Vipac Engineers & Scientists Ltd.
4/5 Leo Lewis Close, Toronto, NSW 2283, Australia
PO Box 306, Toronto, NSW 2283, Australia
t. +61 2 4950 5833 | **f.** +61 2 4950 4276 | **e.** huntervalley@vipac.com.au
w. www.vipac.com.au | A.B.N. 33 005 453 627 | A.C.N. 005 453 627

Vipac Engineers & Scientists

Hydro Aluminium Kurri Kurri Ltd

Demolition and Remediation

Noise and Vibration Impact Assessment

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DOCUMENT NO: 29N-15-0036-TRP-472715-6 **PREPARED FOR:** **Hydro Aluminium Kurri Kurri Ltd** Eastpoint Complex Suite B Level, New South Wales, 2291, Australia **CONTACT:** Shaun Taylor **Tel:** +61 2 4962 5444 **Fax:** +61 2 4962 5888		**REPORT CODE:** TRP **PREPARED BY:** Vipac Engineers & Scientists Ltd. 4/5 Leo Lewis Close, Toronto, NSW 2283, Australia **Tel:** +61 2 4950 5833 **Fax**: +61 2 4950 4276
PREPARED BY: Author:	 Lynne Tan **Project Engineer**	Date: 13 Jul 2016
REVIEWED BY: Reviewer:	 Darragh Kingston **Manager, Hunter Valley/Newcastle** **Team Leader, Acoustics**	Date: 13 Jul 2016
AUTHORISED BY:	 Darragh Kingston **Manager, Hunter Valley/Newcastle** **Team Leader, Acoustics**	Date: 13 Jul 2016

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1	Project	
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KEYWORDS:

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Acronyms and Abbreviations

CoRTN	Calculation of Road Traffic Noise method
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DECCW	The Department of Environment, Climate Change and Water, NSW
ECRTN	Environment Criteria for Road Traffic Noise
ENMM	Environmental Noise Management Manual
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment Protection Authority
NSW	New South Wales
OEH	The Office of Environment and Heritage
RNP	Road Noise Policy
RTA	Roads and Traffic Authority
WHO	World Health Organisation

Glossary of Terms

Hydro	Hydro Aluminium Kurri Kurri Pty Ltd
Vipac	Vipac Engineers and Scientists Ltd
Stage 1 Demolition	Demolition of buildings and structured (and associated activities) at the Smelter, excluding buildings used for material storage, various workshops, offices and storage sheds, the three concrete stacks and the main water tower.
The Project	Demolition of the remaining buildings and structures at the Smelter, remediation of the contaminated soils and ground water and the construction and management of containment cell to contain material generated by demolition and remediation
The Smelter	The former Hydro Aluminium Kurri Kurri Pty Ltd aluminium smelter at Hart Road, Loxford.
$L_{eq,1hr}$	Equivalent Continuous Noise Level - which, lasting for as long as a given noise event, has the same amount of acoustic energy as the given event for the period of one hour.
$L_{A10,1\ hr}$	The noise level, which is equalled or exceeded for 10% of the measurement period of one hour.
$L_{A90,T}$	The noise level, which is equalled or exceeded for 90% of a given measurement period, T. $L_{A90,T}$ is used in Australia as the descriptor for background noise.
$L_{Aeq,T}$	The equivalent continuous A-weighted sound pressure level that has the same mean square pressure level as a sound that varies over time, for a given time period. It can be considered as the average sound pressure level over the measurement period and is commonly used as a descriptor for ambient noise.
L_n	The Sound Pressure levels that is equalled or exceeded for n% of the interval time period. Commonly used noise intervals are L_1, L_{10}, L_{90} and L_{99}%
$L_{A10,18hrs}$	The L_{10} noise level for the time period extending from 6am to midnight.

EXECUTIVE SUMMARY

This Noise and Vibration Impact Assessment has been prepared by Vipac Engineers and Scientists Ltd (Vipac) on behalf of Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) to support an Environmental Impact Statement (EIS) for submission to the Department of Planning and Environment prepared to assess for the Demolition and Remediation Project (the Project) at the former Hydro Aluminium Kurri Kurri Aluminium Smelter (the Smelter) at Hart Road, Loxford, NSW.

Demolition Noise

This Noise and Vibration Impact Assessment concludes that the predicted demolition phase noise levels (for "Standard Construction Hours") are in compliance with the Noise Management Levels of the *Interim Construction Noise Guideline* (DECC 2009) (**Construction Noise Guideline**), at all of the noise sensitive receivers and in compliance with the Highly Affected Levels at all of the potentially affected sensitive receptors.

The predicted demolition phase noise levels are expected to exceed the applicable Noise Management Level during periods "Outside Standard Construction Hours" and could potentially cause sleep disturbance at certain sensitive receptors. It should be noted that an increase of +3dB would only be just perceptible to human ear, an increase of +5dB would considered as clearly noticeable and an increase of +10dB would considered a doubling the loudness of a given noise source. In this context, an increase in a noise level in the order of 1dB would be considered as a negligible impact and any noise exceedance of 5dB or greater would be considered as a perceptible impact. The predicted noise impacts in this regard would not be considered to be significant although controls will be implemented in order to achieve compliance with the applicable noise criteria.

In order to comply with the Noise Management Level for "Outside Standard Construction Hours" applicable noise limits, the number of plant and equipment would be restricted. Details regarding the number and items of equipment that could operate, without exceeding the applicable Noise Management Level , during the "Outside Standard Construction Hours" for each period (i.e. day, evening and night-time periods) are specified in **Table 7.5**.

Traffic Noise

The predicted existing and future traffic noise level associated with The Project, at receivers along Hart Road (South) and the Hunter Expressway (west of Hart road) comply with the daytime and night time noise criteria.

The predicted existing road traffic noise levels at receivers along Hunter Expressway (East of Hart Road) are raised above the daytime and night-time noise criteria. In accordance with the *NSW Road Noise Policy* (DECCW 2001) (**Road Noise Policy**), any increase in total traffic noise level arising from the Project should be limited to 2dB above that of the corresponding existing noise levels at any residential property.

The relative increase between the existing traffic flow and with the additional traffic generated by the Project at receivers along Hunter Expressway (East of Hart Road) is 0.2dB and 0.6dB during day

time and night-time periods, respectively, which is within +2dB of the existing road traffic noise levels. Therefore, the predicted noise impact associated with the Project would comply with the Road Noise Policy criteria. The internal noise levels on existing and proposed noise sensitive receptors associated with the potential traffic movements that may be generated by the Project are predicted to be below the applicable maximum internal noise level limits and would not be expected to cause sleep disturbance impacts.

Vibration

Activities associated with the demolition are likely to generate vibration. However, the nearest receivers to the Project are located approximately 440 metres to the north of the site and based on the vibration levels provided in **Table 7.14**, it is unlikely that the will be any vibration impacts generated by the demolition/construction plant that would give rise to annoyance or structural damage at any of the nearest receivers.

Mitigation and Management Measures

A site specific Noise and Vibration Management Plan (NVMP) outlining feasible mitigation and management measures that would be adopted to control noise emissions from the site during the demolition/remediation phase is provided in **Section 9** of this report. Potential controls to reduce further vibrations are also outlined in the Noise and Vibration Management Plan provided in **Section 9**.

1 INTRODUCTION

This Noise and Vibration Impact Assessment has been prepared by Vipac Engineers and Scientists Ltd (Vipac) on behalf of Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) to support an Environmental Impact Statement (EIS) for submission to the Department of Planning and Environment prepared to assess for the Demolition and Remediation Project (the Project) at the former Hydro Aluminium Kurri Kurri Aluminium Smelter (the Smelter) at Hart Road, Loxford, NSW.

1.1 BACKGROUND

The former Hydro Aluminium Kurri Kurri Smelter (the Smelter) is located on Hart Road, Loxford near Kurri Kurri in New South Wales, Australia. The area owned and managed by Hydro incorporates the former smelter area comprising approximately 60 hectares, and the surrounding Hydro owned lands, comprising approximately 1,940 hectares (the Hydro land).

Smelting activities ceased in September 2012, and in May 2014 Hydro formally announced the closure of the Smelter.

It is Hydro's strategic vision for the Hydro Land to play a key role in allowing the Hunter Region to achieve the economic, employment and environmental objectives identified in the NSW Government NSW State Plan 2021 and the Hunter Regional Action Plan. Hydro aims to achieve this strategic vision by facilitating the rezoning and development of the Project site for significant employment, residential, rural and biodiversity conservation purposes.

Hydro has commenced a number of decommissioning activities to facilitate demolition and remediation of the Smelter. In addition Hydro has submitted a Development Application to Cessnock City Council for the demolition of the majority of the Smelter (Stage 1 Demolition) excluding buildings used for material storage, various workshops, offices and storage sheds, the three concrete stacks and the main water tower.

The remaining activities that would make the Smelter suitable for future employment and industrial land uses are the following:

- The Works. The Works are the activities required to make the Project site suitable for future use. The key element of the Works is the construction of a waste management facility, comprising a state of the art, modern and purpose built containment cell.

  Other ancillary elements of the Works are:

  - Demolition of the remaining Smelter buildings and structures.
  - Site remediation.
  - Leachate and groundwater treatment.

- Containment Cell Management. Following completion of the Works, the containment cell would be subject to a monitoring and management program.

These activities form the Project, which is the subject of the Environmental Impact Statement and this Noise and Vibration Impact Assessment.

1.2 OBJECTIVES

The purpose of the Noise and Vibration Impact Assessment is to assist Department of Planning and Environment in assessing the Project in accordance with the Section 79C(1) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and to address the Noise and Vibration requirements as listed in the Secretary's Environmental Assessment Requirements (SEARs).

The objectives of this Noise and Vibration Impact Assessment are to:

- Assess the potential noise and vibration impacts of the Project
- Assess the potential traffic noise impact on public roads due to additional traffic generated by the Project
- Identify any additional management measures to mitigate noise and vibration impacts of the Project on sensitive receptors.

As listed in the Secretary's Environmental Assessment Requirements (SEARs), a list of Noise and Vibration requirements detailed in Key Issue 8 were to be addressed. **Table 1.1** lists the requirements and where the matters have been addressed in the Assessment.

Table 1.1: Key Issue 8 SEARs

Requirement	Where addressed in the Assessment
Quantitative noise and vibration assessment, including impacts on nearby sensitive receivers	Section 4, 5, 6, 7 and 8
Cumulative impacts of other development on and off site	Section 2.1 and 3
Detailed of the proposed noise management/mitigation and monitoring measures	Section 9

The Assessment must also consider the EPAs Recommended Environmental Assessment Requirements (EPA Requirements) which are attached to the SEARs. **Table 1.2** lists the EPA Requirements regarding Item 5 and Item 8 of the EPA Requirements and where the matters have been addressed in the Assessment.

Table 1.2: EPA Requirements

Requirement	Where addressed in the Assessment
General: Item 5(2) Construction noise associated with the proposed development should be assessed using the Interim Construction Noise Guideline (DECC2009)	Section 4, 5, 7, 8 and 9
General: Item 5(3) Vibration from all activities (including construction and operation) to be undertaken on the premises should be assessed using the premises should be assessed using the guideline contained in the Assessing Vibration : A technical guideline (DEC 2006)	Section 5 and 7.7 and 8.3
Industry: Operational noise from all industrial activities (including private haul roads and private railway line) to be undertaken on the premises should be assessed using the guidelines contains in the NSW Industrial Noise Policy (EPA, 2000) and Industrial Noise Policy Application Notes	Section 3 and 4.1.1. As the Project works would be completed in a short period of time, approximately 12 months to 18 months, a quantitative assessment in accordance with the methodology outlined in the Interim Construction Noise Guideline (2009) is sufficient. The operational noise from industrial activities associated with the Rezoning Masterplan has been addressed in Vipac's Report Ref: 29N-14-0030-TRP-822335-2
Road: Item 5(4) Noise on public roads from increased road traffic generated by land use development should be assessed using the guidelines contained in the Environmental Criteria for Road Traffic Noise (EPA,1999)	Section 4.3, 6.3, 7.4, 7.5 and 8.2
Road: Item 5(5) Noise from new or upgraded public roads should be assessed using the Environmental Criteria for Road Traffic Noise (EPA,1999)	Section 4.2.1, 4.3.2, 6.3, 7.4, 7.5 and 8.2 The additional traffic generated by the Project will be using the existing public roads, which is addressed in Section 4.3 and 6.3. No new or upgraded public roads are proposed by the Project activities
Item 8 Monitoring Programs: The EIS should include a detailed assessment of any noise monitoring required during the construction/development phase and on- going operations of the site to ensure that the development achieves a satisfactory level of environmental performance. The evaluation should include a detailed description of the monitoring locations, sample analysis methods and the level of reporting proposed	Section 3 and 9

The Assessment must consider Cessnock City Council's Requirements which are attached to the SEARs. **Table 1.3** lists the Council Requirements and where the matters have been addressed in the Assessment.

Table 1.3: Cessnock City Council's Requirements

Requirement	Where addressed in the Assessment
Any acoustic assessment should identify activities that could be undertaken within the project outside standard construction hours without resulting in noise impacts on sensitive receivers	Section 4.1, 4.2, 7, 8 and 9
Any acoustics assessment should identify all noise sources that could impact on the surrounding residential area	Section 6, 7, 8 and 9
Establishing individual nose sources as it is important for monitoring and compliance in the event that Council receives nuisance complaints	Section 6, 7, 8 and 9
Depending on the location of the residents, they may be affected by noise emissions from two or more sources. Therefore multiple noise sources need to be identified , including those sourced which may potentially impact on sensitive receptors (people particularly susceptible to illness from environmental pollution, such as the elderly, children or the immunocompromised) in the supporting information	Section 3, 4, 6 and 7
Multiple noise sources should identified so that in the event there is a nuisance impact from the activity, compliance for each source can then be assessed against its recorded noise levels	Section 6, 7, 8 and 9
Any non-compliance can then be directly attributed to the offending noise source and abatement measures can be implemented.	Section 9

The assessment must consider the Hunter New England Local Health District's Requirement (Health Requirements) which are attached to the SEARs. **Table 1.4** lists the Health Requirements and where the matters are addressed in the Assessment.

Table 1.4: Health Requirement

Requirement	Where addressed in the Assessment
A human health risk assessment that consider the potential adverse effects from human exposure to acute and cumulative noise. The assessment should be conducted with the Environmental Health Risk Assessment: Guidelines for assessing human risk from environmental hazards (2012).	Section 7.6 and 9

2 PROJECT DESCRIPTION

The Project would be located within the existing Hydro Aluminium Kurri Kurri Smelter site (the Smelter) at Hart Road Loxford. The Smelter location is shown in **Figure 1**. **Figure 2** shows the overall Project layout, including the locations of key activities.

Table 2.1 outlines the major elements of the Project and the key activities. A detailed description of the Project is provided in **Chapters 8** and **9** of the Environmental Impact Statement.

Table 2.1: Outline of the Project

Element	Key Activities
The Works	
Project Site Establishment	• Establishment of environmental controls (erosion and sediment controls, water quality controls). • Construction of the containment cell haul road. • Continued use of Stage 1 Demolition compounds. • Continued use of Stage 1 Demolition stockpile and storage areas.
Containment Cell Construction	• Vegetation clearance. • Site preparatory works. • Establishment and implementation of environmental controls (erosion and sediment controls, water quality controls). • Construction of the containment cell base layers. • Construction of internal cell walls within the containment cell. • Transport and placement of remediation and demolition materials to the containment cell. • Leachate and stormwater management. • Construction of the final containment cell capping layers.
Stage 2 Demolition	• Completion of hazardous materials removal. • Establishment and implementation of environmental controls (dust mitigation and water quality management). • Demolition of three concrete stacks and a water tower using detonation. • Mechanical demolition of remaining buildings and structures. • Material collection, separation, processing and storage. • Transportation of recyclable metals offsite. • Transport non-recyclable demolition material to the containment cell. • Grading of former building footprints.

Element	Key Activities
Demolition Material Management	• Operation of a concrete and refractory crushing plant processing of up to 140 tonnes per day. • Manage a large stockpile area in the west of the Smelter. • Ferrous (steel) and non-ferrous (predominantly aluminium and copper) metals would be sorted and sized before being transported off site for recycling. It is anticipated that there would be up to 20 truck movements per day.
Contamination Remediation	• Removal of the capped waste stockpile. • Excavation of the contaminated soils within the Smelter (including stockpiled soils sourced from other Hydro land). • Transport to the containment cell. • Filling and grading following removal of contaminated materials.
Leachate and Groundwater Treatment	• Establish and operate water treatment plants (capped waste stockpile and containment cell). • Groundwater monitoring. • Water treatment plant, pumping well network and dam decommissioning.

Environmental Controls	• Dust controls during demolition would include:
	  ○ Accumulated fines from within the buildings would be removed where safe, reasonable and feasible to do so.
	  ○ Pre-wetting of buildings prior to undertaking the induced collapse and use of water sprays for dust suppression (as required due to wind conditions) during induced collapse.
	  ○ Ceasing activities that have the potential to generate significant dust that could have adverse impacts on sensitive receivers.
	• Watering of the demolition areas, unsealed access roads and other unsealed areas.
	• Vehicles would use (where possible) existing sealed roads.
	• Erosion and sediment controls would be installed, monitored and managed to reduce sediment run off entering the existing drainage system.
	• The existing site water management system would capture runoff.
	• Where possible, clean water would be diverted from Works areas.

Containment Cell Management	
Monitoring	• Monitoring of leachate generation within the containment cell.
Maintenance	• Mowing of the containment cell grass cover. • Maintenance (if required) of the capping layers.

The Works component of the Project would take approximately three years to complete. Project traffic would predominantly travel to and from the Smelter via Hart Road and the Hunter Expressway (using the Hart Road interchange). A small number of vehicles (predominantly small vehicles used by Works personnel) are likely to continue to the intersection with Sawyers Gully Road, Gingers Lane and Government Road and along one of these roads.

Works activities that would generate an audible noise at the nearest sensitive receiver would be undertaken between 7:00 am to 6:00 pm, Mondays to Fridays and 7:00 am to 1:00 pm on Saturdays.

2.1 CONCURRENT ACTIVITIES

In August 2015 Hydro submitted a Development Application (supported by a Statement of Environmental Effects) to Cessnock City Council requesting approval of the following:

- Demolition of all buildings and structures at the Smelter excluding:
  - Buildings used for the storage of materials.
  - Three concrete stacks, and one concrete water tower (structures requiring the use of explosives for demolition).
  - The transformer yard and major power supply infrastructure in the north of the Smelter.
  - Administration buildings, amenities building and various shops and a storage sheds
- Establishment of a contractor's compound, either within an existing building located in the south of the Smelter (the former Building 77A Pot Rebuild building), or in the car park near the main entrance to the Smelter.
- A concrete and refractory crushing plant processing up to 28,000 tonnes per year or 140 tonnes per day.
- A demolition materials stockpile area.
- The sorting of recyclable metallic demolition materials and transportation to a metal recycling facility.

The Development Application to Cessnock City Council is known as Stage 1 Demolition. It is proposed that the contractor's compound, the demolition materials stockpile area and the concrete and refractory crushing plant included in the Stage 1 Demolition Development Application to Cessnock City Council would continue to be used for the Project. It is anticipated that some Stage 1 Demolition activities would occur concurrently with the early stage of the Works.

So that the potential cumulative noise and vibration impacts of Stage 1 Demolition activities are considered when assessing the Project, these activities have been included as appropriate in **Chapter 7** (Impact Assessment) of this report. Vipac has been advised that key tasks listed in **Table 2.1** would be overlapping for part of the activities. The overall demolition and remediation plan is divided into 5 phases and activities for each stage associated with proposed plant and equipment is detailed in **Table 2.2**. Locations associated with key activities for each phase are illustrated in **Figure 3** to **Figure 8**. Containment Cell Management was not included in this assessment as it is unlikely to generate significant noise emissions from the site. Only noisy activities were considered in the noise assessment as it represents the worst case scenario.

Table 2.2: Activities associated with proposed plant and machinery for each phase

Key Task	Activities - Scenarios	Operational Conditions	Proposed/Potential Plant and Machinery
Stage 1 Demolition	Demolition	Operating concurrently	1 x 230t Excavators with grab and bucket attachment 1 x 120t Excavators with shear and grab attachment 1 x 70t Excavators with shear, hammer and bucket attachment 1 x 46t Excavator with shear , hammer, bucket and pulverised attachment 4 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 80ft Boom lifts 2 x 40t Dump trucks 1 x Tele handler 1 x 25t Water truck 1 x Concrete crushing plant 2x Jackhammer 2 x Concrete saw
Phase 1 of the Project	Continuation of Stage 1 Demolition compound, concrete crushing plant and stockpile area	Operating concurrently	1 x 230t Excavators with grab and bucket attachment 1 x 120t Excavators with shear and grab attachment 1 x 70t Excavators with shear, hammer and bucket attachment 1 x 46t Excavator with shear , hammer, bucket and pulverised attachment 4 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 80ft Boom lifts 2 x 40t Dump trucks 1 x Tele handler 1 x 25t Water truck 1 x Concrete crushing plant 2 x Jackhammer 2 x Concrete Saw
	Installation of the Project environmental controls		2 x 36t Excavators
	Construction of Haul Road and Containment Cell utilities/services		2 x 36t Excavators 2 x Graders 4 x 30t Articulated trucks 2 x Dozers 1 x Vibrating drum roller 1 x 25t Water truck

Key Task	Activities - Scenarios	Operational Conditions	Proposed/Potential Plant and Machinery
	Containment Cell Establishment (including VENM/ENM Stockpile and compound area)	Vegetation Clearance	1 x Dozer 1 x 36t Excavator 1 x Mulching/ compositing machine 1 x 30t Articulated truck
		Preparatory works (start after vegetation clearance)	2 x 36t Excavators 2 x Scrapers/dozers 2 x 30T Articulated trucks 1 x 25t Water cart
		Cell Base Liner Construction (start after preparatory works)	1 x Wheel dozer 3 x 36t Tracked excavators 3 x Compactors/rollers 4 x 30t Articulated trucks 2 x Backhoes 2 x 25t Water carts
		Internal cell wall construction (start after cell base liner construction)	2 x 36t Excavators 4 x 30t Articulated trucks 2 x Dozers/front end loaders 2 x 25t Water carts
	Removal of Smelters waste stockpiles near anode baking furnace	Operating concurrently	2 x 36t Excavators 4 x 30t Articulated trucks
Phase 2 of the Project	Continuation of compound, concrete plant, stockpile area and ancillary facilities	Operating concurrently	1 x 230t Excavators with grab and bucket attachment 1 x 120t Excavators with shear and grab attachment 1 x 70t Excavators with shear, hammer and bucket attachment 1 x 46t Excavator with shear , hammer, bucket and pulverised attachment 4 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 80ft Boom lifts 2 x 40t Dump trucks 1 x Tele handler 1 x 25t Water truck 1 x Concrete crushing plant
	Demolition (detonations of three stacks)		1 x Excavator 1 x Concrete Saw 1 x Jackhammer

Key Task	Activities - Scenarios	Operational Conditions	Proposed/Potential Plant and Machinery
	Establishment and operation of containment cell and capped waste stockpile water treatment plants		3 x 36t Excavators 2 x Landfill Compactors 4 x 30t Articulated trucks 2 x 25t Water carts
	Establishment of capped waste stockpile crushing plant		1 x Waste stockpile crushing plant 1 x Dozer
	Clearance of vegetation between the Smelter and the North Dams		1 x Dozer 1 x 36t Excavator 1 x Mulching/ compositing machine 1 x 30t Articulated truck
Phase 3 of the Project	Continuation of compound, concrete crushing plant, stockpile area and ancillary facilities	Operating concurrently	1 x 230t Excavators with grab and bucket attachment 1 x 120t Excavators with shear and grab attachment 1 x 70t Excavators with shear, hammer and bucket attachment 1 x 46t Excavator with shear , hammer, bucket and pulverised attachment 4 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 80ft Boom lifts 2 x 40t Dump trucks 1 x Tele handler 1 x 25t Water truck 1 x Concrete crushing plant 1 x Capped waste stockpile crushing plant
	Continuation removal, processing/crushing and transportation of capped waste stockpile material		3 x 36t Excavators 2 x Landfill Compactors 4 x 30t Articulated trucks 2 x 25t Water carts
	Continue placing material in containment cell (Demolition waste and capped waste stockpile)		3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts

Key Task	Activities - Scenarios	Operational Conditions	Proposed/Potential Plant and Machinery
	Excavation of contaminated soils and transportation to and placement in the containment cell		2 x 36t Excavators 2 x Graders 4 x 30t Articulated Trucks
Phase 4 of the Project	Continuation of compound, concrete crushing plant, stockpile area and ancillary facilities	Operating concurrently	1 x 230t Excavators with grab and bucket attachment 1 x 120t Excavators with shear and grab attachment 1 x 70t Excavators with shear, hammer and bucket attachment 1 x 46t Excavator with shear , hammer, bucket and pulverised attachment 4 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 80ft Boom lifts 2 x 40t Dump trucks 1 x Tele handler 1 x 25t Water truck 1 x Concrete crushing plant 1 x Capped waste stockpile crushing plant
	Continuation removal, processing/ crushing and transportation of capped waste stockpile material		3 x 36t Excavators 2 x Landfill Compactors 4 x 30t Articulated Trucks 2 x 25t Water carts
	Continue placing material in containment cell (demolition waste and capped waste stockpile)		3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts
	Demolition of water tower		1 x 36t Excavator 1 x Jack hammer 1 x Concrete Saw

Key Task	Activities - Scenarios	Operational Conditions	Proposed/Potential Plant and Machinery
Phase 5 of the Project	Continuation of compound	Operating concurrently	1 x 230t Excavators with grab and bucket attachment 1 x 120t Excavators with shear and grab attachment 1 x 70t Excavators with shear, hammer and bucket attachment 1 x 46t Excavator with shear , hammer, bucket and pulverised attachment 4 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 40t Dump trucks 1 x 25t Water truck
	Excavation and remediation of eastern and western dam. Material from dam floors to be placed in the containment cell		3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts
	Excavation of contaminated natural soils from the capped waste stockpile footprint and transportation to and placement in the containment cell		3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts

Note: For containment cell establishment activities during Phase 1 of the Project, only Cell Base liner construction was considered in the noise model as the activities for containment cell establishment does not operate concurrently and Cell Base Liner Construction is the most noisiest activity compared to the other activities.

This focuses on the closest of the nominated receiver types in relation to the Project. A summary of the receivers subject to this assessment is listed in **Table 2.3**.

Table 2.3: Noise Sensitive Receivers

Location ID	Sensitive Receptor	Address	Coordinates	
			X	Y
Educational Facilities				
S1	Hunter TAFE	McLeod Road, Kurri Kurri	359142	6370193
S2	Kurri Kurri High School	Deakin and Standford Streets, Kurri Kurri	358235	6368832
S3	Weston Public School	Sixth Street, Weston	355928	6368863
S4	Holy Spirit Primary School	Barton Street, Kurri Kurri	358165	6367845
S5	St Joseph's Convent	31 Victoria Street, Kurri Kurri	357987	6367776
S6	Kurri Kurri Public School	Lang Street, Kurri Kurri	357462	6367542
S7	Weston Community Pre-School	22, Scott Street, Weston	355612	6368077
S8	Abermain Public School	Goulburn Street, Abermain	352716	6368782
Child Care Centres				
CC1	Kurri Early Childhood Centre	107 Lang Street, Kurri Kurri	358114	6368071
CC2	Kurri Kurri Before & After School Care	112 Lang Street, Kurri Kurri	358093	6367961
CC3	Mission Australia Childcare Centre and Preschool	168-170 Rawson Street	357407	6367355
CC4	Abermain Early Learning Centre	23 Grafton Street, Abermain	353116	6369073
Medical Facilities				
H1	Kurri Kurri Hospital	Hospital Road, Kurri Kurri	356124	6367167
H2	Family Medical Centre	312 Lang Street, Kurri Kurri	357372	6367506
Aged Care Facilities				
A1	RFBI Kurri Kurri Masonic Village/Nursing Home	412 Lang Street, Kurri Kurri	356261	6367162
Nearest Residential Property				
R1	Private residential property	685 Old Maitland Road, Bishops Bridge	358070	6375276
R2	Hydro owned property	464 Cessnock Road, Gillieston Heights	361436	6373126
R3	Private residential property	20 Bowditch Avenue, Loxford	359066	6370765
R4	Private residential property	6 Dawes Avenue, Loxford	358004	6370342
R5	Hydro owned property	Scales Avenue (Lot 444, DP755231), Loxford	357739	6370234
R6	Private residential property	78 Hart Road, Loxford	357105	6369995
R7	Private residential property	103 Bishops Bridge Road, Sawyers Gully	356560	6370700
R8	Private residential property	78 Lumby Lane, Sawyers Gully	355743	6371664
Nearest Recreational Facility				
RE1	Kurri Kurri Speedway	73-81, Dickson Road, Loxford	358397	6370830
RE2	Kurri Kurri Junior Motorcycle Club	McLeod Road, Luxford	358480	6371149

RE3	Cricket pitch, park	Dawes Avenue, Loxford	357854	6370314
RE4	Kurri Golf Club	Clift Street, Heddon Greta	360395	6369109
RE5	Nellie Simm Park	Northcote Street, Kurri Kurri	357571	6368469
RE6	Birralee Park	McLeod Road, Kurri Kurri	358716	6368763
RE7	Weston Park	Government Road, Weston	356488	6368421
Places of Worship				
CHC1	Church of Christ	134 Maitland Street, Kurri Kurri	357894	6368038
CHC2	Kurri Kurri Seventh-Day Adventist Church	Maitland Street, Kurri Kurri	357468	6367942
CHC3	Anglican Parish of Mt Vincent & Weston	97 Barton Street, Kurri Kurri	358063	6367912
CHC4	St Paul the Apostle Anglican Church	Lang Street, Kurri Kurri	358037	6367933
CHC5	Kurri Kurri Congregational Church	111 Rawson St, Kurri Kurri	357886	6367649
CHC6	St Mary the Virgin Anglican Church	First Street, Weston	355630	6368339

3 EXISTING ENVIRONMENT

3.1 GENERAL

As shown in **Figure 2**, the Project would impact the fenced Smelter footprint and the area currently known as the clay borrow pit to the immediate west.

