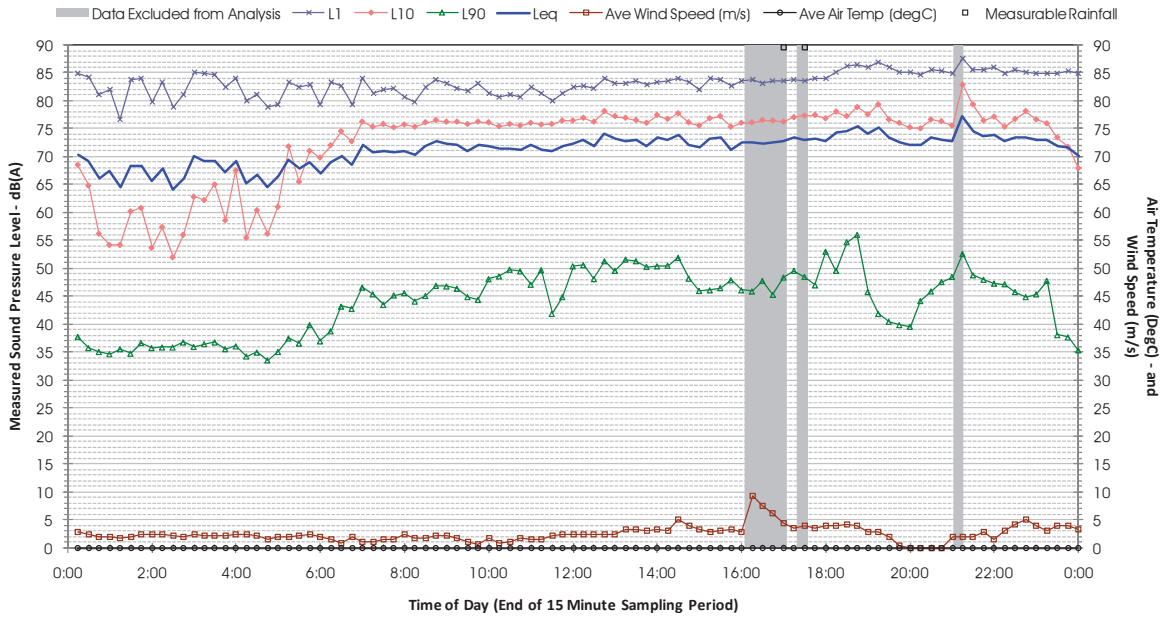
Profile of Noise Environment - Noise Monitoring Location 1438
Saturday 11 February 2012



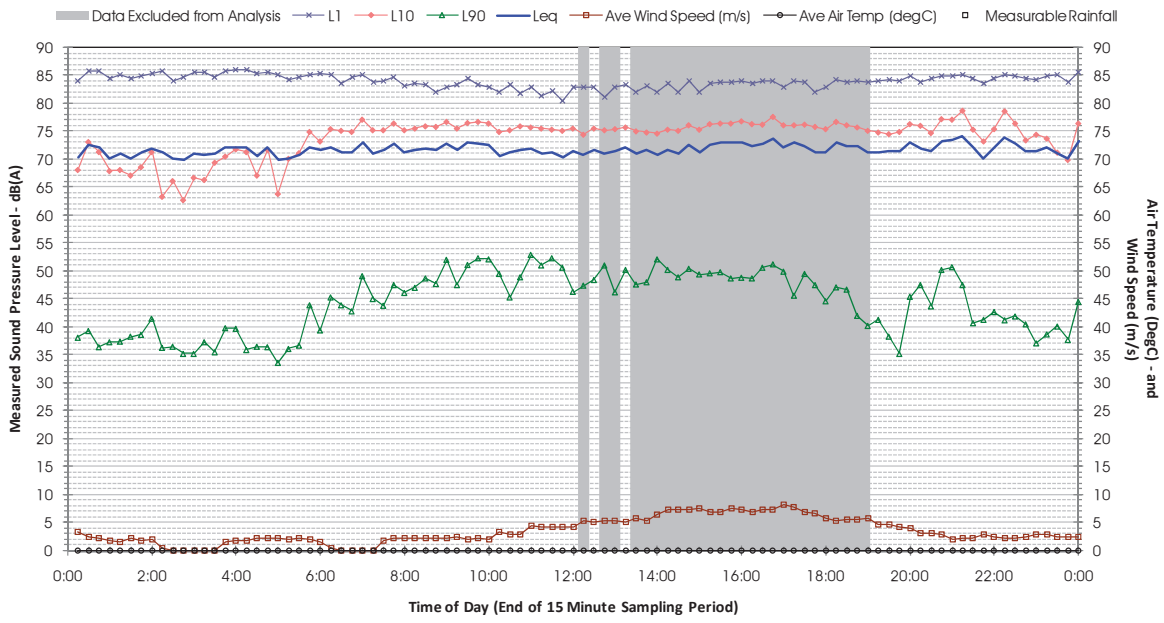
Profile of Noise Environment - Noise Monitoring Location 1438
Sunday 12 February 2012



