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Ingleside Precinct

Noise and Vibration Impact Assessment

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Noise and Vibration Impact Assessment

Client: Department of Planning & Environment

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Prepared by

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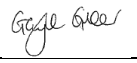
M	21-Oct-2016	Final Draft rev 12	Gayle Greer Technical Director	

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Executive Summary

Over the next 20 years, Sydney's population is forecast to grow by 1.6 million people, requiring an additional 664,000 homes. The Northern Beaches is also expected to change dramatically during this time. In recent years, a number of locations have been identified by the NSW Government and local Councils across Sydney as potential sites for new precincts / communities to be developed in response to these demands.

AECOM Australia Pty Ltd (AECOM) has been commissioned to conduct a noise and vibration impact assessment which will inform the rezoning of the Ingleside Land Release Area (Ingleside Precinct).

This study presents the assessment of the potential noise and vibration emissions associated with the existing and future urban development within the Precinct, including:

- Additional traffic noise generated by the increased capacity on nearby public roads; and
- Noise emission from all noise generating premises within and adjacent to the precinct.

Potential future sources of noise and vibration within the Precinct include retail premises, educational facilities and recreational spaces, as well as existing noise sources including private helipads, animal shelters and horse riding facilities.

The purpose of the study is to consider and assess environmental noise impacts, including the proposed Mona Vale Road Upgrade, on the existing and future residents of Ingleside.

Environmental noise monitoring

Unattended and attended noise monitoring was conducted along the main road sources within the precinct. Noise logging was completed at six locations in order to facilitate calibration of the road traffic noise model. Attended noise monitoring was conducted to qualify noise sources and verify unattended monitoring results.

The background noise environment was controlled by traffic travelling along the main roads, including Mona Vale Road, Powderworks Road and Lane Cove Road, within the Precinct, with noise from natural surrounds also present, namely cicadas.

Road traffic noise levels

Road traffic noise levels in 2036 were predicted and road traffic noise contours presented. The road traffic noise model took into account the proposed Mona Vale Road upgrade. The road traffic noise contours were overlaid on the Draft Plan and presented in Appendix E. It was noted that road traffic noise levels are likely to exceed the criteria presented in the State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP) by up to 10 dB(A), where the proposed low and medium density residential areas are in close proximity to Mona Vale Road and to a lesser extent Lane Cove and Powderworks Roads.

North Ingleside Sub-Precinct

Low and medium density residential development is proposed on the northern side of Mona Vale road. Road traffic noise levels are likely to exceed the Infrastructure SEPP Criteria by up to 10 dB(A) at some proposed facades. Where this occurs it is likely that noise mitigation measures will need to be considered as the Draft Plan for the Ingleside Precinct is further refined and in the preparation of the development control plan for the Ingleside Precinct.

South Ingleside Sub-Precinct

Medium density residential development is proposed to the south of Mona Vale Road, and road traffic noise levels are likely to exceed the Infrastructure SEPP criteria within approximately 200 m from Mona Vale Road. Low density residential development is also proposed to the south of Mona Vale Road within the eastern portion of the sub-precinct. Road traffic noise levels are likely to exceed the Infrastructure SEPP criteria by up to 10 dB(A). Low and medium density residential developments are also proposed on both sides of Powderworks Road. Noise levels are likely to exceed the SEPP criteria by up to 5 dB(A), therefore noise mitigation measures will need to be considered as the Draft Plan for the Ingleside Precinct is further refined and in the preparation of the development control plan for the Ingleside Precinct.

Wirreanda Valley Sub-Precinct

The impact of increased road traffic noise levels as a result of the Mona Vale Road Upgrade project on existing rural residential properties in this area will be fully addressed in the Mona Vale Road West upgrade REF, by NSW Roads and Maritime Services.

Bayview Heights Sub-Precinct

No significant changes to road traffic noise are expected within the Bayview Heights Sub-Precinct given its distance from major roads.

Other noise sources

Noise from both existing sources on proposed residential developments, and noise from proposed community facilities, shops, school and sporting fields on existing residences have been discussed, with planning considerations and indicative mitigation measures provided. These may include standard acoustic treatment to external building services, noise barriers and buffer zones.

Construction noise and vibration

Although construction details are not available at this early stage of the project, construction noise management levels have been established based on measured Rating Background Levels (RBLs). Indicative construction scenarios have been proposed in order to demonstrate typical noise impacts from works that may take place during the Precincts urban development. Generic mitigation measures have been provided to minimise adverse noise and vibration impacts.

Recommendations

The Study has found that it is likely that mitigation measures will be required for the proposed low and medium density developments to reduce noise levels to the appropriate noise criteria. Areas within each sub-precinct where treatment may be necessary have been identified for consideration as the Draft Plan for the Ingleside Precinct is further refined and in the preparation of the development control plan for the Ingleside Precinct however, it is also likely that more prescriptive treatment design will need to be assessed at the development application stage. This study presents conceptual noise control measures and management strategies which are likely to be required to minimise adverse impacts on existing and future residential receivers.

Where land subdivision development application assessments deem noise mitigation measures necessary for proposed residential developments, they shall be implemented according to the following hierarchy:

- Treatment of noise at source; such as integrated design measures such as road design and traffic management, as well as road surface treatment
- Treatment of noise path; such as in-corridor barriers
- Treatment at receivers; such as at-property treatments and receiver building layouts

This process is detailed in Section 6.5.

It is noted that detailed noise and vibration impact assessments will be required during the development application stage for noise sensitive receivers where they are proposed to be located close to existing/future noisy land uses.

Pittwater and Northern Beaches Councils

In May 2016 Pittwater Council was merged into a new body, the Northern Beaches Council. As this report was prepared prior to these changes, it makes reference to the former council. The plans and strategies of the former council continue to apply to the former local government area until the new council prepares its own plans and strategies.

1.0 Introduction

1.1 Background

The NSW Government's "A Plan for Growing Sydney" (December, 2014) reaffirmed the pressures being faced by the metropolitan area in terms of population growth and associated demands for the economy and employment, housing, transport, environment and resources, parks and public places.

Over the next 20 years, Sydney's population is forecast to grow by 1.6 million people, requiring an additional 664,000 homes. The Northern Beaches is also expected to change dramatically during this time. In recent years, a number of locations have been identified by the NSW Government and local Councils across Sydney as potential sites for new precincts / communities to be developed in response to these demands.

The Ingleside Land Release Area (Ingleside Precinct) is located approximately 3.2 km from the Mona Vale Town Centre and is transected by Mona Vale Road (a 20km arterial road corridor running east-west between the Pacific Highway to the west and Pittwater Road to the east), which Roads and Maritime Services (Roads and Maritime) plans to widen to two lanes in each direction between McCarrs Creek Road and Foley Street.

AECOM Australia Pty Ltd (AECOM) has been commissioned by the Department of Planning and Environment (DP&E) to complete a noise and vibration impact assessment which will inform the rezoning of the Ingleside Precinct.

1.2 Study objective

This study presents the assessment of the potential noise and vibration emissions associated with the existing and future urban development within the Precinct, including:

- Additional traffic noise generated by the increased capacity on nearby public roads; and
- Noise emission from all noise generating premises within and adjacent to the precinct.

Potential future sources of noise and vibration within the Precinct include retail premises, educational facilities and recreational spaces, as well as existing noise sources including private helipads, animal shelters and horse riding facilities.

The purpose of the study is to consider and assess environmental noise impacts on the existing and future residents of Ingleside. It is noted that detailed noise and vibration impact assessments will be required during the development application stage for noise sensitive receivers where they are proposed to be located close to existing/future noisy land uses.

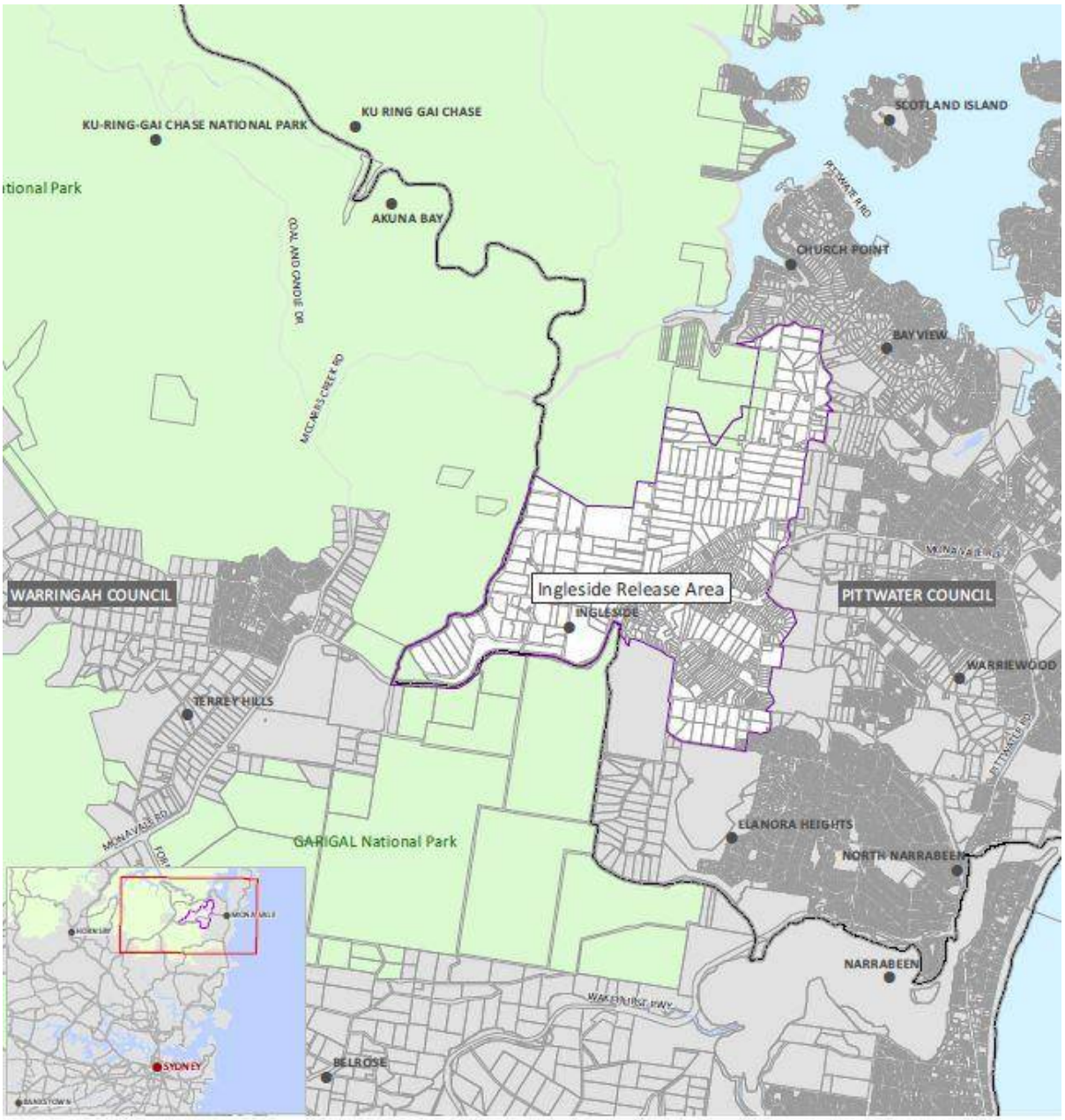
The Study also presents conceptual noise control measures and management strategies which are likely to be required to minimise adverse impacts on existing and future residential receivers.

1.3 Site description

The Ingleside Precinct is located in the Pittwater Local Government Area (LGA), approximately 30 kilometres north of the Sydney CBD by road. The precinct comprises 700 hectares and lies between Terrey Hills and Mona Vale, off Mona Vale Road, the main road linking Mona Vale to western Sydney.

The Precinct and regional context is shown in Figure 1.

Figure 1 Regional context of the Ingleside Precinct



Source: NSW Department of Planning and Environment, 2015

The Precinct currently is zoned RU2 – Rural Landscape under Pittwater Local Environment Plan (LEP) 2014, and a mix of public and private land ownership exists in the Precinct. The Precinct comprises four discernible areas, referred to as South Ingleside, North Ingleside, Bayview Heights and Wirreanda Valley.

1.4 Mona Vale Road upgrade

The NSW Government is proposing to upgrade Mona Vale Road from two lanes to four lanes between McCarrs Creek Road at Terrey Hills and Powderworks Road at Ingleside. The upgrades are being planned in stages and are aimed at improving safety and traffic efficiency. The stages are as follows:

- Stage 1 – Intersection improvement of Mona Vale Road and Ponderosa Parade – This work was completed in early 2015.
- Stage 2 – Mona Vale Road East upgrade – Upgrade of 3.2 km of Mona Vale Road from two lanes to four lanes between Manor Road, Ingleside and Foley Street, Mona Vale. Roads and Maritime have prepared a

Review of Environmental Factors (REF). A noise and vibration assessment report has been prepared as part of the REF. The report provides detailed information on the proposed concept road design, environmental impacts and mitigation measures to minimise the impacts.

- Stage 3 – Mona Vale Road West upgrade – Upgrade of 3.2 m of Mona Vale Road from two lanes to four lanes between McCarrs Creek Road, Terrey Hills and Powderworks Road, Ingleside. Roads and Maritime is preparing an REF to examine potential impacts of the proposed upgrade for this stage. This will include a noise and vibration assessment report and will include measures to reduce and manage impacts.

It should be noted that the section of Mona Vale Road between Powderworks Road, Ingleside and Manor road, Ingleside has been upgraded previously and currently comprises four lanes.