Land uses in the vicinity of the Project include:

- Native vegetation: native ecological communities (with some cleared or disturbed areas) generally surround the Smelter and are within the Hydro owned land. Security fencing separates the Smelter from the vegetation.
- Electricity infrastructure: overhead power lines are located within easements to the north, west, southwest and northwest of the Smelter.
- Recreation: the Kurri Kurri Speedway and the Kurri Kurri Junior Motorcycle Club facility are approximately 500 metres to the east of the Project.
- Roads: The key roads in the vicinity of the Project are:
  - Hart Road is used to access the Smelter and is immediately adjacent to the western section of the Project.
  - Dickson Road intersects with Hart Road approximately 120 metres south of the Smelter security gate and immediately adjacent to the western section of the Project.
  - The Hunter Expressway is approximately 380 metres southwest of the Project.
- Residential: the Project is approximately 440 metres to the north of the nearest sensitive receiver, which is a rural residence owned by Hydro. The nearest rural residence not owned by Hydro is approximately 500 metres to the southeast, and the next nearest is approximately 750 metres to the southeast. There are approximately 24 rural residences within 1000 metres of the Project, of which 15 are on Hydro land.

  The nearest residential area to the Project is Weston, which is approximately 1800 metres to the southwest.
- Education: The Kurri Kurri TAFE is located approximately 1500 metres to the southeast of the Project and Kurri Kurri High School is approximately 1900 metres to the southeast of the Project.

3.2 EXISTING NOISE ENVIRONMENT

3.2.1 UNATTENDED NOISE MEASUREMENTS

A series of baseline noise surveys were undertaken on the Hydro Land and at noise sensitive receptors located in the vicinity of the Project in order to determine Project Specific Noise levels of the potentially affected areas across the site and at representative sensitive receptors located in the surrounding areas.

The purpose of the noise surveys is to determine the existing ambient noise levels in the area, which will be taken into account in the Noise Assessment for the project. This will enable an assessment of the potential noise impacts on the receiving environment.

Vipac installed noise logging equipment at twelve locations to measure baseline environmental noise levels at representative noise sensitive receptor locations in the vicinity of the Project. The location of the monitoring points are listed in **Table 3.1**, and shown in **Figure 9** and **Figure 13.**

Table 3.1: Monitoring Locations

Loc.	Noise Survey Dates	Location / Address	Instrument	Serial No.
N1	25/06/2014 – 04/07/2014	6 Dawes Avenue, Loxford	LD870	1461
N2	02/09/2014 – 08/09/2014	Hunter TAFE, Kurri Kurri Campus	LD870	1464
N3	22/07/2014 – 29/07/2014	18 Bowditch Avenue, Loxford	LD870	1461
N4	22/07/2014 – 29/07/2014	Hydro Land near 10 Howe Street, Cliftleigh	LD824	2595
N5	22/07/2014 – 29/07/2014	Hydro Land near Glen Ayre Avenue, Cliftleigh	LD870	1459
N6	22/07/2014 – 29/07/2014	Hydro Land near 532 Main Road, Cliftleigh	LD870	1464
N7	22/07/2014 – 29/07/2014	Hydro Land near Lot 54, 464 Cessnock Road, Gillieston Heights	LD870	1457
N8	22/07/2014 – 29/07/2014	Hydro Land near Lot 11, 464 Cessnock Road, Gillieston Heights	LD870	1466
N9	25/06/2014 – 04/07/2014	Northwest corner of the Smelter Site	LD870	1466
N10	25/06/2014 – 04/07/2014	Southwest corner of the Smelter Site	LD870	1464
N11	02/09/2014 – 08/09/2014	14 Horton Road, Loxford	LD870	1466
N12	25/06/2014 – 04/07/2014	Kurri Kurri Speedway Track, 73 Dickson Road, Loxford	Duo dB1	10304

The instruments were programmed to accumulate noise data continuously over sampling periods of 15-minutes for the entire monitoring period. Internal software then calculates and stores the Ln percentile noise levels for each sampling period, which can later be retrieved for detailed analysis. Meteorological data during the noise logging survey period was obtained from the Bureau of Meteorology (BoM) Weather Station at Cessnock Airport NSW (061260). Where adverse meteorological conditions such as wind exceeding 5m/s and/or rain were observed in any 15-minutes period, these data were excluded.

The instruments were calibrated using a Rion NC-73 calibrator immediately before and after monitoring and showed a maximum error of 0.5 dB.

A summary of the current ambient noise levels at the monitoring locations as determined for the baseline noise logging surveys is presented in **Table 3.2**. The results of the noise logging surveys are presented graphically in **Appendix A**.

Table 3.2: Summary of current ambient noise levels - dB(A)

Loc.	Period	L_{Aeq}	L_{A90}	RBL[1]
N01	Day	49	44	43
	Evening	48	43	42
	Night	47	43	40
N02	Day	52	44	44
	Evening	46	43	43
	Night	46	41	41
N03	Day	48	39	38
	Evening	46	35	35
	Night	42	37	34
N04	Day	51	38	36
	Evening	45	35	35
	Night	49	35	32
N05	Day	46	39	38
	Evening	46	33	33
	Night	40	35	31
N06	Day	49	42	41
	Evening	46	35	34
	Night	42	36	33
N07	Day	59	45	44
	Evening	54	45	44
	Night	49	51	36
N08	Day	58	36	35
	Evening	47	33	33
	Night	40	34	32
N09	Day	45	39	38
	Evening	43	37	37
	Night	44	39	36
N10	Day	50	45	44
	Evening	51	45	44
	Night	50	43	38
N11	Day	55	50	50
	Evening	52	47	47
	Night	51	45	42
N12	Day	46	43	41
	Evening	46	38	38
	Night	43	39	36

[1] RBL is the median of the overall assessment background noise level calculated using OEH Industrial Noise Policy methodology as defined in the glossary of acoustic terms

3.2.2 ATTENDED NOISE MEASUREMENTS

In addition to the unattended noise logging surveys, Vipac also conducted short period 15-minute attended noise measurements at the baseline monitoring locations (N1 to N12) to quantify the dominant and contributory noise sources associated with the overall ambient noise levels in the area. The results of the attended noise surveys at each monitoring location are presented in **Table 3.3**

Table 3.3: Attended Noise Survey Results

Loc.	Date & Time	L_{Aeq}	L_{A90}	Description
N01	04/07/2014 16:31	44.8	41.9	Traffic Noise and machinery noise from Loxford Fabrications dominated the environment. Noise from birds was significant and dominant at times. No insects were noted during the survey.
N02	08/09/2014 13:48	52.3	42.1	Dominant noise source initially was truck reversing and manoeuvring near the monitoring point. Subsequently the noise environment was dominated by the birds. Air conditioning system on Block G (canteen) of the Hunter TAFE campus was noted throughout the survey. Excavator and truck reversing were dominating the environment towards the end of the survey.
N03	22/07/2014 15:30	49.0	37.6	Bird noise in the area dominated the overall noise environment. Traffic noise towards Main Road also influenced the noise levels in this area. Distant reversing beacon, air plane and cattle grazing were influential at times.
N04	22/07/2014 13:53	42.7	39.1	Dominant source was construction noise from new housing land near Cliftleigh/Kelman Drive. Noise from birds in this area was significant. Occasionally, dog barking was faintly audible.
N05	22/07/2014 14:39	50.0	45.6	Dominant source was construction noise (bulldozer activities) from new housing land near Cliftleigh/Kelman Drive. Noise from Jet passing was significant briefly during the survey.
N06	22/07/2014 12:45	41.4	36.5	Construction noise from new housing land near Cliftleigh/Kelman Drive dominated the overall noise environment. Construction activities were from earthworks, graders, dozers, excavators and trucks. Noise from rustling foliage was also noted at times.
N07	22/07/2014 11:03	45.5	39.0	Dominant noise source was bird noise and traffic noise from Main Road. Occasionally, noise from airplane overhead was influential.
N08	22/07/2014 11:53	43.1	35.9	Bird noise in the area dominated at this monitoring location. Construction activities in the vicinity to the monitoring position were significant. No traffic noise was

Loc.	Date & Time	L_{Aeq}	L_{A90}	Description
				audible at this location.
N09	04/07/2014 15:02	42.6	40.0	Dominant noise source was from distant traffic noise. Occasionally, noise from rattling of metal panels and birds chirping were audible in this area. Airplane noise influential briefly but the overall noise environment was dominated by the distant traffic noise. Noise generated by the substation was inaudible during the survey.
N10	04/07/2014 14:33	54.1	49.8	Traffic noise from Hunter Expressway dominated the overall noise environment. Birds chirping and steel storage yard activities were audible occasionally. Light airplane flying overhead the monitoring was significant source briefly. No noise sources were audible from the Smelter
N11	08/09/201 13:09	50.4	46.0	Dominant source was traffic on Hunter Expressway especially truck pass-by. Noise from birds in the area was also significant in this area. Occasionally noise from metal cutting/grinding was noted.
N12	04/07/2014 15:45	39.4	37.4	Frogs/Insects noise and distant traffic noise from Hunter Expressway dominated the overall noise environment. Occasionally bird noise was audible in this area. Sound of breeze blowing in trees and reeds was also influential but not significant.

4 ASSESSMENT METHODOLOGY AND NOISE CRITERIA

4.1 NSW "INTERIM CONSTRUCTION NOISE GUIDELINE"

The *Interim Construction Noise Guideline* contains detailed procedures for the assessment and management of construction noise impacts.

The *Interim Construction Noise Guideline* presents two approaches for assessing construction noise impacts – the quantitative method, which is generally suited to longer-term construction, and the qualitative method, which is generally suited to short-term works such as infrastructure maintenance. Due to the length of the proposed works (i.e. proposed construction works are expected to be completed within approximately 12 to 18 months), a quantitative method has been used for this assessment.

4.1.1 RESIDENCES AND OTHER SENSITVE LAND USES

Table 4.1 and **Table 4.2** set out the management levels for noise at residences and sensitive land uses (other than residences), respectively. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

Table 4.1: Noise at residence using Quantitative Assessment

Recommended Hours	Time of Day	Management level $L_{Aeq(15min)*}$ [1]
Recommended standard hours	Monday to Friday - 7 am to 6pm Saturday - 8am to 1 pm No Work on Sundays or Public holidays	Noise affected RBL[2] + 10dB
		Highly noise affected[3] 75dB
Outside recommended standard hours		Noise affected RBL[2] + 5dB

*$L_{Aeq,15mins}$ refers to the equivalent continuous A-weighted sound pressure level over a 15-minute period.

1 Noise levels apply at the boundary that is most exposed to construction noise and at a height of 1.5 m 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 30m of the residence. Noise levels may be higher at upper floors of the noise-affected residence.

2 RBL is the Rating Background Level as defined in the OEH Industrial Noise Policy.

3 $L_{Aeq\ 15\text{-}minute} \geq 75$ dB is highly likely to generate strong community reactions and should be avoided.

Table 4.2: Noise at sensitive land uses (other than residences) using quantitative assessment

Land use	Management Level, $L_{Aeq(15min)}$ Applies when properties are being used
Classrooms at schools and other educational institutions	Internal Noise level - 45dB
Hospital wards and operating theatres	Internal Noise levels - 45dB
Aged Care	Internal Noise levels - 45dB
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External Noise levels - 65dB
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation	External Noise Levels - 60dB

Where internal noise management levels are specified, the external noise level may be 10dB(A) greater for buildings with no adequate ventilation or 20dB(A) for buildings with fixed external windows and mechanical ventilation.

When assessing construction noise it should be noted that several types of plant and equipment can be particularly annoying to nearby residents. In those instances a 5dB penalty is applied to the predicted noise level in accordance with the *Interim Construction Noise Guideline*. Below are examples of the type of machines and operations that typically fit this category.

- Use of 'beeper' style reversing or movement alarms, particularly at night time
- Use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work
- Grinding metal, concrete or masonry
- Rock drilling
- Line drilling
- Vibratory rolling
- Rail tamping and regulating
- Bitumen milling or profiling
- Jack hammering, rock hammering or rock breaking
- Impact piling

The noise limits for the Project have been determined in accordance with the *Interim Construction Noise Guideline* (outlined in **Section 4.1** above) which is standard practice for construction projects in NSW. The Project Specific Noise Limits (determined on the basis of the *Interim Construction Noise Guideline* Noise Management Levels) are summarised in **Table 4.3**. Where internal noise levels were specified, 10dB was added to approximate an external noise level to take account of the effect of façade attenuation.

Table 4.3: Project Specific Noise Limits (determined on the basis of the Interim Construction Noise Guideline Noise Management Levels)

Loc.	Type	Noise Management Level dB(A)					
		Standard hours		Outside Standard hours			When in use
		Noise affected (RBL+10)	Highly noise affected	Day[1] (RBL+5)	Evening[1] (RBL +5)	Night[1] (RBL +5)	
R1 (N8)	Residential	45	75	40	38	37	-
R2 (N7)	Residential	54	75	49	49	41	-
R3 (N3)	Residential	48	75	43	40	39	-
R4 (N1)	Residential	53	75	48	47	45	-
R5 (N1)	Residential	53	75	48	47	45	-
R6 (N11)	Residential	60	75	55	52	47	-
R7 (N10)	Residential	54	75	49	49	43	-
R8 (N10)	Residential	54	75	49	49	43	-
S1	School	-	75	-	-	-	65
S2	School	-	75	-	-	-	65
S3	School	-	75	-	-	-	65
S4	School	-	75	-	-	-	65
S5	School	-	75	-	-	-	65
S6	School	-	75	-	-	-	65
S7	School	-	75	-	-	-	65
S8	School	-	75	-	-	-	65
CC1	Childcare Centre	-	75	-	-	-	65
CC2	Childcare Centre	-	75	-	-	-	65
CC3	Childcare Centre	-	75	-	-	-	65
CC4	Childcare Centre	-	75	-	-	-	65
H1	Hospital	-	75	-	-	-	65
H1	Medical Centre	-	75	-	-	-	65
A1	Aged Care	-	75	-	-	-	65
RE1	Active Recreation Area	-	75	-	-	-	65
RE2	Active Recreation Area	-	75	-	-	-	65
RE3	Passive Recreation Area	-	75	-	-	-	60
RE4	Passive Recreation Area	-	75	-	-	-	60
RE5	Passive Recreation Area	-	75	-	-	-	60

[1] Any works outside the recommended standard hours detailed in Table 4.1 shall comply with the "Outside Standard Hours" noise levels, where the Day Period is defined as hours between 07:00 to 18:00, the Evening Period is defined as hours between 18:00 to 22:00 and the Night Period is defined as the hours between 22:00 to 07:00.

Loc.	Type	Noise Management Level dB(A)					
		Standard hours		Outside Standard hours			When in use
		Noise affected (RBL+10)	Highly noise affected	Day[1] (RBL+5)	Evening[1] (RBL +5)	Night[1] (RBL +5)	
RE6	Passive Recreation Area	-	75	-	-	-	60
RE7	Passive Recreation Area	-	75	-	-	-	60

4.2 NOISE AND VIBRATION IMPACT ASSESSMENT APPROACH

The Noise Impact Assessment approach which encompasses undertaking noise predictions to determine potential noise impacts and assessing the predicted levels against appropriate criteria is summarised in **Figure 14.**

4.2.1 SLEEP DISTURBANCE ASSESSMENT APPROACH

The NSW Construction Noise Guideline also recommends that when construction works extend for more than two consecutive nights, the assessment should cover maximum noise levels, and the extent that they exceed the Rating Background Level (RBL).

Guidance indicating the potential for sleep disturbance is set out in the NSW *Environmental Criteria for Road Traffic Noise* (EPA 1999) and the *NSW Road Noise Policy* (DECCW 2001), and is summarised as follows:

The EPA reviewed research on sleep disturbance in the NSW Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999). This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.

From the research, the EPA recognised that current sleep disturbance criterion of an $L_{A1,\ (1\ minute)}$ not exceeding the $L_{A90,\ (15\ minute)}$ by more than 15 dB(A) is not ideal. Nevertheless, as there was insufficient evidence to determine what should replace it, the EPA continued to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.

The detailed analysis should cover the maximum noise level or $L_{A1,\ (1\ minute),}$ that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the appendices to the ECRTN. Other factors that may be important in assessing the extent of impacts on sleep include:

- How often high noise events will occur
- Time of day (normally between 10pm and 7am)
- Whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).

The $L_{A1, (1\ minute)}$ descriptor is meant to represent a maximum noise level measured under 'fast' time response. DECCW will accept analysis based on either $L_{A1, (1\ minute)}$ or $L_{A(Max)}$. As outlined in *Section 5.4 Sleep Disturbance* of the *Road Noise Policy* (DECCW 2001) "*the Environmental Criteria for Road Traffic Noise (EPA 1999) discussed a guideline aimed at limiting the level of sleep disturbance due to environmental noise – that the $L_{AF1, 1\ minute}$ level of any noise should not exceed the ambient L_{AF90} noise level by more than 15dB. This guideline takes into account the emergence of noise events, but does not directly limit the number of such events or their highest level, which are also found to affect sleep disturbance.*

Triggers for, and effects of sleep disturbance from, exposure to intermittent noise such as noise from road traffic are still being studied. There appears to be insufficient evidence to set new indicators for potential sleep disturbance due to road traffic noise. The NSW Roads and Traffic Authority's Practice Note 3 (Protocol for assessing maximum noise levels, RTA Environmental Noise Management Manual, December 2001*) outlines a protocol for assessing and reporting on maximum noise levels and the potential for sleep disturbance. DECCW will continue to review research on sleep disturbance as it becomes available.*

Table 4.4 details the criteria for sleep disturbance for each of the individual noise receiver locations.

Table 4.4: Sleep Disturbance Noise Criteria at Noise Sensitive Receptors dB(A) - Residential

Location	L_{A90}	Criteria L_{90}+15
R1 (N8)	32	47
R2 (N7)	36	51
R3 (N3)	34	49
R4 (N1)	40	55
R5 (N1)	40	55
R6 (N11)	42	57
R7 (N10)	38	53
R8 (N10)	38	53

4.3 NSW ROAD NOISE POLICY (RNP)

4.3.1 OPERATIONAL PHASE

The Environmental Criteria for Road Traffic Noise (EPA, 1999) was replaced by the Road Noise Policy (EPA 2011). The requirements of the Road Noise Policy are also applicable to this assessment. The activities associated with the Project have the potential to generate additional traffic on the arterial and local roads that will provide access to the Project site, and could potentially impact on the existing nearby noise sensitive receivers. **Table 4.5** summarises the applicable road categories to establish the noise assessment criteria based on the type of road and the proposed land use developments.

Table 4.5: Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of project / land use	Assessment Criteria/ Target Noise Level, dB(A)	
		Day (7am-10pm)	Night (10pm-7am)
Freeway/arterial/sub-arterial Road (Hunter Expressway, Hart Road(South))	3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments.	L_{Aeq}, (15hour). 60 (external)	L_{Aeq}, (9 hour) 55 (external)
Local Road (Sawyers Gully Road, Hart Road (North))	6. Existing residences affected by additional traffic on existing local roads generated by land use developments	L_{Aeq}, (1hour). 55 (external)	L_{Aeq}, (1 hour) 50 (external)

Note: These criteria are for assessment against façade- corrected noise levels when measured in front of a building façade. Hence, a correction factor of 2.5 dB is added to the predicted noise levels

As stated in Section 3.4 of the RNP, with regard to existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use development, any increase in total traffic noise level should be limited to 2dB above that of the corresponding 'no build option'.

Currently, Hart Road (North) is considered a local road with the main purpose to provide access to/from the Smelter. However, the classification for Hart Road (South) is different from Hart Road (North) as Hart Road (South) connects the Hunter Expressway and Local Roads in the area, which is classified as a Sub-arterial Road.

The nearest noise sensitive receptor (Scales Avenue) to Hart Road (North) is located approximately 250 metres away from the road kerb and this noise receptor is also located approximately 250m from the Hunter Expressway. Vipac believes that the traffic impact at this location will be dominated by Hunter Expressway as the traffic volumes at Hart Road (North) are relatively low compared to Hunter Expressway. Therefore, this noise receptor (Scales Avenue) will be compared against noise criteria of $L_{Aeq,15\ hour}$ and $L_{Aeq,9hour}$ during the day time and night time, respectively.

4.3.2 PRACTICE NOTE 3 (TRAFFIC SLEEP DISTUBANCE)

As outlined above a substantial portion of the RNP discusses a review of international research on the subject of sleep disturbance associated with noise. The guidance outlined with regard to road traffic noise and potential impacts on sleep disturbance expands on previous guidance set out in the RTA Environmental Noise Management Manual (ENMM) (2001) and earlier guidance set out in the Environmental Protection Authority Environmental Criteria for Road Traffic Noise (ECRTN)(1999).

The most recent guidance set out in the RNP states that "*there appears to be insufficient evidence to set new indicators for potential sleep disturbance due to road traffic noise*". The RNP refers to the RTA Practice Note 3 "*Protocol for assessing maximum noise levels"* as the method for assessing and reporting on maximum noise levels that may cause sleep disturbance. The Practice Note 3 indicates that:

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

5 VIBRATION CRITERIA

The effects of construction vibration upon buildings can be separated into three main categories:

- Perceptibility of the occupants to the vibration, and the possibility of them being disturbed or annoyed;
- Vulnerability of the building structures to vibration induced damaged;
- Vulnerability of the contents of the building that includes types of equipment, activities and processes.

5.1 HUMAN RESPONSE TO VIBRATION

Humans are very sensitive to vibration, and they can be disturbed, annoyed, and have their work activities interfered with if the levels are too high. The DEC "*Assessing Vibration – A Technical Guideline*" (2006) and British Standard 6472-1:2008 "*Guide to evaluation of human exposure to vibration in buildings, Part 1 – Vibration sources other than blasting*" provides guidance on human response to vibration in buildings. The guidelines set down base vibration levels at which there would be minimal interference to occupants.

BS6841:1987 "*Guide to measurement and evaluation of human exposure to whole-body mechanical vibration and repeated shock*" also sets out guidance on the effects of physical health from sustained exposure to vibration. However it is unlikely that such levels would be encountered from construction or demolition activities. The frequency weighting to be applied to the vibration levels are obtained from BS6841.

The criteria and guidelines relating to human response are summarised below.

5.1.1 DEC ASSESSING VIBRATION: A TECHNICAL GUIDELINE

The DEC *Assessing Vibration: A Technical Guideline* (2006) provides evaluation methods to assess the human response from continuous, impulsive and intermittent vibration in buildings from 1Hz to 80Hz which is based on British Standards 6472:1992 "*Evaluation of the Human Exposure to Vibration in Building (1Hz to 80Hz)*".

For continuous and impulsive vibration, assessment of impact should be considered on the basis of weighted RMS acceleration values. For intermittent vibration, assessment of impact should be considered on the basis of vibration dose values (VDV).

The DEC guidelines also include a section on mitigation when the predicted vibration value exceeds the criteria. Vibration mitigation may be achieved by way of:

- Controlling the vibration at the source, using the application of Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA).
- Controlling the transmission of vibration.
- Controlling the vibration at the receiver

5.1.2 BRITISH STANDARD 6472:2008- EVALUATION OF HUMAN EXPOSURE TO VIBRATION IN BUILDINGS

BS6472:1992 was updated in 2008 by BS6472:2008 Parts 1 and 2. BS6472:2008 Part 1 sets out vibration levels at which minimal comment is likely to be provoked from the occupants of a building subject to vibration (BS6472:2008 "*Part 2 relates to Blast-induced vibration*"). BS6472 takes into account the fact that humans perceive vertical vibrations to a greater extent than horizontal vibrations, although the effect is reversed at very low frequencies, below 4 Hz.

The evaluation of building vibration with respect to annoyance and comfort for occupants, over all weighted values of vibration is the preferred method of evaluation.

Continuous vibration would be generated for typical construction work. The curves in **Figure 15** represent the magnitudes of continuous vibration in buildings for Z-axis acceleration, below which adverse comments or complaints are rare. Multiplication factors are applied to the base level curve to define criteria for residential or office spaces. There are similar curves for x and y-axes.

The Vibration Dose Value in BS6472 is a concept used to evaluate the cumulative effects of bursts of both intermittent vibration and impulsive vibrations. Vibration Dose Value or the VDV represents a single value amount used to quantify the level of vibration.

The recommended VDV levels outlined in the DEC Vibration Guidelines (based on the BS6472:1992 Standard) which specifies levels of VDV expressed in daytime, night-time and typical human response are presented in **Table 5.1**. **Table 5.2** presents levels of VDV expressed in daytime, night-time and typical human response, based on the updated BS6472:2008 Part 1.

Table 5.1: Acceptable vibration dose values for intermittent vibration in various buildings ($m/s^{1.75}$)

Location	Daytime[1]		Night-time	
	Preferred Value $m/s^{1.75}$	**Maximum Value** $m/s^{1.75}$	**Preferred Value** $m/s^{1.75}$	**Maximum Value** $m/s^{1.75}$
Critical areas[2]	0.1	0.2	0.1	0.2
Residences	0.2	0.4	0.13	0.26
Offices, schools, educational institutions and places of worship	0.4	0.8	0.4	0.8
Workshops	0.8	1.6	0.8	1.6

Note 1: Daytime is 07:00 am to 10:00 pm and night-time is 10:00 pm to 07:00 am.

Note 2: Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical cases.

Table 5.2: Vibration dose value ranges which might result in various probabilities of adverse comment within various buildings (m/s$^{1.75}$)

Place and time	Low probability of adverse comment m/s$^{1.75}$ Note 1	Adverse comment possible m/s$^{1.75}$	Adverse comment probable m/s$^{1.75}$ Note 2
Residential buildings 16h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8
Office buildings 16h day	0.4 to 0.8	0.8 to 1.6	1.6 to 3.2
Workshop buildings 16h day	0.8 to 1.6	1.6 to 3.2	3.2 to 6.4

Note 1: Below these ranges, adverse comment is not expected.

Note 2: Above these ranges, adverse comment is very likely.

Vibration frequency was assessed in a range from 8Hz - 80 Hz, as predominant frequencies are known to be above 8Hz. Vibration levels below the low probability of adverse comment range presented in **Table 5.2** correspond to a low probability of disturbance to building occupants. Adverse comment or complaints may be expected when the VDV approaches the higher range levels in the possible and probable categories. Values up to the maximum level in **Table 5.1** can only be used where all reasonable and feasible measures have been implemented and they can be justified.

Criteria for exposure to continuous and impulsive vibration with regard to PPV levels expressed in daytime and night-time (outlined in the DEC Vibration Guidelines) is provided in **Table 5.3.**

Table 5.3: Peak Particle velocity for z-axis

Place	Time	Peak Particle velocity (mm/s) for z-axis vibration - Frequency range 8Hz-80Hz	
		Exposure to continuous vibration (16h day, 8h night)	Impulsive vibration excitation with up to three occurrences
Critical working areas (e.g. hospital operating theatres, precision laboratories)	Day Night	0.14 to 0.28 0.14 to 0.28	0.14 to 0.28 0.14 to 0.28
Residential	Day Night	0.28 to 0.56 0.2 to 0.4	8.6 to 17.0 2.8 to 5.6
Office	Day Night	0.56 to 1.1 0.56 to 1.1	18.0 to 36.0 18.0 to 36.0
Workshops	Day Night	1.1 to 2.2 1.1 to 2.2	18.0 to 36.0 18.0 to 36.0

5.2 STRUCTURAL RESPONSE TO VIBRATION

The response of a building to vibration is affected by several factors that include its type of foundation; the underlying ground conditions, its construction and the state of the building.

BS7385: Part 2-1993 "*Evaluation and measurement for vibration in buildings - Part 2: Guide to damage levels from ground borne vibration*" provides guidance values for building damage, as well as guidance on vibration measurement and data analysis. The German Standard DIN 4150: Part 3-1999 "*Structural vibration - Effects of vibration on structures*" also provides guidelines for evaluating the effects of vibration on structures.

5.2.1 GERMAN STANDARD DIN 4150-3:1999 – STRUCTURAL VIBRATION – EFFECTS OF VIBRATION ON STRUCTURES

The German Standard DIN 4150-3 "*Structural Vibration Part 3: Effects on buildings and structures*" is commonly used in Australia to evaluate the effects of vibration on structures primarily used for static loading.

Short-term vibration is defined as vibration which does not occur often enough to cause structural fatigue and which does not produce resonance in the structure being evaluated.