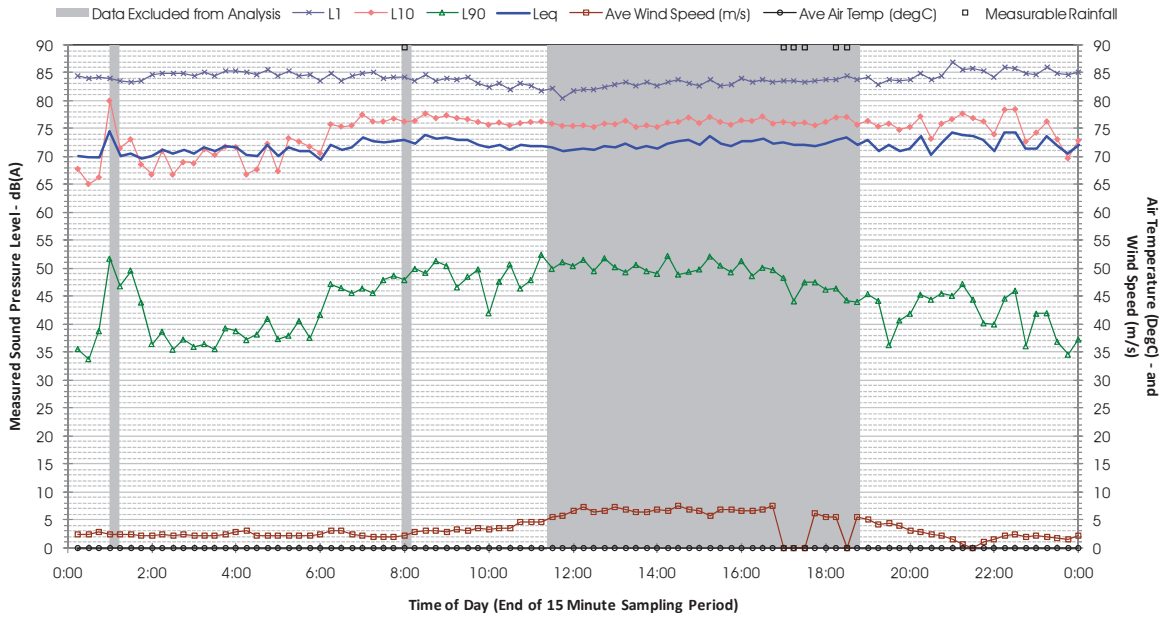
Profile of Noise Environment - Noise Monitoring Location 1438
Monday 13 February 2012



Profile of Noise Environment - Noise Monitoring Location 1438
Tuesday 14 February 2012



Profile of Noise Environment - Noise Monitoring Location 1438
Wednesday 15 February 2012



Appendix E
Noise Management Levels and Predicted Noise Levels Results

Noise Management Levels and Predicted Noise Levels

Notes

1. The results presented in this table have been reproduced from Appendix E of the document "Upgrading the Pacific Highway: Woolgoolga to Ballina Upgrade, Working paper: Noise and vibration, November 2012 Final"
2. An asterix * indicates that the receiver is situated within the project boundary, but has not been assessed
3. A receiver that has orange text (e.g. 1234) is exposed to levels as a result of one construction activity that exceeds the proposed hours noise management level (NML)
4. A receiver that has bold red text (e.g. **1234**) is exposed to levels as a result of one construction activity that exceed highly noise affected criteria of 75dB(A)
5. The exact location of receivers in the ranges 899 to 1238 and 1274 to 1407 is not identified in the working paper referred to in point 1 above. Therefore, it is not possible to determine which of these receivers will potentially be affected by the Wave 1 & 3 (part) works. All receivers in these ranges are listed in the table below.
6. NCA = Noise Catchment Area; NML = Noise Management Level

ID	NCA	Noise Management Level dB(A)		Predicted Noise Level from Construction Scenario dB(A)							Highest Construction Lmax dB(A)
		Standard hours	Out of hours	Enabling works	Clearing	Earthworks	Paving	Ancillary Sites	Bridges/ Piling	Haul Roads	
780*	3-c	55	40	0	0	0	0	0	0	0	0
784*	3-c	55	40	0	0	0	0	0	0	0	0
782*	3-d	44	47	0	0	0	0	0	0	0	0
805	3-d	44	47	0	63	68	66	57	52	0	76
811	3-d	70	70	0	57	62	60	51	46	0	70
812	3-d	44	47	0	58	63	61	50	43	0	71
813	3-d	44	47	0	58	63	61	46	34	0	71
816	3-d	44	47	0	60	65	63	46	34	0	73
817	3-d	44	47	0	61	66	64	45	33	0	74
818	3-d	44	47	0	62	67	65	44	34	0	75
820	3-d	44	47	0	52	57	55	39	17	0	65
824	3-d	44	47	0	58	63	61	38	17	0	71
793	3-e	55	44	0	51	56	54	65	55	0	73
800	3-e	55	44	0	50	55	53	63	53	0	71
801	3-e	55	44	0	51	56	54	65	54	0	73
802	3-e	55	44	0	52	57	55	67	54	0	75
786	3-f	55	40	0	42	47	45	47	44	0	55
787	3-f	55	40	0	42	47	45	48	45	0	56
788	3-f	70	70	0	43	48	46	50	47	0	58
789	3-f	55	40	0	46	51	49	51	47	0	59
790	3-f	70	70	0	46	51	49	50	47	0	59
791	3-f	55	40	0	47	52	50	51	47	0	60
792	3-f	55	40	0	47	52	50	53	49	0	61
794	3-f	55	40	0	48	53	51	54	49	0	62
795	3-f	55	40	0	48	53	51	55	51	0	63
797	3-f	55	40	0	49	54	52	58	53	0	66
798	3-f	55	40	0	49	54	52	59	53	0	67
866	4-a	43	44	41	45	50	48	46	0	0	58
986	4-a	43	44	0	44	49	47	44	40	0	57
991	4-a	43	44	0	45	50	48	44	40	0	58
1007	4-a	43	44	0	47	52	50	44	40	0	60
1012	4-a	43	44	0	43	48	46	42	39	0	56
1016	4-a	43	44	0	44	49	47	43	39	0	57
1017	4-a	43	44	0	48	53	51	44	40	0	61
1021	4-a	43	44	0	48	53	51	44	40	0	61
1023	4-a	43	44	0	43	48	46	41	39	0	56
1027	4-a	43	44	0	44	49	47	42	39	0	57
1030	4-a	43	44	0	44	49	47	42	39	0	57
1040	4-a	43	44	0	44	49	47	41	39	0	57
1041	4-a	43	44	0	44	49	47	41	39	0	57
1045	4-a	43	44	0	44	49	47	41	39	0	57
1047	4-a	43	44	0	44	49	47	40	38	0	57
1052	4-a	43	44	0	44	49	47	40	38	0	57
1054	4-a	43	44	0	44	49	47	41	38	0	57
1056	4-a	43	44	0	45	50	48	41	38	0	58
1067	4-a	43	44	0	45	50	48	40	38	0	58
1069	4-a	43	44	0	45	50	48	40	38	0	58
1070	4-a	43	44	0	46	51	49	40	38	0	59
1080	4-a	43	44	0	47	52	50	41	38	0	60
823	4-b	45	35	0	42	47	45	31	34	0	55
865	4-b	45	35	43	49	54	52	47	0	0	62
867	4-b	45	35	46	53	58	56	47	0	0	66
988	4-b	45	35	39	57	62	60	52	44	0	70
993	4-b	45	35	37	57	62	60	50	43	0	70
994	4-b	45	35	32	57	62	60	50	43	0	70
996	4-b	45	35	31	56	61	59	50	43	0	69
998	4-b	45	35	31	56	61	59	48	43	0	69
1001	4-b	45	35	0	55	60	58	48	42	0	68
1006	4-b	45	35	0	54	59	57	48	42	0	67
1009	4-b	45	35	0	54	59	57	47	42	0	67