This study has been completed based on the year 2036, when the precinct is likely to be fully developed. The road traffic noise modelling has included Mona Vale Road as a four lane road.

It should be noted that operational and construction noise and vibration impact assessments have been or are being completed for the three stages of the Mona Vale Road upgrade. These impact assessments will consider all existing noise sensitive receivers and those which have Development Application approval.

The REF for Mona Vale Road upgrade Stage 2 recommended the use of Stone Mastic Asphalt along the entire alignment. In addition architectural treatments were recommended for some existing residential buildings. As these recommendations are subject to change during the detailed design phase the use of Stone Mastic Asphalt has not been included in this assessment to present a conservative approach.

The criteria applicable to road projects are detailed in the NSW Road Noise Policy, whilst criteria for land use developments affected by road traffic noise are detailed in the State Environment Planning Policy (Infrastructure) 2007. Feasible and reasonable noise mitigation measures for road projects generally include ‘quiet’ road surfaces, noise barriers and architectural treatments whilst feasible and reasonable noise mitigation measures for land use developments generally include noise barriers, buffer zones, architectural layouts and architectural treatments.

2.0 Draft Plan

2.1 Introduction

Structure and precinct plans are a proven approach for the delivery of greenfield residential developments. The intention being to achieve high quality outcomes, including easy access to jobs and major town centres, streets and suburbs so that people can walk / cycle to shops (or for other short distance journeys), and frequent bus services that link to the rail network for longer journeys.

A Draft Plan was developed through an iterative process over a period of time, involving multiple stakeholders across a range of technical disciplines providing inputs and guidance as to the precinct development opportunities and constraints.

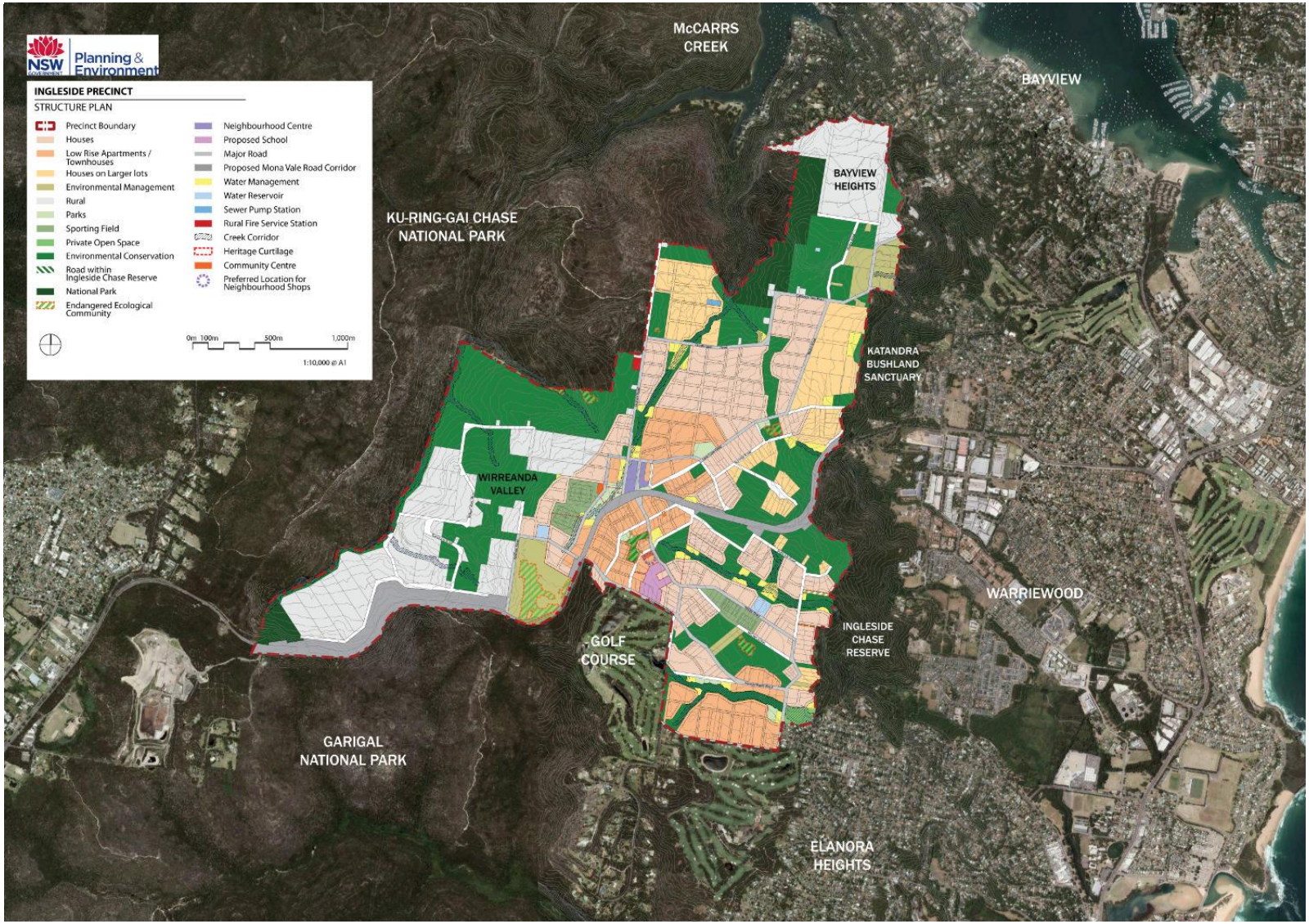
2.2 Draft Plan

The Draft Plan for Ingleside is shown in Figure 2. The Ingleside Precinct comprises four sub-precincts, North Ingleside, South Ingleside, Bayview and Wirreanda Valley. Bayview is the rural area at the north of the Precinct and Wirreanda Valley is the rural area at the west of the Precinct. The remainder of the Precinct comprises North and South Ingleside with North Ingleside lying to the North of Mona Vale Road and South Ingleside lying to the South of Mona Vale Road. All of the proposed development will occur in North and South Ingleside. Should the final plans for Ingleside significantly change from the Draft Plan this assessment will be revised accordingly.

2.2.1 Residential land uses

The proposed development is predominantly low and medium density residential dwellings,(houses and apartments / townhouses respectively) with both a neighbourhood retail centre (North Ingleside) and a community node (South Ingleside) to serve local residents. Current projections estimate that approximately 3,400 dwellings will be provided as part of the proposed development. Estimates of population density suggest an average of 2.7 persons per dwelling or approximately 9,000 residents for the precinct.

Figure 2: Draft Plan for Ingleside



Source: Department of Planning and Environment, October 2016

2.2.2 Neighbourhood Centre

Given the physical constraints of the precinct, access to the Mona Vale Town Centre and the small village centre at Elanora Heights may be difficult for residents seeking to travel by non-car modes. As such, one neighbourhood centre and one community centre are proposed within the precinct. The proposed neighbourhood centre will be located in North Ingleside, at the intersection of Mona Vale Road / Chiltern Road. It is proposed that this neighbourhood centre would include retail uses and a supermarket. The proposed community centre is proposed to be located to the south of Sophie Avenue in North Ingleside. In addition a preferred location for a community nodes with small retail offerings has been identified in South Ingleside at the intersection of Manor Road / King Road.

2.2.3 Educational land uses

It is proposed that one new school will be located within South Ingleside between Manor Road and Powderworks Road. The school is positioned close to key public transport corridors and would be accessed via local roads where appropriate. It is important to provide high quality walking and cycling routes to each school.

2.2.4 Community uses and open space

Under the currently proposed Draft Plan there is opportunity to provide several open space areas. A number of parks and sporting fields are proposed within the precinct. These will be accessible by public transport, walking and cycling routes. There is also an opportunity to locate leisure cycling and walking routes along riparian corridors (subject to feasibility).

2.3 Noise and vibration implications

As detailed above, a number of future developments have been proposed for the Precinct. A summary is provided in Table 1. Pertinent to noise, the developments listed in may act as noise sources, sensitive receivers, or both.

Table 1 Proposed development sources and receivers

Development	Location	Noise source or sensitive receiver
Neighbourhood centre	North Ingleside - Intersection of Chiltern Road and Lane Cove Road	Both
Community node with small retail offerings	South Ingleside - Intersection of King Street and Manor Road	Both
Community centre	North Ingleside, Sophie Avenue	Both
Primary school	South Ingleside	Both
Sports fields – may host 1000s of attendees	North Ingleside, Sophie Avenue	Source
	South Ingleside, Wattle Road	Source

In addition, the proposed Mona Vale Road upgrade will result in the widening of the road corridor to two lanes in each direction for the entirety of its length (4-lane divided road). The proposed upgrade pertains to two sections of Mona Vale Road that are currently 1 lane in each direction, from McCarrs Creek Road to Powderworks Road (west) and Lane Cove Road / Manor Road to Foley Street (east).

Although at this stage of development details of future works are unknown, provisions have been made to control noise and vibration from a planning perspective.

3.0 Existing ambient noise environment

The Ingleside Land Release Area (Ingleside Precinct) is semi-rural in nature and includes a mix of existing land uses comprising predominantly lifestyle blocks, recreational land uses, plant nurseries, the equine industry and small scale commercial agriculture. Other land uses include places of worship, a school and conference facility.

3.1 Sources

The existing noise environment at the proposed Ingleside Land Release area (Ingleside Precinct) is controlled largely by noise from traffic along Mona Vale Road, Powderworks Road and Lane Cove Road. Noise from natural surrounds is present from bushlands surrounding these roads.

A number of locations within the Precinct have also been identified to be associated with potentially noisy activities. The significant noise sources within the Precinct are identified in Figure 3 and listed in Table 2.

Figure 3 Approved non-compatible land uses within Ingleside Precinct

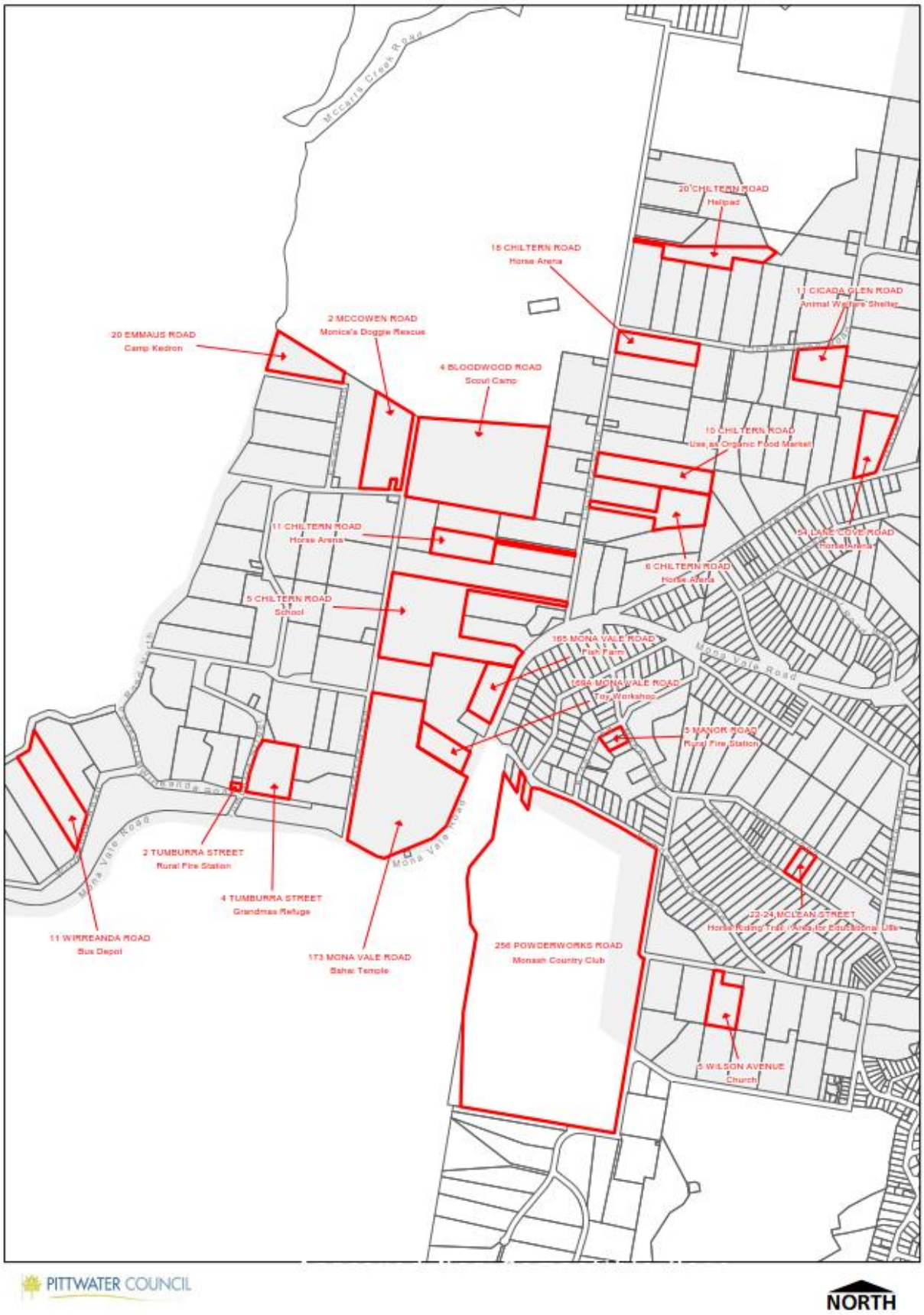


Table 2 Existing noise sources

Source type	Address
Helipad	20 Chiltern Road
Horse arena / stable arena / riding trail / area for educational use	6 Chiltern Road
	11 Chiltern Road
	18 Chiltern Road
	22-24 Mclean Street
Dog rescue / animal shelter	2 McCowen Road
	11 Cicada Glen Road
Church	Wilga Wilson Area
Heavy vehicles and construction equipment	Rural lots within Wirreanda Valley

The Precinct is surrounded by bushlands to the north-west, west, south-west, and east. To the south, south-east, north and north-east lie residential zones. No existing noise sources which could significantly impact the noise environment within the Precinct were identified adjacent to the precinct. These include such sources as airports, industrial sites, ports or terminals, etc.