Table 5.4 provides guideline limits for short-term vibration to ensure that damage reducing the serviceability of a building will not occur provided vibration levels do not exceed these limits. This is also shown graphically in **Figure 16**. Vibration at the foundation is taken as the maximum absolute value in the x, y, and z directions, and vibration at the highest floor is the maximum of the in plane components.

Table 5.4: DIN4150-3 Vibration Limits

Type of structure	Guideline values for velocity in mm/s			
	Vibration at the foundation at a frequency of			Vibration at horizontal plane of highest floor at all frequencies
	1Hz to 10Hz	10 to 50Hz	50 to 100Hz (and above)	
Buildings 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 occupancy	5	5 to 15	15 to 20	15
Structures that because of their particular sensitivity to vibration, cannot be classified as above and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10	8

5.2.2 BRITISH STANDARD 7385 PART 2 – 1993 GUIDE TO DAMAGE LEVELS FROM GROUNDBORNE VIBRATION

The limits for transient vibration, above which cosmetic damage could occur to buildings, are given in **Table 5.5** and shown graphically in **Figure 17**.

These guide values however relate predominantly to transient vibration that does not give rise to resonant responses in structures. The guide values in **Table 5.5** should be reduced by up to 50%, in the case of dynamic loading caused by continuous vibration. The values presented in BS7385-2 are frequency dependant levels that are judged to give a minimal risk of vibration-induced damage.

Table 5.5: Transient vibration guide values for cosmetic damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced framed structures, Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
Un-reinforced or light framed structures, Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Note 1: Values referred to are at the base of the building Note 2: For the residential buildings group, at frequencies below 4 Hz, a maximum displacement of 0.6mm (zero to peak) should not be exceeded		

5.2.3 CONSTRUCTION VIBRATION ASSESSMENT CRITERIA SUMMARY

A comparison to the above criteria is shown in **Figure 18**. PPV values have been used for the human disturbance values, in order to compare against building damage guide values.

The human disturbance criterion from BS6472 for continuous vibration is significantly lower than the various threshold damage levels from DIN 4150 and BS7385. This is due to humans being able to perceive vibration levels that are well below those that could cause any risk to damage to a building or its contents.

The values in DIN 4150 are levels that if complied with, damage will not occur. If levels are exceeded damage will not necessarily occur, however if they are significantly exceeded, then further investigations will be required.

The vales in BS7385 are the lowest vibration levels above which damage has been credibly demonstrated. This is the basis on which the values are much higher than those of DIN 4150.

Based on the above, the following criterion is deemed most appropriate and is recommended for use in this assessment:

- When the adjacent building subject to vibration is being occupied, continuous vibration levels from BS6472 will be used to assess human perception. Human perception occurs at lower thresholds than that for building damage and during occupied periods will be the limiting criteria.

- When it is un-occupied, vibration levels from DIN 4150 will be used to protect the building from cosmetic damage.

Table 5.6 provides a summary of vibration management levels criterion at the sensitive receivers (which have been determined in accordance with the Interim Construction Noise Guideline).

Table 5.6: Human perception and cosmetic damage criteria (minimum value)

Type	Human Perception and cosmetic damage criteria	
	Human Perception (mm/s)	Cosmetic Damage (mm/s)
Residential	0.28-0.56	5

6 NOISE PREDICTION MODELLING

Noise prediction modelling was undertaken using the SoundPLAN computational noise prediction software package. The use of the SoundPLAN noise prediction modelling software and referenced modelling methodology is accepted for use in the state of NSW by the Environmental Protection Authority (EPA) for environmental noise modelling purposes. SoundPLAN is a proprietary noise prediction modelling package that has been used for numerous quarrying, mining and industrial noise and vibration impact assessments conducted both by Vipac and other consultancy practices.

6.1 GEOGRAPHICAL DATA

ESS Australia supplied topographical details of the area to Vipac for noise modelling purposes. **Table 6.1** below lists the drawings received and used in the noise model.

Table 6.1: Drawings used

Drawing Ref	Description	Date
Hydro base Data 20140701.DWG	Ground Terrain	18/12/2014

6.2 CONSTRUCTION PLANT AND EQUIPMENT

Table 6.2 details the proposed plant and equipment to be used during the construction works, and sets out the corresponding sound power levels produced by each item. The typical sound levels of the plant and equipment were extracted from *"Australian Standard AS2436-2010, Appendix A", "British Standard BS5228-1: 2009 – Code of practice for noise and vibration control on construction and open sites – Part 1: Noise"* and "*Vipac database"* (based on noise monitoring data of mobile and fixed plant and machinery equipment monitored previously by Vipac).

Table 6.2: Predicted Sound Powel Levels

Plant & Equipment	Reference	Sound Power Levels (dBA)	Predicted Sound Pressure Levels (dBA) at various distances per equipment (metres)					
			100	200	300	500	1000	1500
230T Excavators with grab and bucket attachment	BS5228-1: 2009	117	69	63	59	55	49	45
120T Excavators with shear and grab attachment	BS5228-1: 2009	114	66	60	56	52	46	42
70T Excavators with shear, hammer and bucket attachment	BS5228-1: 2009	114	66	60	56	52	46	42
46T Excavator with shear , hammer, bucket and pulverised attachment	BS5228-1: 2009	109	61	55	51	47	41	37
36T Excavators with shear, hammer, bucket and pulveriser attachment	BS5228-1: 2009	104	56	50	46	42	36	32
80ft Boomlifts	BS5228-1: 2009	105	57	51	47	43	37	33
40t Dump trucks	BS5228-1: 2009	118	70	64	60	56	50	46

Plant & Equipment	Reference	Sound Power Levels (dBA)	Predicted Sound Pressure Levels (dBA) at various distances per equipment (metres)					
			100	200	300	500	1000	1500
Telehandler	BS5228-1: 2009	106	58	52	48	44	38	34
25T Water truck	Vipac Database	108	60	54	50	46	40	36
Concrete crushing plant	Vipac Database	115	67	61	57	53	47	43
Concrete saw	BS5228-1: 2009	115	67	61	57	53	47	43
Jackhammer	BS5228-1: 2009	113	65	59	55	51	45	41
Delivery truck	BS5228-1: 2009	108	60	54	50	46	40	36

6.3 NOISE IMPACT FROM GENERATED TRAFFIC

The Calculation of Road Traffic Noise (CoRTN) method of traffic noise prediction was used, which is a method approved by the EPA. The traffic data presented in the "*Hydro Kurri Kurri Aluminium Smelter Demolition and Remediation Project Traffic Impact Assessment*" (by Hyder Consulting, 2015) and traffic count data from February 2015 were used to calculate the traffic noise generation.

Additional data was also referenced from the Hunter Expressway Noise Assessment entitled "F3 Freeway to Branxton Link" (by Atkins Acoustics, dated March 2007). Details regarding traffic volumes on the Hunter Expressway between Allandale Road and Lang Street, were sourced from the Atkins Acoustics report.

The noise model assumed 2015 as the operation year with the following background traffic growth:

- 4% per annum on the Hunter Expressway between Allandale Road and Hart Road for light vehicles
- 6.5% per annum on the Hunter Expressway between Allandale Road and Hart Road for heavy vehicles,
- 3% per annum on the Hunter Expressway between Hart Road and Lang Street for light vehicles,
- 5.5% per annum on the Hunter Expressway between Hart Road and Lang Street for heavy vehicles,

6.3.1 TRAFFIC GENERATED BY THE PROJECT

The traffic generated from the Project is detailed in **Table 6.3.**

Table 6.3: Development Thresholds and Generated Trips

Key Task	Key Action	Light Vehicles (Daily)	Heavy Vehicles (Daily)
Stage 1 Demolition	Site Establishment Management	24	5
	Demolition Activities	75	54
Site Establishment	Environmental Controls	15	46
	Haul Road Construction	45	5
Stage 2 Demolition	Site Establishment	15	5
	Demolition Activities	75	57
Containment Cell Construction	Vegetation Clearance	15	5
	Preparatory works	24	5
	Cell Base Liner Construction	48	17
	Internal Cell Wall Construction	36	5
	Cell Material Acceptance and Placement	36	5
	Leachate/Rainwater Management	6	3
	Containment Cell Cap Construction	42	17
Capped Waste Stockpile Removal	Site Establishment	12	4
	Cap Removal	36	5
	Material Removal	36	5
Leachate and groundwater management	Operate water treatment plant	6	4
	Decommission water treatment infrastructure	6	3
	Total	**552**	**250**

Project traffic would predominantly travel to and from the Smelter via Hart Road and the Hunter Expressway (using the Hart Road interchange). A small number of vehicles (predominantly small vehicles used by Works personnel) are likely to continue to the intersection with Sawyers Gully Road, Gingers Lane and Government Road and along one of these roads. In the absence of the traffic distribution of the additional traffic generated, Vipac assumed the following:

- 100% light and heavy vehicles travelling pass Hart Road (North of Hunter Expressway)
- 100% of heavy vehicles travelling to Hunter Expressway via Hart Road Interchange.
- Approximately 50% of heavy vehicles travelling to Upper Hunter and another 50% travelling to Newcastle, M1 Pacific Motorway via Hunter Expressway
- 90% of light vehicles travelling to Hunter Expressway via Hart Road interchange, where the additional traffic generated are evenly distributed to Upper hunter and Newcastle.

- 10% of light vehicles travelling pass Hart Road (South of Hunter Expressway) to Sawyers Gully Road, Ginger Lane and Government Road Intersection.

Taking into consideration the fact that the majority of the light vehicles traffic movements would be associated with the Works personnel travelling to and from the Project site, it is expected that the hourly diurnal period would be concentrated in the AM peak (travelling to the Project site) and PM peak (travelling from the Project site) and therefore, Vipac assumed that the hourly traffic for light vehicles will be 50% of the daily traffic.

Vipac conservatively assumed the additional traffic generated by the Demolition activities will be operating at the same time. **Table 6.4** shows the total additional traffic generated by the Project activities on Hart Road (South) and the Hunter Expressway based on the trip distribution and potential traffic generated by the Project. In the absence of traffic distribution profiles during the day period (07:00 – 22:00) and night period (22:00 – 07:00), Vipac conservatively assumed both day and night periods will generate the same traffic.

Table 6.4: Traffic Generated on roads

Road	Day (07:00 – 22:00)		Night (22:00 – 07:00)	
	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
Hart Road (North of the Hunter Expressway)	573	252	573	252
Hart Road (South of the Hunter Expressway)	60	0	60	0
Hunter Expressway (North of Hart Road)	271	129	271	129
Hunter Expressway (South of Hart Road)	271	129	271	129

Table 6.5 summaries the base traffic data and potential traffic that may be generated by the Project for each individual road, which was used to predict the potential traffic noise impact on sensitive receivers in the surrounding areas.

Table 6.5: Traffic Volume – Year 2015

Traffic Details	Hunter Expressway (North)		Hunter Expressway (South)		Hart Road (North)		Hart Road (South)	
	Base Traffic	Base Traffic + Proposed Operations	Base Traffic	Base Traffic + Proposed Operations	Base Traffic	Base Traffic + Proposed Operations	Base Traffic	Base Traffic + Proposed Operations
Average Daily Traffic-	16,960	17,759	20,798	21,597	130	1850	3,840	3,961
15 hour traffic flows (Day Period)	14,123	14,523	17,329	17,729	117	977	3,610	3,670
% Percentage Heavy Vehicles (15 hours)-2015	13.6%	14.1%	12.6%	13.1%	15.4%	28.1%	6.0%	5.9%
9 hour traffic flows (Night Period)	2,837	3,237	3,469	3,869	13	873	230	291
% Percentage Heavy Vehicles (9 hours)	23.0%	24.1%	21.4%	22.5%	15.4%	29.7%	6.0%	4.7%
Speed Limit (km/h)	110		110		70		70	

6.4 WEATHER CONDITIONS

Two noise prediction modelling scenarios were assessed using the SounPLAN program using CONCAWE algorithms in order to approximate the expected neutral and worst-case weather scenarios. It should be noted that sound will propagate further through the atmosphere under certain weather conditions. The 'worst-case' weather conditions chosen are those that are highly conducive to sound propagation.

The weather parameters used in the CONCAWE calculations to approximate expected neutral and worst-case weather situations at the site are outlined in **Table 6.6** below. As operations would primarily occur during daytime hours, this situation has been considered in the noise predictions. The weather parameters used in the noise predictions have been determined based on the annual data from the the Bureau of Meteorology (BoM) Weather Station at Cessnock Airport NSW (061260), which is located approximately 15 kilometres to the Project site.

Table 6.6: Sound Plan Weather Parameters

Parameter	Day		Evening/Night	
	Neutral	Worst-Case	Neutral	Worst-Case
Pasquill Stability Category	B	D	D	F
Wind Speed (m/s)	0	3	0	3
Humidity (%)	50	50	70	70
Temperature (deg Celsius)	10	10	4	4
Met Category	3	5	4	6

7 IMPACT ASSESSMENT

7.1 OPERATIONAL NOISE IMPACT

The predicted noise levels were based on the worst-case scenario for the demolition element, where the plant and equipment are placed closer to the noise sensitive receptors, at the southern end of pot rooms and the north-eastern corner of demolition works area. The noise model also takes into account the operations of the concrete crushing plant located at the southwest of the Project site, as shown in **Figure 3**.

Noise levels are expressed as external L_{Aeq-15} minutes (i.e. outdoor ambient noise levels over a 15-minute period) at the nearest boundary of the receiver properties. The predicted levels are presented in **Table 7.1** for "Standard Construction Hours" and in **Table 7.2** to **Table 7.4** for "Outside Standard Construction Hours". The results presented in **bold font** represent exceedances of the applicable noise assessment criteria.

Table 7.1: Predicted Noise Levels (L_{Aeq}) - Standard Construction Hours

Receiver	Stage 1 Demolition		Phase 1		Phase 2		Phase 3		Phase 4		Phase 5		Criteria
	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	
A1	19	29	19	29	19	29	18	28	18	28	16	25	55
CC1	24	34	24	34	24	35	23	33	24	34	22	32	55
CC2	23	33	23	34	24	34	22	33	24	34	21	31	55
CC3	21	31	21	31	21	31	20	30	20	31	18	28	55
CC4	16	26	13	23	14	25	12	22	9	20	3	13	55
CHC1	24	34	24	34	24	35	23	33	24	34	21	31	55
CHC2	24	34	24	34	24	34	23	33	24	34	21	31	55
CHC3	23	33	23	34	24	34	22	32	23	33	21	31	55
CHC4	23	33	23	34	24	34	22	32	23	34	21	31	55
CHC5	20	30	21	31	21	31	20	30	21	31	18	28	55
CHC6	23	33	23	33	23	33	21	31	22	32	19	29	55
H1	19	29	19	29	19	29	17	28	18	28	15	25	55
H2	21	32	21	32	22	32	20	30	21	31	18	28	55
R1	16	26	20	30	17	28	17	27	17	27	15	24	45
R2	16	27	19	29	17	27	17	27	18	28	15	25	54
R3	33	43	35	45	34	44	34	44	36	46	34	43	48
R4	42	51	42	51	44	53	44	53	46	53	44	53	53
R5	42	51	40	50	43	52	43	52	43	52	41	50	53
R6	38	47	39	48	39	48	39	48	39	48	34	43	60
R7	40	49	40	49	40	49	39	48	39	48	33	43	54
R8	31	41	33	43	30	40	29	39	29	39	26	36	54
RE1	40	49	42	51	44	53	45	53	48	56	46	54	65
RE2	39	48	43	52	43	52	45	53	46	55	43	51	65
RE3	44	52	43	51	46	55	45	54	45	54	43	52	60
RE4	21	32	23	33	22	32	21	31	23	33	20	30	60
RE5	26	37	27	37	27	37	26	36	27	37	24	34	60
RE6	27	37	27	37	27	37	26	36	27	37	25	35	60
RE7	26	36	25	35	26	36	24	34	25	35	22	32	60
S1	26	36	28	38	28	38	27	37	29	39	26	35	55
S2	28	38	28	38	29	39	27	37	29	39	26	36	55
S3	26	36	26	36	26	36	25	35	25	35	22	32	55
S4	22	33	23	33	23	33	21	32	23	33	20	30	55
S5	20	30	20	31	20	31	19	30	20	30	17	27	55
S6	22	32	22	32	22	32	20	31	21	32	19	29	55
S7	22	32	21	32	22	32	20	30	21	31	18	28	55
S8	6	16	6	16	7	17	6	16	6	17	0	5	55

Table 7.2: Predicted Noise Levels (L_{Aeq}) – Outside Standard Construction Hours (Day Period)

Receiver	Stage 1		Phase 1		Phase 2		Phase 3		Phase 4		Phase 5		Criteria
	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	
A1	19	29	19	29	19	29	18	28	18	28	16	25	55
CC1	24	34	24	34	24	35	23	33	24	34	22	32	55
CC2	23	33	23	34	24	34	22	33	24	34	21	31	55
CC3	21	31	21	31	21	31	20	30	20	31	18	28	55
CC4	16	26	13	23	14	25	12	22	9	20	3	13	55
CHC1	24	34	24	34	24	35	23	33	24	34	21	31	55
CHC2	24	34	24	34	24	34	23	33	24	34	21	31	55
CHC3	23	33	23	34	24	34	22	32	23	33	21	31	55
CHC4	23	33	23	34	24	34	22	32	23	34	21	31	55
CHC5	20	30	21	31	21	31	20	30	21	31	18	28	55
CHC6	23	33	23	33	23	33	21	31	22	32	19	29	55
H1	19	29	19	29	19	29	17	28	18	28	15	25	55
H2	21	32	21	32	22	32	20	30	21	31	18	28	55
R1	16	26	20	30	17	28	17	27	17	27	15	24	40
R2	16	27	19	29	17	27	17	27	18	28	15	25	49
R3	33	43	35	**45**	34	**44**	34	**44**	36	46	34	43	43
R4	42	**51**	42	**51**	44	**53**	44	**53**	46	**54**	44	**53**	48
R5	42	**51**	40	**50**	43	**52**	43	**52**	43	**52**	41	**50**	48
R6	38	47	39	48	39	48	39	48	39	48	34	43	55
R7	40	49	40	49	40	49	39	48	39	48	33	43	49
R8	31	41	33	43	30	40	29	39	29	39	26	36	49
RE1	40	49	42	51	44	53	45	53	48	56	46	54	65
RE2	39	48	43	52	43	52	45	53	46	55	43	51	65
RE3	44	52	43	51	46	55	45	54	45	54	43	52	60
RE4	21	32	23	33	22	32	21	31	23	33	20	30	60
RE5	26	37	27	37	27	37	26	36	27	37	24	34	60
RE6	27	37	27	37	27	37	26	36	27	37	25	35	60
RE7	26	36	25	35	26	36	24	34	25	35	22	32	60
S1	26	36	28	38	28	38	27	37	29	39	26	35	55
S2	28	38	28	38	29	39	27	37	29	39	26	36	55
S3	26	36	26	36	26	36	25	35	25	35	22	32	55
S4	22	33	23	33	23	33	21	32	23	33	20	30	55
S5	20	30	20	31	20	31	19	30	20	30	17	27	55
S6	22	32	22	32	22	32	20	31	21	32	19	29	55
S7	22	32	21	32	22	32	20	30	21	31	18	28	55
S8	6	16	6	16	7	17	6	16	6	17	0	5	55

Table 7.3: Predicted Noise Levels (L_{Aeq}) – Outside Standard Construction Hours (Evening Period)

Receiver	Stage 1		Phase 1		Phase 2		Phase 3		Phase 4		Phase 5		Criteria
	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	
A1	24	30	19	30	24	30	23	28	23	29	20	26	55
CC1	28	35	24	35	29	35	28	34	29	35	26	32	55
CC2	28	34	23	34	28	35	27	33	28	34	26	31	55
CC3	26	32	21	32	26	32	24	30	25	31	23	28	55
CC4	21	27	13	24	19	25	17	23	14	20	8	14	55
CHC1	28	35	24	35	29	35	28	34	29	35	26	32	55
CHC2	29	35	24	34	29	35	27	33	28	34	25	31	55
CHC3	28	34	23	34	28	34	27	33	28	34	25	31	55
CHC4	28	34	23	34	28	35	27	33	28	34	25	31	55
CHC5	25	31	21	32	26	32	25	31	26	32	23	29	55
CHC6	27	34	23	34	27	34	26	32	26	33	23	29	55
H1	24	30	19	30	24	30	22	28	23	29	20	26	55
H2	26	33	21	32	26	33	25	31	26	32	23	29	55
R1	21	27	20	31	22	28	22	28	22	28	19	25	38
R2	21	27	19	30	22	28	22	27	23	29	20	26	49
R3	37	43	35	45	39	**44**	39	**44**	41	**46**	38	44	40
R4	46	**51**	42	**51**	**49**	**54**	**48**	**53**	**50**	**55**	**48**	**53**	47
R5	46	**51**	40	**50**	**48**	**53**	47	**52**	47	**52**	45	**50**	47
R6	42	47	39	48	43	48	43	48	43	48	38	44	52
R7	44	**50**	40	**50**	44	**50**	43	48	43	48	38	43	49
R8	35	41	33	43	35	41	34	40	33	39	30	36	49
RE1	44	50	42	51	48	53	49	54	52	57	50	54	60
RE2	43	49	43	53	48	53	49	54	50	55	47	51	60
RE3	48	53	43	52	50	55	49	54	49	54	47	52	60
RE4	26	32	23	33	27	33	26	32	27	33	25	31	60
RE5	31	37	27	37	32	38	30	36	31	37	28	34	60
RE6	31	37	27	38	32	38	31	36	32	38	29	35	60
RE7	30	36	25	36	30	36	29	35	29	35	26	32	60
S1	30	37	28	38	32	38	32	38	33	39	30	36	55
S2	32	39	28	39	33	39	32	38	33	39	31	36	55
S3	31	37	26	37	31	37	29	35	30	36	26	32	55
S4	27	33	23	34	28	34	26	32	27	34	25	31	55
S5	25	31	20	31	26	32	25	30	25	31	22	28	55
S6	26	33	22	33	27	33	25	31	26	32	23	29	55
S7	26	33	21	32	26	33	25	31	25	31	22	28	55
S8	11	17	6	17	12	18	11	17	12	17	1	6	55

Table 7.4: Predicted Noise Levels (L_{Aeq}) – Outside Standard Construction Hours (Night Period)

Receiver	Stage 1		Phase 1		Phase 2		Phase 3		Phase 4		Phase 5		Criteria
	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	
A1	24	30	19	30	24	30	23	28	23	29	20	26	55
CC1	28	35	24	35	29	35	28	34	29	35	26	32	55
CC2	28	34	23	34	28	35	27	33	28	34	26	31	55
CC3	26	32	21	32	26	32	24	30	25	31	23	28	55
CC4	21	27	13	24	19	25	17	23	14	20	8	14	55
CHC1	28	35	24	35	29	35	28	34	29	35	26	32	55
CHC2	29	35	24	34	29	35	27	33	28	34	25	31	55
CHC3	28	34	23	34	28	34	27	33	28	34	25	31	55
CHC4	28	34	23	34	28	35	27	33	28	34	25	31	55
CHC5	25	31	21	32	26	32	25	31	26	32	23	29	55
CHC6	27	34	23	34	27	34	26	32	26	33	23	29	55
H1	24	30	19	30	24	30	22	28	23	29	20	26	55
H2	26	33	21	32	26	33	25	31	26	32	23	29	55
R1	21	27	20	31	22	28	22	28	22	28	19	25	38
R2	21	27	19	30	22	28	22	27	23	29	20	26	49
R3	37	43	35	45	39	**44**	39	**44**	41	**46**	38	44	40
R4	46	**51**	42	**51**	**49**	**54**	**48**	**53**	**50**	**55**	**48**	**53**	47
R5	46	**51**	40	**50**	**48**	**53**	47	**52**	47	**52**	45	**50**	47
R6	42	47	39	48	43	48	43	48	43	48	38	44	52
R7	44	**50**	40	**50**	44	**50**	43	48	43	48	38	43	49
R8	35	41	33	43	35	41	34	40	33	39	30	36	49
RE1	44	50	42	51	48	53	49	54	52	57	50	54	60
RE2	43	49	43	53	48	53	49	54	50	55	47	51	60
RE3	48	53	43	52	50	55	49	54	49	54	47	52	60
RE4	26	32	23	33	27	33	26	32	27	33	25	31	60
RE5	31	37	27	37	32	38	30	36	31	37	28	34	60
RE6	31	37	27	38	32	38	31	36	32	38	29	35	60
RE7	30	36	25	36	30	36	29	35	29	35	26	32	60
S1	30	37	28	38	32	38	32	38	33	39	30	36	55
S2	32	39	28	39	33	39	32	38	33	39	31	36	55
S3	31	37	26	37	31	37	29	35	30	36	26	32	55
S4	27	33	23	34	28	34	26	32	27	34	25	31	55
S5	25	31	20	31	26	32	25	30	25	31	22	28	55
S6	26	33	22	33	27	33	25	31	26	32	23	29	55
S7	26	33	21	32	26	33	25	31	25	31	22	28	55
S8	11	17	6	17	12	18	11	17	12	17	1	6	55

The predicted noise levels associated with the number of plant and equipment listed in **Section 2** comply with the standard construction noise criteria and highly affected noise criteria at all noise sensitive receptors. The predicted noise levels are also within the applicable noise criteria at the majority of the noise sensitive receptors "Outside Standard Construction Hours" for the majority of scenarios, associated with neutral weather conditions. However, the predicted noise levels associated with the worst-case scenarios are expected to exceed the noise criteria "outside standard construction hours" at a number of the noise sensitive receptors during the following periods:

Outside Standard Construction Hours – Day Period

- Predicted noise levels are expected to exceed the applicable noise criteria at the noise sensitive receptors R4 and R5 for the worst-case scenario associated with all phases of the Project's Works program and are predicted to exceed the applicable criteria at the noise sensitive receptor R3 for the worst-case scenario associated with Phase 2 of the Project's Works program.

Outside Standard Construction Hours – Evening and Night Periods

- Predicted noise levels are expected to exceed the applicable noise criteria at the noise sensitive receptors R4 and R5 for the worst-case scenario associated with all phases of the Project's Works program. The predicted noise levels are also predicted to exceed the applicable criteria at the noise sensitive receptor R3 for the worst-case scenario associated with Phase 2, Phase 3 and Phase 4 of the works program. The predicted noise levels are predicted to exceed the applicable criteria at the noise sensitive receptor R7 for the worst-case scenario associated with Stage1 Demolition, Phase 1 and Phase 2 of the Project's Works program.

- Predicted noise levels are expected to exceed the applicable noise criteria at the noise sensitive receptors R4 for the neutral scenarios associated with Phase 2, Phase 3, Phase 4 and Phase 5. The predicted noise levels are also predicted to exceed the applicable noise criteria at the noise sensitive receptor R5 for the neutral scenario associated with Phase 2. The predicted noise levels at all of the other noise sensitive receptors are within the applicable criteria for neutral conditions for all Phases of the Project's Works program.

It should be noted that an increase of +3dB would only be just perceptible to human ear, an increase of +5dB would considered as clearly noticeable and an increase of +10dB would considered a doubling the loudness of a given noise source. In this context, an increase in a noise level in the order of 1dB would be considered as a negligible impact and any noise exceedance of 5dB or greater would be considered as a perceptible impact. The predicted noise impacts in this regard would not be considered to be significant although controls will be implemented in order to achieve compliance with the applicable noise criteria.

In order to comply with the "outside standard construction hours" noise criteria during the neutral and worst-case conditions, it will be necessary to restrict the number of plant and equipment items operating at the site. Details of the number and items of equipment that could operate (without exceeding the applicable noise limit criterion) during the "outside standard construction hours" for each period (i.e. day, evening and night-time periods) are provided in **Table 7.5**.