ID	NCA	Noise Management Level dB(A)		Predicted Noise Level from Construction Scenario dB(A)							Highest Construction Lmax dB(A)
		Standard hours	Out of hours	Enabling works	Clearing	Earthworks	Paving	Ancillary Sites	Bridges/ Piling	Haul Roads	
1019	4-b	45	35	0	49	54	52	45	41	0	62
1022	4-b	45	35	31	60	65	63	49	43	0	73
1033	4-b	45	35	0	59	64	62	48	42	0	72
1035	4-b	45	35	0	57	62	60	48	42	0	70
1037	4-b	45	35	0	56	61	59	47	42	0	69
1049	4-b	45	35	0	49	54	52	44	40	0	62
1061	4-b	45	35	0	55	60	58	45	41	0	68
1063	4-b	45	35	0	56	61	59	45	41	0	69
1071	4-b	45	35	0	52	57	55	44	40	0	65
834	4-c	52	41	0	55	60	58	54	38	0	68
934*	4-c	52	41	0	0	0	0	0	0	0	0
958*	4-c	52	41	0	0	0	0	0	0	0	0
963*	4-c	52	41	0	0	0	0	0	0	0	0
966*	4-c	52	41	0	0	0	0	0	0	0	0
969*	4-c	52	41	0	0	0	0	0	0	0	0
973*	4-c	52	41	0	0	0	0	0	0	0	0
974*	4-c	52	41	0	0	0	0	0	0	0	0
975	4-c	52	41	41	69	74	72	59	46	0	82
976	4-c	52	41	41	67	72	70	58	46	0	80
977	4-c	52	41	40	64	69	67	56	45	0	77
979	4-c	52	41	41	66	71	69	57	46	0	79
980	4-c	52	41	40	65	70	68	56	46	0	78
981	4-c	52	41	40	63	68	66	55	45	0	76
983	4-c	52	41	39	62	67	65	54	45	0	75
984	4-c	52	41	39	62	67	65	53	45	0	75
987	4-c	52	41	39	61	66	64	53	44	0	74
995*	4-c	52	41	0	72	0	0	0	0	0	80
999	4-c	52	41	39	63	68	66	53	44	0	76
1000	4-c	52	41	40	70	75	73	54	45	0	83
1002	4-c	52	41	39	67	72	70	53	44	0	80
1003	4-c	52	41	39	63	68	66	52	44	0	76
1013	4-c	52	41	38	63	68	66	51	44	0	76
1020	4-c	52	41	35	62	67	65	50	43	0	75
1026	4-c	52	41	38	67	72	70	52	44	0	80
1031	4-c	52	41	31	63	68	66	49	43	0	76
1038	4-c	52	41	31	64	69	67	48	41	0	77
1046	4-c	52	41	31	67	72	70	49	43	0	80
1050	4-c	52	41	31	65	70	68	48	42	0	78
1065	4-c	52	41	0	67	72	70	47	42	0	80
828	4-d	53	44	0	57	62	60	42	54	0	70
840*	4-d	53	44	0	0	0	0	0	0	0	0
858*	4-d	53	44	44	0	0	0	0	0	0	52
860	4-d	53	44	0	0	0	0	0	0	0	0
861*	4-d	53	44	0	0	0	0	0	0	0	0
873	4-d	53	44	52	53	58	56	49	0	0	66
897	4-d	70	70	54	54	59	57	53	56	0	67
915	4-d	53	44	48	53	58	56	52	56	0	66
919	4-d	53	44	66	61	66	64	60	58	0	74
920	4-d	53	44	46	54	59	57	51	54	0	67
923	4-d	53	44	45	56	61	59	53	53	0	69
926	4-d	53	44	34	52	57	55	45	41	0	65
935	4-d	53	44	58	64	69	67	61	53	0	77
940	4-d	53	44	36	50	55	53	46	43	0	63
946	4-d	53	44	32	47	52	50	44	39	0	60
948	4-d	53	44	40	53	58	56	47	48	0	66
951	4-d	53	44	38	54	59	57	45	43	0	67
953	4-d	53	44	49	63	68	66	58	50	0	76
954	4-d	53	44	49	64	69	67	58	50	0	77
955	4-d	53	44	46	62	67	65	57	50	0	75
957	4-d	53	44	34	56	61	59	44	41	0	69
959	4-d	53	44	42	63	68	66	55	49	0	76
960	4-d	53	44	48	64	69	67	58	49	0	77
962	4-d	53	44	32	53	58	56	43	39	0	66
965	4-d	53	44	41	63	68	66	54	48	0	76
968	4-d	53	44	28	48	53	51	39	35	0	61
970	4-d	53	44	30	53	58	56	43	38	0	66
972	4-d	53	44	41	64	69	67	53	48	0	77
982	4-d	53	44	39	64	69	67	52	46	0	77
831	4-e	57	43	0	51	56	54	43	53	0	64
842	4-e	57	43	0	49	54	52	47	54	0	62
853	4-e	57	43	0	42	47	45	45	44	0	55
875	4-e	57	43	47	49	54	52	44	0	0	62