3.2 Receivers

Ingleside Precinct currently consists largely of suburban residential properties surrounded by bushland. Residential receivers have been grouped into Noise Catchment Areas (NCAs). The NCAs are shown in Figure 4.

In addition, existing non-residential noise sensitive receivers located within the Precinct are listed in Table 3.

Table 3 Non-residential sensitive receivers

Receiver	Address	Receiver type
Hamazkaine Arshak & Sophie Galstaun School	5 Chiltern Road, Ingleside	Educational institution
Monash Country Club	Powderworks Road, Ingleside	Recreation area
National Baha'i Centre	173 Mona Vale Road, Ingleside	Place of Worship

3.3 Ambient noise monitoring

Unattended and attended noise monitoring was conducted at the following six locations within the Precinct in December 2013:

NL1 - 1 Wirreanda Road, Ingleside

NL2 – Baha'i Temple Way, Ingleside

NL3 - 240 Powderworks Road, Ingleside

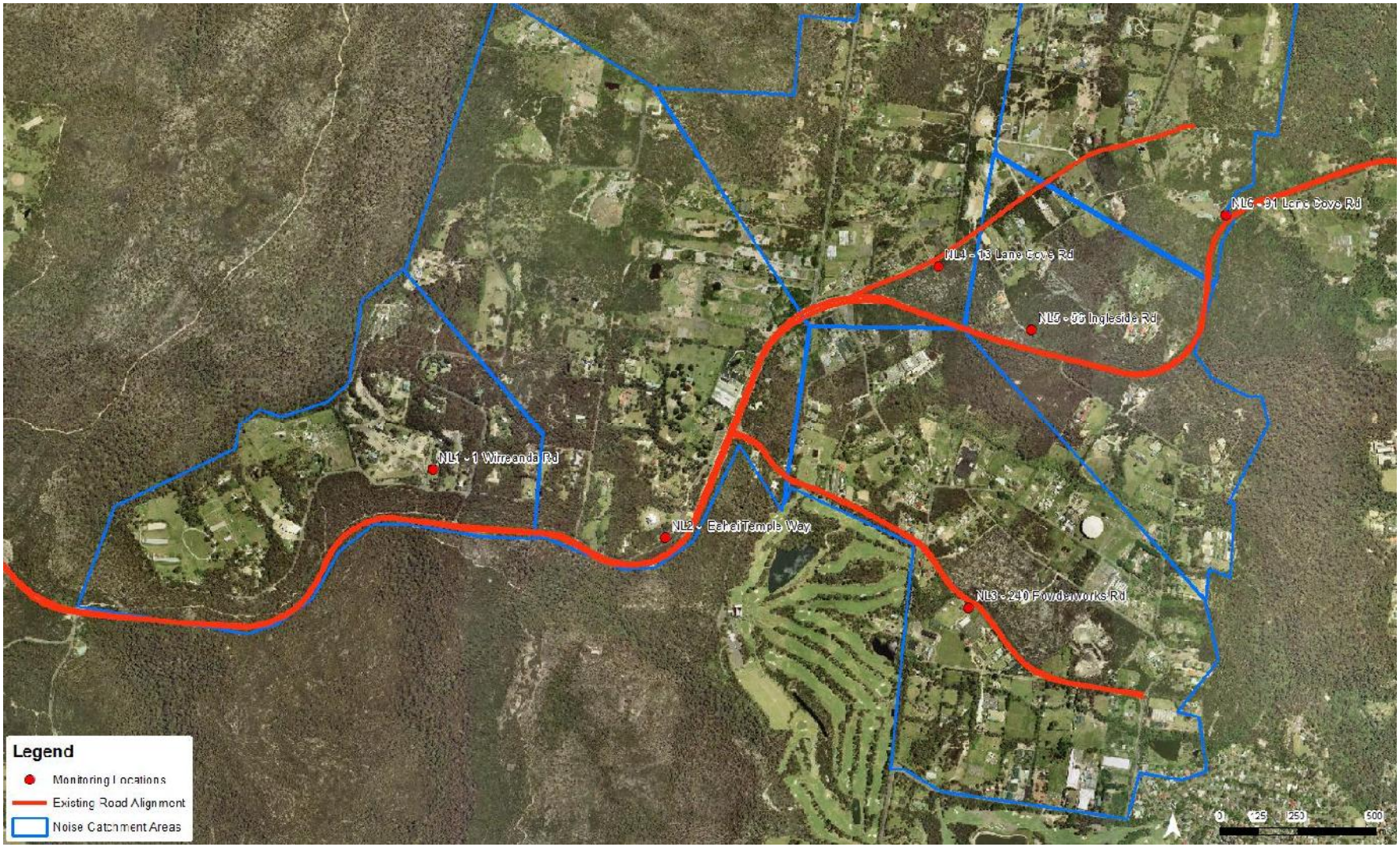
NL4 - 13 Lane Cove Road, Ingleside

NL5 - 56 Ingleside Road, Ingleside

NL6 - 91 Lane Cove Road, Ingleside

These locations were considered to provide good representations of typical background noise levels of the most affected receivers within the Precinct and also facilitate calibration of the operational road traffic noise model. The logging locations are presented in Figure 4.

Figure 4 Noise monitoring locations and NCAs



3.3.1 Instrumentation

Attended noise measurements were undertaken at the site using a Brüel & Kjær Type 2270 (Serial No. 3000860) integrating sound level meter. This meter complies with Australian Standard 1259.2:1990 "Acoustics - Sound Level Meters – Part 2: Integrating - averaging" and is designated as a Type 1 instrument having accuracies suitable for field and laboratory use.

Long-term unattended noise logging was conducted using the following instrumentation:

- Infobyte Noise Monitors Serial No. 104, 109, 110 & 112
- ARL 315 Serial No. 15-299-444
- Rion NL-21 Serial No. 409169

All instrumentation used was designated as either Type 1 or Type 2 appropriate for field measurements. The noise loggers and the sound level meter were calibrated before and after the measurements with no drift in calibration exceeding ±0.5 dB.

All equipment used for this assessment has current calibration certificates.

3.3.2 Background noise monitoring results

Unattended noise monitoring was conducted over a seven day period from 3 December to 10 December 2013.

The background noise level is defined by the Environmental Protection Authority's (EPA's) NSW Industrial Noise Policy 2000 (INP) as 'the underlying level of noise present in ambient noise when all unusual extraneous noise is removed'. It can include sounds that are normal features of a location and may include birds, traffic, insects etc. The background noise level is represented by the L_{A90} descriptor. The noise levels measured at the monitoring locations were analysed to determine a single assessment background level (ABL) for each daytime, evening and night-time period in accordance with the INP, for each monitoring location.

The assessment background level (ABL) is established by determining the lowest tenth-percentile level of the L_{A90} noise data acquired over each period of interest. The background noise level or rating background level (RBL) representing the daytime, evening and night-time assessment periods is based on the median of individual ABLs determined over the entire monitoring duration.

Periods which were affected by noise from wind and rain were omitted from results as noise from the wind blowing through trees, falling rain and increased tyre noise from wet roads may affect results.

A summary of the noise monitoring results is presented in Table 4.

A graphical representation of unattended monitoring results is presented in Appendix B.

Table 4 Background noise monitoring results

Noise logging location	Rating Background Level, L_{A90} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
NL1	43	44	35
NL2	58	47	30
NL3	49	41	30
NL4	47	39	31
NL5	-[1]	-[1]	-[1]
NL6	55	45	34

Notes:

1. *Results unavailable due to logger failure*

3.3.3 Operational road traffic noise monitoring results

Provided in Table 5 are the average noise levels measured at each noise monitoring location.

Table 5 Operational road noise monitoring results

Noise logging location	Ambient road traffic noise level, L_{Aeq} dB(A)	
	Day (7 am to 10 pm)	Night (10 pm to 7 am)
NL1	57	55
NL2	68	57
NL3	62	59
NL4	63	51
NL5	-[1]	-[1]
NL6	72	60

Notes:

1. *Results unavailable due to logger failure*

3.3.4 Attended monitoring

Attended noise monitoring was also conducted at the six unattended monitoring locations. Monitoring was conducted over a 15 minute period in order to identify noise sources on site.

Road traffic noise was present at all locations; however cicada noise was dominant at some locations. No industrial noise was noticeable at any measurement locations.

Table 6 Attended monitoring results

Monitoring location	Date / time	Description	Noise levels dB(A)	
			$L_{eq(15min)}$	$L_{90(15min)}$
1 Wirreanda Road	11/12/2013 12:01	Traffic along Mona Vale Road dominant. Cicadas, trucks and some nearby construction work also noted.	63	58
Baha'i Temple Way	11/12/2013 9:18	Noise from traffic along Mona Vale Road dominant. Cicadas, kookaburras and distant trucks also noted.	77	75
240 Powderworks Road	11/12/2013 9:44	Noise from traffic along Powderworks Road dominant. Birds and cicadas also noted.	61	53
13 Lane Cove Road	11/12/2013 10:07	Noise from Cicadas dominant. Cars, trucks, helicopters and car horns also noted.	65	61
56 Ingleside Road	11/12/2013 11:28	Cicadas very loud. Traffic along Mona Vale Road and planes also noted.	79	75
91 Lane Cove Road	11/12/2013 10:32	Cicadas very loud. Traffic along Mona Vale Road also noted.	77	75

4.0 Operational assessment criteria

4.1 Road traffic noise intrusion criteria

The State Environment Planning Policy (Infrastructure) 2007 (Infrastructure SEPP) requires that appropriate measures are taken to meet the following internal L_{Aeq} noise levels in residential developments that are on land in or adjacent to a road corridor with an annual average daily traffic volume (AADT) of more than 40,000 vehicles, pertinent to Mona Vale Road. In other circumstances (eg. development adjacent to a road with an annual average daily traffic volume of 20,000–40,000 vehicles) these guidelines provide best practice advice. Although AADTs for Powderworks Road and Lane Cove Road are approximately 15,000 and 7,000 vehicles respectively, below the 20,000 vehicle 'best practice' limit, these roads have been included in the assessment for the sake of thoroughness:

- In any bedroom in the building – 35 dB(A) at any time between 10pm and 7am; and
- Anywhere else in the building (other than the garage, kitchen, bathroom or hallway) – 40 dB(A) at any time.

In addition the *Development Near Rail Corridors and Busy Roads- Interim Guideline* states:

> *"If internal noise levels with windows or doors open exceed the criteria by more than 10 dB(A), the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and meet the Building Code of Australia (BCA) ventilation requirements."*

Assuming a 10 dB loss through a partially open window the external criteria become:

Table 7- External noise level criteria

Type of occupancy	External noise level, dB(A)	Time period
Bedroom	55	10pm – 7am
Other habitable rooms	60	Any time

Road traffic noise levels for the year 2036 have been modelled in order to reflect the ultimate development of the Precinct.

4.2 Operational noise emissions

The main acoustic requirement of Protection of the Environment Operations Act 1997 (POEO) is to ensure that "a noise is not offensive". The definition for an offensive noise is included below.

> ***offensive noise*** *is:*
>
> *(d) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:*
>
> *(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or*
>
> *(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or*
>
> *(e) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.*

To determine if a source of noise is offensive, a primary consideration is to determine whether the noise is intrusive. The EPA provides guidelines for external noise emissions from developments in the INP. The INP recommends a method which can be used to ascertain the intrusiveness of noise emissions.

EPA states that the relationship between the statutory definition of offensive noise and intrusive noise is that intrusive noise can represent offensive noise, but whether this is always true can depend on the source of the noise, noise characteristics and cumulative noise levels. Therefore to avoid the emission of an offensive noise, noise emissions should not be intrusive as defined by the EPA in the following manner:

> *"A noise source is generally considered to be intrusive if noise from the source, when measured over a 15 minute period, exceeds the background noise by more than 5 dB(A).*

Any noise generated within the precinct, including noise mechanical services or associated with site buildings would be assessed in accordance with the INP.

The assessment procedure for industrial noise sources has two components that must be satisfied:

- Controlling intrusive noise impacts in the short term for residences; and
- Maintaining noise level amenity for residences and other land uses.

4.2.1 Intrusive noise impacts

The INP states that the noise from any single source should not intrude greatly above the prevailing background noise level. Industrial noises are generally considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (L_{Aeq}), measured over a 15 minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB. This is termed the Intrusiveness Criterion. The rating background level (RBL) is the background noise level to be used for assessment purposes and is determined by the methods given in Section 3.1 of the INP. Adjustments are to be applied to the level of noise produced if the noise at the receiver contains annoying characteristics such as tonality or impulsiveness.

4.2.2 Protecting noise amenity

To limit continuing increases in noise levels, the maximum ambient noise level resulting from industrial noise sources should not normally exceed the acceptable noise levels specified in *Table 2.1* of the INP. That is, the background noise level should not exceed the level appropriate for the particular locality and land use. This is termed the Amenity criterion.