Table 7.5: Equipment for each period during "outside standard construction hours"

Key Task	Activities - Scenarios	Day	Evening	Night
Stage 1 Demolition	Demolition	1 x 46t Excavator with shear , hammer, bucket and pulverised attachment 4 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 80ft Boom lifts 2 x 40t Dump trucks 1 x Tele handler 1 x 25t Water truck 1 x Concrete crushing plant	3 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 40t Dump trucks 1 x 25t Water truck 1 x Concrete crushing plant	3 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 40t Dump trucks 1 x 25t Water truck
Phase 1 of the Project	Continuation of Stage 1 Demolition compound, concrete crushing plant and stockpile area	1 x 70t Excavators with shear, hammer and bucket attachment 1 x 46t Excavator with shear , hammer, bucket and pulverised attachment 4 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 80ft Boom lifts 2 x 40t Dump trucks 1 x Tele handler 1 x 25t Water truck 1 x Concrete crushing plant	1 x 46t Excavator with shear , hammer, bucket and pulverised attachment 4 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 80ft Boom lifts 2 x 40t Dump trucks 1 x Tele handler 1 x 25t Water truck 1 x Concrete crushing plant	3 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 40t Dump trucks 1 x 25t Water truck
	Installation of the Project's environmental controls	2 x 36t Excavators	2 x 36t Excavators	2 x 36t Excavators
	Construction of Haul Road and Containment Cell utilities/services	2 x 36t Excavators 2 x Graders 4 x 30t Articulated trucks 2 x Dozers	No activities for this scenario	No activities for this scenario

Key Task	Activities - Scenarios	Day	Evening	Night
		1 x Vibrating drum roller 1 x 25t Water truck		
	Containment Cell Establishment (including VENM/ENM Stockpile and compound area)	1 x Wheel dozer 3 x 36t Tracked excavators 3 x Compactors/rollers 4 x 30t Articulated trucks 2 x Backhoes 2 x 25t Water carts	1 x Wheel dozer 3 x 36t Tracked excavators 3 x Compactors/rollers 4 x 30t Articulated trucks 2 x Backhoes 2 x 25t Water carts	1 x Wheel dozer 3 x 36t Tracked excavators 3 x Compactors/rollers 4 x 30t Articulated trucks 2 x Backhoes 2 x 25t Water carts
	Removal of Smelters waste stockpiles near anode baking furnace	2 x 36t Excavators 4 x 30t Articulated trucks	2 x 36t Excavators 4 x 30t Articulated trucks	2 x 36t Excavators 4 x 30t Articulated trucks
Phase 2 of the Project	Continuation of compound, concrete plant, stockpile area and ancillary facilities	1 x 46t Excavator with shear , hammer, bucket and pulverised attachment 2 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 1 x 80ft Boom lifts 2 x 40t Dump trucks 1 x 25t Water truck 1 x Concrete crushing plant	1 x 46t Excavator with shear , hammer, bucket and pulverised attachment 2 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 1 x 80ft Boom lifts 2 x 40t Dump trucks 1 x 25t Water truck 1 x Concrete crushing plant	1 x 46t Excavator with shear , hammer, bucket and pulverised attachment 2 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 1 x 80ft Boom lifts 2 x 40t Dump trucks 1 x 25t Water truck
	Establishment and operation of containment cell and capped waste stockpile water treatment plants	2 x 36t Excavators 2 x Landfill Compactors 4 x 30t Articulated trucks 2 x 25t Water carts	2 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts	2 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts
	Establishment of capped waste stockpile crushing plant	1 x Waste stockpile crushing plant 1 x Dozer	1 x Waste stockpile crushing plant 1 x Dozer	1 x Waste stockpile crushing plant 1 x Dozer

Key Task	Activities - Scenarios	Day	Evening	Night
	Clearance of vegetation between the Smelter and the North Dams	1 x Dozer 1 x 36t Excavator 1 x Mulching/ compositing machine 1 x 30t Articulated truck	1 x Dozer 1 x 36t Excavator 1 x Mulching/ compositing machine 1 x 30t Articulated truck	1 x Dozer 1 x 36t Excavator 1 x Mulching/ compositing machine 1 x 30t Articulated truck
Phase 3 of the Project	Continuation of compound, concrete crushing plant, stockpile area and ancillary facilities	1 x Concrete crushing plant 1 x Capped waste stockpile crushing plant	1 x Concrete crushing plant 1 x Capped waste stockpile crushing plant	1 x Capped waste stockpile crushing plant
	Continuation removal, processing/crushing and transportation of capped waste stockpile material	3 x 36t Excavators 2 x Landfill Compactors 4 x 30t Articulated trucks 2 x 25t Water carts	3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts	3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts
	Continue placing material in containment cell (Demolition waste and capped waste stockpile)	3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts	3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts	3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts
	Excavation of contaminated soils and transportation to and placement in the containment cell	2 x 36t Excavators 2 x Graders 4 x 30t Articulated Trucks	2 x 36t Excavators 2 x Graders 4 x 30t Articulated Trucks	2 x 36t Excavators 2 x Graders 4 x 30t Articulated Trucks
Phase 4 of the Project	Continuation of compound, concrete crushing plant, stockpile area and ancillary facilities	4 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 40t Dump trucks 1 x 25t Water truck 1 x Concrete crushing plant 1 x Capped waste stockpile crushing plant	1 x Concrete crushing plant 1 x Capped waste stockpile crushing plant	1 x Capped waste stockpile crushing plant

Key Task	Activities - Scenarios	Day	Evening	Night
	Continuation removal, processing/crushing and transportation of capped waste stockpile material	3 x 36t Excavators 4 x 30t Articulated Trucks 2 x 25t Water carts	3 x 36t Excavators 4 x 30t Articulated Trucks 2 x 25t Water carts	3 x 36t Excavators 4 x 30t Articulated Trucks 2 x 25t Water carts
	Continue placing material in containment cell (demolition waste and capped waste stockpile)	3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts	3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts	3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts
Phase 5 of the Project	Continuation of compound	1 x 46t Excavator with shear , hammer, bucket and pulverised attachment 4 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 40t Dump trucks 1 x 25t Water truck	1 x 46t Excavator with shear , hammer, bucket and pulverised attachment 4 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 40t Dump trucks 1 x 25t Water truck	4 x 36t Excavators with shear, hammer, bucket and pulveriser attachment 2 x 40t Dump trucks 1 x 25t Water truck
	Excavation and remediation of eastern and western dam. Material from dam floors to be placed in the containment cell	3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts	3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts	3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts
	Excavation of contaminated natural soils from the capped waste stockpile footprint and transportation to and placement in the containment cell	3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts	3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts	3 x 36t Excavators 4 x 30t Articulated trucks 2 x 25t Water carts

The predicted noise levels associated with the equipment listed in **Table 7.5** are detailed in **Table 7.6** to **Table 7.8**.

Table 7.6: Predicted Noise Level Outside Standard Construction Hour – Day period (Restricted number of equipment) – L_{eq} dBA

Receiver	Stage 1 Demolition		Phase 1		Phase 2		Phase 3		Phase 4		Phase 5		Criteria
	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	
A1	14	24	17	27	15	25	14	24	14	24	10	20	55
CC1	19	29	21	31	20	30	19	29	20	29	16	26	55
CC2	18	28	21	31	19	30	19	29	19	29	15	25	55
CC3	15	26	18	28	17	27	16	26	16	26	12	22	55
CC4	10	20	12	22	10	20	9	19	9	20	3	13	55
CHC1	19	29	21	31	20	30	19	29	20	30	15	25	55
CHC2	19	29	21	31	20	30	19	29	19	29	15	25	55
CHC3	18	28	21	31	19	29	18	29	19	29	15	25	55
CHC4	18	28	21	31	19	30	19	29	19	29	15	25	55
CHC5	15	25	18	28	16	27	16	26	16	26	12	22	55
CHC6	18	28	20	30	19	29	18	28	18	28	13	23	55
H1	13	24	16	26	15	25	14	24	14	24	10	20	55
H2	16	26	19	29	17	28	16	27	17	27	12	23	55
R1	10	21	16	27	13	24	13	23	12	22	10	20	40
R2	9	19	15	25	13	23	13	23	12	22	9	19	49
R3	26	36	31	41	31	41	32	41	31	40	28	37	43
R4	37	46	39	48	39	48	38	47	40	48	38	46	48
R5	34	42	37	46	36	45	34	43	37	46	35	44	48
R6	36	45	37	46	37	46	37	45	37	45	29	38	55
R7	37	46	39	48	38	47	37	46	37	46	30	39	49
R8	25	35	31	41	27	37	26	36	25	35	22	32	49
RE1	33	43	39	48	42	51	43	52	42	49	39	47	65
RE2	32	41	38	48	42	51	45	53	43	50	39	46	65
RE3	38	47	40	49	40	49	39	47	41	49	37	46	60
RE4	15	25	19	29	18	28	17	28	17	27	14	24	60
RE5	22	32	24	34	23	33	22	32	22	32	18	28	60
RE6	21	31	24	34	23	33	22	32	22	32	19	29	60
RE7	20	30	23	33	22	32	21	31	21	31	16	26	60
S1	21	30	25	34	25	35	25	35	24	33	20	29	55
S2	23	33	25	35	24	34	24	34	24	34	20	30	55
S3	21	31	24	34	22	32	21	31	22	31	17	27	55
S4	17	27	20	30	19	29	18	28	18	28	14	24	55
S5	15	26	18	28	17	27	16	26	16	26	11	22	55
S6	16	26	19	29	18	28	17	27	17	27	13	23	55
S7	16	27	19	29	18	28	17	27	17	27	12	22	55
S8	6	16	6	16	7	17	6	16	6	17	0	5	55

Table 7.7: Predicted Noise Level Outside Standard Construction Hour – Evening period (Restricted number of equipment) – L_{eq} dBA

Receiver	Stage 1 Demolition		Phase 1		Phase 2		Phase 3		Phase 4		Phase 5		Criteria
	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	
A1	17	24	20	25	20	26	19	25	18	24	15	21	55
CC1	22	28	24	30	24	30	24	30	23	29	20	26	55
CC2	22	28	24	30	24	30	23	29	23	28	20	26	55
CC3	19	25	21	27	21	27	21	26	20	26	17	23	55
CC4	14	20	16	21	15	21	14	20	14	20	8	14	55
CHC1	22	28	24	30	25	30	24	30	23	29	20	26	55
CHC2	22	28	24	30	24	30	24	29	23	29	20	25	55
CHC3	21	28	24	29	24	30	23	29	22	28	19	25	55
CHC4	22	28	24	30	24	30	23	29	22	28	20	25	55
CHC5	19	25	21	27	21	27	21	26	20	26	17	23	55
CHC6	21	28	23	29	23	29	23	28	22	28	18	24	55
H1	17	23	19	25	19	25	19	25	18	24	15	21	55
H2	20	26	22	28	22	28	21	27	20	26	17	23	55
R1	14	20	18	24	18	24	17	23	16	22	15	20	40
R2	13	19	18	23	18	23	17	23	16	22	14	20	49
R3	29	35	33	39	34	39	35	40	34	39	32	37	43
R4	40	45	42	47	42	47	41	46	41	46	42	46	48
R5	36	41	40	45	40	45	38	43	37	42	39	44	48
R6	40	45	41	46	41	46	41	45	41	45	33	38	55
R7	41	45	42	47	42	47	42	46	41	46	35	40	49
R8	29	34	33	38	31	37	30	36	29	35	27	32	49
RE1	36	41	41	46	42	47	44	49	44	48	43	48	65
RE2	34	40	40	45	43	47	46	50	46	49	42	46	65
RE3	42	46	43	48	44	48	43	47	42	47	41	46	60
RE4	19	25	22	28	22	28	22	27	20	26	19	25	60
RE5	25	31	27	33	27	33	27	32	26	32	23	28	60
RE6	24	30	27	33	27	33	26	32	25	31	23	29	60
RE7	24	30	26	32	26	32	25	31	25	30	21	27	60
S1	24	30	27	33	28	33	28	33	27	32	24	30	55
S2	26	32	28	34	29	34	28	34	27	33	25	30	55
S3	25	31	27	33	27	33	26	32	25	31	21	27	55
S4	21	27	23	29	23	29	22	28	22	28	19	25	55
S5	19	25	21	27	21	27	21	27	20	26	17	22	55
S6	20	26	22	28	22	28	21	27	21	27	18	23	55
S7	20	26	22	28	22	28	21	27	21	27	17	23	55
S8	11	17	11	17	12	18	11	17	12	17	1	6	55

Table 7.8: Predicted Noise Level Outside Standard Construction Hour – Night period (Restricted number of equipment) – L_{eq} dBA

Receiver	Stage 1 Demolition		Phase 1		Phase 2		Phase 3		Phase 4		Phase 5		Criteria
	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case n	Neutral	Worst case	Neutral	Worst case	
A1	11	17	17	23	17	23	15	21	13	19	14	20	55
CC1	16	22	22	28	22	28	21	27	19	25	19	25	55
CC2	16	22	21	27	21	27	20	26	18	24	19	25	55
CC3	13	19	18	24	19	25	17	23	16	21	16	22	55
CC4	8	14	12	18	12	18	9	15	8	14	8	14	55
CHC1	16	22	22	28	22	28	21	27	19	25	19	25	55
CHC2	16	22	21	27	22	27	20	26	18	24	19	25	55
CHC3	16	21	21	27	21	27	20	26	18	24	19	24	55
CHC4	16	22	21	27	21	27	20	26	18	24	19	25	55
CHC5	13	19	19	25	19	24	18	23	16	22	16	22	55
CHC6	15	21	20	26	20	26	19	25	17	23	18	23	55
H1	11	17	17	23	17	23	15	21	13	19	14	20	55
H2	14	20	19	25	19	25	18	24	16	22	16	22	55
R1	9	15	17	23	17	23	16	22	13	19	14	20	40
R2	8	14	16	22	16	22	16	22	14	20	14	20	49
R3	25	30	32	38	33	38	34	39	33	38	31	36	43
R4	35	40	40	45	40	45	39	43	38	42	40	45	48
R5	36	40	40	44	40	44	38	42	36	41	38	43	48
R6	31	36	35	40	36	41	34	39	34	38	33	38	55
R7	33	38	38	43	38	43	36	41	35	39	34	39	49
R8	23	28	31	37	29	35	28	33	25	31	26	32	49
RE1	32	37	40	45	42	46	44	48	43	47	42	46	65
RE2	31	36	40	45	42	47	46	50	45	49	42	45	65
RE3	37	41	41	45	42	46	39	44	39	43	40	45	60
RE4	14	20	20	26	20	26	20	26	18	24	18	24	60
RE5	19	25	24	30	24	30	23	29	21	27	22	28	60
RE6	19	25	24	30	25	30	23	29	22	28	22	28	60
RE7	18	23	23	29	23	29	21	27	20	25	20	26	60
S1	18	24	25	31	26	32	26	32	25	30	23	29	55
S2	21	26	26	32	26	32	25	30	23	29	24	29	55
S3	18	24	24	29	24	30	22	28	20	26	21	27	55
S4	15	21	20	26	20	26	19	25	18	24	18	24	55
S5	13	19	19	25	19	25	18	23	16	22	16	22	55
S6	14	20	19	25	19	25	18	24	16	22	17	23	55
S7	14	20	19	25	19	25	18	23	16	22	16	22	55
S8	0	6	7	12	7	12	0	6	3	9	1	6	55

7.2 SLEEP DISTURBANCE ASSESSMENT

For construction activities, the L_1 sound pressure level of a known L_{eq} (ambient noise level) is typically 10dB higher than the L_{eq} level, (L_1 refers to the 1 percentile noise level, i.e. the noise level that is exceeded for 1% over a given measurement period and L_{eq} refers to the equivalent (or average) noise level over a given measurement period). It is on this basis (i.e. the relationship of an L_1 noise level being approximately 10dB greater than the L_{eq} noise level for a given noise source) that the L_1 noise emission level of the proposed construction equipment has been estimated. Vipac have assessed sleep disturbance by using the criteria of RBL+15dB, (in accordance with the applicable guidelines outlined in **Section 4.2**).

Table 7.9 presents the result of the sleep disturbance assessment associated with the number and items of equipment that have been identified as acceptable for any works that may be required to be undertaken during the night-time, as outlined in **Table 7.5**.

Table 7.9: Sleep Disturbance Assessment – L_{1A} - dB

Receiver	Stage 1 Demolition		Phase 1		Phase 2		Phase 3		Phase 4		Phase 5		Criteria
	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	Neutral	Worst case	
R1	19	25	27	33	27	33	26	32	23	29	24	30	47
R2	18	24	26	32	26	32	26	32	24	30	24	30	51
R3	35	40	42	48	43	48	44	49	43	48	41	46	49
R4	45	50	50	55	50	55	49	53	48	52	50	55	55
R5	46	50	50	54	50	54	48	52	46	51	48	53	55
R6	41	46	45	50	46	51	44	49	44	48	43	48	57
R7	43	48	48	53	48	53	46	51	45	49	44	49	53
R8	33	38	41	47	39	45	38	43	35	41	36	42	53

7.3 DISCUSSION

Overall, the Noise and Vibration Impact Assessment indicates that the predicted noise levels associated with the worst-case scenario in terms of operational plant and machinery items that would be used for the Works, would be within the applicable Project Specific Noise Limits during the standard construction hours and would be within the Highly Affected noise limit of 75dB (as prescribed in the Interim Construction Noise Guideline) at all noise sensitive receivers. The Project Specific Noise Limits for the Project were determined in accordance with the *Interim Construction Noise Guideline* on the basis of the Noise Management Levels outlined in the guidelines and the Highly Noise Affected Levels as specified in the *Interim Construction Noise Guideline*.

The predicted noise levels are also within the applicable noise criteria at the majority of the noise sensitive receptors “Outside Standard Construction Hours” for the majority of scenarios, associated with neutral weather conditions. However, the predicted noise levels associated with the worst-case scenarios in terms of operational plant and machinery items that would be used for the Works, are

raised above the applicable Noise Limits for periods outside the standard construction hours at a number of the noise sensitive receptors during the following periods:

Outside Standard Construction Hours – Day Period

- Predicted noise levels for the worst-case scenario are expected to exceed the noise criteria at R4 and R5 for all stages of the Project's Works program
- Predicted noise levels for the worst-case scenario are also expected to exceed the noise criteria at R3 for Phase 2 of the Project's Works program.

Outside Standard Construction Hours – Evening and Night Periods

- Predicted noise levels for the worst-case scenario are expected to exceed the noise criteria at R4 and R5 for all stages of the Project's Works program.
- Predicted noise levels for the worst-case scenario are also expected to exceed the noise criteria at R3 for Phase 2, Phase 3 and Phase 4 of the Project's Works program.
- Predicted noise levels for the worst-case scenario are expected to exceed the noise criteria at R7 for the Demolition, Phase 1 and Phase 2 of the Project's Works program.
- Predicted noise levels for neutral scenarios are expected to exceed the noise criteria at R4 for Phase 2, Phase 3, Phase 4 and Phase 5 of the Project's Works program.
- Predicted noise levels for neutral scenarios are expected to exceed the noise criteria at R5 for Phase 2 of the Project's Works program.
- Predicted noise levels at all of the other noise sensitive receptors are within the applicable criteria for neutral conditions for all Stages of the Project's Works program.

In order to comply with the "Outside Standard Construction Hours" noise criteria during the neutral and worst-case conditions, the number of plant and equipment items would be restricted. Details of the number and items of equipment that could operate (without exceeding the applicable noise limit criterion) during the "Outside Standard Construction Hours" for periods (i.e. day, evening and night-time periods) are provided in **Table 7.5**.

Best practice noise control measures would be implemented for the Project during the Works Phase, in order to minimise noise emission from the Project site. A Noise Management Plan would be implemented for the duration of the Works, whereby reasonable and feasible mitigation measures are adopted and implemented in order to minimise potential noise impacts associated with the Project.

A Construction Noise Management Plan is therefore included as **Section 9** of this report. Consultation would be undertaken with residents in the vicinity of the Project site in advance of the Works to advise them of the planned work, the duration of the Works Program and the proposed working hours during the Works program, in accordance with the *Interim Construction Noise Guideline*.

7.4 TRAFFIC NOISE IMPACT ON EXISTING NOISE SENSITIVE RECEPTORS

Noise modelling has been undertaken to assess the potential noise impacts on existing noise sensitive receptors, associated with vehicle movements along Hart Road (South) and the Hunter Expressway (between Allandale Road and Lang Street). The noise model has taken into account all the sources associated with traffic that may be generated in conjunction with the Project, to determine the potential cumulative road traffic noise levels in the area.

The CoRTN method predicts the L_{A10} statistics. In order to convert the noise descriptor data from L_{A10} noise levels to L_{Aeq} noise levels, Vipac has used a 3dB constant to determine the L_{Aeq} levels. The results of the noise predictions associated with the Project are presented in **Table 7.10** and **Table 7.11.**

Table 7.10: Cumulative Traffic Noise Impact (dBA) – Day Period

Location	Day Period		Criteria (Day Period)
	Base Traffic Flow	Base Traffic Flow + Proposed development traffic	
Hunter Expressway (West of Hart Road) (103 Bishops Bridge Road, Sawyers Gully)	$L_{eq,15hour}$ 54.1	$L_{eq,15hour}$ 54.3	$L_{eq,15hour}$ 60
Hunter Expressway (East of Hart Road) (8-10 Horton Road, Loxford)	$L_{eq,15hour}$ 61.4	$L_{eq,15hour}$ 61.6	$L_{eq,15hour}$ 60
Hart Road (South) (78 Hart Road)	$L_{eq,15hour}$ 58.5	$L_{eq,15hour}$ 58.7	$L_{eq,15hour}$ 60

Table 7.11: Cumulative Traffic Noise Impact (dBA) – Night Period

Location	Night Period		Criteria (Night Period)
	Base Traffic Flow	Base Traffic Flow + Proposed development traffic	
Hunter Expressway (West of Hart Road) (103 Bishops Bridge Road, Sawyers Gully)	$L_{eq,9hour}$ 48.1	$L_{eq,9hour}$ 48.9	$L_{eq,15hour}$ 55
Hunter Expressway (East of Hart Road) (8-10 Horton Road, Loxford)	$L_{eq,9hour}$ 55.4	$L_{eq,9hour}$ 56.0	$L_{eq,15hour}$ 55
Hart Road (South) (78 Hart Road)	$L_{eq,9hour}$ 50.9	$L_{eq,9hour}$ 51.8	$L_{eq,15hour}$ 55

The predicted existing and future traffic noise level associated with the Project, at receivers along Hart Road (South) and the Hunter Expressway (west of Hart road) comply with the daytime and night time noise criteria. However, the predicted existing road traffic noise levels at receivers along Hunter Expressway (east of Hart Road) are raised above the daytime and night-time noise criteria. As stated in Section 3.4 of the Road Noise Policy, with regards to existing residences and other sensitive land uses affected by additional traffic on existing roads, generated by land use development, any increase in total traffic noise level should be limited to 2dB above that of the corresponding existing noise levels at any residential property.

The relative increase between the existing traffic flow and with the additional traffic generated by the Project at receivers along Hunter Expressway (east of Hart Road) is 0.2dB and 0.6dB during day time and night-time periods, respectively, which is within +2dB of the existing road traffic noise levels.

As shown in **Table 7.10** and **Table 7.11**, the additional traffic generated by the Project along the Hunter Expressway and Hart Road (South) is insignificant as the relative increase between the existing and future traffic noise levels is extremely low. Therefore, the predicted noise impact associated with the Project would comply with the Road Noise Policy criteria.

7.5 TRAFFIC NOISE IMPACT – SLEEP DISTURBANCE

The CoRTN method predicts the L_{A10} statistics. To determine L_{Amax} parameter, Vipac used the constant between L_{Aeq} and L_{Amax} from sound power measurement of trucks to determine the L_{Amax} (+12dB). In order to convert the noise parameter of L_{A10} to L_{Aeq}, Vipac has used a 3dB constant to determine L_{Aeq}.

Table 7.12 presents the predicted external noise level at the nearest receiver at Hart Road (South) and the Hunter Expressway.

Table 7.12: Predicted Noise Levels, External - dB(A)

Location	Night Period	
	Base Traffic Flow	Base Traffic Flow + Proposed development traffic
Hunter Expressway (West of Hart Road) (103 Bishops Bridge Road, Sawyers Gully)	$L_{Amax,9hour}$ 58	$L_{Amax,9hour}$ 58
Hunter Expressway (East of Hart Road) (8-10 Horton Road, Loxford)	$L_{Amax,9hour}$ 65	$L_{Amax,9hour}$ 66
Hart Road (South) (78 Hart Road)	$L_{Amax,9hour}$ 60	$L_{Amax,9hour}$ 61

Typically building façades exposed to a road are generally closed structures (including doors and windows) which provide a degree of attenuation (in the order of 20dB) to the inside amenity of the building. The corresponding internal noise levels that would be expected are presented in **Table 7.13**, taking into account the expected level of noise reduction for external to internal areas of a property.

Table 7.13: Predicted Noise Levels, Internal - dB(A)

Location	Night Period	
	Base Traffic Flow	Base Traffic Flow + Proposed development traffic
Hunter Expressway (west of Hart Road) (103 Bishops Bridge Road, Sawyers Gully)	$L_{Amax,9hour}$ 38	$L_{Amax,9hour}$ 38
Hunter Expressway (east of Hart Road) (8-10 Horton Road, Loxford)	$L_{Amax,9hour}$ 45	$L_{Amax,9hour}$ 46
Hart Road (South) (78 Hart Road)	$L_{Amax,9hour}$ 40	$L_{Amax,9hour}$ 41

The internal noise levels on existing noise sensitive receptors are predicted to be below the applicable maximum internal noise level limits, which would not be expected to cause any awakening reactions to occupants and would be unlikely to cause sleep disturbance impacts.

7.6 HUMAN HEALTH RISK ASSESSMENT

The noise produced by the Project activities may potentially impact the human beings health. As part of the Hunter New England Local Health District Requirement, the potential adverse effects from human exposure to acute and cumulative noise should be assessed in accordance with the Environmental Health Risk Assessment: "*Guideline for Assessing Human Health Risk from Environmental Hazard*" (2012)".

Guidance regarding the human exposure to noise, associated with occupational noise environments, as set out within the "*Guideline for Assessing Human Health Risk from Environmental Hazard*", is referenced from the National Occupational Health and Safety Commission: "*National Standard for Occupational Noise*" [NOHSC: 1007 (2000)]. The national standard for exposure to noise in the occupational environment is as follows:

- Eight hour equivalent continuous A-weighted sound pressure level, $L_{Aeq,8hr}$ of 85 dB
- Peak noise of C-weighted peak pressure level $L_{C,peak}$ of 140dB

The "*Guideline for Assessing Human Health Risk from Environmental Hazard*" also referenced the noise exposure from the World Health Organisation (WHO) "*Guidelines for Community Noise*" (1995). In this guideline, it states that for workers exposed to noise and for people living near airports, industries and noisy streets, noise exposure may have a temporary, as well as permanent impact on physiological functions. After prolonged exposures, susceptible individuals in the general population may develop permanent effects such as hypertension and ischaemic disease associated with exposure to high sound levels. The magnitude and duration of the effects are determined in part by individual characteristics, lifestyle behaviours and environmental conditions. Cardiovascular effects have also been demonstrated after long term exposure to air traffic and road traffic noise levels in the order of $L_{Aeq,24hr}$ of 65-70dB.

The noise results detailed in **Section 7.1** shows that the noise levels associated with each stage are predicted to be within the $L_{Aeq,24hr}$ 65dBA at all sensitive receptors during the Standard Construction Hours and Outside Standard Construction Hours, which is unlikely to cause adverse effects on human health.

The occupational noise exposure for employees within the Project site have not been determined at this stage as the occupational noise exposure of levels for persons working at the site during the Works Phase of the Project will vary, dependent on a range of factors such as the activities undertaken by each employee, the noise levels within the cabs of plant/machinery items and associated noise levels for persons working in close proximity to the various noise sources that will be apparent during the Works Phase of the Project. The noise attenuation controls (such as personal protective equipment) appropriate to and typical with the Works activity would be provided to employees, to ensure that the occupational noise exposure levels are maintained within the National Standard's Occupational noise limits.

7.7 CONSTRUCTION VIBRATION ASSESSMENT

Vibration may also be generated as a result of the Works and has been considered both in respect of potential damage of buildings and potential annoyance to the occupants.

In many cases, it is the occupants/residents fear of building damage that enhances the potential annoyance. The most common form of vibration measurement is peak particle velocity (PPV) in mm/s. In respect to building damage, a vibration level limit and frequency is normally specified, however, in respect of potential annoyance to receivers, a combination of vibration level frequency and duration is more appropriate. This is normally termed as a dose value.

Table 7.14 shows the typical vibration levels associated with the plant equipment that is likely to be used. It should be noted that the vibration levels presented in **Table 7.14** are indicative levels only. The actual vibration levels that may impact upon properties located in the vicinity of the works site may vary. This is due to the fact that vibration magnitudes will dissipate at varying levels dependent on ground conditions and source level variations associated with operational conditions of the plant and equipment.

Table 7.14: Vibration levels of equipment

Typical Vibration levels of construction plant items	Typical Ground vibration level
Vibratory roller	Up to 1.5mm/s @ 25m
Compactor	20mm/s @ 5m <0.3mm/s @30m
Bulldozer	1-2mm/s @5m 0.1 @ 50m
Truck traffic (Smooth surface)	<0.2mm/s @20m

The nearest receivers to the Project are located approximately 440 metres to the north of the site and based on the vibration levels provided in **Table 7.14**, it is unlikely that the will be any vibration impacts generated by the demolition/construction plant that would give rise to annoyance or structural damage at any of the nearest receivers.

8 CONCLUSION

This Noise and Vibration Impact Assessment has been prepared by Vipac on behalf of Hydro Aluminium Kurri Kurri Pty Ltd to support an EIS for submission to the Department of Planning and Environment prepared to assess for the Demolition and Remediation Project (the Project) at the former Hydro Aluminium Kurri Kurri aluminium smelter at Hart Road Loxford (the Smelter).

8.1 DEMOLITION NOISE

This Noise and Vibration Impact Assessment concludes that the predicted demolition phase noise levels (for "Standard Construction Hours") are in compliance with the Noise Management Levels of the *Interim Construction Noise Guideline* (DECC 2009), at all of the noise sensitive receivers and in compliance with the Highly Affected Levels at all of the potentially affected sensitive receptors.

The predicted demolition phase noise levels are expected to exceed the applicable Noise Management Level during periods "Outside Standard Construction Hours" and could potentially cause sleep disturbance at a certain sensitive receptors. An increase in a noise level in the order of 1dB would be considered as a negligible impact and any noise exceedance of 5dB or greater would be considered as a perceptible impact. The predicted noise impacts in this regard would not be considered to be significant although controls will be implemented in order to achieve compliance with the applicable noise criteria. In order to comply with the Noise Management Level for "Outside Standard Construction Hours" applicable noise limits, the number of plant and equipment would be restricted. Details regarding the number and items of equipment that could operate, without exceeding the applicable Noise Management Level , during the "Outside Standard Construction Hours" for each period (i.e. day, evening and night-time periods) are specified in **Table 7.5**.