ID	NCA	Noise Management Level dB(A)		Predicted Noise Level from Construction Scenario dB(A)							Highest Construction Lmax dB(A)
		Standard hours	Out of hours	Enabling works	Clearing	Earthworks	Paving	Ancillary Sites	Bridges/ Piling	Haul Roads	
881	4-e	57	43	47	49	54	52	50	0	0	62
884	4-e	57	43	46	48	53	51	52	37	0	61
899	4-e	57	43	43	44	49	47	46	42	0	57
901	4-e	57	43	40	40	45	43	46	41	0	54
902	4-e	57	43	46	49	54	52	50	53	0	62
903	4-e	57	43	40	41	46	44	46	41	0	54
904	4-e	57	43	37	41	46	44	45	40	0	54
905	4-e	57	43	50	54	59	57	53	56	0	67
907	4-e	57	43	30	38	43	41	44	37	0	52
910	4-e	70	70	33	44	49	47	45	42	0	57
912	4-e	57	43	27	37	42	40	39	36	0	50
914	4-e	57	43	27	37	42	40	41	36	0	50
916	4-e	57	43	26	36	41	39	43	35	0	51
918	4-e	57	43	29	42	47	45	44	39	0	55
921	4-e	57	43	26	36	41	39	43	34	0	51
922	4-e	57	43	29	42	47	45	44	39	0	55
924	4-e	57	43	29	40	45	43	43	37	0	53
925	4-e	57	43	29	39	44	42	40	36	0	52
927	4-e	57	43	29	39	44	42	40	36	0	52
929	4-e	57	43	32	47	52	50	45	39	0	60
930	4-e	57	43	29	39	44	42	39	34	0	52
932	4-e	57	43	29	39	44	42	36	33	0	52
933	4-e	57	43	31	43	48	46	40	37	0	56
936	4-e	57	43	29	39	44	42	36	33	0	52
937	4-e	57	43	29	40	45	43	39	34	0	53
938	4-e	57	43	30	42	47	45	37	36	0	55
939	4-e	70	70	26	37	42	40	39	32	0	50
941	4-e	57	43	30	41	46	44	38	34	0	54
942	4-e	70	70	26	36	41	39	37	29	0	49
943	4-e	57	43	28	38	43	41	35	32	0	51
944	4-e	70	70	26	37	42	40	42	29	0	50
945	4-e	57	43	29	42	47	45	41	34	0	55
947	4-e	57	43	28	39	44	42	39	32	0	52
949	4-e	57	43	28	42	47	45	42	33	0	55
950	4-e	57	43	27	39	44	42	39	30	0	52
952	4-e	57	43	31	48	53	51	43	39	0	61
956	4-e	57	43	30	48	53	51	42	38	0	61
964	4-e	57	43	27	41	46	44	40	32	0	54
967	4-e	57	43	26	40	45	43	40	29	0	53
971	4-e	57	43	26	40	45	43	39	28	0	53
1126	4-e	57	43	0	48	53	51	41	41	0	61
1134	4-e	57	43	0	47	52	50	41	41	0	60
1146	4-e	57	43	0	44	49	47	39	40	0	57
1150	4-e	57	43	0	44	49	47	37	40	0	57
1152	4-e	57	43	0	45	50	48	39	40	0	58
1153	4-e	57	43	0	45	50	48	38	40	0	58
1158	4-e	57	43	0	47	52	50	38	40	0	60
1159	4-e	57	43	0	52	57	55	41	40	0	65
1161	4-e	57	43	0	47	52	50	40	40	0	60
1162	4-e	57	43	0	51	56	54	41	40	0	64
1166	4-e	57	43	0	51	56	54	40	40	0	64
1169	4-e	57	43	0	50	55	53	40	39	0	63
1176	4-e	57	43	0	50	55	53	41	39	0	63
1177	4-e	57	43	0	50	55	53	40	39	0	63
1179	4-e	57	43	0	50	55	53	41	39	0	63
1182	4-e	57	43	0	50	55	53	41	39	0	63
1184	4-e	57	43	0	50	55	53	41	39	0	63
1186	4-e	57	43	0	49	54	52	41	39	0	62
1190	4-e	57	43	0	49	54	52	41	39	0	62
1191	4-e	57	43	0	49	54	52	41	39	0	62
1194	4-e	57	43	0	49	54	52	41	39	0	62
1195	4-e	57	43	0	49	54	52	41	39	0	62
1201	4-e	57	43	0	48	53	51	41	39	0	61
1203	4-e	57	43	0	48	53	51	41	39	0	61
1204	4-e	57	43	0	48	53	51	41	39	0	61
1207	4-e	57	43	0	48	53	51	41	39	0	61
1209	4-e	57	43	0	48	53	51	41	39	0	61
1210	4-e	57	43	0	47	52	50	41	38	0	60
1211	4-e	57	43	0	48	53	51	41	38	0	61
1212	4-e	57	43	0	48	53	51	41	38	0	61
1221	4-e	57	43	0	47	52	50	41	38	0	60
1222	4-e	57	43	0	46	51	49	41	38	0	59