Existing and proposed receivers scattered throughout Ingleside would be classified as being in a suburban area. For residential receivers, the amenity criteria are shown in Table 8. Amenity criteria for other nearby receiver types are also presented in Table 8.

Table 8- External Recommended L_{Aeq} noise levels from industrial noise sources

Type of receiver	Indicative noise amenity area	Time of day	Recommended L_{Aeq} Noise Level dB(A)	
			Acceptable	Recommended maximum
Residence	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
School classroom	All	Noisiest 1 hour period	35[1]	40
Place of worship	Internal	When in use	40	45
Passive recreation area	All	When in use	50	55
Active recreation area	All	When in use	55	60
Industrial premises	All	When in use	70	75
Commercial Premises	All	When in use	65	70

Provided below in Table 9 is the appropriate criteria for each of the assessment locations.

Table 9 Operational noise criteria

Location	Assessment period	RBL (L_{A90}), dB(A)	Intrusive criteria	Amenity criteria
NCA1	Day	43	48	55
	Evening	44	49	45
	Night	35	40	40
NCA2	Day	58	63	55
	Evening	47	52	45
	Night	30	35	40
NCA3	Day	49	54	55
	Evening	41	46	45
	Night	30	36	40
NCA4	Day	47	52	55
	Evening	39	44	45
	Night	31	35	40
NCA5	Day	-	63	55
	Evening	-	52	45
	Night	-	35	40
NCA6	Day	55	60	55
	Evening	45	50	45
	Night	34	39	40

Notes:

1. *RBLs at location 5 were unable to be determined due to equipment failure, therefore the RBLs at this location have been adopted from location 2 as the attended measurement at this location was closest to location 5 and more conservative than location 6.*

The criteria apply at the most-affected point on or within the residential property boundary- or, if that is more than 30 m from the residence, at the most-affected point within 30 m of the residence.

Indicative noise criteria for industrial/commercial noise sources are presented above, however it is recommended that a full assessment is completed when likely noise sources are known.

4.3 EPA Noise Guide for Local Government

The EPAs Noise Guide for Local Government outlines the techniques for assessing and managing common neighbourhood noise issues. It addresses noise emissions from schools and other educational facilities and outdoor sporting events involving sound amplification equipment for 200 or more people. These fields are to be assessed using the 'offensive noise test' outlined in the POEO. Management measures are also suggested in the form of noise control notices and prevention notices.

5.0 Construction noise and vibration criteria

5.1 Construction noise

The EPA's *Interim Construction Noise Guideline* (ICNG) provides the basis for construction noise assessments in NSW. This document replaces the previous publication, the *Environmental Noise Control Manual*, and is used as the basis for establishing construction noise management levels.

The ICNG recommends that a quantitative assessment is carried out for all 'major construction projects that are typically subject to the EIA process'. Noise levels due to construction activities are predicted at nearby receivers using environmental noise modelling software and compared to the levels provided in Section 4 of the ICNG.

Where an exceedance of the management levels is predicted the ICNG advises that receivers can be considered 'noise affected' and the proponent should apply all feasible and reasonable work practises to minimise the noise impact. The proponent should also inform all potentially impacted residents of the nature of the works to be carried out, the expected noise level and duration, as well as contact details.

Where construction noise levels reach 75 dB(A) residential receivers can be considered as 'highly noise affected' and the proponent should, in consultation with the community, consider restricting hours to provide respite periods.

The *ICNG* defines what is considered to be feasible and reasonable as follows:

> *"Feasible*
>
> *A work practice or abatement measure is feasible if it is capable of being put into practice or of being engineered and is practical to build given project constraints such as safety and maintenance requirements.*
>
> *Reasonable*
>
> *Selecting reasonable measures from those that are feasible involves making a judgment to determine whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure."*

5.1.1 Noise management levels for residential receivers

Noise management levels for residential receivers were established using the information provided in the ICNG as reproduced in Table 10.

Table 10 Construction noise management levels

Time of day	Management level, $L_{Aeq\ (15min)}$ [1]	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. · Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. · The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. · Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	· A strong justification would typically be required for works outside the recommended standard hours. · The proponent should apply all feasible and reasonable work practices to meet the noise affected level. · Where all feasible and reasonable practices have been applied and noise is more than 5 dB (A) above the noise affected level, the proponent should negotiate with the community. · For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Notes:

1) Noise levels apply at the property 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 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

5.1.2 Noise catchment areas

The study area has been divided into 6 distinct noise catchment areas (NCAs), shown in Figure 4. The noise environment at each of the sensitive receivers within a noise catchment area is considered to have a similar noise environment to the unattended monitoring location within that NCA. As such each of these sensitive receivers is assigned the same background noise level and noise management level. Table 11 provides details of the construction noise management levels for each NCA.

Table 11 Noise catchment areas and noise management levels

NCA	Representative logger	Period	Rating background level (RBL), dB(A)	Noise management levels (NML), dB(A)
NCA1	NL1	Day	43	53
		Evening	44	49
		Night	35	40
NCA2	NL2	Day	58	63
		Evening	47	52
		Night	30	35
NCA3	NL3	Day	49	54
		Evening	41	46
		Night	30	35
NCA4	NL4	Day	47	57
		Evening	39	44
		Night	31	36
NCA5	NL5	Day	-	63[1]
		Evening	-	52[1]
		Night	-	35[1]
NCA6	NL6	Day	55	65
		Evening	45	50
		Night	34	39

Notes:

1. *NMLs at location 5 were unable to be determined due to unavailable RBLs due to equipment failure, therefore NMLs at this location have been adopted from location 2 as the attended measurement at this location was closest to location 5 and more conservative than location 6.*

5.1.3 Non-residential receivers

Noise management levels recommended by the ICNG for other sensitive land uses, such as schools, hospitals or places of worship are shown in Table 12. Noise management levels for commercial and industrial premises are provided in Table 13.

Table 12 Construction noise management levels – Sensitive land uses other than residential

Land use	Management level, $L_{Aeq\ (15\ min)}$ (applies when properties are in use)
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)
Places of worship	Internal noise level 45 dB(A)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dB(A)
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 level 60 dB(A)
Community centres	Depends on the intended use of the centre. Refer to the recommended "maximum" internal levels in AS2107 for specific uses.

Table 13 Construction noise management levels – Commercial and industrial land uses

Land use	Management level, $L_{Aeq\ (15min)}$ (applies when properties are in use)
Industrial premises	External noise level 75 dB(A)
Offices, retail outlets	External noise level 70 dB(A)

5.1.4 Sleep disturbance (construction)

The ICNG requires a sleep disturbance assessment to be undertaken where construction works are planned to extend over more than two consecutive nights. The ICNG makes reference to the EPA's NSW Environment Criteria for Road Traffic Noise (ECRTN), now superseded by the NSW Road Noise Policy (RNP), for assessment of sleep disturbance. The RNP references the recommendations in the ECRTN as providing the most appropriate assessment guidance.

The guidance provided in the RNP for assessing the potential for sleep disturbance recommends that to minimise the risk of sleep disturbance during the night-time period (10pm to 7am), the $L_{A1(1\ min)}$ noise level outside a bedroom window should not exceed the $L_{A90\ (15\ minute)}$ background noise level by more than 15 dB. The EPA considers it appropriate to use this metric as a screening criterion to assess the likelihood of sleep disturbance. If this screening criterion is found to be exceeded then a more detailed analysis must be undertaken and include the extent that the maximum noise level exceeds the background noise level and the number of times this is likely to happen during the night-time period.

The RNP contains a review of research into sleep disturbance which represents NSW EPA advice on the subject of sleep disturbance due to noise events. It concludes that having considered the results of research to date that, 'Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions'. Therefore, given that an open window provides around 10 dB in noise attenuation from outside to inside, external noise levels of 60-65 dB(A) are unlikely to result in awakening reactions.

Table 14 presents the sleep disturbance screening and sleep disturbance awakening reaction criteria.

Table 14 Construction noise sleep disturbance criteria

NCA	Rating background level (RBL)	Sleep disturbance screening $L_{A1(1min)}$ criteria, dB(A)	Sleep disturbance awakening reaction $L_{A1(1min)}$ criteria, dB(A)
NCA1	35	50	65
NCA2	30	45	65
NCA3	30	45	65
NCA4	31	46	65
NCA5	30	45	65
NCA6	34	49	65

Notes:

1. *RBLs at location 5 were unable to be determined due to equipment failure, therefore the RBLs at this location have been adopted from location 2 as the attended measurement at this location was closest to location 5 and more conservative than location 6.*

5.2 Construction vibration

The relevant standards/guidelines used for assessing construction vibration are summarised in Table 15.

Table 15 Standards/guidelines used for assessing construction vibration

Item	Standard/Guideline
Structural Damage	DIN4150-Part 3:1999 'Structural Vibration Part 3 – Effects of vibration on structures
Human Comfort (tactile vibration)	NSW Department of Environment and Conservation (2006) document "*Assessing Vibration: A Technical Guideline*" [1]

Notes:

1. *This document is based upon the guidelines contained in British Standard 6472:1992, "Evaluation of human exposure to vibration in buildings (1-80 Hz)". This British Standard was superseded in 2008 with BS 6472-1:2008 "Guide to evaluation of human exposure to vibration in buildings – Part 1: Vibration sources other than blasting" and the 1992 version of the Standard was withdrawn. Although a new version of BS 6472 has been published, the EPA still requires vibration to be assessed in accordance with the 1992 version of the Standard at this point in time.*

In the absence of Australian based vibration criteria for structural damage, German Standards and British Standards have been considered. These have been referred to in the absence of any Australian or International structural damage guidelines, and are accepted as relevant criteria in Australia. DIN4150 structural damage criteria are more conservative (i.e. more onerous) than the British Standard BS7385-Part 2:1993 'Evaluation and Measurement for Vibration in Buildings' and have been adopted for this assessment.

5.2.1 Structural damage

Structural damage ground vibration criteria are defined in terms of levels of vibration that would minimise the risk of damage to buildings and other structures.

Most commonly specified 'safe' structural vibration levels are designed to minimise the risk of threshold or cosmetic surface cracks and are set well below the levels that have the potential to cause damage to the main structure. Examples of threshold or cosmetic cracking include minor non-structural effects such as superficial cracking in cement render or plaster. Larger exceedances of structural damage criteria increase the risk of more significant damage to a building's underlying structure.

Structural damage criteria are presented in German Standard DIN 4150-Part 3 in terms of recommended maximum levels of vibration that reduce the likelihood of structural damage caused by vibration. These levels are

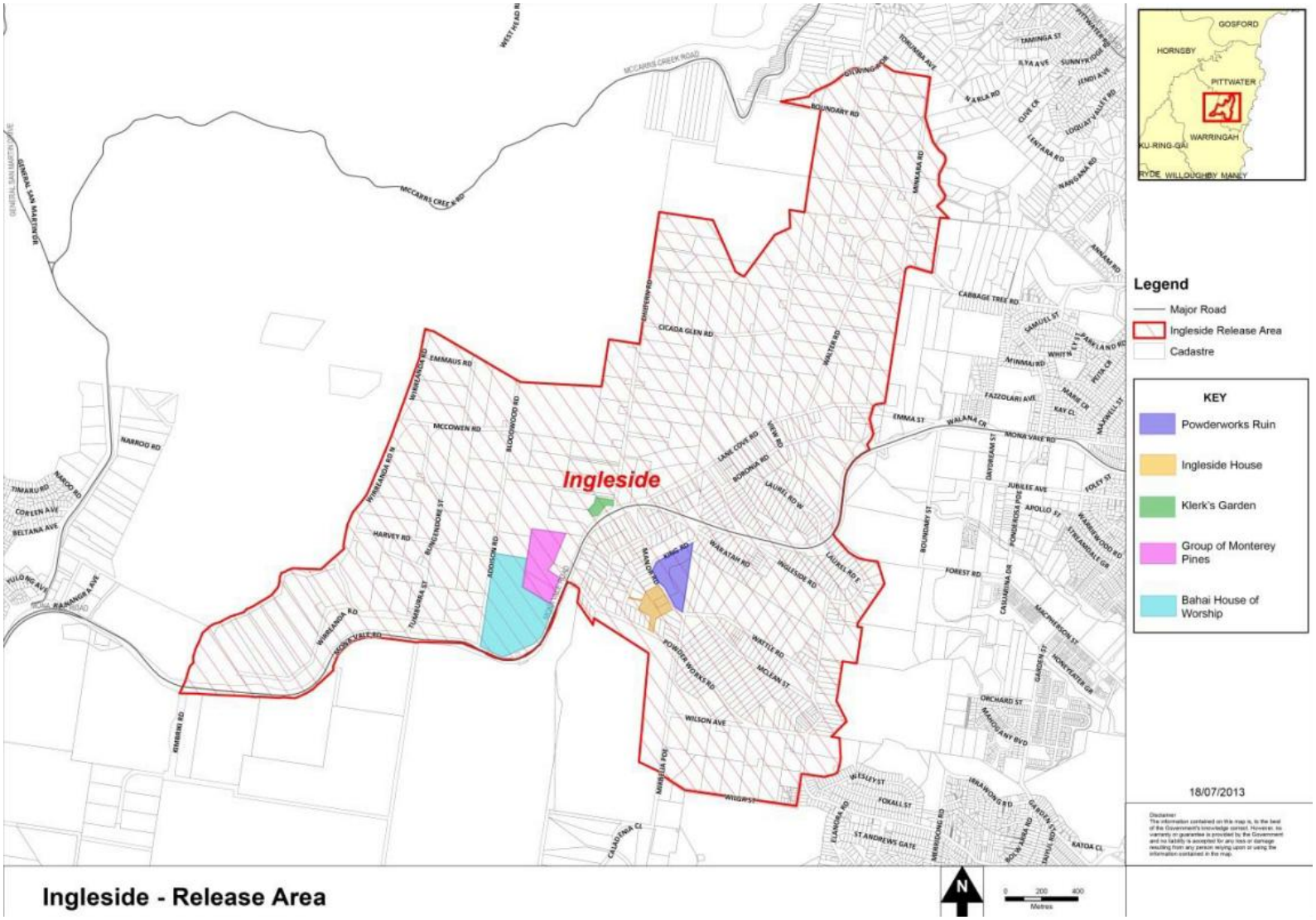
presented in Table 16. Receivers classified as Group 1, Group 2 and Group 3 have been identified as being potentially affected by construction vibration.