8.2 TRAFFIC NOISE

The predicted existing and future traffic noise level associated with The Project, at receivers along Hart Road (South) and the Hunter Expressway (west of Hart road) comply with the daytime and night time noise criteria.

The predicted existing road traffic noise levels at receivers along Hunter Expressway (East of Hart Road) are raised above the daytime and night-time noise criteria. In accordance with the '*NSW Road Noise Policy'* (DECCW 2001), any increase in total traffic noise level arising from the Project should be limited to 2dB above that of the corresponding existing noise levels at any residential property.

The relative increase between the existing traffic flow and with the additional traffic generated by the Project at receivers along Hunter Expressway (East of Hart Road) is 0.2dB and 0.6dB during day time and night-time periods, respectively, which is within +2dB of the existing road traffic noise levels. Therefore, the predicted noise impact associated with the Project would comply with the Road Noise Policy criteria. The internal noise levels on existing and proposed noise sensitive receptors associated with the potential traffic movements that may be generated by the Project are predicted to be below the applicable maximum internal noise level limits and would not be expected to cause sleep disturbance impacts.

8.3 VIBRATION

Activities associated with the demolition would potentially generate vibration levels that may cause impacts on nearby sensitive receptors. However, the nearest potentially affected receptor is located approximately 440 metres from the Project site and it is unlikely that there would be any vibration impacts generated by the demolition and construction plant that would give rise to annoyance or structural damage at any of the nearest receivers.

8.4 MITIGATION AND MANAGEMENT MEASURES

A site specific Noise and Vibration Management Plan (NVMP) outlining feasible mitigation and management measures that would be adopted to control noise emissions from the site during the demolition/remediation phase is provided in **Section 9** of this report. Potential controls to reduce further vibrations are also outlined in the Noise and Vibration Management Plan provided in **Section 9**.

9 CONSTRUCTION NOISE MANAGEMENT PLAN

Construction Noise Management Plan		
Component		**Details**
General / Site. Management Issues		All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: requirements of Transport for NSW's Construction Noise Strategy (2011), and should instruct all persons at the site with regard to all relevant project specific and standard noise and vibration mitigation measures detailed herein including permissible hours of work; any limitations on high noise generating activities; location of nearest sensitive receivers; construction employee parking areas; designated loading/unloading areas and procedures; site opening/closing times (including deliveries); and environmental incident procedures.
		A Stakeholder Engagement would define the method and persons responsible for the dissemination of information regarding the Project. This would include the procedure for receiving and responding to comment or complaint from community.
Hours of Work / Respite Periods		Standard Hours for Works: 07:00 – 18:00 Monday – Friday 08:00 -13:00 Saturday Proposal works outside standard work hours would be permitted with a restricted number of equipment. Details of equipment that is considered to be acceptable Outside Standard Work Hours are detailed in **Table 7.5.**
Source Controls	**General / Work Practices**	Avoid unnecessary revving of engines and turn off plant that is not being where practicable.
		Use only non-tonal reverse alarms (broadband alternatives are needed). Where possible organise the site so that delivery trucks and haulage trucks only drive forward to avoid the use of reversing alarms.

Construction Noise Management Plan		
Component		**Details**
		Site set up / movement of plant / delivery of materials to / waste removal from the Project site would be restricted to the daytime period.
		Truck drivers are to be informed of site access routes, acceptable delivery hours and must minimise extended periods of engine idling.
		Equipment must be inspected on a regular basis and maintained as necessary, to ensure it is in good working order. This must include inspections of the condition and performance of mufflers.
	Substitution	Use less noise-intensive equipment where reasonable and feasible.
		Construction equipment with the most effective mufflers, enclosures and low-noise tool bits and blades must be procured and utilised where practicable for the Project.
		Where possible mains power should be utilised for temporary traffic signals / work area lighting. Where this is not feasible silenced generator sets are to be used instead.
		All the plant and equipment shall be reviewed prior to use. Should the sound power level of equipment and plant higher than the sound power levels listed in **Table 6.2**, replace the equipment with less noise intensive equipment
	Use and Siting of Equipment/ activities	Where practical fixed plant should be positioned as far away as possible from sensitive receivers.
Consultation	**General**	A Stakeholder Engagement Plan would be implemented to engage with government agencies, Cessnock and Maitland City Councils, landowners, community members and other stakeholders to provide a single consultation framework.

Construction Noise Management Plan		
Component		**Details**
	Notification	Local residents would be notified in advance of the Project of the nature and estimated timescales for completion of the Project. Thereafter on going notifications and updates on new or changes to Demolition activities would be provided in accordance with the Stakeholder Engagement Plan.
	Project info-line and Construction response line	A 24-hour construction response line should be provided as a contact point for any complaints regarding the Project.
Complaints management		Upon receiving a noise complaint regarding demolition activities, the person nominated in the Stakeholder Engagement Plan would investigate the source of the complaint. The aim would be to initiate an investigation no later than two hours after the complaint has been made (dependent on the nature of the complaint). Where practicable a visit would be made to the complainant to verify the nature of the complaint and, if justified, appropriate action would be taken to amend the activity causing the complaint. Where three or more substantiated complaints of a similar nature are received (from at least two complainants), the work element must be reviewed in order to consider whether the work methods can be changed or if additional mitigation methods can be employed in order to prevent or reduce the likelihood of further complaints being made.
Monitoring Requirements	**Noise**	Attended monitoring would be undertaken in response to substantiated complaints in order to validate and assess the source(s) giving rise to complaint(s).

Construction Noise Management Plan		
Component		**Details**
		Attended monitoring would be undertaken every three months to assess compliance with the relevant noise limits. The attended monitoring would be conducted at the five nearest receivers surrounding the Project site. These monitoring locations are receiver R3, R4, R6, R7 and S1 and are illustrated in **Figure 9**. An example of the scope and information that will be contained within a Noise Compliance Monitoring Report is provided in **Appendix B**.
		The noise attenuation controls (such as personal protective equipment) appropriate to and typical with the Works activity would be provided to employees, to ensure that the occupational noise exposure levels are maintained within the National Standard's Occupational noise limits.

10 REFERENCES

Atkins Acoustics, *F3 Freeway to Branxton Link* (Hunter Expressway Noise Assessment), March 2007.

Australian Standard AS 2436-2010 *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites.*

British Standard BS5228-1:2009 - *Code of practice for noise and vibration control on construction and open sites- Part 1: Noise.*

British Standard BS6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings, Part 1 – Vibration sources other than blasting*.

British Standard BS7385: Part 2-1993 *Evaluation and measurement for vibration in buildings - Part 2: Guide to damage levels from ground borne vibration*.

British Standard BS6841:1987 *Guide to measurement and evaluation of human exposure to whole-body mechanical vibration and repeated shock.*

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Hyder Consulting *Hydro Kurri Kurri Aluminium Smelter Demolition and Remediation Project Traffic Impact Assessment*, 2015.

Hyder Consulting, *Hydro Redevelopment at Kurri Kurri- Traffic and Transport Study,* 2015.

National Occupational Health and Safety Commission: *National Standard for Occupational Noise* NOHSC: 1007 (2000).