ID	NCA	Noise Management Level dB(A)		Predicted Noise Level from Construction Scenario dB(A)							Highest Construction Lmax dB(A)
		Standard hours	Out of hours	Enabling works	Clearing	Earthworks	Paving	Ancillary Sites	Bridges/ Piling	Haul Roads	
1223	4-e	57	43	0	47	52	50	41	38	0	60
1225	4-e	57	43	0	46	51	49	40	38	0	59
1226	4-e	57	43	0	35	40	38	40	38	0	48
1231	4-e	57	43	0	31	36	34	35	33	0	44
1233	4-e	57	43	0	38	43	41	38	35	0	51
1235	4-e	57	43	0	36	41	39	36	35	0	49
1236	4-e	57	43	0	33	38	36	33	32	0	46
1237	4-e	57	43	0	37	42	40	37	35	0	50
845	4-f	54	42	0	43	48	46	58	47	0	66
854	4-f	54	42	0	44	49	47	44	45	0	57
870	4-f	54	42	39	44	49	47	43	0	0	57
877	4-f	70	70	44	46	51	49	48	0	0	59
908	4-f	54	42	40	41	46	44	45	36	0	54
992	4-f	54	42	22	43	48	46	40	29	0	56
997	4-f	54	42	22	44	49	47	40	29	0	57
1010	4-f	54	42	22	45	50	48	40	30	0	58
1024	4-f	54	42	20	41	46	44	39	28	0	54
1025	4-f	54	42	21	45	50	48	40	32	0	58
1032	4-f	54	42	21	46	51	49	40	32	0	59
1036	4-f	54	42	20	40	45	43	39	27	0	53
1039	4-f	54	42	21	47	52	50	40	32	0	60
1043	4-f	54	42	21	48	53	51	40	32	0	61
1044	4-f	54	42	19	42	47	45	39	28	0	55
1048	4-f	54	42	20	49	54	52	39	32	0	62
1053	4-f	54	42	19	44	49	47	39	28	0	57
1055	4-f	54	42	20	51	56	54	39	32	0	64
1060	4-f	54	42	20	52	57	55	39	33	0	65
1066	4-f	54	42	19	50	55	53	39	30	0	63
1068	4-f	54	42	20	52	57	55	39	33	0	65
1075	4-f	54	42	20	52	57	55	39	34	0	65
1078	4-f	54	42	20	52	57	55	39	34	0	65
1081	4-f	54	42	20	45	50	48	39	32	0	58
1083	4-f	54	42	20	51	56	54	39	35	0	64
1084	4-f	54	42	20	44	49	47	32	29	0	57
1086	4-f	54	42	19	51	56	54	31	37	0	64
1089	4-f	54	42	20	44	49	47	28	32	0	57
1095	4-f	54	42	20	44	49	47	30	32	0	57
1097	4-f	54	42	19	52	57	55	30	36	0	65
1102	4-f	54	42	19	44	49	47	31	32	0	57
1105	4-f	54	42	19	44	49	47	31	33	0	57
1111	4-f	54	42	19	46	51	49	30	34	0	59
1112	4-f	54	42	19	44	49	47	32	34	0	57
1117	4-f	54	42	0	46	51	49	33	38	0	59
1122	4-f	54	42	0	48	53	51	32	39	0	61
1124	4-f	54	42	0	46	51	49	33	38	0	59
1125	4-f	54	42	0	51	56	54	32	41	0	64
1129	4-f	54	42	0	49	54	52	41	41	0	62
1135	4-f	54	42	0	51	56	54	40	41	0	64
1137	4-f	54	42	0	51	56	54	39	41	0	64
1140	4-f	54	42	0	51	56	54	41	41	0	64
1143	4-f	54	42	0	51	56	54	38	41	0	64
1144	4-f	54	42	0	53	58	56	41	41	0	66
1148	4-f	54	42	0	51	56	54	41	40	0	64
1149	4-f	54	42	0	52	57	55	41	40	0	65
1171	4-f	54	42	0	49	54	52	42	40	0	62
1173	4-f	54	42	0	49	54	52	42	40	0	62
1175	4-f	54	42	0	50	55	53	41	39	0	63
1181	4-f	54	42	0	49	54	52	42	39	0	62
1183	4-f	54	42	0	49	54	52	41	39	0	62
1187	4-f	54	42	0	49	54	52	42	39	0	62
1193	4-f	54	42	0	49	54	52	41	39	0	62
1196	4-f	54	42	0	47	52	50	41	39	0	60
1198	4-f	54	42	0	48	53	51	42	39	0	61
1199	4-f	54	42	0	48	53	51	42	39	0	61
1202	4-f	54	42	0	48	53	51	42	39	0	61
1206	4-f	54	42	0	48	53	51	43	39	0	61
1208	4-f	54	42	0	48	53	51	41	39	0	61
1213	4-f	54	42	0	48	53	51	41	39	0	61
1214	4-f	54	42	0	34	39	37	29	29	0	47
1215	4-f	54	42	0	47	52	50	41	38	0	60
1216	4-f	54	42	0	47	52	50	41	38	0	60
1217	4-f	54	42	0	34	39	37	30	31	0	47