Heritage buildings are listed within Ingleside Precinct and are considered as particularly sensitive to vibration impacts, and as such are classified as group 3 structures. A number of heritage items have been identified by GML Heritage in their report "Ingleside Precinct Non-Indigenous Heritage Assessment, Executive Summary" (GML Heritage, Nov 2014). These items are:

- Baha'i Temple
- Ingleside House
- The Powderworks Ruins
- Klerks Garden
- The Monterey Pines

The locations of these items are shown in Figure 5.

Figure 5 Plan of non-Indigenous heritage items



Source: DP&E with GML overlay, 2015

Consideration should be given to adverse vibration impacts affecting these items when assessing construction in the vicinity.

It should be noted that the vibration criteria presented below are conservative. DIN 4150 states that:

> "*exceeding the values in table 1 does not necessarily lead to damage; should they be significantly exceeded, however, further investigations are necessary*".

It is noted that the application of Group 3 criteria to the Monterey Pine trees and Klerk's Garden is not strictly appropriate, however it is considered to provide a conservative approach.

Table 16 DIN4150 structural damage vibration criteria

Group	Type of structure	Guideline values for velocity in mm/s			
		Vibration at the foundation			Vibration at the horizontal plane of highest floor at all frequencies
		1 H to 10 Hz	10 H to 50 Hz	50 H to 100 Hz	
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20-40	40-50	40
2	Dwellings and buildings of similar design and/or use	5	5-15	15-20	15
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under Group 1 or 2 and are of great intrinsic value (e.g. listed buildings under a preservation order)	3	3-8	8-10	8

5.2.2 Human comfort

In general, human response to vibration is a complex phenomenon. There are wide variations in vibration tolerance of humans. Accordingly, acceptance goals for human comfort are hard to define and quantify. Acceptable values of human exposure to vibration are primarily dependent on the activity taking place in the occupied space (e.g. workshop, office, or residence) and the character of vibration (e.g. continuous or intermittent). In addition, specific values are dependent upon social and cultural factors, psychological attitudes, expected interference with privacy, and ultimately the individual's perception.

The procedure outlined in DEC (2006)'s "*Assessing Vibration: A Technical Guideline"* has been used in this assessment. Disturbance caused by vibration will depend on its duration as well as its magnitude. This method involves the calculation of a Vibration Dose Value (VDV) which is used to evaluate the cumulative effects of bursts of intermittent vibration. Various studies have shown that VDV assessment methods far more accurately assess the level of disturbance than methods which assess the vibration magnitude only.

The VDV is the fourth root of the integral of the fourth power of vibration with respect to time. The VDV represents an 'amount' of vibration. In assessing the VDVs, criteria detailed in BS6472:1992 'Guide to evaluation of human exposure to vibration in buildings (1 Hz to 80Hz)' are used, however the base values and multiples are converted into VDVs assuming constant levels over a 15 hour day and a 9 hour night. The resulting VDV criteria are shown in Table 17.

Table 17 Acceptable vibration dose values for intermittent vibration (m/s$^{1.75}$)

Location	Daytime		Night-time	
	Preferred	Maximum	Preferred	Maximum
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

The guideline states:

> *"There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. Activities should be designed to meet the preferred values where an area is not already exposed to vibration. Where all feasible and reasonable measures have been applied, values up to the maximum range may be used if they can be justified. For values beyond the maximum value, the operator should negotiate directly with the affected community."*

6.0 Road traffic noise assessment

To assess the potential impacts of road traffic noise on proposed on sensitive receivers, the following steps have been completed:

- Modelling of road traffic noise levels with existing (2013) road traffic volumes, to provide a baseline for the assessment of future noise levels. This model was calibrated with noise measurements and road traffic surveys.
- Modelling of the 'Build' scenario road traffic noise levels for the year of the ultimate development of the Ingleside Precinct (2036).

6.1 Road traffic noise modelling methodology

Road traffic noise levels were calculated using SoundPLAN software, which implements the Calculation of Road Traffic Noise (CoRTN) algorithm. The UK Department of Transport devised the CoRTN algorithm and with suitable corrections, this method has been shown to give accurate predictions of road traffic noise under Australian conditions.

The modelling parameters which are included in the model are detailed in Table 18.

Table 18 Modelling noise parameters

Parameter	Comment
Traffic volumes and mix	Existing traffic volumes were obtained from traffic count data recorded at various locations along the proposed alignment. Predicted traffic volumes (2036) were sourced from traffic modelling conducted by AECOM. Traffic volumes used in the noise model are presented in Appendix C. Heavy vehicles include buses which are to be introduced in new public transport services.
Traffic speeds	Traffic speeds have been based on measured road speeds from traffic counters.
Traffic noise source heights	Road traffic noise is generally considered to comprise three source heights: Light vehicles: 0.5 metres. Truck tyres and engines: 1.5 metres. Truck exhausts: 3.6 metres. Corrections were made to the road traffic noise model to take account of the relative source contributions of the truck tyres and engines (-0.6 dB) and truck exhausts (-8.6 dB) compared with light vehicle sources.
Road surface	Dense graded asphalt (DGA) is accepted as the standard road surface with no correction applied under the CoRTN algorithm. DGA has been modelled along Mona Vale Road, Powderworks Road and Lane Cove Road.
Ground absorption	The noise calibration model verified that a ground absorption factor of 0.8 was appropriate for this project due to the high density shrub land surrounding Mona Vale Road, Powderworks Road and Lane Cove Road. A ground absorption factor of 0 would represent hard, reflective ground and a ground absorption factor of 1 would represent totally absorptive ground. High density vegetation is acoustically absorptive to an extent and a factor of 0.8 is considered appropriate.
Terrain	The model incorporates two metre terrain contours.
Buildings	The height of all buildings within the study area was determined through site observation and map resources. Where building heights were unable to be determined buildings were assumed to be 1 storey. The difference between one and multi-storey buildings to the modelling outcomes would be insignificant since noise levels were not predicted at each receiver. One storey buildings provide a conservative estimate of impacts due to less shielding being provide to adjacent buildings, and since predicted modelled impacts do not result in the implementation of specific treatments for this assessment, the

Parameter	Comment
	assumption that all buildings are one storey is considered appropriate here.
Road network	The Infrastructure SEPP requires that appropriate measures are taken to ensure that noise levels within new residential buildings adjacent to roads with an annual average daily traffic (AADT) volume of more than 40,000 vehicles are not above certain L_{Aeq} levels. As a conservative approach the existing major roads (Mona Vale Road, Powderworks Road and Lane Cove Road) were included in the noise model, as noise levels at sensitive receiver locations are predominantly controlled by these roads. This was verified by attended noise measurements throughout the study extents of the project. On this basis local roads have been excluded in the noise modelling.
Standard corrections	CoRTN provides L_{A10} road traffic noise levels. The industry standard correction of -3 dB was applied to convert the L_{A10} levels to L_{Aeq} road traffic noise levels to allow assessment of the results against the criteria.

6.2 Existing road traffic noise model

A road traffic noise model was developed incorporating the existing traffic flows and alignment for comparison and calibration with road traffic noise measurements. The traffic flows used in the model were provided by tube counts that were deployed concurrently with noise logging for the project. Noise logging charts are provided in Appendix B. Road traffic volumes are presented in Appendix C.

If it can be proven that the predicted road traffic noise levels are accurate at discrete locations across the extents of a project, then it is reasonable to assume that the road traffic noise levels are accurate at all modelled receivers. Furthermore, it can then be assumed that if the same road traffic noise model is updated to include the project design model parameters (eg including alignment, traffic flow etc), then the design noise model would predict to the same level of accuracy.

For a project corridor of 600 metres either side of the road, the CoRTN algorithm has a well-documented accuracy of ±2 dB(A). If the differences between measured and predicted road traffic noise levels fall within this factor, then the model is considered to have a suitable level of accuracy for that location. Provided below in Table 19 is a summary of the noise logger calibration results. Discussion on loggers that fall outside the acceptable calibration allowance of ±2 dB(A) is presented below.

Due to the bushland surroundings of the Precinct and the monitoring period falling in December, cicada noise was present at all locations and in some cases was the dominant source of noise. As such, daytime measured noise levels were significantly louder than modelled noise levels at all locations except 240 Powderworks Road, where the logger was not as exposed to trees and therefore cicada noise. Cicada noise subsided during the evening and was low or not present during the night time. Since extraneous noise was minimal at night, night time noise levels have been used to calibrate the noise model.

At location NL1 logger graphs showed an irregular increase in noise levels between approximately 12:00am and 5:00am, seen in Appendix B, which raised overall night-time L_{eq} levels significantly and resulted in poor calibration over the night time period. The origin of this noise was unable to be identified, however the time, level and irregularity of this noise indicates traffic was not the source.

Table 19 Noise logger calibration

Noise logger	Measured $L_{Aeq(15hr)}$	Predicted with standard correction $L_{Aeq(15hr)}$	Difference	Measured $L_{Aeq(9hr)}$	Predicted with standard correction $L_{Aeq(9hr)}$	Difference
NL1	57.1	52.8	**-4.3**[2]	54.8	46	**-8.8**[3]
NL2	68.4	65.3	**-3.1**[2]	56.6	58.4	1.8
NL3	62.4	64	1.6	58.9	57.4	-1.5
NL4	62.9	57.6	**-5.3**[2]	50.8	50.4	-0.4
NL5	-[4]	58.6	N/A	-[4]	52.1	N/A
NL6	71.5	65.7	**-5.8**[2]	59.5	59.2	-0.3

Notes:

1. *Items in Bold Red indicate the measured noise level is outside*
2. *Measured daytime noise levels were affected by cicada noise*
3. *Measured night time noise levels were affected by noise of unknown origin.*
4. *Noise levels not recorded due to logger failure*

Considering all but one receiver calibrates effectively during the more stringent night-time period, the noise model can be considered to be operating within the acceptable accuracies.

6.3 Future road traffic modelling

Noise impacts from traffic along Mona Vale Road, Powderworks Road and Lane Cove Road have been predicted at the worst affected façade of existing receivers for the year 2036. The results of the road traffic noise modelling are presented as noise contour maps in Appendix D. The following section provides recommendations to reduce internal noise levels at the proposed residences within the proposed subdivisions.

6.4 Road traffic noise impacts

The predicted road traffic noise levels for 2036 have been overlaid on the Draft Plan presented in Appendix E. Impacts are outlined in this Section, with mitigation measures detailed in Section 6.5.

6.4.1 North Ingleside Sub-Precinct

Low rise apartments, townhouses and houses are proposed on the northern side of Mona Vale road. Road traffic noise levels are likely to exceed the Infrastructure SEPP Criteria by up to 10 dB(A) at some proposed facades. Where this occurs it is likely that noise mitigation measures will need to be considered as the Draft Plan for the Ingleside Precinct is further refined and in the preparation of the development control plan for the Ingleside Precinct.

6.4.2 South Ingleside Sub-Precinct

Low rise apartments and townhouses are proposed to the south of Mona Vale Road. Appendix E shows how road traffic noise levels are likely to exceed the Infrastructure SEPP criteria within approximately 200 m from Mona Vale Road by up to 10 dB(A). Houses are also proposed to the south of Mona Vale Road within the eastern portion of the sub-precinct. Generally this is located further from Mona Vale Road than the low rise and townhouse development. However noise mitigation measures would need to be considered as road traffic noise levels are likely to exceed the Infrastructure SEPP criteria. Residential development is also proposed on both sides of Powderworks Road. Noise levels are likely to exceed criteria by up to 5 dB(A), therefore noise mitigation measures will need to be considered as the Draft Plan for the Ingleside Precinct is further refined and in the preparation of the development control plan for the Ingleside Precinct.

6.4.3 Wirreanda Valley Sub-Precinct

The impact of increased road traffic noise levels as a result of the Mona Vale Road Upgrade project on existing rural residential properties in this area will be fully addressed in the Mona Vale Road West upgrade REF, by NSW Roads and Maritime Services.

6.4.4 Bayview Heights Sub-Precinct

No significant changes to road traffic noise are expected within the Bayview Heights Sub-Precinct given its distance from major roads.

6.5 Noise mitigation measures

Noise mitigation measures should be implemented in the following hierarchy:

- Treatment of noise at source: Integrated design measures such as road design and traffic management, as well as road surface treatment
- Treatment of noise path: In-corridor barriers
- Treatment at receivers: At-property treatments and receiver building layouts

Prioritising noise treatment in this order is the most efficient means of reducing impacts. Accordingly, noise mitigation measures that attenuate noise path and receivers will need to be considered as the Draft Plan for the Ingleside Precinct is further refined and in the preparation of the development control plan for the Ingleside Precinct.