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Figures

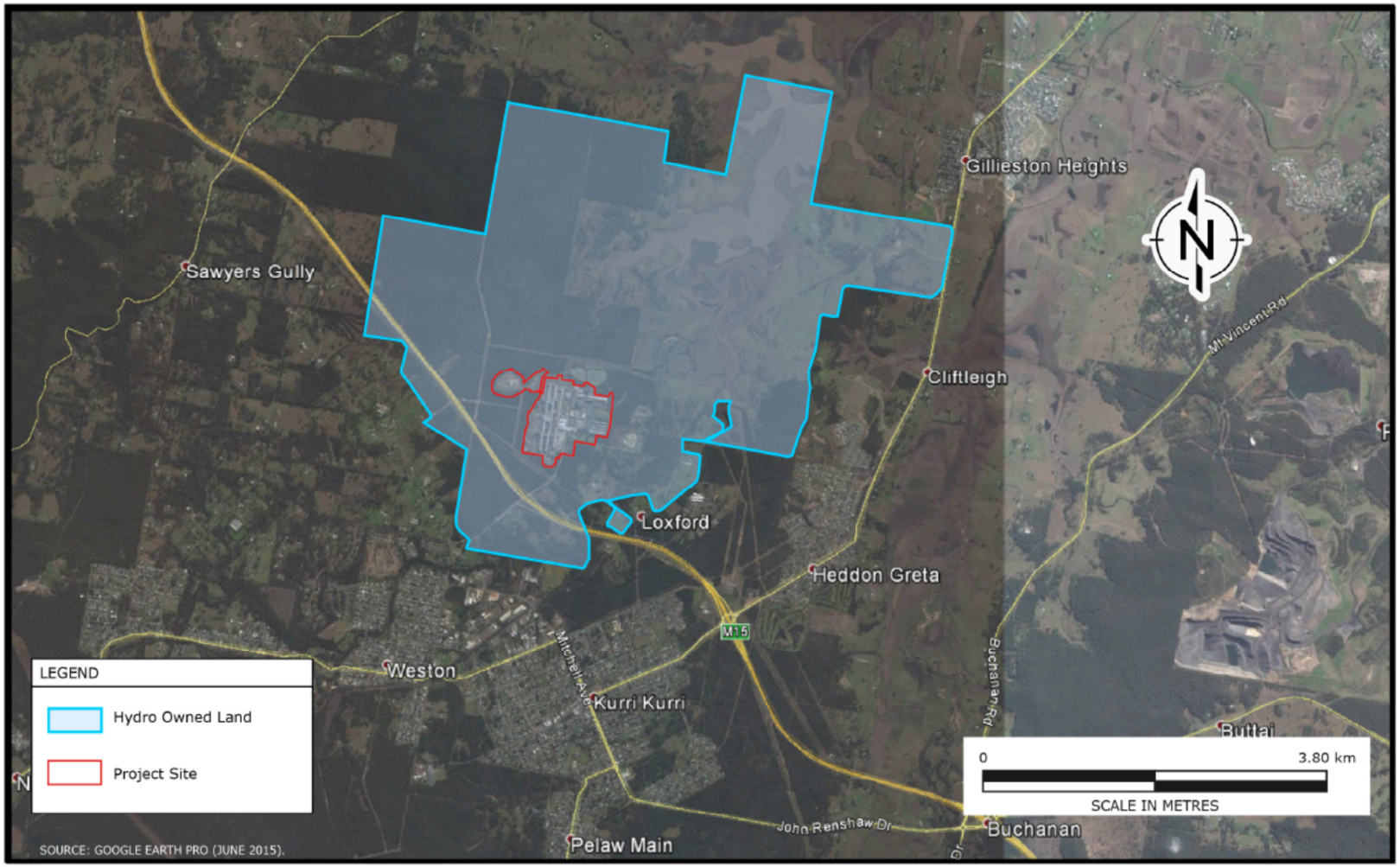


Figure 1: Project Site Location

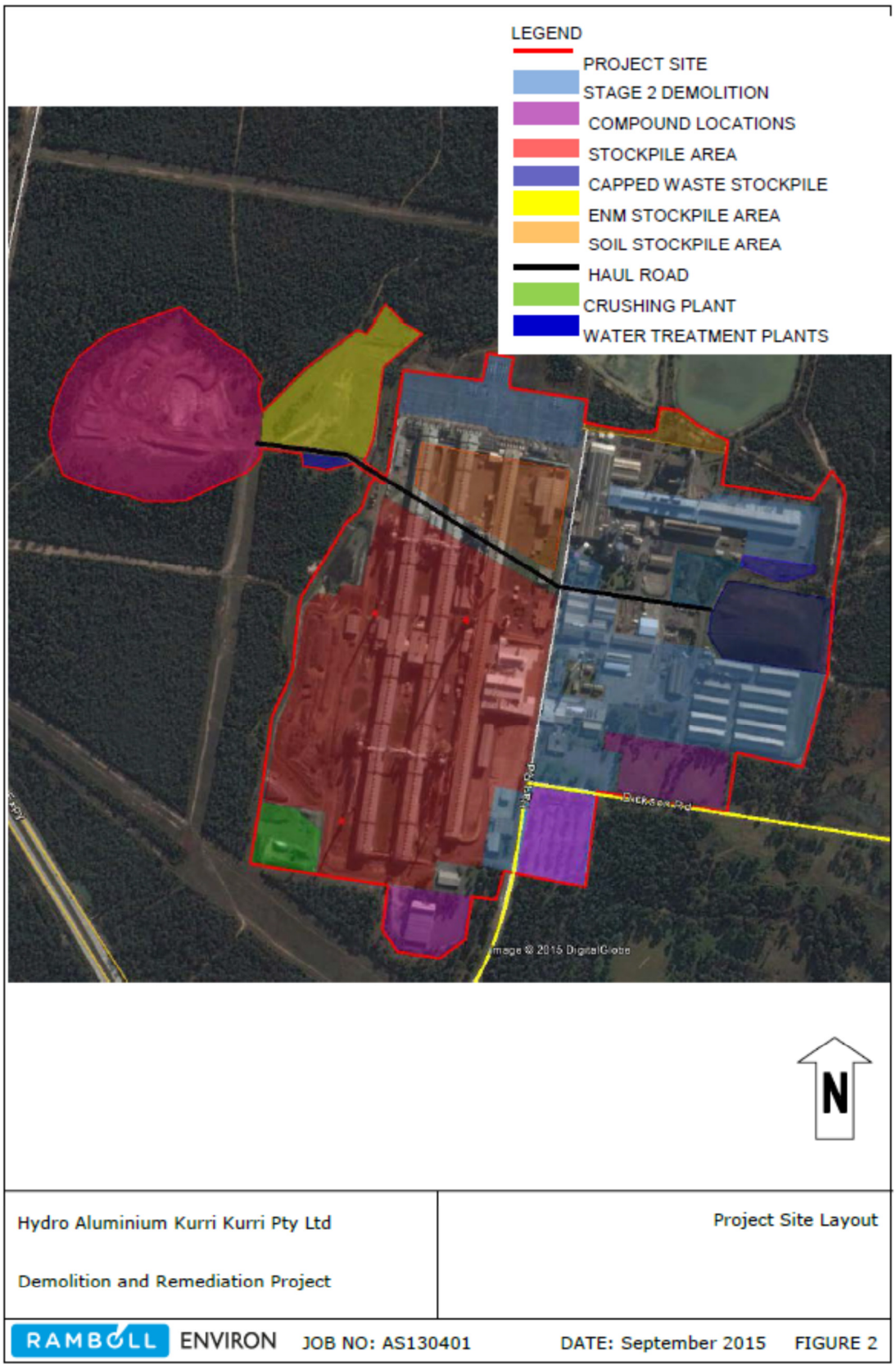


Figure 2: Project Site Layout

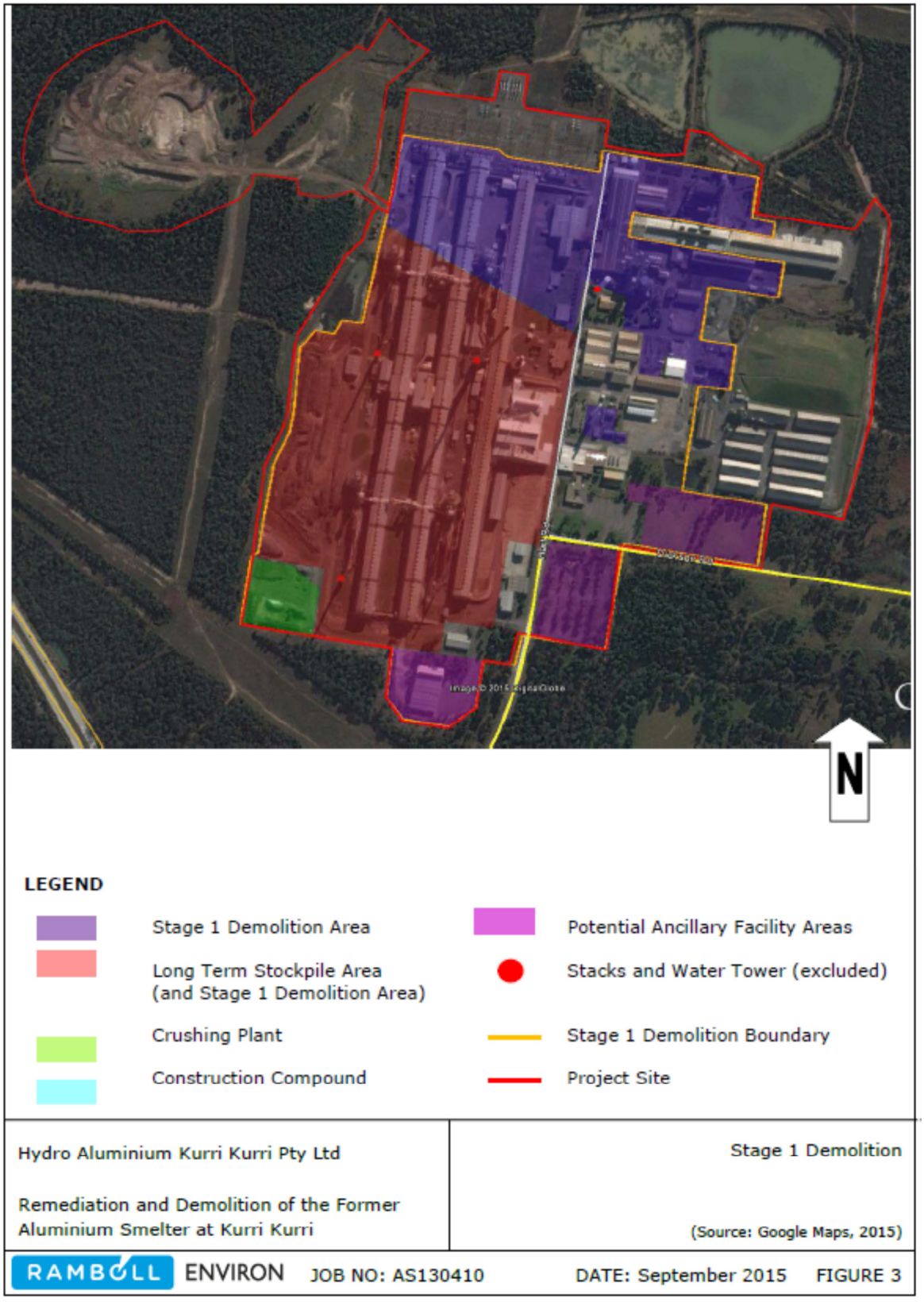


Figure 3: Stage 1 Demolition

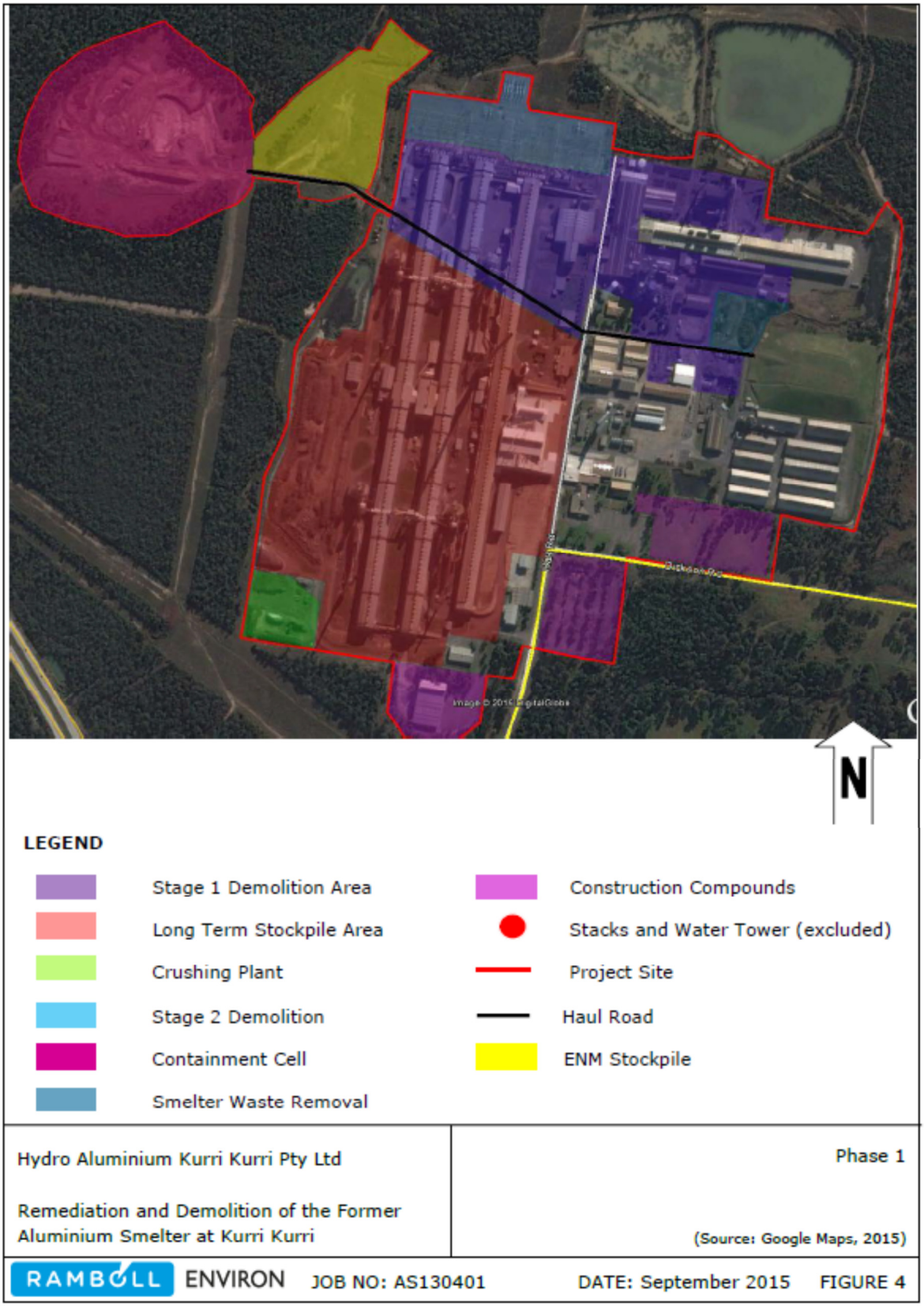


Figure 4: Phase 1 of the Project's Works program

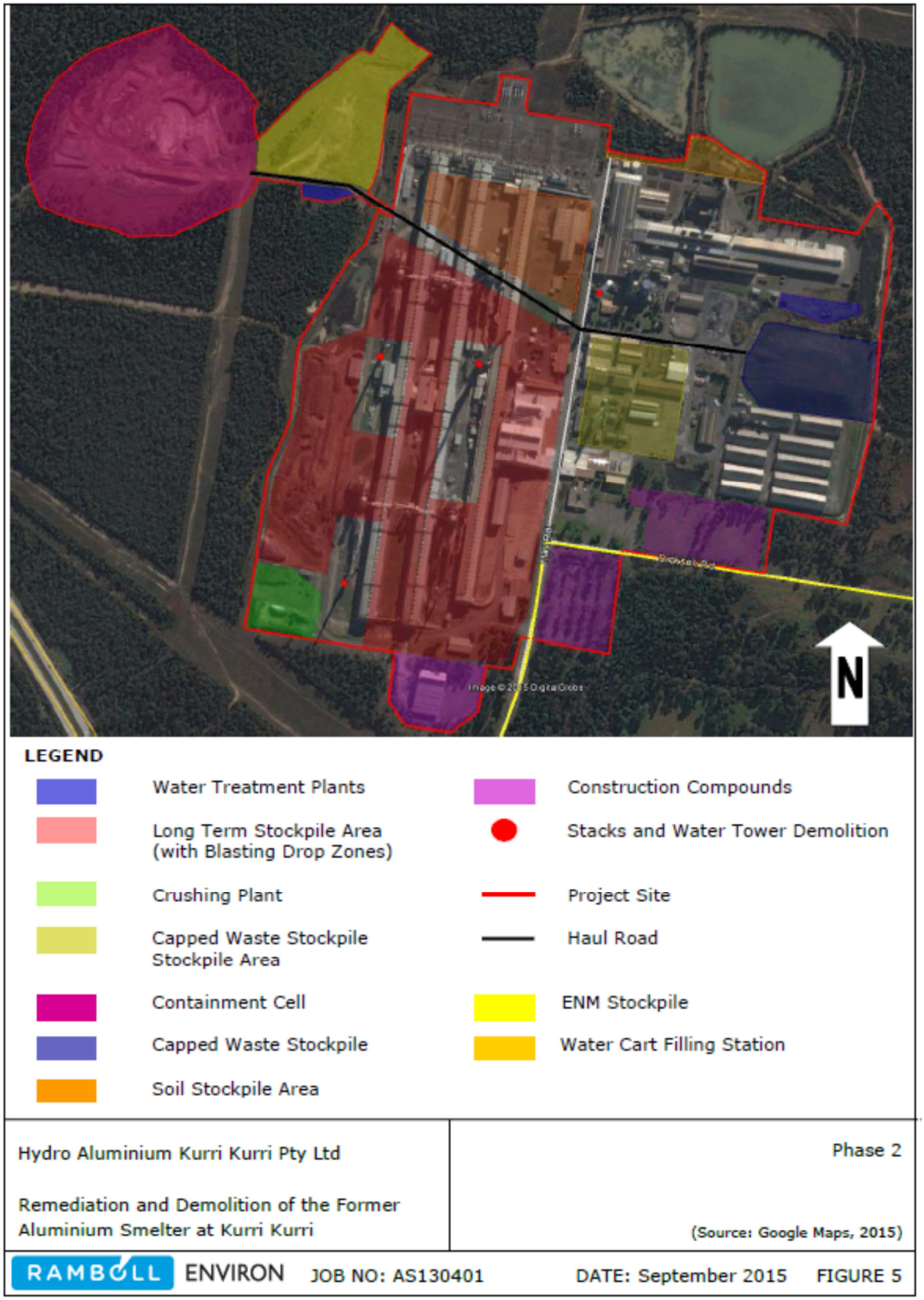


Figure 5: Phase 2 of the Project's Works program

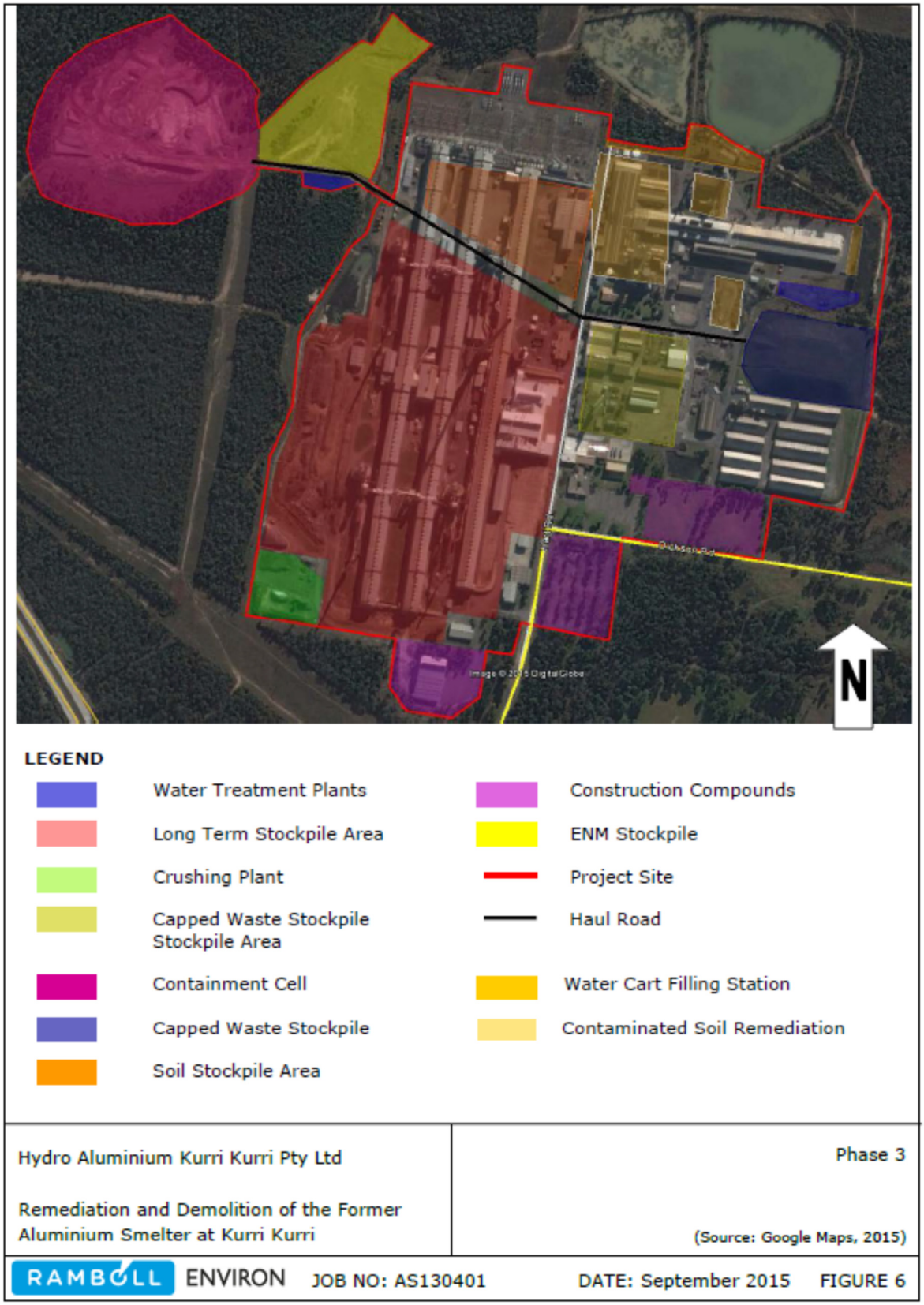


Figure 6: Phase 3 of the Project's Works program

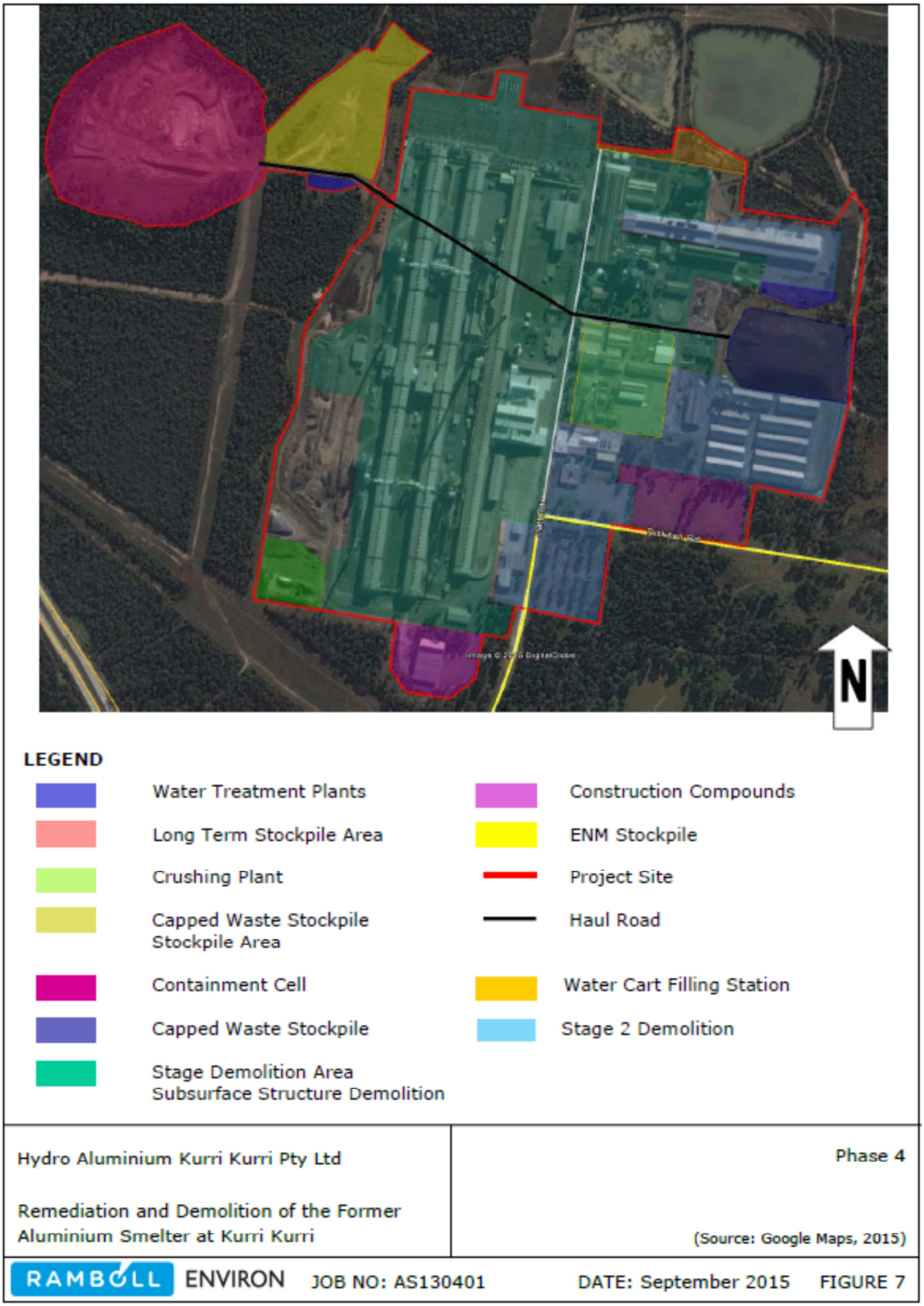


Figure 7: Phase 4 of the Project's Works program

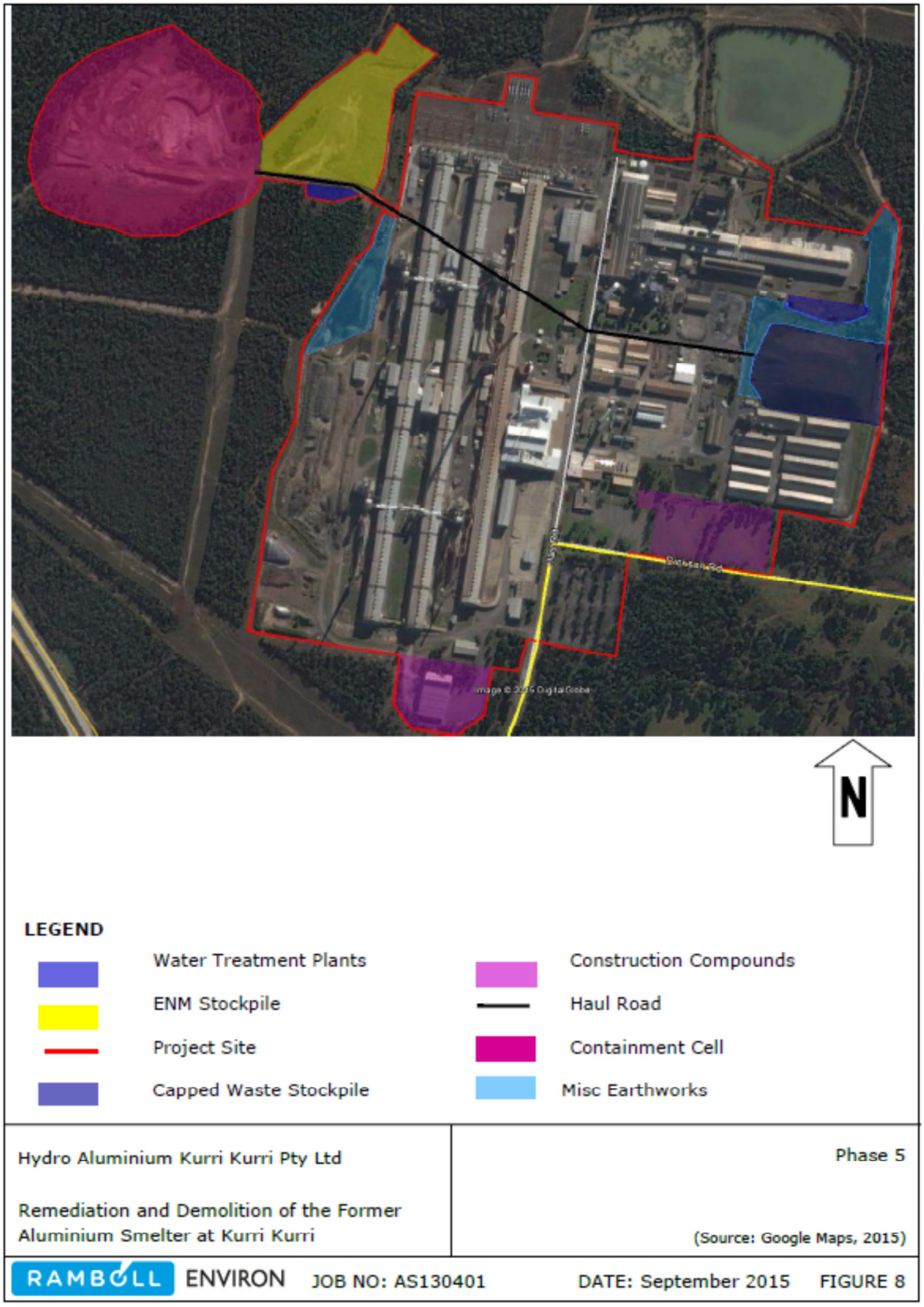
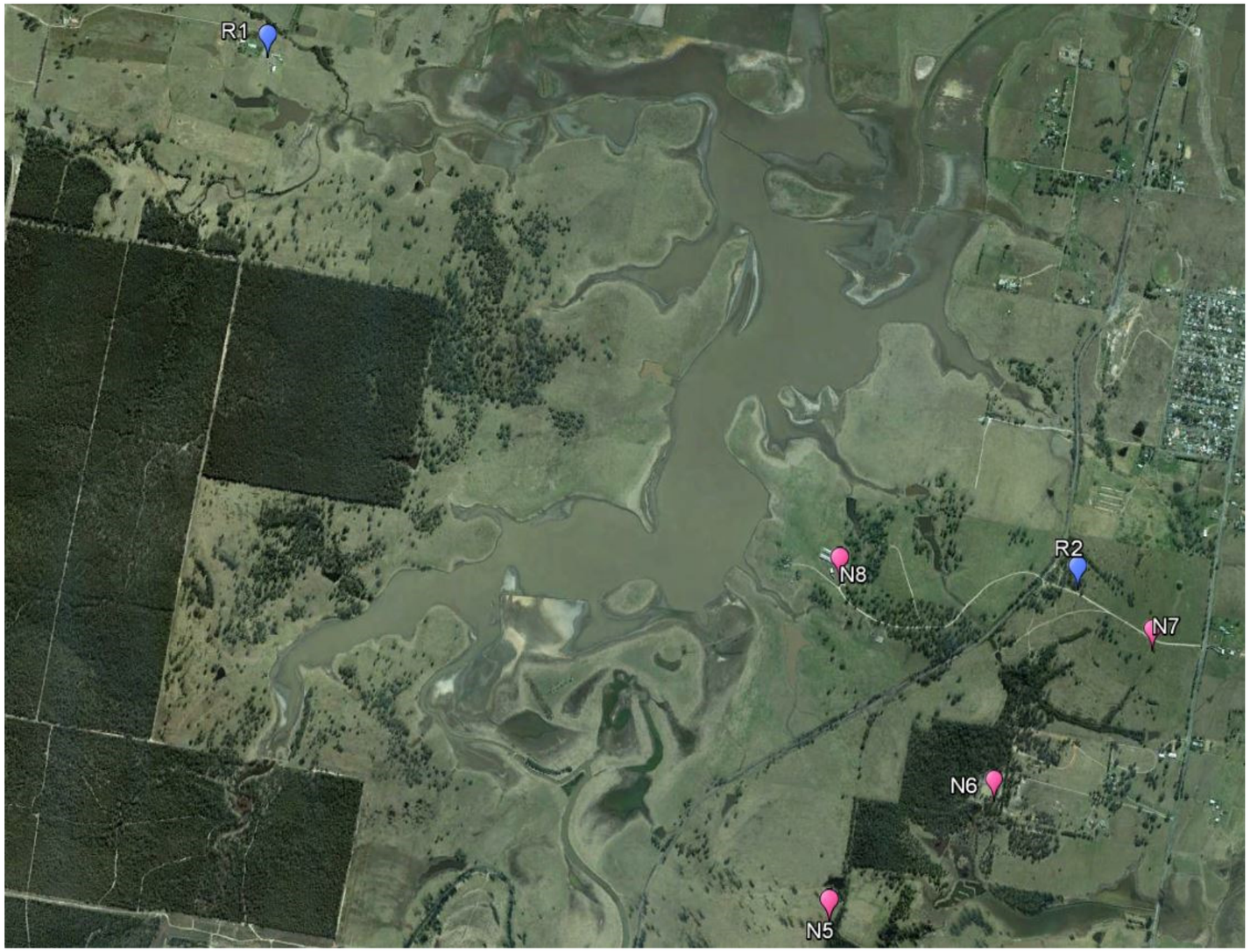
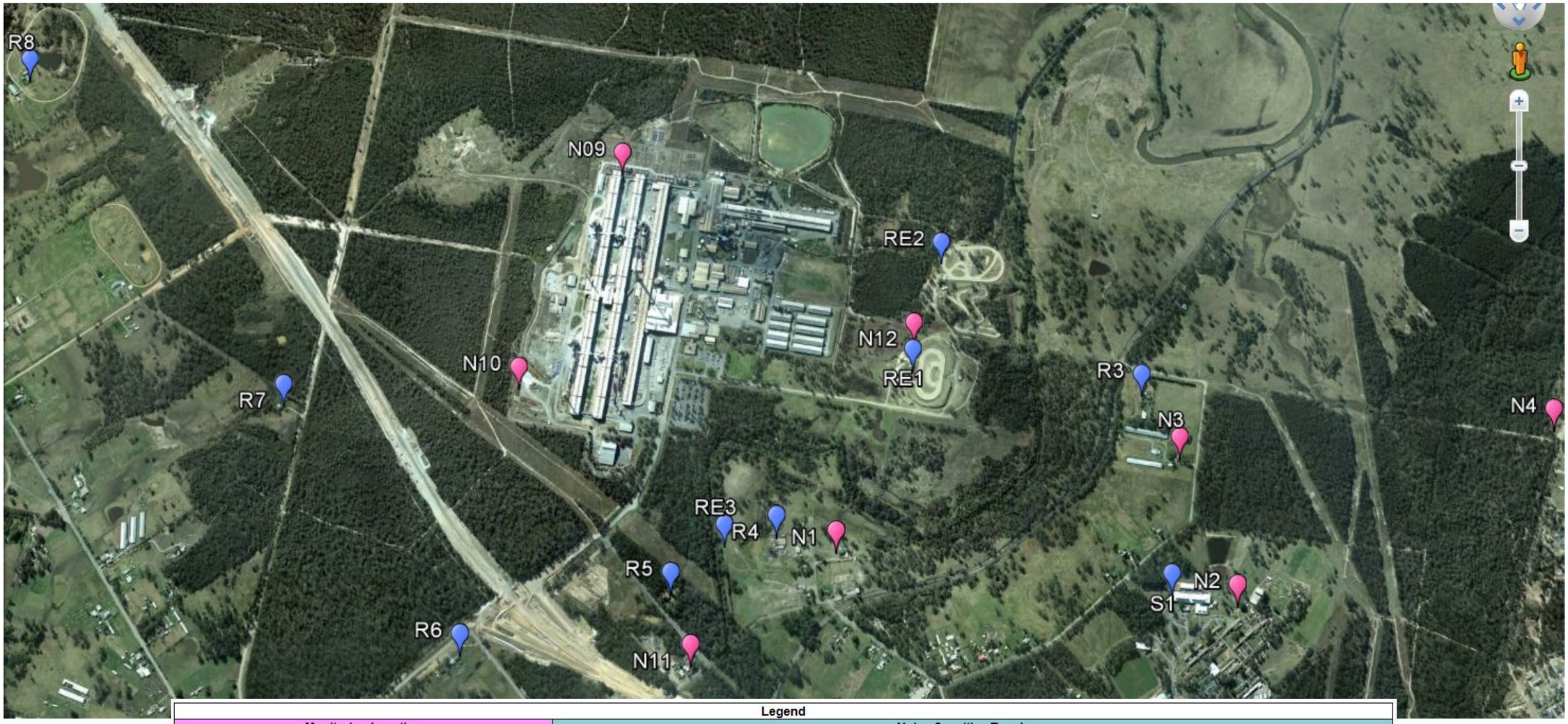


Figure 8: Phase 5 of the Project's Works program



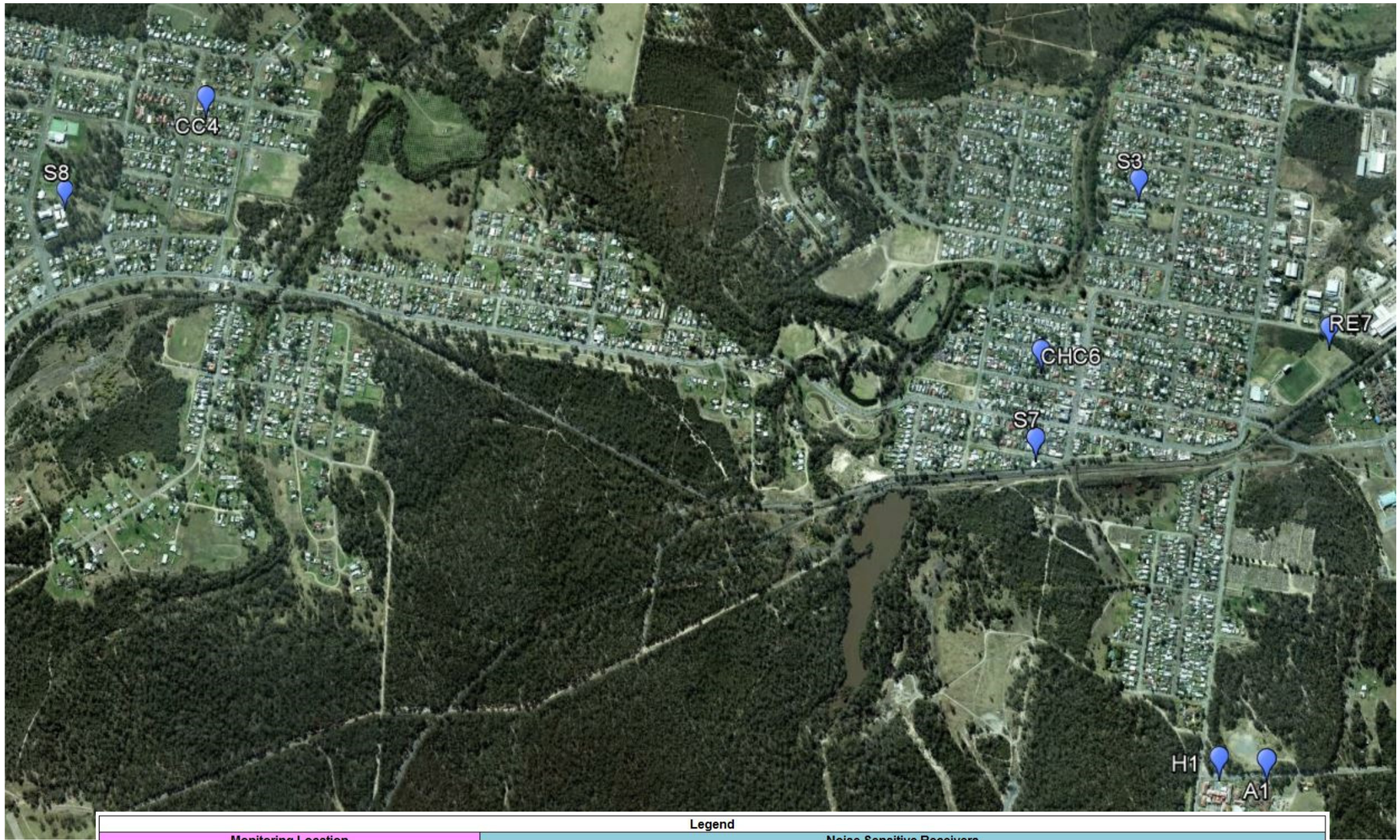
Legend							
Monitoring Location		Noise Sensitive Receivers					
N1	6 Dawes Avenue, Loxford	S1	Hunter TAFE	H1	Kurri Kurri Hospital	RE4	Kurri Golf Club
N2	Hunter TAFE, Kurri Kurri Campus	S2	Kurri Kurri High School	H2	Family Medical Centre	RE5	Nellie Simm Park
N3	18 Bowditch Avenue, Loxford	S3	Weston Public School	A1	RFBI Kurri Kurri Masonic Village	RE6	Birralle Park
N4	Hydro Land near 10 Howe Street, Cliftleigh	S4	Holy Spirit Primary School	CHC1	Church of Chirst	RE7	Weston Park
N5	Hydro Land near Gen Ayre Avenue, Cliftleigh	S5	St Joseph's Convent	CHC2	Kurri Kurri Seventh Day Adventist Church	R1	685 Old Maitland Road, Bishops Bridge
N6	Hydro Land near 532 Main Road, Cliftleigh	S6	Kurri Kurri Public School	CHC3	Anglican Parish of Mt Vincent & Weston	R2	464 Cessnock Road, Gillieston Heights
N7	Hydro Land near Lot 54, 464 Cessnock Road, Gillieston Heights	S7	Weston Community Pre-school	CHC4	St Paul the Apostle Angican Church	R3	20 Bowditch Avenue, Loxford
N8	Hydro Land near Lot 11, 464 Cessnock Road, Gillieston Heights	S8	Abermain Community Pre-school	CHC5	Kurri Kurri Congregational Church	R4	6 Dawes Avenue, Loxford
N9	Northwest Corner of Smelter Site	CC1	Kurri Early Childhood Centre	CHC6	St Mary the Virgin Anglican Church	R5	Scales Avenue, Loxford
N10	Southwest corner of the Smelter Site	CC2	Kurri Kurri Before & After School Care	RE1	Kurri Kurri Speedway	R6	78 Hart Road, Loxford
N11	14 Horton Road, Loxford	CC3	Mission Australia Childcare Centre and Preschool	RE2	Kurri Kurri Junior Motorcycle Club	R7	103 Bishops Bridge Road, Sawyers Gully
N12	Kurri Kurri Speedway Track, &3 Dickson Road, Loxford	CC4	Abermain Early Learning Centre	RE3	Cricket Pitch Park	R8	78 Lumby Lane, Sawyers Gully

Figure 9: Noise Monitoring Locations and Noise Sensitive Receptors (1/5)



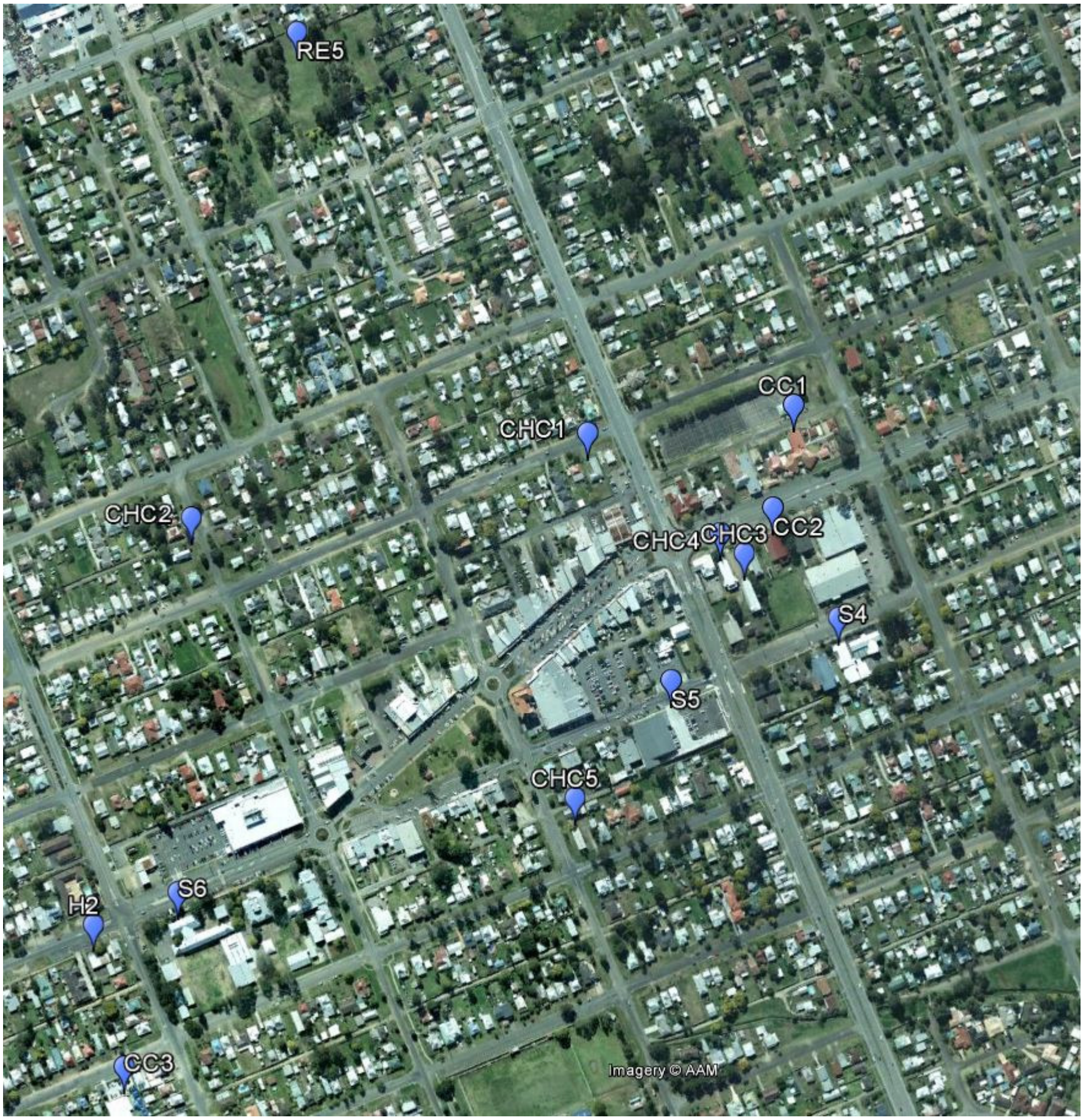
Legend							
Monitoring Location		**Noise Sensitive Receivers**					
N1	6 Dawes Avenue, Loxford	S1	Hunter TAFE	H1	Kurri Kurri Hospital	RE4	Kurri Golf Club
N2	Hunter TAFE, Kurri Kurri Campus	S2	Kurri Kurri High School	H2	Family Medical Centre	RE5	Nellie Simm Park
N3	18 Bowditch Avenue, Loxford	S3	Weston Public School	A1	RFBI Kurri Kurri Masonic Village	RE6	Birralle Park
N4	Hydro Land near 10 Howe Street, Cliftleigh	S4	Holy Spirit Primary School	CHC1	Church of Chirst	RE7	Weston Park
N5	Hydro Land near Gen Ayre Avenue, Cliftleigh	S5	St Joseph's Convent	CHC2	Kurri Kurri Seventh Day Adventist Church	R1	685 Old Maitland Road, Bishops Bridge
N6	Hydro Land near 532 Main Road, Cliftleigh	S6	Kurri Kurri Public School	CHC3	Anglican Parish of Mt Vincent & Weston	R2	464 Cessnock Road, Gillieston Heights
N7	Hydro Land near Lot 54, 464 Cessnock Road, Gillieston Heights	S7	Weston Community Pre-school	CHC4	St Paul the Apostle Angican Church	R3	20 Bowditch Avenue, Loxford
N8	Hydro Land near Lot 11, 464 Cessnock Road, Gillieston Heights	S8	Abermain Community Pre-school	CHC5	Kurri Kurri Congregational Church	R4	6 Dawes Avenue, Loxford
N9	Northwest Corner of Smelter Site	CC1	Kurri Early Childhood Centre	CHC6	St Mary the Virgin Anglican Church	R5	Scales Avenue, Loxford
N10	Southwest corner of the Smelter Site	CC2	Kurri Kurri Before & After School Care	RE1	Kurri Kurri Speedway	R6	78 Hart Road, Loxford
N11	14 Horton Road, Loxford	CC3	Mission Australia Childcare Centre and Preschool	RE2	Kurri Kurri Junior Motorcycle Club	R7	103 Bishops Bridge Road, Sawyers Gully
N12	Kurri Kurri Speedway Track, &3 Dickson Road, Loxford	CC4	Abermain Early Learning Centre	RE3	Cricket Pitch Park	R8	78 Lumby Lane, Sawyers Gully

Figure 10: Noise Monitoring Locations and Noise Sensitive Receptors (2/5)



Legend							
Monitoring Location		**Noise Sensitive Receivers**					
N1	6 Dawes Avenue, Loxford	S1	Hunter TAFE	H1	Kurri Kurri Hospital	RE4	Kurri Golf Club
N2	Hunter TAFE, Kurri Kurri Campus	S2	Kurri Kurri High School	H2	Family Medical Centre	RE5	Nellie Simm Park
N3	18 Bowditch Avenue, Loxford	S3	Weston Public School	A1	RFBI Kurri Kurri Masonic Village	RE6	Birralle Park
N4	Hydro Land near 10 Howe Street, Cliftleigh	S4	Holy Spirit Primary School	CHC1	Church of Chirst	RE7	Weston Park
N5	Hydro Land near Gen Ayre Avenue, Cliftleigh	S5	St Joseph's Convent	CHC2	Kurri Kurri Seventh Day Adventist Church	R1	685 Old Maitland Road, Bishops Bridge
N6	Hydro Land near 532 Main Road, Cliftleigh	S6	Kurri Kurri Public School	CHC3	Anglican Parish of Mt Vincent & Weston	R2	464 Cessnock Road, Gillieston Heights
N7	Hydro Land near Lot 54, 464 Cessnock Road, Gillieston Heights	S7	Weston Community Pre-school	CHC4	St Paul the Apostle Angican Church	R3	20 Bowditch Avenue, Loxford
N8	Hydro Land near Lot 11, 464 Cessnock Road, Gillieston Heights	S8	Abermain Community Pre-school	CHC5	Kurri Kurri Congregational Church	R4	6 Dawes Avenue, Loxford
N9	Northwest Corner of Smelter Site	CC1	Kurri Early Childhood Centre	CHC6	St Mary the Virgin Anglican Church	R5	Scales Avenue, Loxford
N10	Southwest corner of the Smelter Site	CC2	Kurri Kurri Before & After School Care	RE1	Kurri Kurri Speedway	R6	78 Hart Road, Loxford
N11	14 Horton Road, Loxford	CC3	Mission Australia Childcare Centre and Preschool	RE2	Kurri Kurri Junior Motorcycle Club	R7	103 Bishops Bridge Road, Sawyers Gully
N12	Kurri Kurri Speedway Track, &3 Dickson Road, Loxford	CC4	Abermain Early Learning Centre	RE3	Cricket Pitch Park	R8	78 Lumby Lane, Sawyers Gully