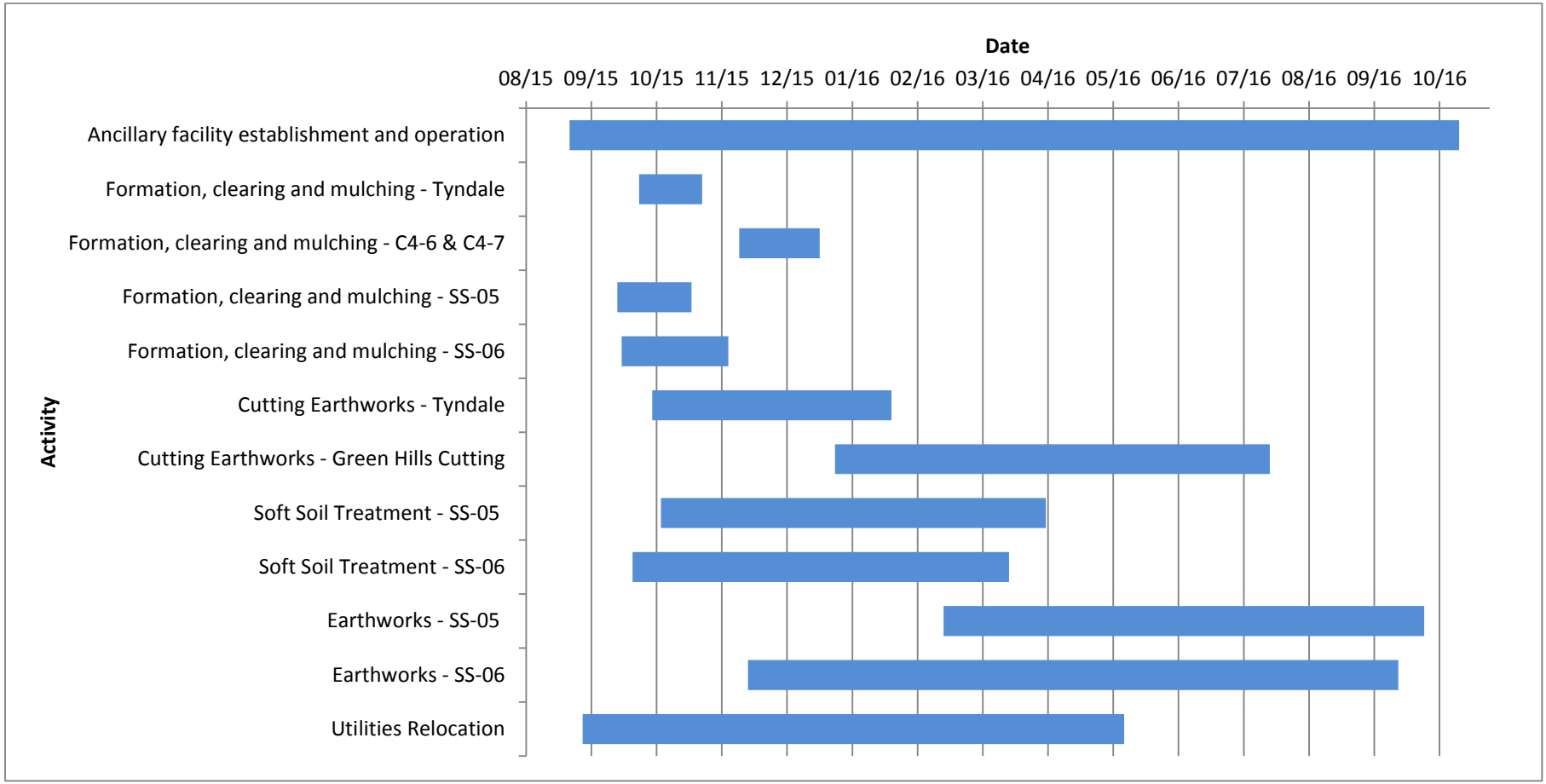
ID	NCA	Noise Management Level dB(A)		Predicted Noise Level from Construction Scenario dB(A)							Highest Construction Lmax dB(A)
		Standard hours	Out of hours	Enabling works	Clearing	Earthworks	Paving	Ancillary Sites	Bridges/ Piling	Haul Roads	
1218	4-f	54	42	0	47	52	50	41	38	0	60
1219	4-f	54	42	0	47	52	50	41	38	0	60
1220	4-f	54	42	0	47	52	50	41	38	0	60
1224	4-f	54	42	0	33	38	36	29	28	0	46
1227	4-f	54	42	0	24	29	27	27	23	0	37
1228	4-f	54	42	0	28	33	31	32	28	0	41
1229	4-f	54	42	0	27	32	30	28	25	0	40
1230	4-f	54	42	0	28	33	31	30	27	0	41
1232	4-f	54	42	0	23	28	26	23	21	0	36
1234	4-f	54	42	0	27	32	30	26	22	0	40
1238	4-f	54	42	0	24	29	27	19	15	0	37
1059	5-a	37	50	0	43	48	46	27	0	0	56
1064	5-a	37	50	0	43	48	46	27	0	0	56
1074	5-a	37	50	0	44	49	47	27	0	0	57
1076	5-a	37	50	0	44	49	47	27	0	0	57
1077	5-a	37	50	0	45	50	48	27	0	0	58
1079	5-a	37	50	0	44	49	47	27	0	0	57
1082	5-a	37	50	0	45	50	48	27	0	0	58
1085	5-a	37	50	0	45	50	48	27	0	0	58
1087	5-a	37	50	0	44	49	47	27	0	0	57
1088	5-a	37	50	0	44	49	47	27	0	0	57
1090	5-a	37	50	0	44	49	47	27	0	0	57
1091	5-a	37	50	0	45	50	48	27	0	0	58
1092	5-a	37	50	0	45	50	48	27	0	0	58
1093	5-a	37	50	0	45	50	48	27	0	0	58
1094	5-a	37	50	0	45	50	48	27	0	0	58
1098	5-a	37	50	0	44	49	47	29	0	0	57
1100	5-a	37	50	0	44	49	47	29	0	0	57
1101	5-a	37	50	0	43	48	46	29	0	0	56
1103	5-a	37	50	0	45	50	48	29	0	0	58
1104	5-a	37	50	0	46	51	49	29	0	0	59
1106	5-a	37	50	0	46	51	49	29	0	0	59
1107	5-a	37	50	0	46	51	49	29	0	0	59
1108	5-a	37	50	0	45	50	48	35	0	0	58
1110	5-a	37	50	0	47	52	50	34	0	0	60
1113	5-a	37	50	0	45	50	48	35	0	0	58
1114	5-a	37	50	0	46	51	49	35	0	0	59
1115	5-a	37	50	0	46	51	49	35	0	0	59
1116	5-a	37	50	0	46	51	49	35	0	0	59
1118	5-a	37	50	0	47	52	50	35	0	0	60
1120	5-a	37	50	0	45	50	48	35	0	0	58
1123	5-a	37	50	0	45	50	48	35	0	0	58
1128	5-a	37	50	0	46	51	49	35	0	0	59
1132	5-a	37	50	0	46	51	49	35	0	0	59
1136	5-a	37	50	0	47	52	50	35	0	0	60
1145	5-a	37	50	0	0	0	0	0	0	0	0
1147	5-a	37	50	0	0	0	0	0	0	0	0
1359	5-a	70	70	0	43	48	46	51	54	0	62
1373	5-a	37	50	39	47	52	50	54	56	0	64
1374	5-a	37	50	0	46	51	49	54	55	0	63
1377	5-a	37	50	0	46	51	49	54	55	0	63
1378	5-a	37	50	0	47	52	50	55	56	0	64
1382	5-a	37	50	0	46	51	49	54	55	0	63
1384	5-a	37	50	0	46	51	49	55	56	0	64
1386	5-a	37	50	0	45	50	48	54	55	0	63
1392	5-a	70	70	0	45	50	48	42	53	0	61
1447	5-a	37	50	39	45	50	48	32	41	0	58
1449	5-a	37	50	0	44	49	47	32	41	0	57
1479	5-a	37	50	0	41	46	44	14	46	0	54
1096	5-b	70	70	0	47	52	50	27	0	0	60
1109	5-b	56	50	0	48	53	51	30	0	0	61
1119	5-b	56	50	0	49	54	52	34	0	0	62
1121	5-b	56	50	0	48	53	51	36	0	0	61
1130	5-b	56	50	0	49	54	52	36	0	0	62
1133	5-b	56	50	0	46	51	49	36	0	0	59
1138	5-b	56	50	0	45	50	48	35	0	0	58
1139	5-b	56	50	0	49	54	52	36	0	0	62
1141	5-b	56	50	0	48	53	51	35	0	0	61
1142	5-b	56	50	0	48	53	51	37	0	0	61
1151	5-b	56	50	0	0	0	0	0	0	0	0
1154	5-b	56	50	0	0	0	0	0	0	0	0
1155	5-b	56	50	0	0	0	0	0	0	0	0