6.5.1 Treatment of noise at source

Treatment of road traffic noise at the source includes changes to gradients, alignments, road design, administrative controls and road surface treatment. Design controls and traffic management have already been considered as part of the options study prior to the Mona Vale Road Upgrade REF assessment, and a number of road surface treatment options have been considered at the REF stage.

As noted in Section 1.4, the REF for the Mona Vale Road Upgrade Stage 2 (Mona Vale Road Upgrade East – Noise and Vibration Assessment, SMEC, 22 May 2015) recommended the use of Stone Mastic Asphalt. This would reduce road traffic noise levels by approximately 2 dB(A). This reduction has not been included in this assessment as during the Mona Vale Road Upgrade Stage 2 detailed design phase the road surface may be changed.

As the primary treatment of the noise at source is the first priority of noise mitigation, it is recommended that the Project Partners liaise with Roads and Maritime regarding the preferred road surface treatment for the Mona Vale Road Upgrade to minimise road traffic noise.

6.5.2 Treatment of noise path

Noise path treatment involves the attenuation of noise paths between a source and receiver. This typically involves shielding of receivers with noise barriers.

6.5.2.1 Roadside noise walls and mounds

Acoustic barriers provide immediate reductions in road traffic noise at the shielded properties.

The acoustic effectiveness of a barrier depends on its density, height, length and location. The higher the barrier (compared to the direct line-of-sight from the source to the receiver) and the closer its location to either the source or the receiver, the greater the noise attenuation provided. The barrier also needs to have a sufficient length. Roadside barriers, as distinct from barriers close to dwellings, usually have to provide shielding along an appreciable length of road to be effective.

6.5.2.2 Noise barriers close to dwellings

As noted above noise barriers are most effective when they located either close to the road or close to the affected dwelling(s) or other noise-sensitive land uses.

With the consent of owners, acoustic barriers can sometimes be located within a residential property boundary so that they provide maximum shielding of the dwelling. These barriers might also be designed to form a courtyard, providing some benefit for an outdoor area near the dwelling.

6.5.3 Treatment at receivers

Noise mitigation measures implemented at receivers include planning layouts of buildings and rooms and treatment to building facades.

6.5.3.1 Property layout

Where residential properties are located adjacent to major roads, such as Mona Vale Road, buildings should be orientated such that the buildings shield outdoor living areas such as courtyards and private open spaces.

6.5.3.2 Building layout and design

The layout of the rooms within a building is also important in determining noise levels at the façade of sensitive spaces. The less noise sensitive rooms such as garages, bathrooms and laundries should be located closer to the noise source to provide a buffer zone to noise sensitive areas such as bedrooms and frequently used living areas.

The number of doors and windows on the exposed façade(s) of the buildings should be minimised as these represent paths of least resistance for noise ingress.

6.5.3.3 Building construction materials and methods

Windows and doors present acoustic weaknesses which control the overall sound transmission loss of the composite wall. Buildings should be constructed so that facades most exposed to the noise source have a minimum number of windows and doors to reduce the internal noise levels.

Where road traffic noise levels exceed the external noise criteria within habitable rooms fresh air must be provided to these rooms so windows can be left closed, in order to meet the Infrastructure SEPP internal noise criteria. In addition where residential buildings are located along Mona Vale Road it is likely that laminated glazing systems (such as those comprising 6.38 mm or 10.38 mm laminated glass) will be required to sufficiently attenuate road traffic noise within habitable rooms. Suitable glazing systems should be confirmed during the development application stage.

The following building construction details are also recommended:

- A brick veneer building facade;
- Window detailing will have gaps between the window frames and the house frame/masonry sealed with flexible mastic;
- Hinged or casement windows are preferred over sliding windows as the former two have more effective sealing mechanisms. The overall intent is to form an air-tight construction; and
- Acoustic insulation such as polyester or rock wool/glass wool batts placed between the wall studs of brick veneer and timber framed buildings will reduce the noise entering the building.

6.5.3.4 Principal private open space

It is recommended that properties within Ingleside Precinct include private outdoor amenity areas with noise levels less than $L_{Aeq,15hr}$ 55 dB(A), however it is noted that this is not a requirement of the Infrastructure SEPP, but rather good practice. This can be accommodated through planning of building layouts and lot divisions so that the residential buildings provide shielding from road traffic noise to the private outdoor amenity areas.

7.0 Other noise sources assessment

7.1 Existing noisy premises

Existing noise sources within the Precinct have the potential to disturb proposed residential and sensitive noise receivers. Existing noise sources include a private helipad, horse riding facilities, animal shelters, churches and heavy machinery on rural lots.

In the case that proposed residential developments encroach on existing noise sources, distances between residential premises and noise sources should be maximised. Building construction materials & methods, building layout & design and the location of principal private open spaces should be optimised to mitigate noise from these sources as prescribed in Sections 6.5.2 and 6.5.3. These should be incorporated into the refinement of the Draft Plan for the Ingleside Precinct and considered in the preparation of the development control plan for the Ingleside Precinct. Additional measures may also be necessary through site specific detailed investigations as part of the development application stage.

7.2 Community centre including community hall and shops

The main sources of noise associated with community halls and shops include external building services and refrigeration plant and, in the case of the community hall, entertainment music. It is recommended that at the Development Application stage for these types of developments an environmental noise emission assessment is completed in accordance with the Industrial Noise Policy. Typical noise mitigation measures are likely to include standard external building services plant acoustic treatments such as attenuators, acoustic louvres and lined ductwork.

7.3 Schools and educational facilities

Schools may play a role as sources of noise (playgrounds and school sporting events) as well as noise sensitive receivers. Most educational facilities operate during the daytime period, and therefore impacts to and from residential premises are typically low due to residential zones' reduced activity and sensitivity to noise during the day. For this reason schools are ideally located in residential zones, away from daytime noise sources such as main roads and industrial zones.

One potential school site is identified in the Draft Plan, in South Ingleside along Powderworks Road. Traffic noise levels along Mona Vale Road may result in internal noise levels above recommended design levels. Architectural treatment may be required to achieve recommended internal noise levels. The degree of treatment shall be determined through an acoustic assessment, to be undertaken during the Development Application stage of the schools' design. Typical noise mitigation measures are likely to standard external building services plant acoustic treatments and noise barriers.

The EPAs Noise Guide for Local Government provides management measures and regulations for private and public schools, colleges and childcare facilities.

7.4 Sporting fields

Plans for sporting fields to be located on Sophie Avenue in North Ingleside and Wattle Street in South Ingleside have been put forward. The plans indicate that the fields may have the capacity to host sporting events with seating for a large number of patrons. Existing residential receivers lie within 200 m of the proposed locations, and may be adversely affected when large events are held at the ground.

Where possible, the distance between crowd seating and noise sensitive receivers should be maximised, using parking lots, parks and back of house areas as buffer zones between the grounds and receivers where feasible. Buildings and storage facilities should also be placed between potentially noisy areas and receivers where possible.

The EPAs Noise Guide for Local Government presents guidelines for the assessment of such activities as sporting events, and suggests noise management procedures in the form of noise control notices and prevention notices.

7.5 Future construction works

Construction works to be undertaken in the future as part of the development of the Precinct shall require noise and vibration assessments to be undertaken prior to work commencing. Construction noise and vibration assessments shall be conducted by a qualified acoustic consultant and in accordance with the ICNG and relevant vibration guidelines.

8.0 Construction noise and vibration assessment

As details of proposed works within the precinct are unavailable at this early stage of the project, typical construction activities have been modelled using spreadsheet calculations in order to provide indicative noise and vibration impacts for works likely to take place as part of the urban development. A construction noise and vibration assessment shall be conducted prior to any construction works within the precinct, including the upgrade of Mona Vale Road. In addition a Construction Noise and Vibration Management Plan (CNVMP) detailing noise feasible and reasonable mitigation measures should be prepared before any site works begin.

Noise emissions from typical construction activities have been calculated assuming a flat ground model and geometric spreading assuming no attenuation from air or ground absorption or shielding from buildings or ground effects.

A list of typical construction activities and associated plant has been assumed and are listed in Table 20.

Table 20 Typical construction activities and associated plant items.

Construction works	Equipment	SWL, dB(A)
Site clearing and demolition	Excavator with Breaker Attachment	112
	Excavator	99
	Dump Trucks	88
	Bobcat	104
	Handheld Breaker	108
	Flat Bed Truck	91
	Demolition Saw	110
	Total	**116**
Concrete works & construction	Concrete Agitator	105
	Small Mobile Crane	101
	Concrete Pump	106
	Flat Bed Truck	91
	Semi-trailers	101
	Welder	101
	Boilermaker	101
	Elevated Work Platform	97
	Generator	101
	Total	**111**
Minor road works	Bobcat	104
	Excavator with Breaker Attachment	112
	Flat Bed Truck	91
	Vibratory Roller	102
	Total	**113**
Major road works	Excavator	99
	Demolition Saw	110
	Excavator with Breaker Attachment	112

Construction works	Equipment	SWL, dB(A)
	Mini Road Planer	110
	Dump Truck	88
	Dozer	109
	Road Grader	109
	Vibratory Roller	102
	Concrete Agitator	105
	Concrete Pump	106
	Asphalt Paver	106
	Small Mobile Crane	98
	Flat Bed Truck	91
	Semi-Trailer	101
	Total	**118**

Predicted noise impacts from these typical construction works are presented in Table 21.

Table 21 Indicative predicted construction noise impacts

Construction works	Total SWL, dB(A)	Sound pressure level at distance, dB(A)			
		20m	50m	100m	500m
Site clearing and demolition	116	**82**	74	68	54
Concrete works & construction	111	**77**	70	63	50
Minor road works	113	**79**	71	65	51
Major road works	118	**84**	**76**	70	56

Notes:

1. *Items in Bold Red indicate 'highly affected' noise levels in accordance with the ICNG, i.e. greater than 75 dB(A).*

Results show receivers closer than 50 m from clearing and demolition works, concrete works or minor road works may be 'highly affected and provisions should be made to avoid where possible. Major road works may result in 'highly affected' receivers at distances up to 100 m away, with an increased risk of disturbance due to the after-hours nature of most road works.

At 100 m, noise from all proposed construction works is predicted to exceed daytime construction NMLs at all NCAs. Predicted noise levels from some construction works (major road works and site clearing & demolition) exceed the most stringent do exceed daytime NMLs at some NCAs at 500m. A more detailed assessment would be required.

These results assume all plant items are operating simultaneously over an entire 15 minute period, and as such present a conservative worst case scenario.

8.1.1 Sleep disturbance

Due to the likely low local traffic volumes and low measured night-time RBL values throughout Ingleside Precinct, the possibility of sleep disturbance during night-time construction works is high. As no details on future construction works are currently available, a sleep disturbance assessment would be highly speculative at this stage, and has therefore not been included. Generic noise mitigation measures provided below should be implemented in the case that any night-time works are deemed necessary.

8.2 Mitigation measures

The mitigation measures for all proposed construction should be developed in a "*Construction Noise and Vibration Management Plan*" (CNVMP).

The noise emission levels from site plant and the potential annoyance to sensitive receptors would depend on the selection of plant, the type of operation, the activity duration and the time of day it is conducted. Consideration of all reasonable and feasible noise mitigation measures should be included in the construction management plan.

Generic measures to minimise the construction noise impact are detailed below, and are given to illustrate the range of techniques available:

- Construction activities to be limited to between 8 am and 5 pm Monday to Friday and 8 am to 1 pm Saturday.
- Where work is undertaken outside of the standard working hours it would be in accordance with the EPA Interim Construction Noise Guideline (EPA 2009) and all feasible and reasonable noise mitigation measures implemented.
- Possible restrictions to construction hours (beyond the above hours) where noise impacts are significant.
- All plant items should be properly maintained and operated according to manufacturers' recommendations in such a manner as to avoid causing excessive noise.
- All pneumatic tools should be fitted with silencers or mufflers.
- Any compressors brought on to site should be silenced or sound reduced models fitted with acoustic enclosures.
- Notification of property owners likely to be affected prior to works being carried out.
- Noise monitoring at sensitive locations as agreed with EPA for any excessive noise or noise complaints being assessed with appropriate action taken.

9.0 Construction vibration

Vibration intensive works may occur during construction activities. Safe working distances for individual plant items that relate to cosmetic/structural damage and human comfort for the proposed works are presented in Table 22.

Table 22 Recommended safe working distances for vibration intensive plant

Plant	Rating/Description	Safe Working Distance			
		Cosmetic damage (metres)			Human response (metres)
		Residential Building	Commercial Building – Non Heritage Listed	Heritage Building	
Vibratory roller	< 50 kN (Typically 1-2t)	5	-	9	15-20
	< 100 kN (Typically 2-4t)	6	-	11	20
	< 200 kN (Typically 4-6t)	12	3	22	40
	< 300 kN (Typically 7-13t)	15	6	27	100
	> 300 kN (Typically 13-18t)	20	8	36	100
	> 300 kN (> 18 t)	25	10	45	100
Small hydraulic hammer	(300 kg – 5-12t excavator)	2	-	3	7
Medium hydraulic hammer	(900 kg – 12-18t excavator)	7	3	13	23
Large hydraulic hammer	(1,600 kg – 18-34t excavator)	22	9	40	73
Pile boring	≤ 800 mm	2	-	3	N/A

An exceedance of the safe working distances in Table 22 would not necessarily mean cosmetic damage or human discomfort would occur, however the level of risk of occurrence is such that further mitigation measures would be required. Further mitigation of vibration would not be required provided that there is adherence to the safe working distances listed in Table 22.