Figure 11: Noise Monitoring Locations and Noise Sensitive Receptors (3/5)



Legend							
Monitoring Location		Noise Sensitive Receivers					
N1	6 Dawes Avenue, Loxford	S1	Hunter TAFE	H1	Kurri Kurri Hospital	RE4	Kurri Golf Club
N2	Hunter TAFE, Kurri Kurri Campus	S2	Kurri Kurri High School	H2	Family Medical Centre	RE5	Nellie Simm Park
N3	18 Bowditch Avenue, Loxford	S3	Weston Public School	A1	RFBI Kurri Kurri Masonic Village	RE6	Birralle Park
N4	Hydro Land near 10 Howe Street, Cliftleigh	S4	Holy Spirit Primary School	CHC1	Church of Chirst	RE7	Weston Park
N5	Hydro Land near Gen Ayre Avenue, Cliftleigh	S5	St Joseph's Convent	CHC2	Kurri Kurri Seventh Day Adventist Church	R1	685 Old Maitland Road, Bishops Bridge
N6	Hydro Land near 532 Main Road, Cliftleigh	S6	Kurri Kurri Public School	CHC3	Anglican Parish of Mt Vincent & Weston	R2	464 Cessnock Road, Gillieston Heights
N7	Hydro Land near Lot 54, 464 Cessnock Road, Gillieston Heights	S7	Weston Community Pre-school	CHC4	St Paul the Apostle Angican Church	R3	20 Bowditch Avenue, Loxford
N8	Hydro Land near Lot 11, 464 Cessnock Road, Gillieston Heights	S8	Abermain Community Pre-school	CHC5	Kurri Kurri Congregational Church	R4	6 Dawes Avenue, Loxford
N9	Northwest Corner of Smelter Site	CC1	Kurri Early Childhood Centre	CHC6	St Mary the Virgin Anglican Church	R5	Scales Avenue, Loxford
N10	Southwest corner of the Smelter Site	CC2	Kurri Kurri Before & After School Care	RE1	Kurri Kurri Speedway	R6	78 Hart Road, Loxford
N11	14 Horton Road, Loxford	CC3	Mission Australia Childcare Centre and Preschool	RE2	Kurri Kurri Junior Motorcycle Club	R7	103 Bishops Bridge Road, Sawyers Gully
N12	Kurri Kurri Speedway Track, &3 Dickson Road, Loxford	CC4	Abermain Early Learning Centre	RE3	Cricket Pitch Park	R8	78 Lumby Lane, Sawyers Gully

Figure 12: Noise Monitoring Locations and Noise Sensitive Receptors (4/5)

Legend							
Monitoring Location		**Noise Sensitive Receivers**					
N1	6 Dawes Avenue, Loxford	S1	Hunter TAFE	H1	Kurri Kurri Hospital	RE4	Kurri Golf Club
N2	Hunter TAFE, Kurri Kurri Campus	S2	Kurri Kurri High School	H2	Family Medical Centre	RE5	Nellie Simm Park
N3	18 Bowditch Avenue, Loxford	S3	Weston Public School	A1	RFBI Kurri Kurri Masonic Village	RE6	Birralle Park
N4	Hydro Land near 10 Howe Street, Cliftleigh	S4	Holy Spirit Primary School	CHC1	Church of Chirst	RE7	Weston Park
N5	Hydro Land near Gen Ayre Avenue, Cliftleigh	S5	St Joseph's Convent	CHC2	Kurri Kurri Seventh Day Adventist Church	R1	685 Old Maitland Road, Bishops Bridge
N6	Hydro Land near 532 Main Road, Cliftleigh	S6	Kurri Kurri Public School	CHC3	Anglican Parish of Mt Vincent & Weston	R2	464 Cessnock Road, Gillieston Heights
N7	Hydro Land near Lot 54, 464 Cessnock Road, Gillieston Heights	S7	Weston Community Pre-school	CHC4	St Paul the Apostle Angican Church	R3	20 Bowditch Avenue, Loxford
N8	Hydro Land near Lot 11, 464 Cessnock Road, Gillieston Heights	S8	Abermain Community Pre-school	CHC5	Kurri Kurri Congregational Church	R4	6 Dawes Avenue, Loxford
N9	Northwest Corner of Smelter Site	CC1	Kurri Early Childhood Centre	CHC6	St Mary the Virgin Anglican Church	R5	Scales Avenue, Loxford
N10	Southwest corner of the Smelter Site	CC2	Kurri Kurri Before & After School Care	RE1	Kurri Kurri Speedway	R6	78 Hart Road, Loxford
N11	14 Horton Road, Loxford	CC3	Mission Australia Childcare Centre and Preschool	RE2	Kurri Kurri Junior Motorcycle Club	R7	103 Bishops Bridge Road, Sawyers Gully
N12	Kurri Kurri Speedway Track, &3 Dickson Road, Loxford	CC4	Abermain Early Learning Centre	RE3	Cricket Pitch Park	R8	78 Lumby Lane, Sawyers Gully

Figure 13: Noise Monitoring Locations and Noise Sensitive Receptors (5/5)