ID	NCA	Noise Management Level dB(A)		Predicted Noise Level from Construction Scenario dB(A)							Highest Construction Lmax dB(A)
		Standard hours	Out of hours	Enabling works	Clearing	Earthworks	Paving	Ancillary Sites	Bridges/ Piling	Haul Roads	
1156	5-b	56	50	0	0	0	0	0	0	0	0
1157	5-b	56	50	0	0	0	0	0	0	0	0
1160	5-b	56	50	0	48	53	51	37	0	0	61
1163	5-b	56	50	0	49	54	52	36	0	0	62
1164	5-b	56	50	0	52	57	55	37	0	0	65
1165	5-b	56	50	0	46	51	49	36	0	0	59
1167	5-b	56	50	0	49	54	52	36	0	0	62
1168	5-b	56	50	0	52	57	55	37	0	0	65
1170	5-b	56	50	0	49	54	52	36	0	0	62
1172	5-b	56	50	0	49	54	52	36	0	0	62
1174	5-b	56	50	0	46	51	49	37	0	0	59
1178	5-b	56	50	0	0	0	0	0	0	0	0
1180	5-b	56	50	0	49	54	52	38	0	0	62
1185	5-b	56	50	0	49	54	52	37	0	0	62
1188	5-b	56	50	0	49	54	52	37	0	0	62
1189	5-b	56	50	0	47	52	50	37	0	0	60
1192	5-b	56	50	0	53	58	56	37	0	0	66
1197	5-b	56	50	0	54	59	57	38	0	0	67
1200	5-b	56	50	0	51	56	54	37	0	0	64
1205	5-b	56	50	0	50	55	53	37	0	0	63
1256	5-b	56	50	39	50	55	53	49	58	0	66
1273	5-b	56	50	39	50	55	53	49	58	0	66
1311	5-b	56	50	34	54	59	57	53	63	0	71
1313	5-b	56	50	34	53	58	56	52	62	0	70
1314	5-b	56	50	34	51	56	54	53	62	0	70
1318	5-b	56	50	39	50	55	53	53	61	0	69
1330	5-b	56	50	34	54	59	57	54	63	0	71
1334	5-b	56	50	34	52	57	55	53	61	0	69
1335	5-b	56	50	34	49	54	52	52	58	0	66
1336	5-b	56	50	34	53	58	56	54	62	0	70
1344	5-b	56	50	34	53	58	56	54	61	0	69
1349	5-b	56	50	34	56	61	59	55	64	0	72
1354	5-b	56	50	33	48	53	51	53	58	0	66
1355	5-b	56	50	39	49	54	52	54	59	0	67
1361	5-b	56	50	0	55	60	58	55	62	0	70
1436	5-b	56	50	38	50	55	53	30	39	0	63
1445	5-b	56	50	0	48	53	51	31	40	0	61
1463	5-b	56	50	38	51	56	54	47	53	0	64
1476	5-b	56	50	34	49	54	52	15	49	0	62
1299*	5-c	0	46	0	0	0	0	0	0	0	0
1300	5-c	53	46	39	67	72	70	53	72	0	80
1302	5-c	53	46	39	64	69	67	53	70	0	78
1303	5-c	53	46	39	61	66	64	52	67	0	75
1305	5-c	53	46	39	62	67	65	53	68	0	76
1306	5-c	53	46	35	56	61	59	52	66	0	74
1308	5-c	53	46	35	58	63	61	53	65	0	73
1321	5-c	53	46	34	57	62	60	53	64	0	72
1323*	5-c	53	46	0	0	0	0	0	0	0	0
1325	5-c	53	46	34	56	61	59	53	64	0	72
1327	5-c	53	46	34	60	65	63	54	66	0	74
1331	5-c	53	46	0	0	0	0	0	0	0	0
1337	5-c	53	46	34	57	62	60	53	64	0	72
1339	5-c	53	46	34	56	61	59	54	65	0	73
1340	5-c	53	46	33	58	63	61	54	67	0	75
1352	5-c	53	46	34	59	64	62	55	65	0	73
1353	5-c	53	46	34	58	63	61	55	64	0	72
1420	5-c	53	46	34	58	63	61	55	64	0	72
1425*	5-c	53	46	0	0	0	0	0	0	0	0
1427	5-c	70	70	38	71	76	74	47	51	0	84
1428	5-c	70	70	39	61	66	64	47	51	0	74
1429	5-c	53	46	39	61	66	64	47	51	0	74
1432*	5-c	53	46	0	0	0	0	0	0	0	0
1441	5-c	53	46	0	74	79	77	32	40	0	87
1471	5-c	53	46	40	62	67	65	36	51	0	75
1472	5-c	53	46	39	61	66	64	35	51	0	74
1474	5-c	53	46	39	56	61	59	32	51	0	69
1475	5-c	53	46	35	56	61	59	17	51	0	69
1244	5-d	53	35	0	68	73	71	50	0	0	81
1246	5-d	53	35	0	52	57	55	52	0	0	65
1251	5-d	53	35	0	66	71	69	44	0	0	79
1263	5-d	53	35	39	56	61	59	50	65	0	73
1285	5-d	70	70	39	56	61	59	50	65	0	73