In the event that equipment must operate within the safe working distances listed in , the following procedure should be considered:

- informing the community of the nature and duration of vibration activities prior to and during construction and updating potentially vibration-affected neighbours on progress;
- prior to construction, conducting dilapidation surveys on buildings located within the safe working distances as deemed required;
- at the commencement of construction:
  - Conduct attended vibration monitoring at the commencement of works;
  - Minimise the use of vibration intensive equipment where possible; and
  - Lighter construction equipment would be used where possible.

10.0 Conclusion

AECOM Australia Pty Ltd (AECOM) has been commissioned to conduct a noise and vibration impact assessment which will inform the rezoning of the Ingleside Land Release Area (Ingleside Precinct).

This study presents the assessment of the potential noise and vibration emissions associated with the existing and future urban development within the Precinct, including:

- Additional traffic noise generated by the increased capacity on nearby public roads; and
- Noise emission from all noise generating premises within and adjacent to the precinct.

Potential future sources of noise and vibration within the Precinct include retail premises, educational facilities and recreational spaces, as well as existing noise sources including private helipads, animal shelters and horse riding facilities.

The purpose of the study is to consider and assess environmental noise impacts, including the proposed Mona Vale Road Upgrade, on the existing and future residents of Ingleside.

Environmental noise monitoring
Unattended and attended noise monitoring was conducted along the main road sources within the precinct. Noise logging was completed at six locations in order to facilitate calibration of the road traffic noise model. Attended noise monitoring was conducted to qualify noise sources and verify unattended monitoring results.

The background noise environment was controlled by traffic travelling along the main roads, including Mona Vale Road, Powderworks Road and Lane Cove Road, within the Precinct, with noise from natural surrounds also present, namely cicadas.

Road traffic noise levels
Road traffic noise levels in 2036 were predicted and road traffic noise contours presented. The road traffic noise model took into account the proposed Mona Vale Road upgrade. The road traffic noise contours were overlaid on the Draft Plan. It was noted that road traffic noise levels are likely to exceed the criteria presented in the State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP) by up to 10 dB(A), where the proposed low and medium density residential areas are in close proximity to Mona Vale Road and to a lesser extent Lane Cove and Powderworks Roads. Indicative recommendations were provided which may be required to achieve the criteria.

Other noise sources
Noise from both existing sources on proposed residential developments, and noise from proposed community facilities, shops, school and sporting fields on existing residences have been discussed, with planning considerations and indicative mitigation measures provided.

Construction noise and vibration
Although construction details are not available at this early stage of the project, construction noise management levels have been established based on measured Rating Background Levels (RBLs). Indicative construction scenarios have been proposed in order to demonstrate typical noise impacts from works that may take place during the Precincts urban development. Generic mitigation measures have been provided to minimise adverse noise and vibration impacts.

Recommendations
The Study has found that it is likely that noise mitigation measures will be required to meet the appropriate criteria. This study presents conceptual noise control measures and management strategies which are likely to be required to minimise adverse impacts on existing and future residential receivers. Residential developments where road traffic noise levels are likely to exceed Infrastructure SEPP noise limits have been identified, and mitigation measures may need to be implemented at these locations. Potential treatments have been identified in Section 6.4.2, which include noise barriers, buffer zones, building and architectural layouts and building construction materials. These may be incorporated into the Development Control Plan (DCP).

It is noted that detailed noise and vibration impact assessments will be required during the development application stage for noise sensitive receivers where they are proposed to be located close to existing/future noisy land uses.

Appendix A

Acoustic Terminology

Appendix A Acoustic Terminology

The following is a brief description of acoustic terminology used in this report.

Sound power level	The total sound emitted by a source
Sound pressure level	The amount of sound at a specified point
Decibel [dB]	The measurement unit of sound
A Weighted decibels [dB(A])	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:
	0dB(A) Threshold of human hearing
	30dB(A) A quiet country park
	40dB(A) Whisper in a library
	50dB(A) Open office space
	70dB(A) Inside a car on a freeway
	80dB(A) Outboard motor
	90dB(A) Heavy truck pass-by
	100dB(A) Jackhammer/Subway train
	110 dB(A) Rock Concert
	115dB(A) Limit of sound permitted in industry
	120dB(A) 747 take off at 250 metres
Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.
Equivalent continuous sound level [L_{eq}]	The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy.
L_{max}	The maximum sound pressure level measured over the measurement period
L_{min}	The minimum sound pressure level measured over the measurement period
L_{10}	The sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the L_{10}.
L_{90}	The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the L_{90}.

Ambient noise	The all-encompassing noise at a point composed of sound from all sources near and far.
Background noise	The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The L_{90} sound pressure level is used to quantify background noise.
Traffic noise	The total noise resulting from road traffic. The L_{eq} sound pressure level is used to quantify traffic noise.
Day	The period from 0700 to 1800 h Monday to Saturday and 0800 to 1800 h Sundays and Public Holidays.
Evening	The period from 1800 to 2200 h Monday to Sunday and Public Holidays.
Night	The period from 2200 to 0700 h Monday to Saturday and 2200 to 0800 h Sundays and Public Holidays.
Assessment background level [ABL]	The overall background level for each day, evening and night period for **each day** of the noise monitoring.
Rating background level [RBL]	The overall background level for each day, evening and night period for the **entire length** of noise monitoring.
Impulsive noise	Noise of a short duration, characterised by a short rise time of 35 milliseconds and decay time of 1.5 seconds.
Tonal noise	Noise which is tonal in nature, characterised by a one-third octave band exceeding the level of each adjacent band by: - 5 dB(A) or more if the frequency band containing the tone is above 400 Hz - 8 dB(A) or more if the frequency band containing the tone is below 400 Hz and above 160 Hz inclusive - 15 dB(A) or more if the frequency band containing the tone is below 160 Hz

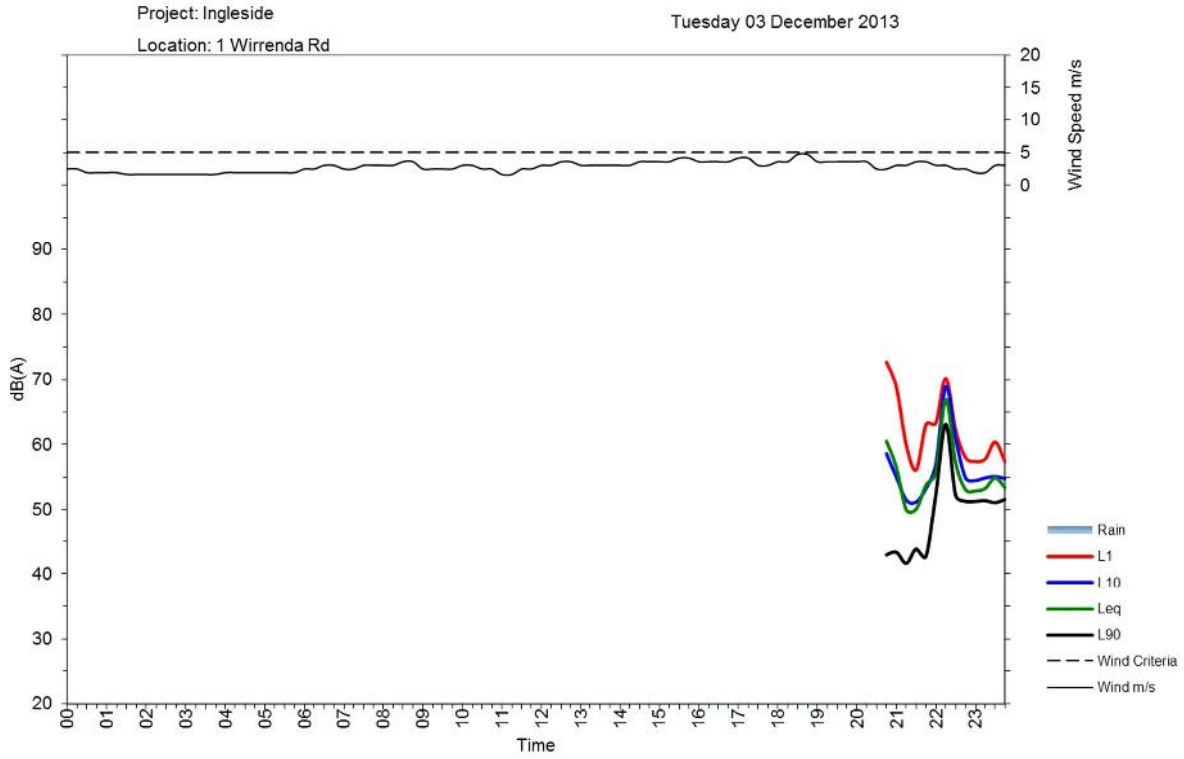
*Definitions of a number of terms have been adapted from Australian Standard AS1633:1985 *"Acoustics – Glossary of terms and related symbols"*, the EPA's NSW Industrial Noise Policy and the EPA's Road Noise Policy.