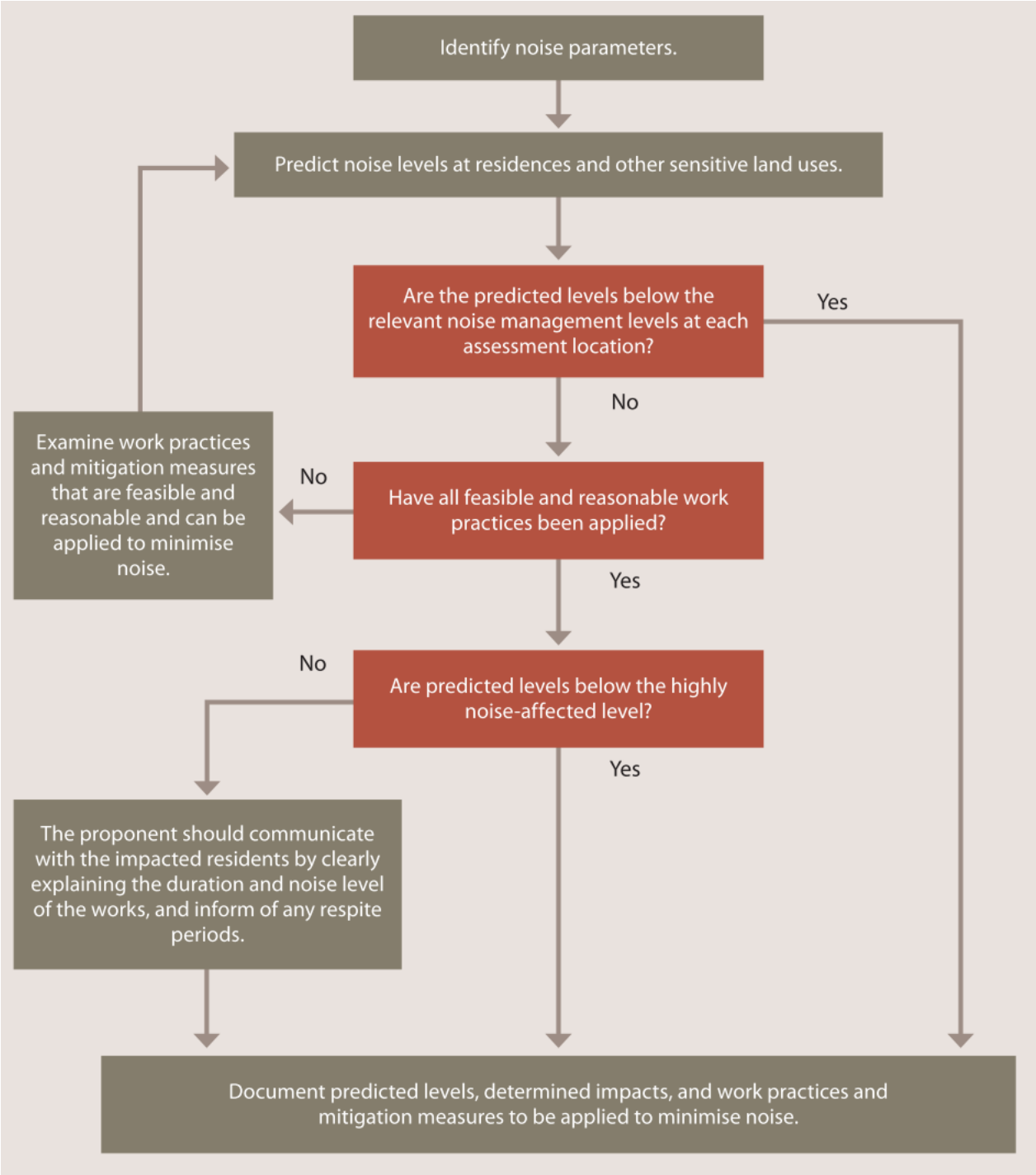


Figure 14: Prediction and Assessment of Impacts – Quantitative Method

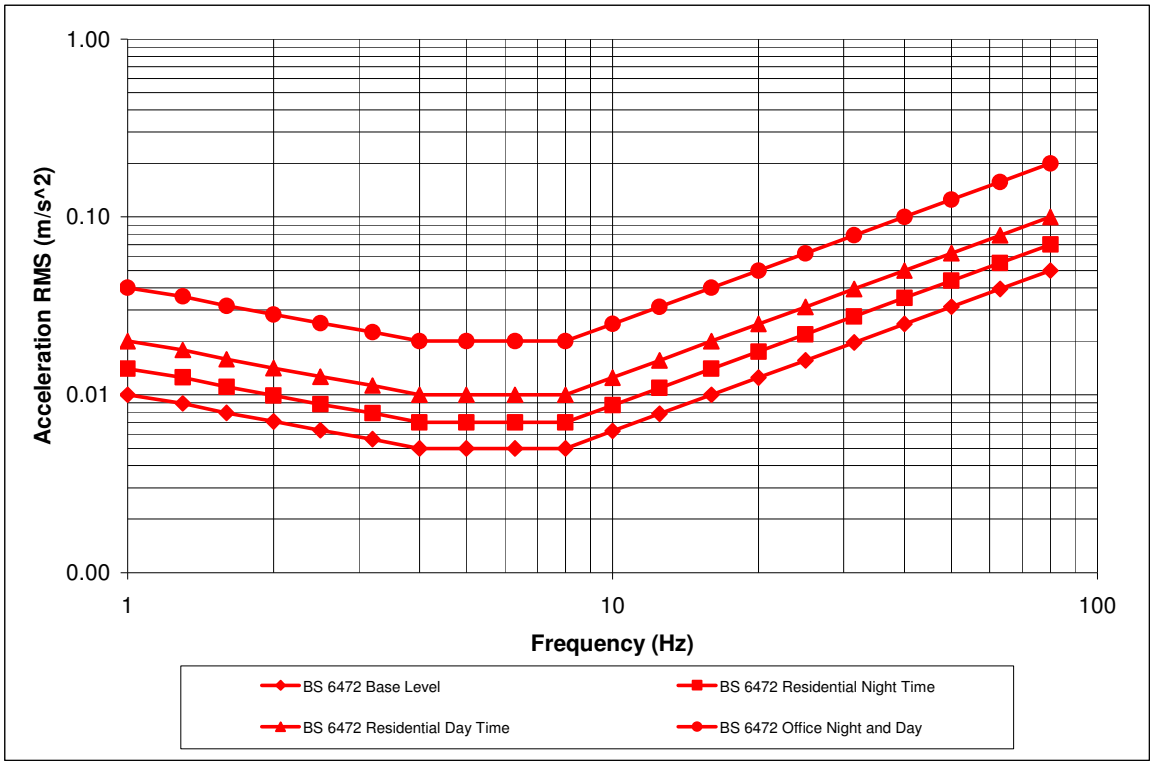


Figure 15: BS6472 Building Vibration Levels Z-axis

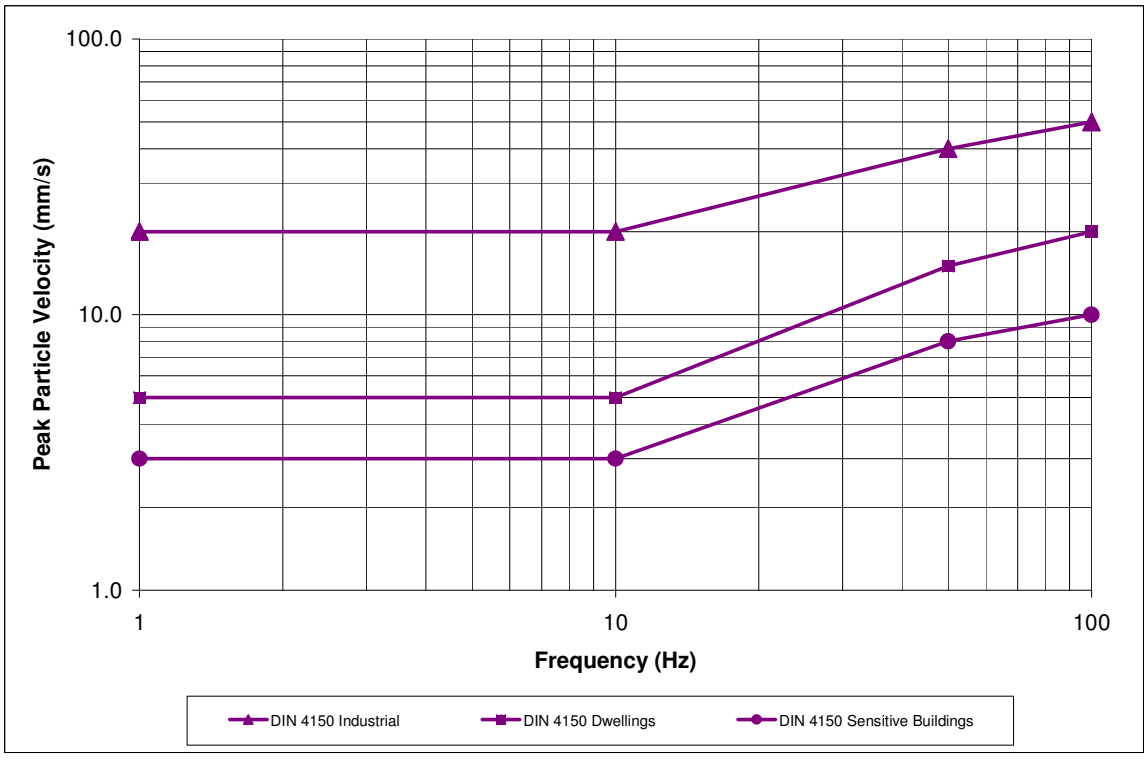


Figure 16: DIN 4150-3 Vibration Limits

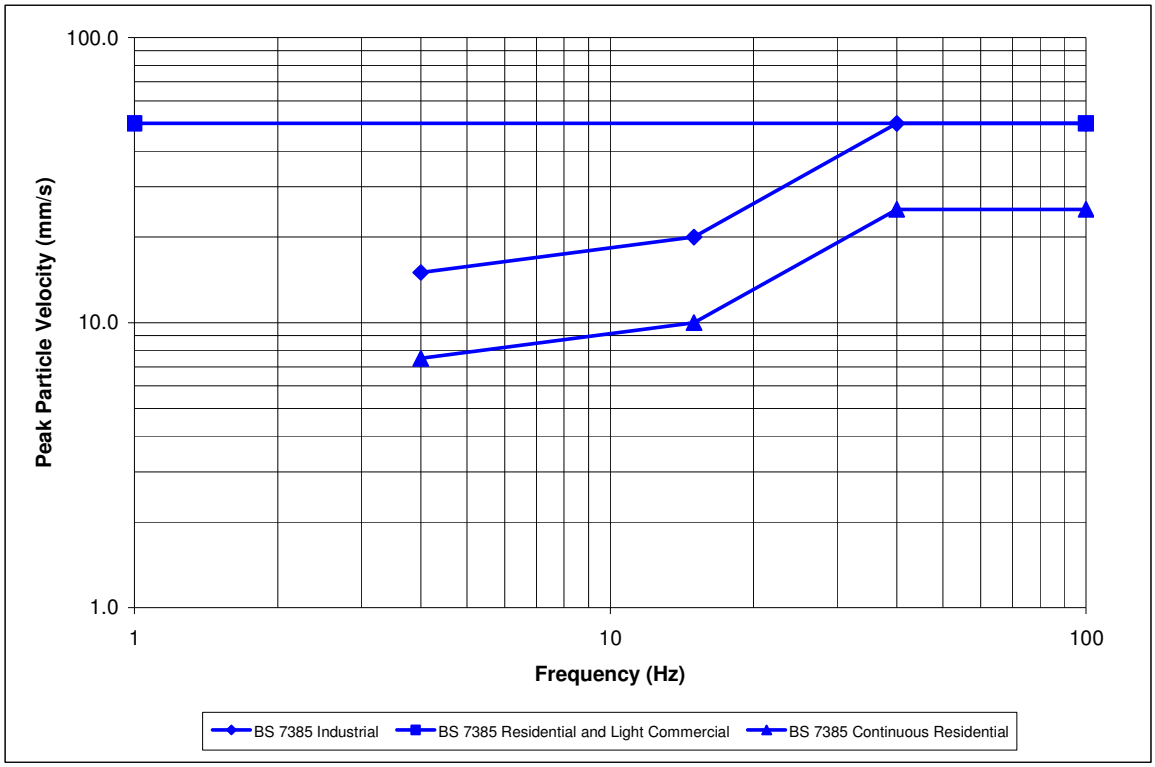


Figure 17: Transient Vibration Guide for Cosmetic Damage

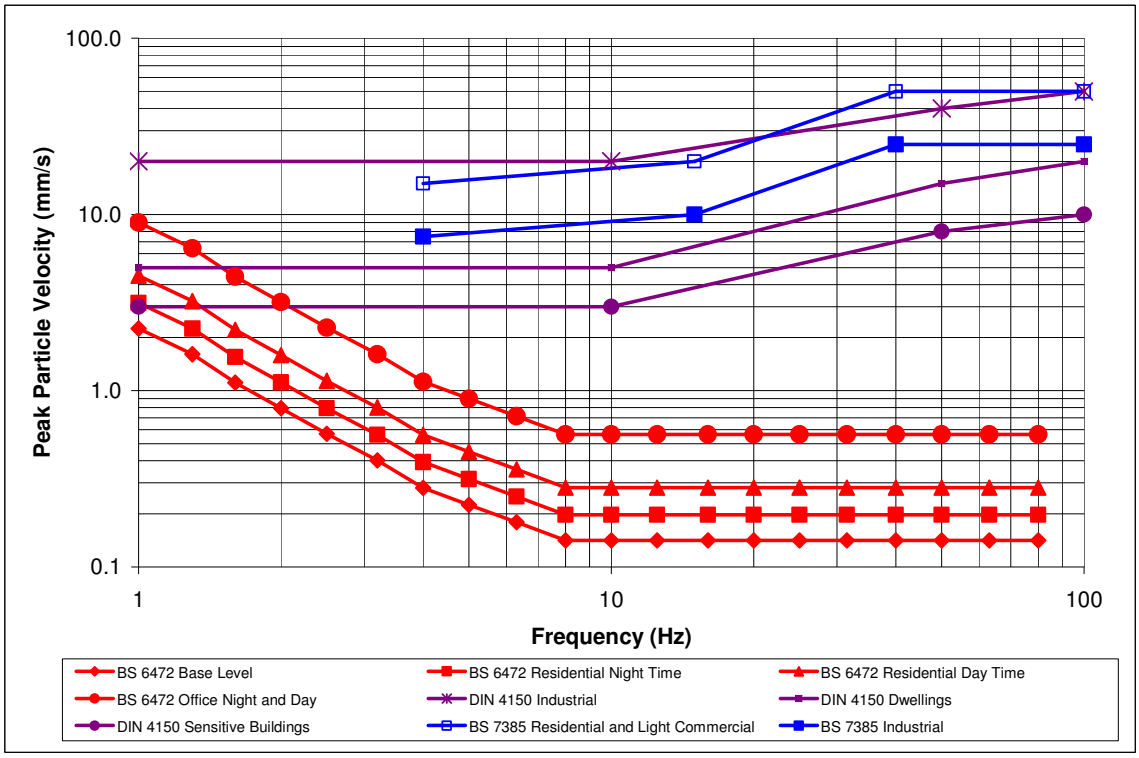


Figure 18: Human Disturbance and Building Damage Guide Values

Appendix A
Noise Logging Survey – Measurement Results

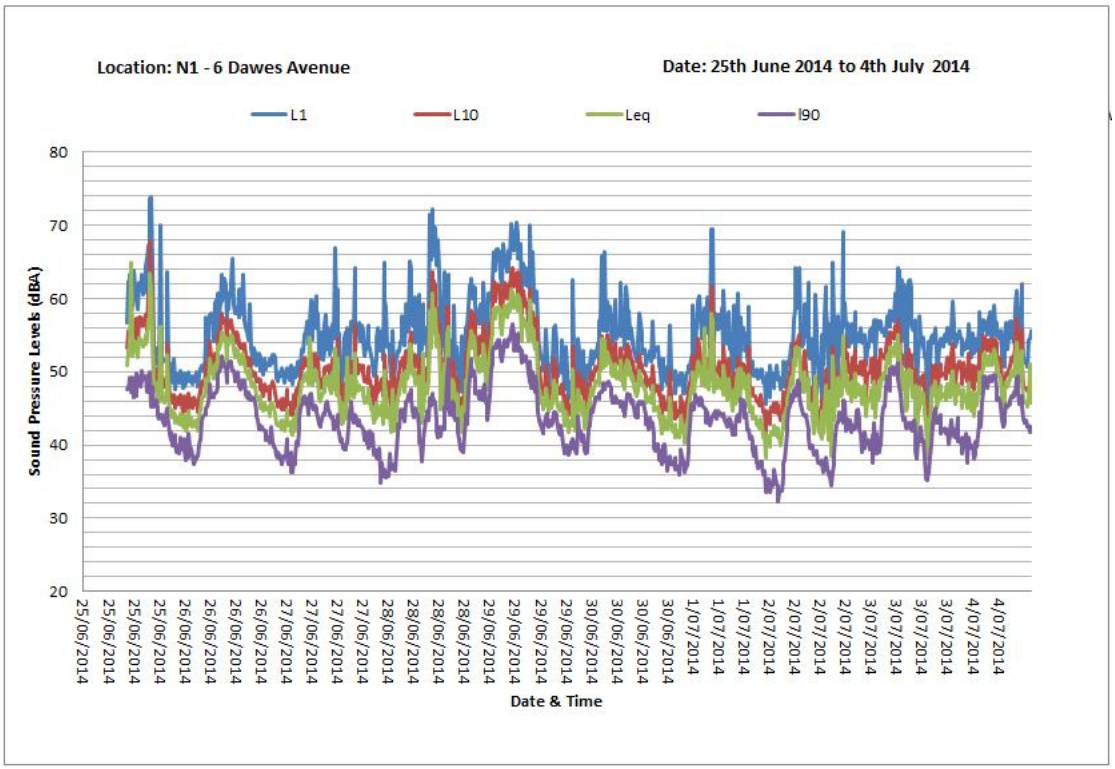


Figure 19: Noise Logging Results – N1

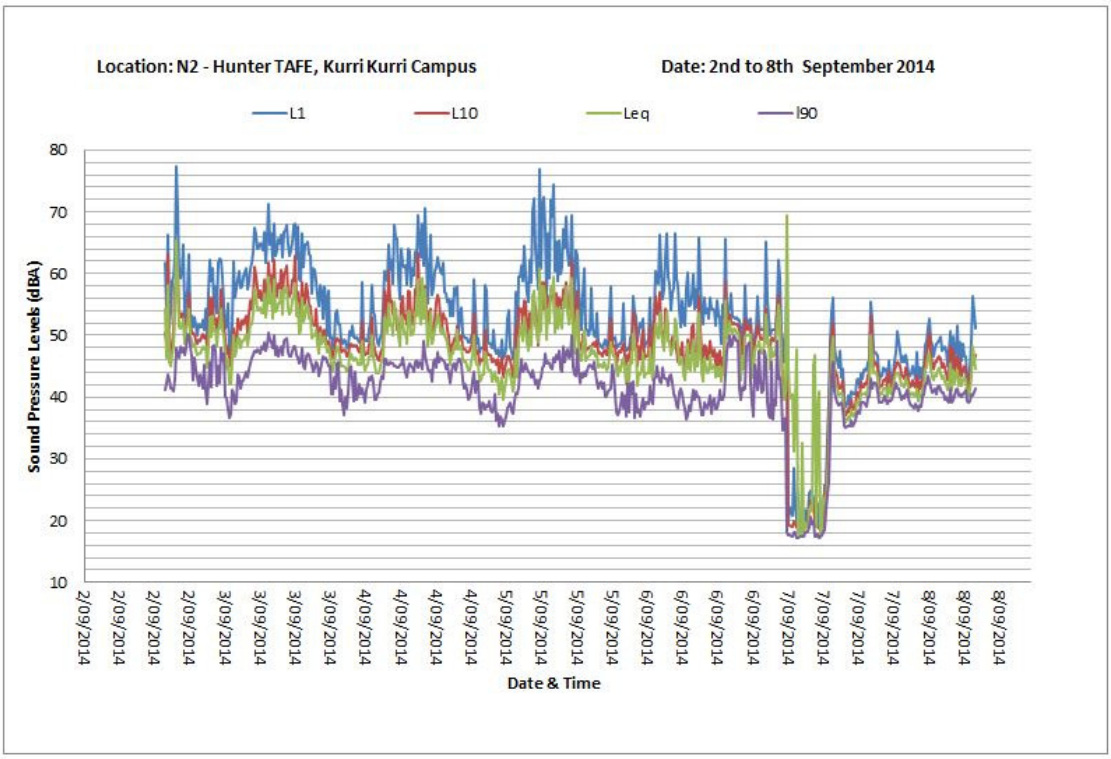


Figure 20: Noise Logging Results – N2

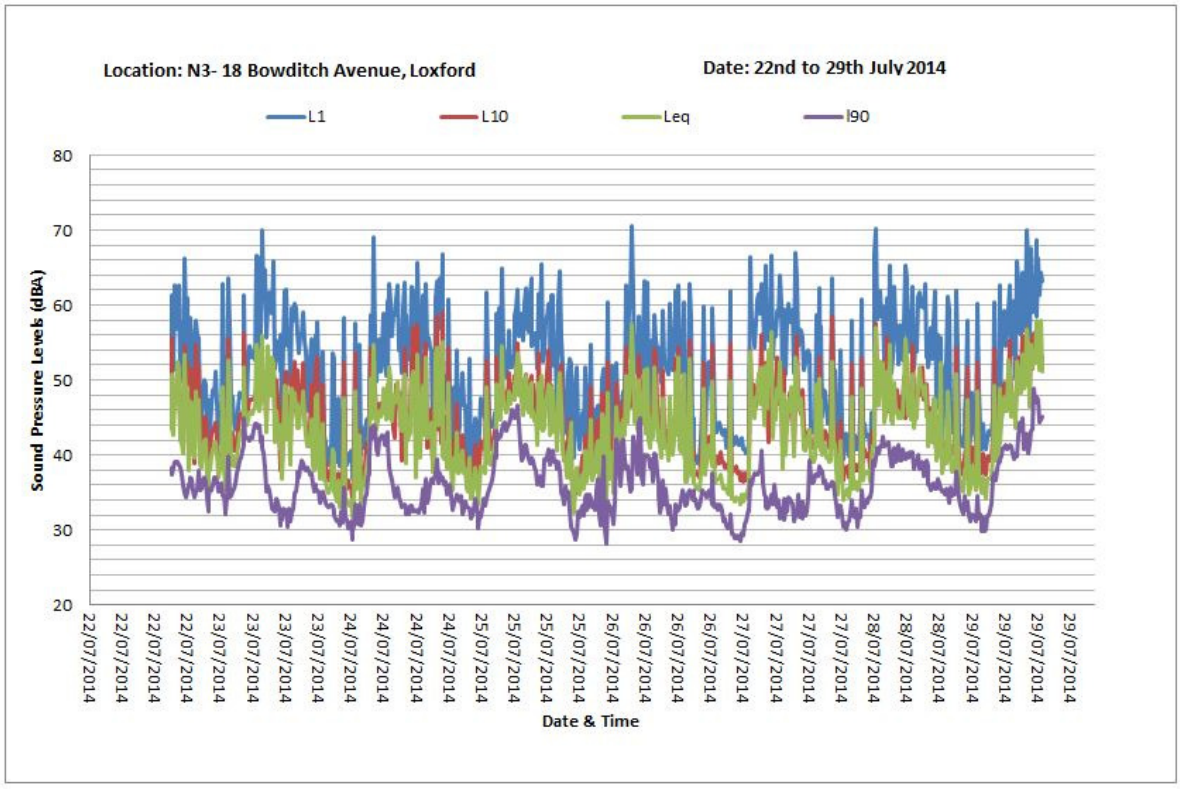


Figure 21: Noise Logging Results – N3

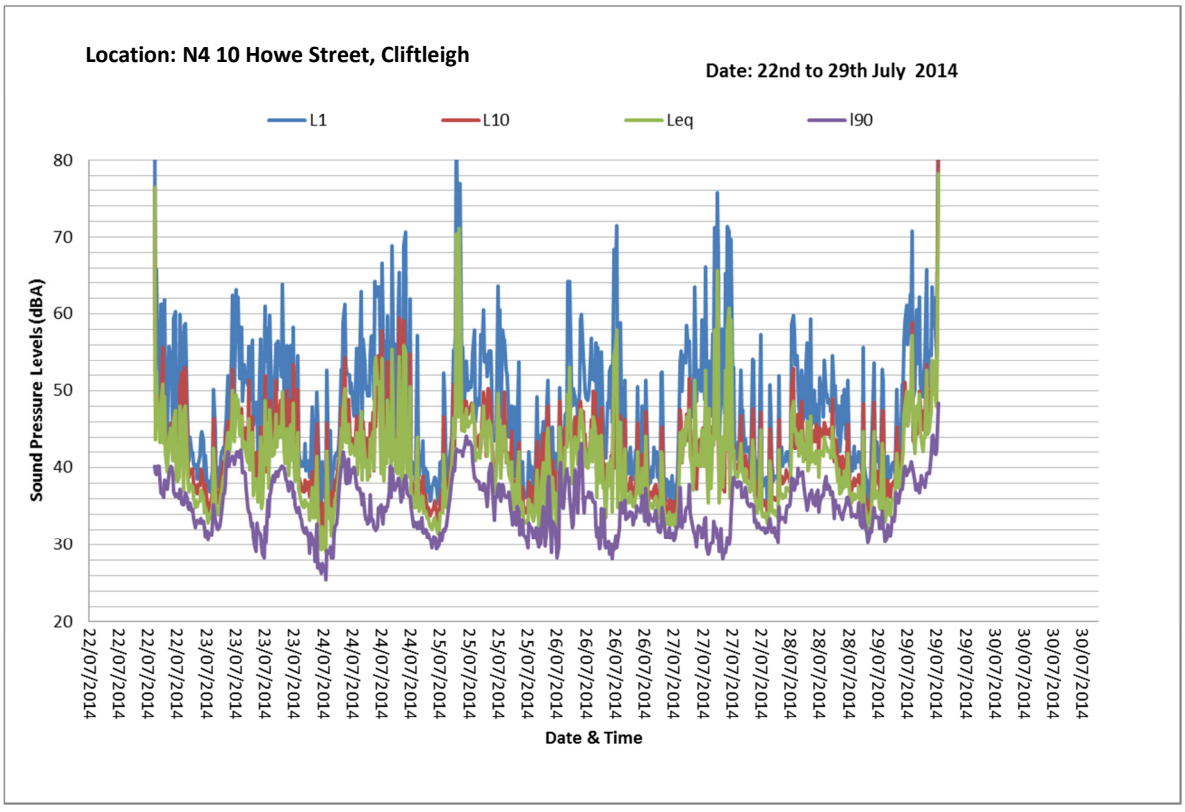


Figure 22: Noise Logging Results – N4

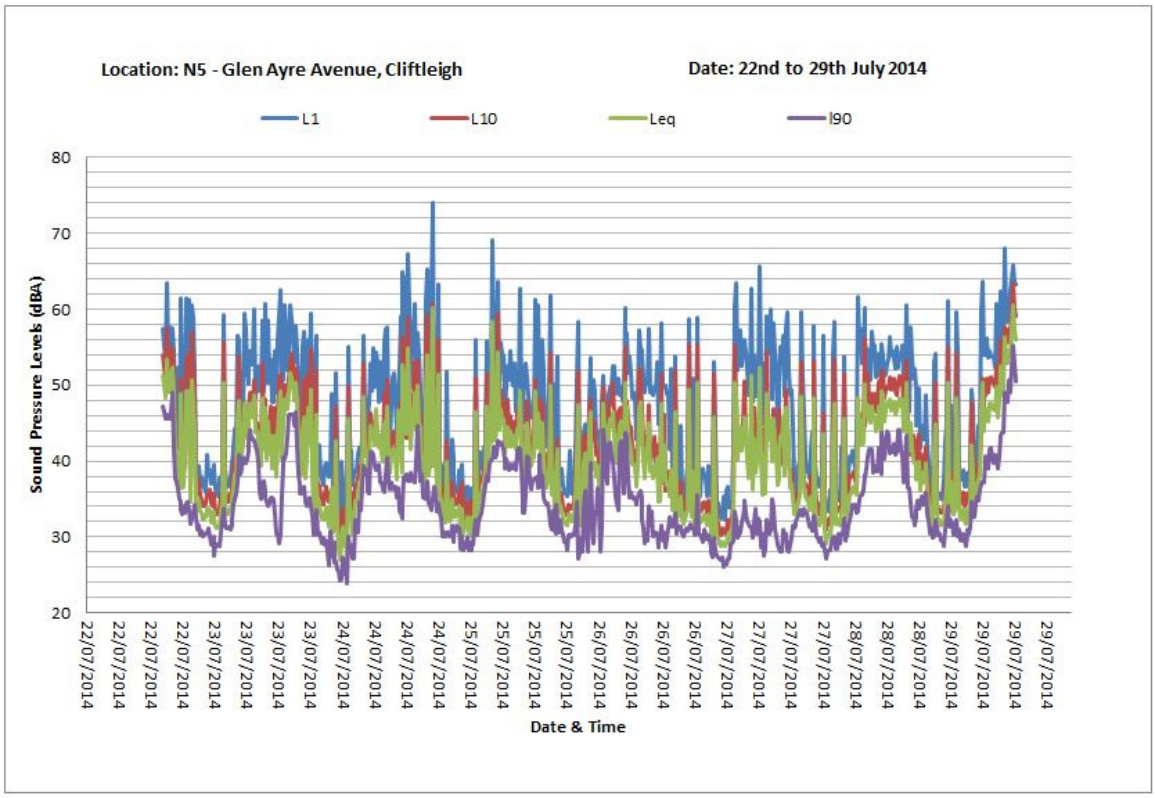


Figure 23: Noise Logging Results – N5

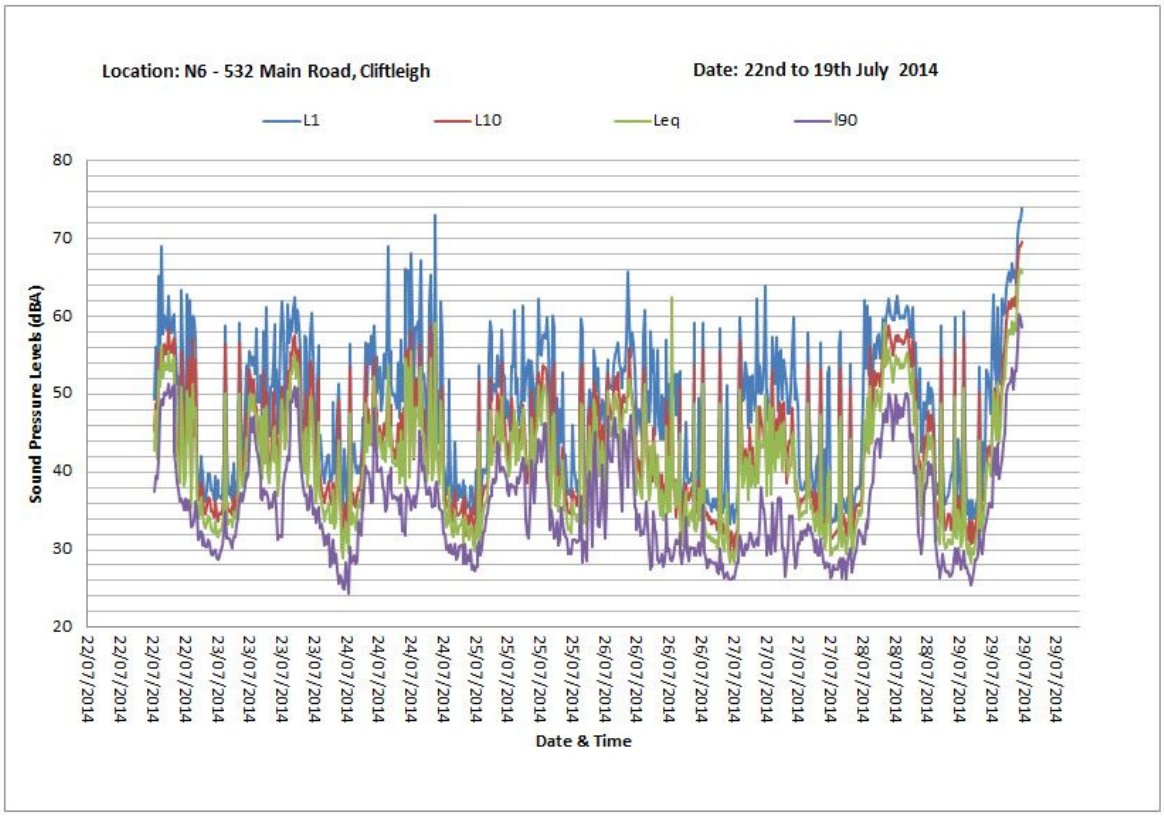


Figure 24: Noise Logging Results – N6

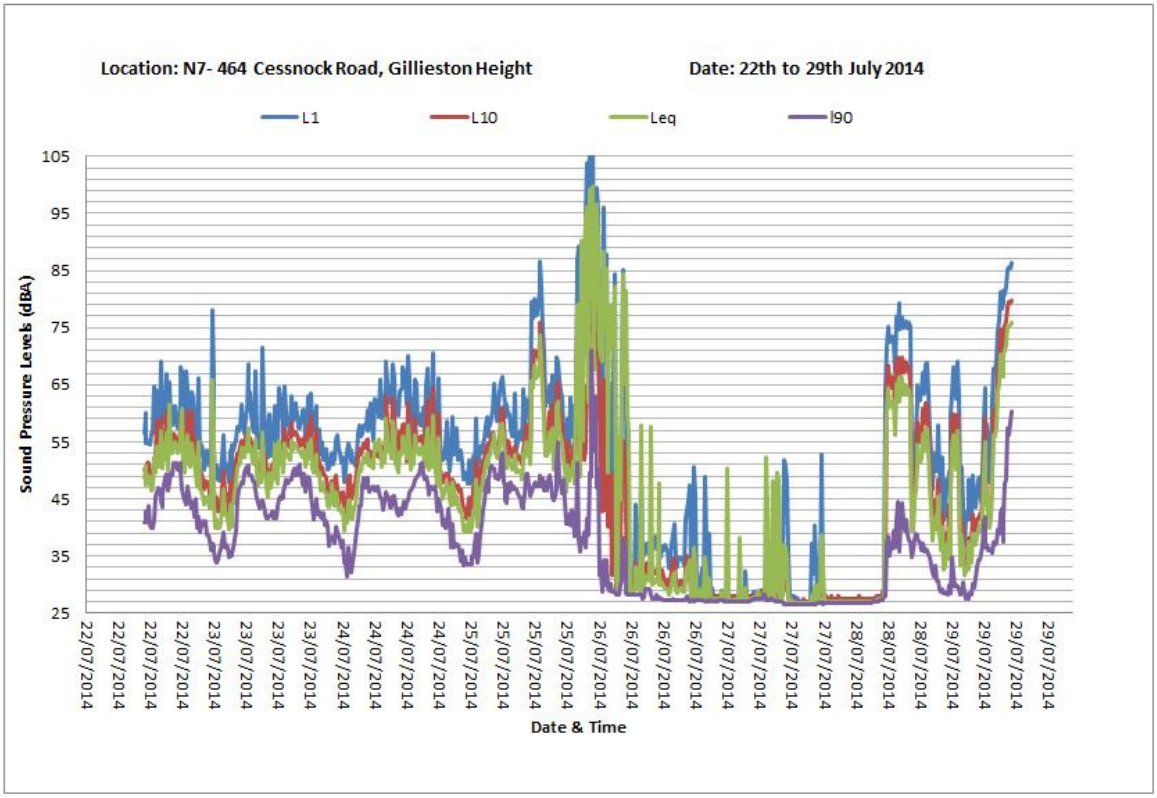


Figure 25: Noise Logging Results – N7

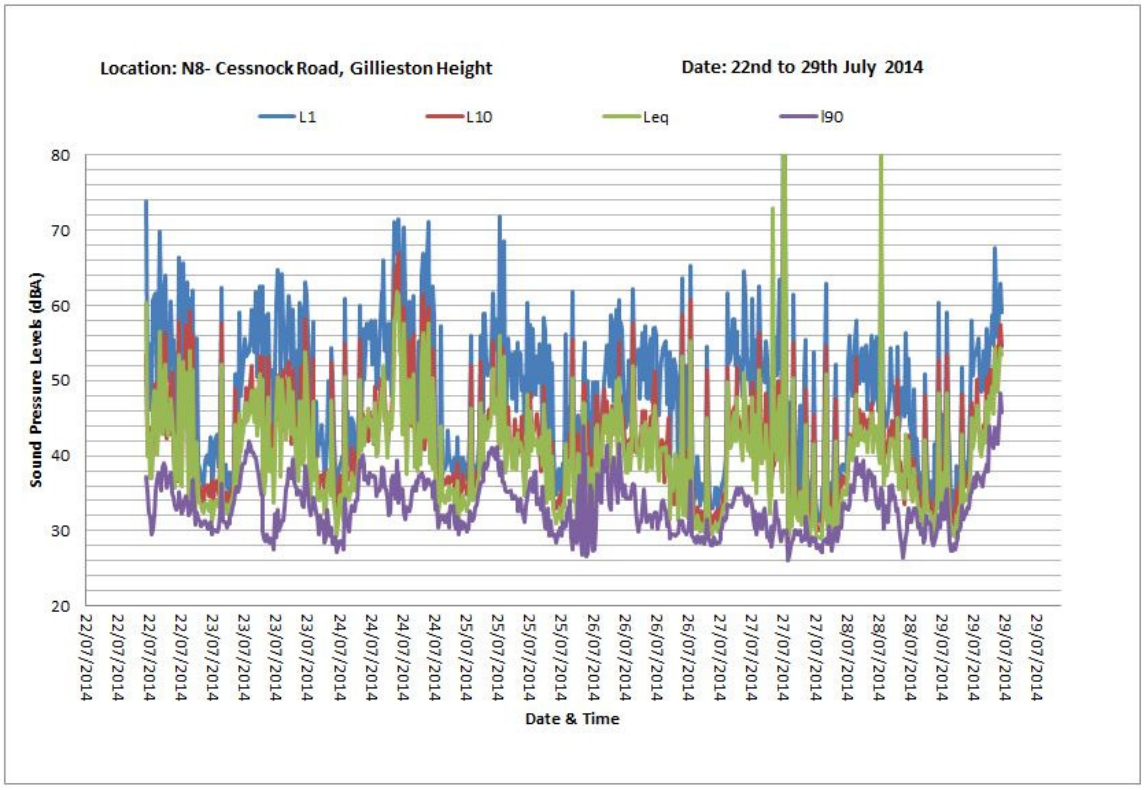


Figure 26: Noise Logging Results – N8

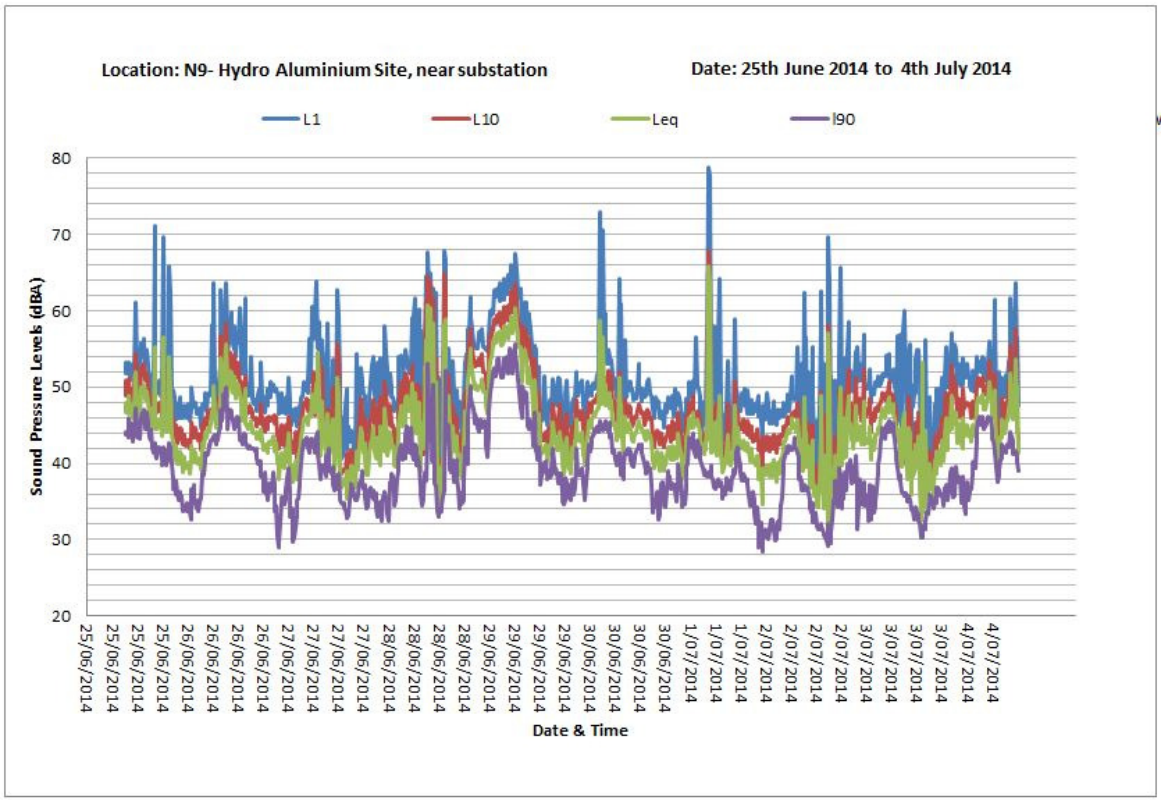


Figure 27: Noise Logging Results – N9

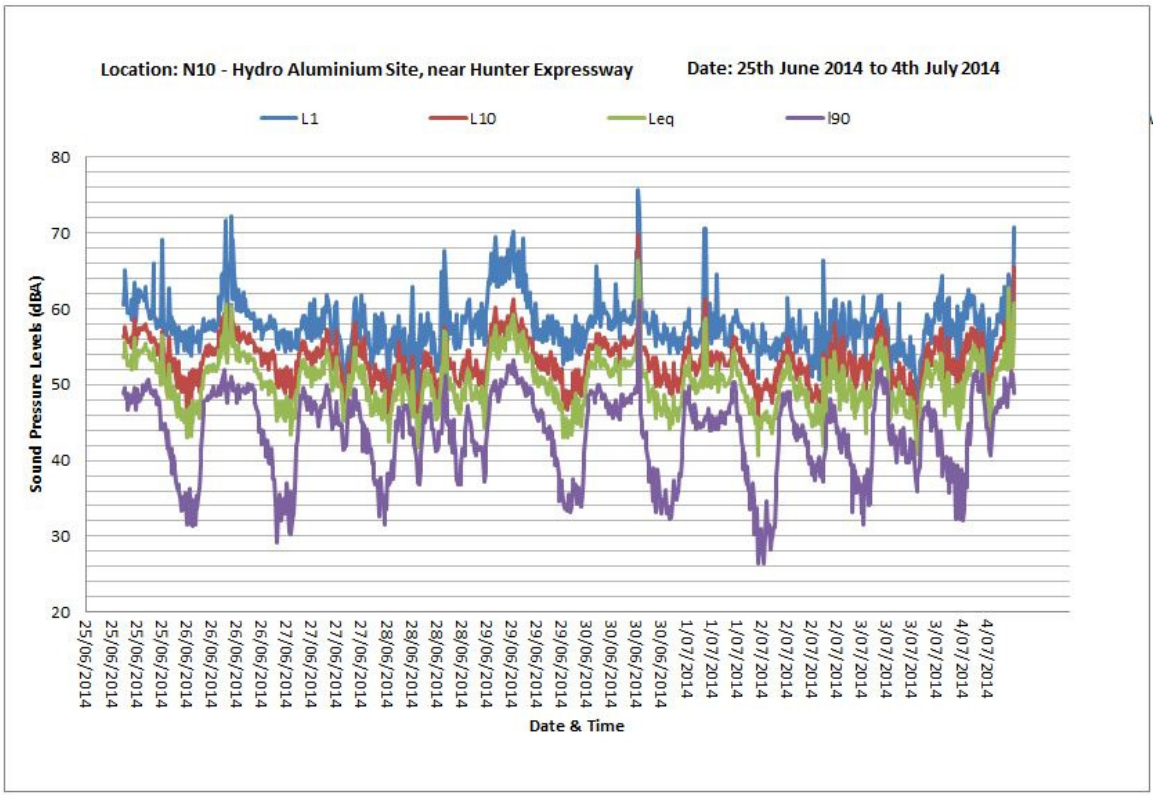


Figure 28: Noise Logging Results – N10

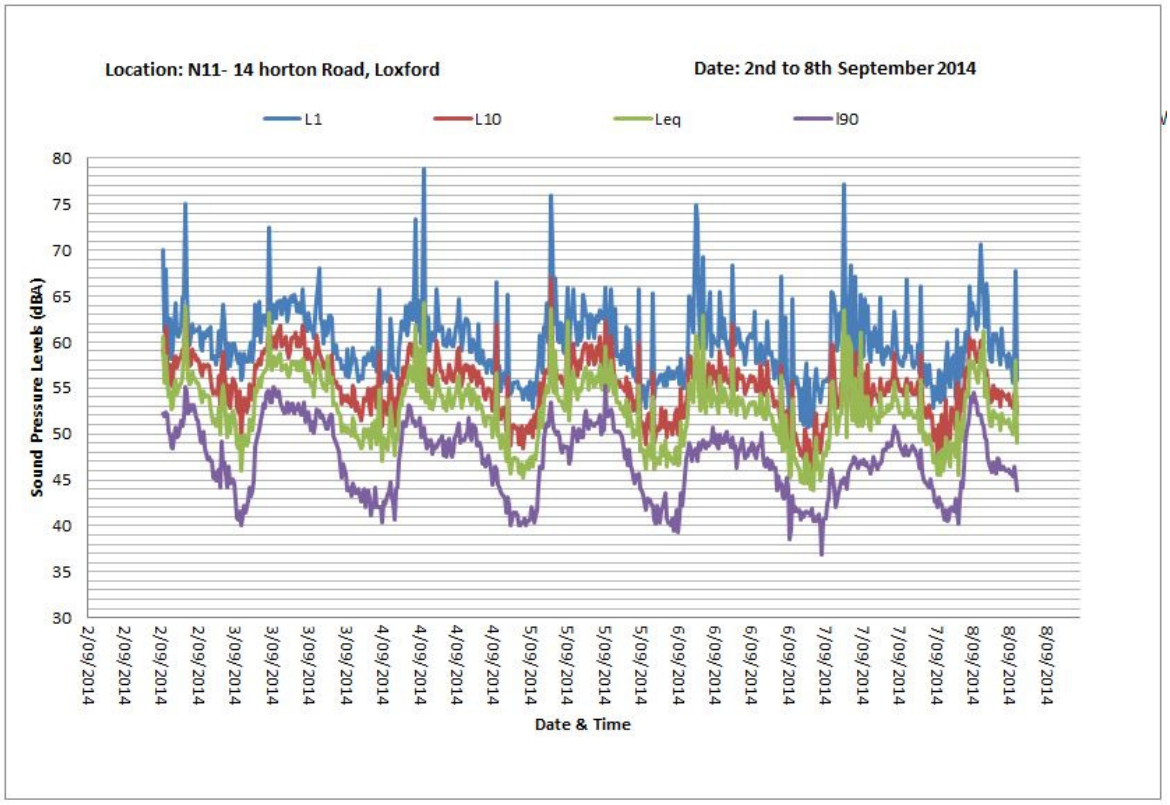


Figure 29: Noise Logging Results – N11

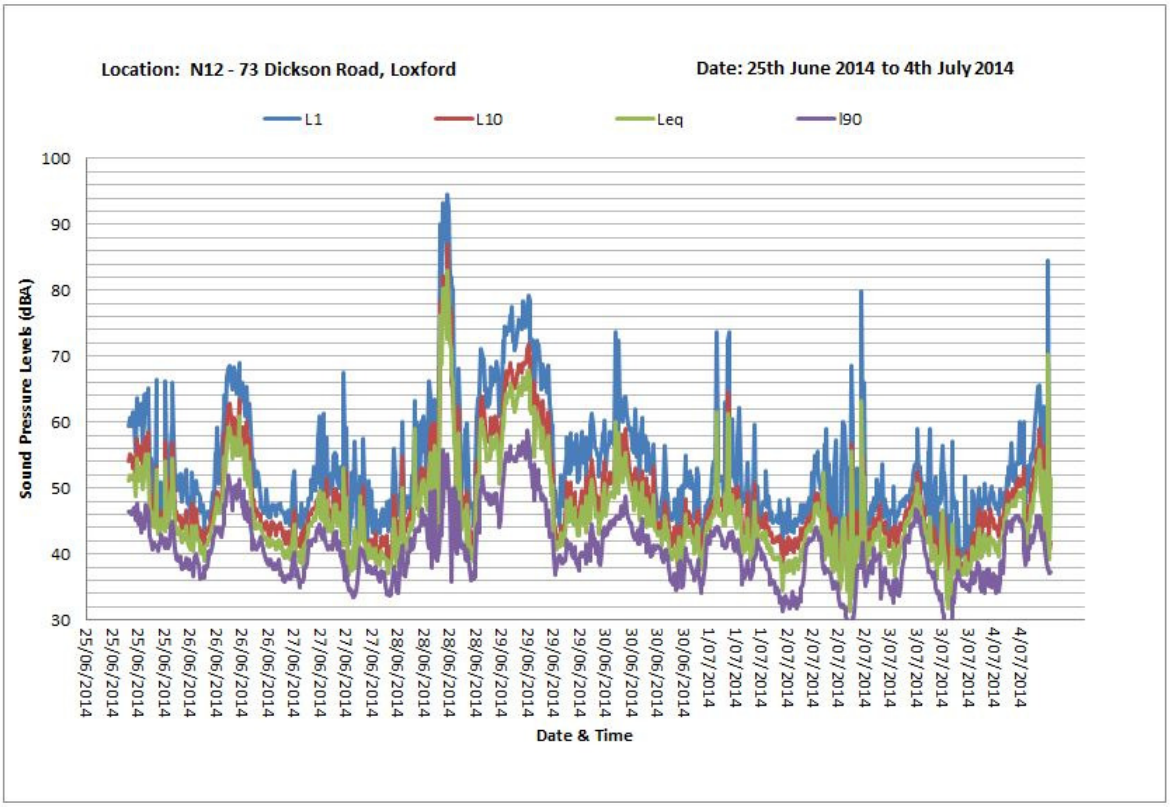


Figure 30: Noise Logging Results – N12

Appendix B
Noise Monitoring Program

The noise monitoring program will be conducted in general accordance with the NSW Industrial Noise Policy and Australian Standard (AS) 1055-1997: Acoustics- Description and Measurement of Environmental Noise. Monitoring would consist of attended noise monitoring at the 5 nearest affected receivers (R3, R4, R6, R7 and S1) outlined in **Section 9** and illustrated in **Figure 9**.

Attended noise monitoring will be conducted on at least quarterly basis at the monitoring locations surrounding the Project. These monitoring locations (R3, R4, R6, R7 and S1) are considered to provide a representative measure of noise emissions from the proposed works.

The noise compliance report would detail the following:

- Site operations to be provided by the client detailing the location and number of equipment that will be operating during the course of the environmental noise survey.
- At each nominated monitoring location, the attended noise measurements will be conducted using a Type 1 integrating sound level meter over 15-minute period during day, evening and night periods, depending on the Project operation hours.
- On- site meteorological data is to be collected from the “on-site” meteorological station and also during the operator attended survey using hand held weather station. Atmospheric conditions including wind speed, wind direction and air temperature will be measured during each attended noise monitoring survey.
- Reporting of noise results from each monitoring period will include the following
    - Summary of appropriate noise descriptors
    - Evaluation of results, including analysis and correlation of data from attended noise monitoring and weather stations together with comparison to noise limits detailed in table below.
    - Report will include statement of compliance.

Noise Limit at Noise Sensitive Receptors

Loc	Standard Construction Hours $L_{Aeq,15minutes}$	Outside Standard Construction Hours $L_{Aeq,15minutes}$			Highly Noise Affected	Sleep Disturbance $L_{A1,1minute}$
		Day	Evening	Night		
R3	48	43	40	39	75	49
R4	53	48	47	45	75	55
R6	60	55	52	47	75	57
R7	54	49	49	43	75	53
S1	65 (When in Use)	65 (When in Use)	65 (When in Use)	65 (When in Use)	75	-