ID	NCA	Noise Management Level dB(A)		Predicted Noise Level from Construction Scenario dB(A)							Highest Construction Lmax dB(A)
		Standard hours	Out of hours	Enabling works	Clearing	Earthworks	Paving	Ancillary Sites	Bridges/ Piling	Haul Roads	
1288	5-d	53	35	40	56	61	59	50	67	0	75
1289	5-d	53	35	40	59	64	62	50	67	0	75
1290	5-d	53	35	39	60	65	63	51	68	0	76
1293	5-d	53	35	39	56	61	59	50	67	0	75
1294	5-d	53	35	39	68	73	71	51	74	0	82
1295	5-d	53	35	39	61	66	64	51	69	0	77
1298	5-d	53	35	39	64	69	67	51	72	0	80
1329	5-d	53	35	34	56	61	59	51	65	0	73
1343	5-d	53	35	34	62	67	65	53	69	0	77
1385	5-d	53	35	0	54	59	57	54	65	0	73
1390	5-d	70	70	0	57	62	60	54	65	0	73
1394	5-d	53	35	0	56	61	59	56	64	0	72
1396	5-d	53	35	0	57	62	60	56	64	0	72
1397	5-d	53	35	0	57	62	60	56	64	0	72
1398	5-d	53	35	0	58	63	61	57	64	0	72
1399	5-d	53	35	32	58	63	61	57	64	0	72
1400	5-d	53	35	0	58	63	61	57	64	0	72
1401	5-d	53	35	0	58	63	61	57	65	0	73
1402	5-d	53	35	0	58	63	61	57	65	0	73
1403	5-d	53	35	0	58	63	61	57	66	0	74
1405	5-d	53	35	0	58	63	61	57	67	0	75
1407	5-d	53	35	0	59	64	62	58	68	0	76
1409	5-d	53	35	0	58	63	61	54	62	0	71
1412	5-d	53	35	0	56	61	59	54	65	0	73
1414	5-d	53	35	0	62	67	65	54	66	0	75
1418*	5-d	53	35	0	0	0	0	0	0	0	0
1433	5-d	70	70	0	0	0	0	0	0	0	0
1434*	5-d	53	35	0	0	0	0	0	0	0	0
1435*	5-d	53	35	0	0	0	0	0	0	0	0
1438*	5-d	53	35	0	0	0	0	0	0	0	0
1464	5-d	53	35	37	65	70	68	46	74	0	82
1466	5-d	53	35	39	58	63	61	42	73	0	81
1247	5-e	55	40	0	52	57	55	53	0	0	65
1259	5-e	55	40	0	50	55	53	56	59	0	67
1265	5-e	55	40	0	50	55	53	56	59	0	67
1266	5-e	70	70	39	49	54	52	52	58	0	66
1267	5-e	55	40	39	51	56	54	54	60	0	68
1268	5-e	55	40	40	52	57	55	54	61	0	69
1269	5-e	55	40	39	53	58	56	55	63	0	71
1270	5-e	55	40	39	55	60	58	56	65	0	73
1271	5-e	55	40	40	55	60	58	56	65	0	73
1277	5-e	55	40	39	48	53	51	49	58	0	66
1278	5-e	55	40	39	51	56	54	49	61	0	69
1280	5-e	55	40	39	51	56	54	49	60	0	68
1281	5-e	55	40	39	51	56	54	49	61	0	69
1283	5-e	55	40	39	50	55	53	49	59	0	67
1287	5-e	70	70	38	54	59	57	49	63	0	71
1291	5-e	70	70	40	53	58	56	50	64	0	72
1309	5-e	55	40	34	54	59	57	51	64	0	72
1317	5-e	55	40	34	52	57	55	51	63	0	71
1326	5-e	70	70	39	54	59	57	51	64	0	72
1342	5-e	55	40	40	53	58	56	51	63	0	71
1357	5-e	55	40	0	53	58	56	52	64	0	72
1364	5-e	55	40	0	56	61	59	53	64	0	72
1369	5-e	55	40	0	51	56	54	53	64	0	72
1372	5-e	55	40	0	55	60	58	53	64	0	72
1376	5-e	55	40	0	56	61	59	53	65	0	73
1381	5-e	55	40	0	53	58	56	53	65	0	73
1387	5-e	70	70	0	56	61	59	54	64	0	72
1422	5-e	55	40	0	56	61	59	50	58	0	69
1252	5-f	46	34	0	46	51	49	49	0	0	59
1262	5-f	46	34	0	46	51	49	49	0	0	59
1275	5-f	46	34	39	46	51	49	48	56	0	64
1279	5-f	46	34	39	43	48	46	48	54	0	62
1347	5-f	46	34	34	43	48	46	48	54	0	62
1410	5-f	46	34	0	46	51	49	49	54	0	62
1415	5-f	46	34	0	44	49	47	48	51	0	59
1440	5-f	46	34	0	42	47	45	32	40	0	55
1457	5-f	70	70	38	45	50	48	47	52	0	60
1459	5-f	70	70	0	43	48	46	46	52	0	60
1461	5-f	46	34	39	45	50	48	46	53	0	61
1469	5-f	46	34	39	45	50	48	40	54	0	62

Appendix F
Indicative Schedule for Construction Works

Figure F-1: Indicative schedule for construction works



Notes:

1. SS-05 includes soft soil embankments between Farlows Lane and Yamba Road (Ch 83,400 to 85,800) & SS-06 includes soft soil embankments between Harwood and the northern side of Chatsworth Road (Ch 87, 500 to 91,200).
2. "Soft soil treatment" includes installation of drainage rock, wick drains and geotechnical instrumentation.