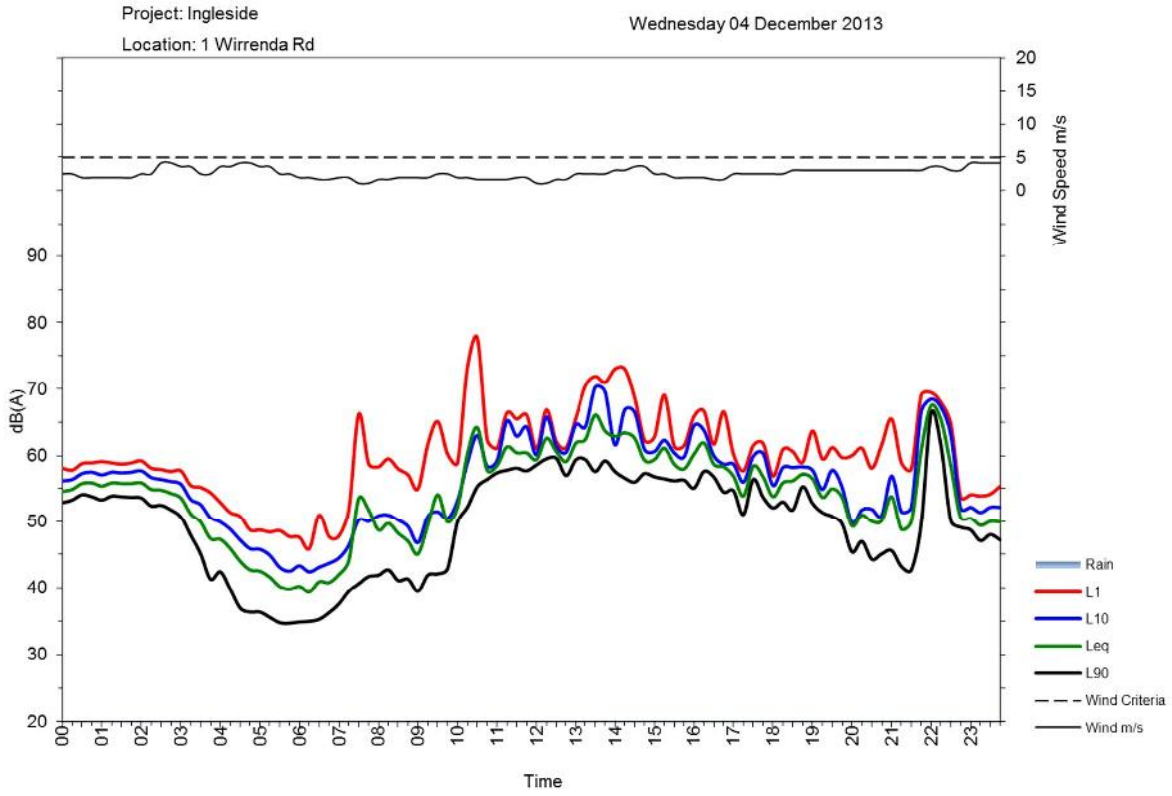
Appendix B

Logger Graphs

Appendix B Logger Graphs

NL1

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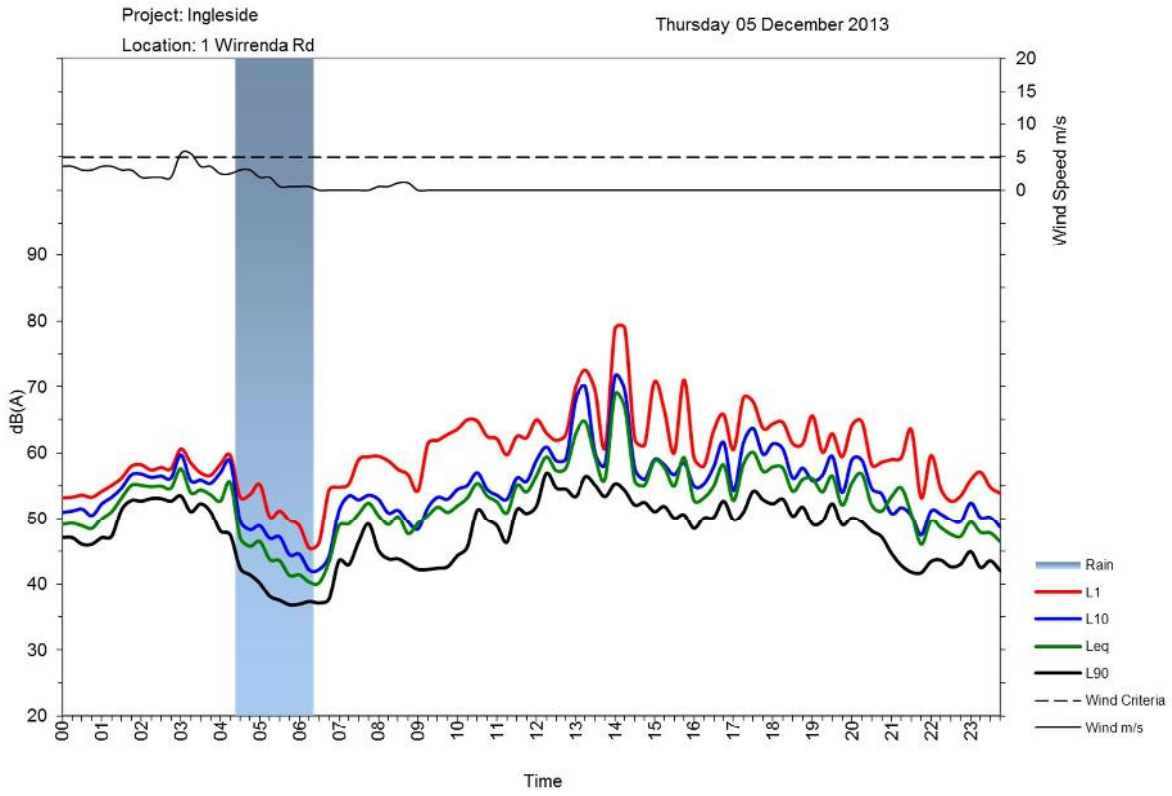
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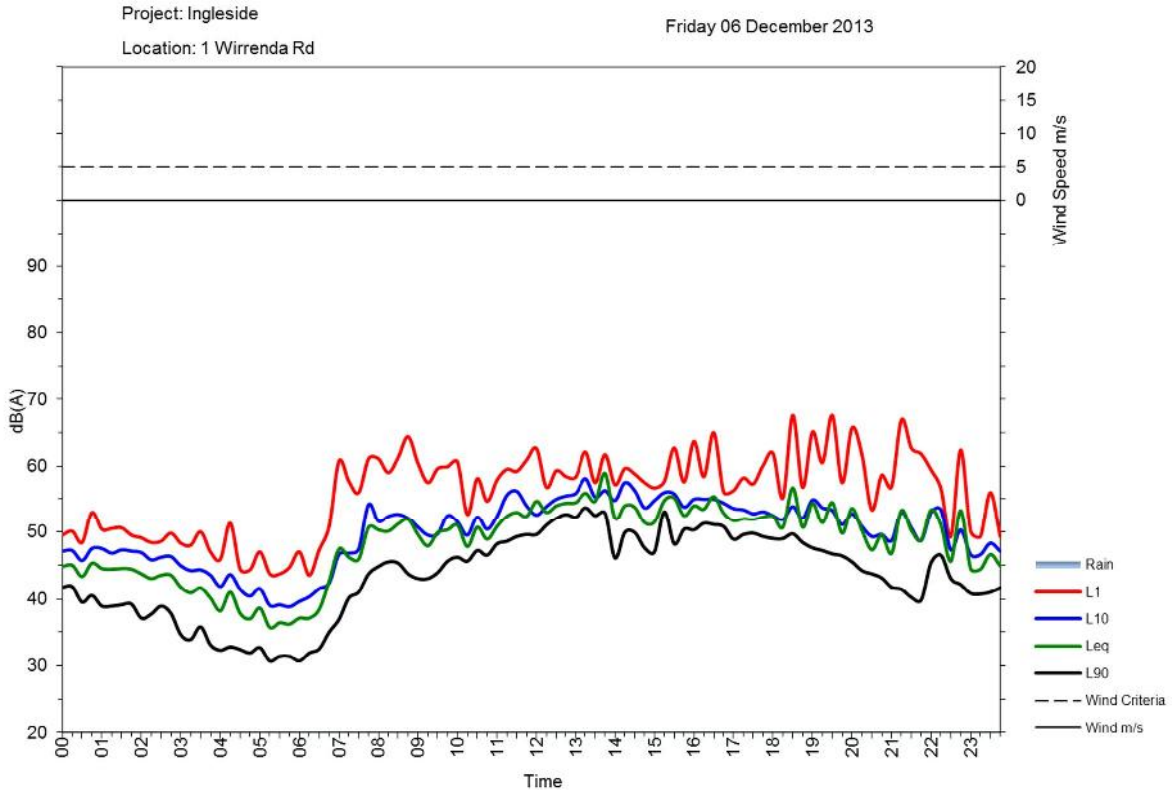
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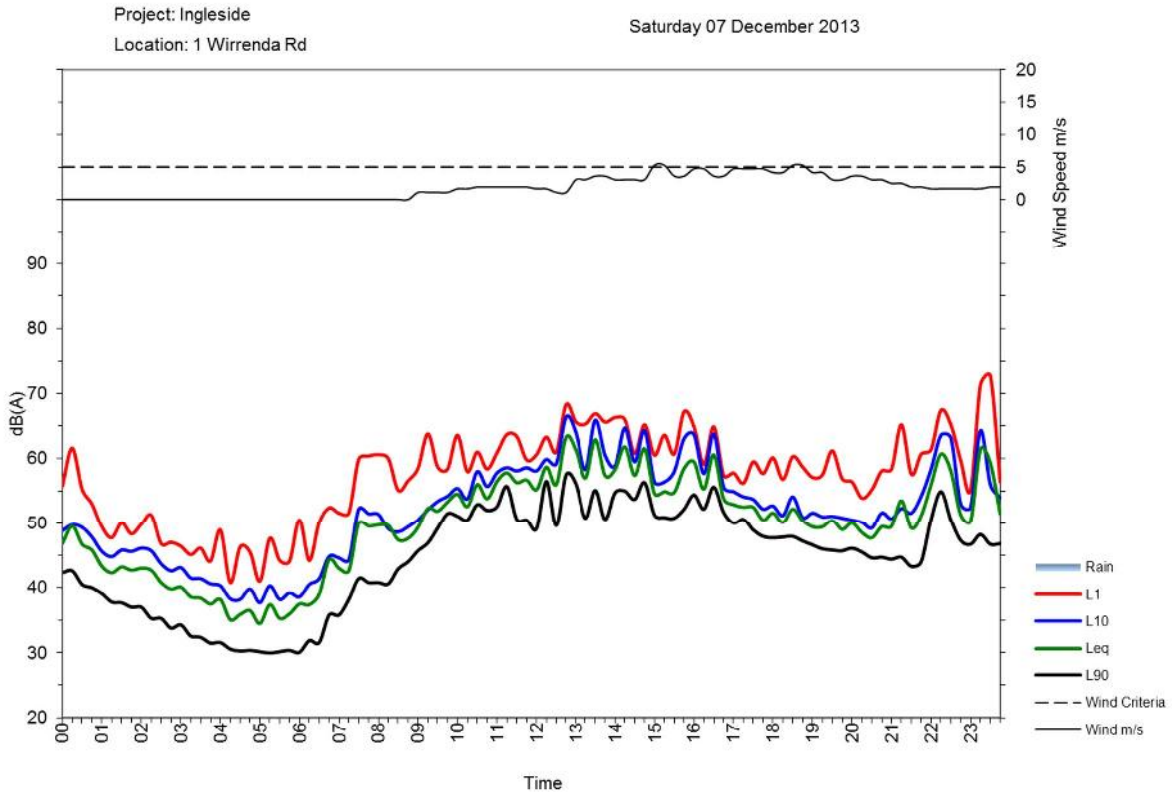
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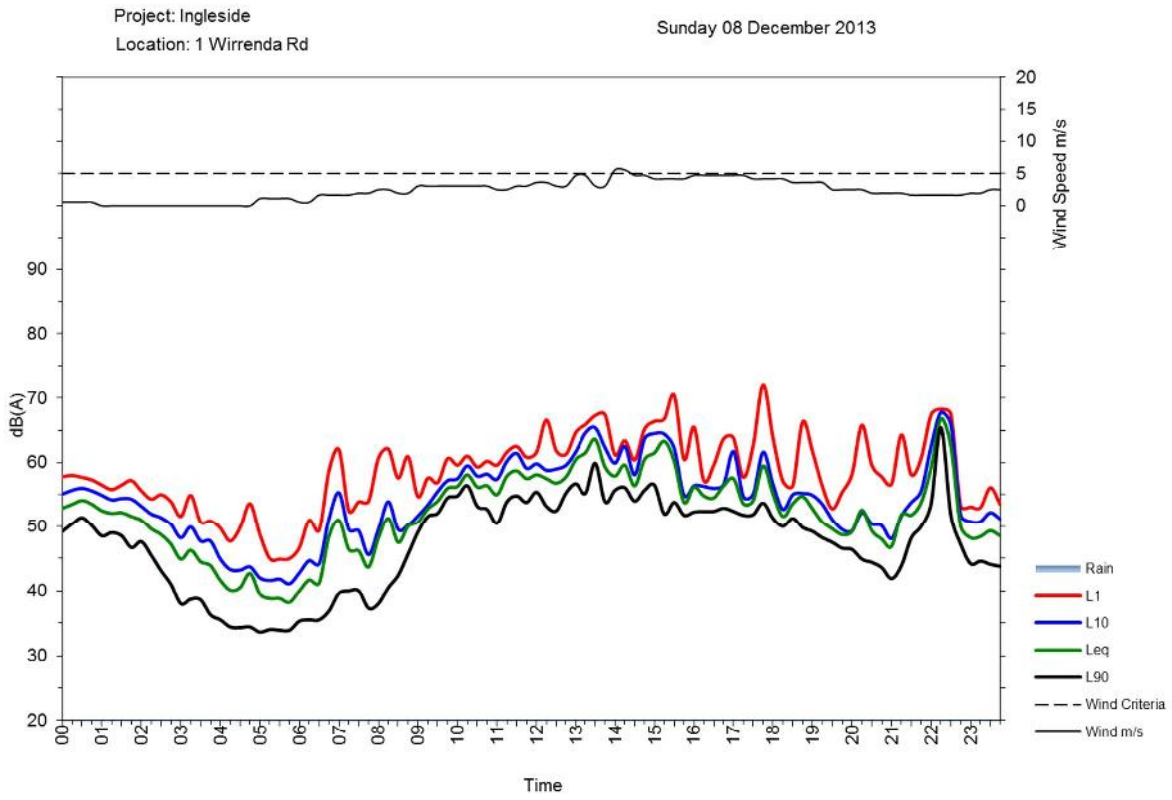
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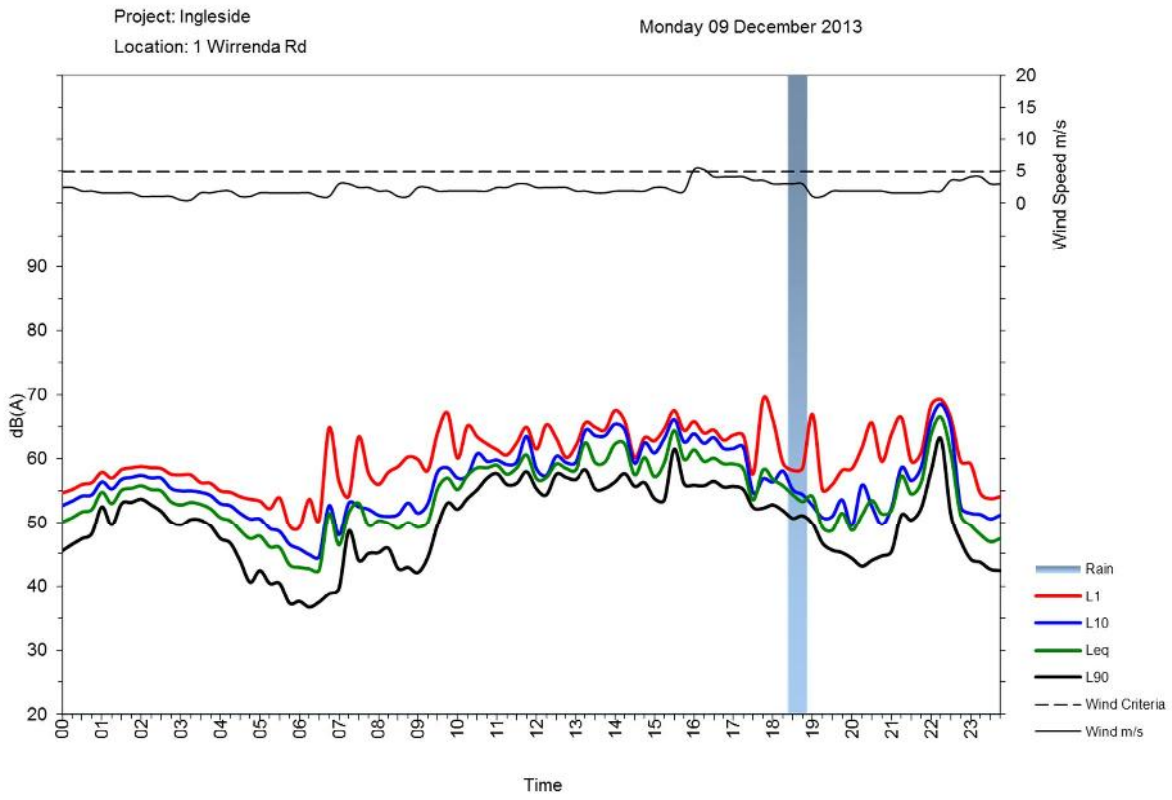
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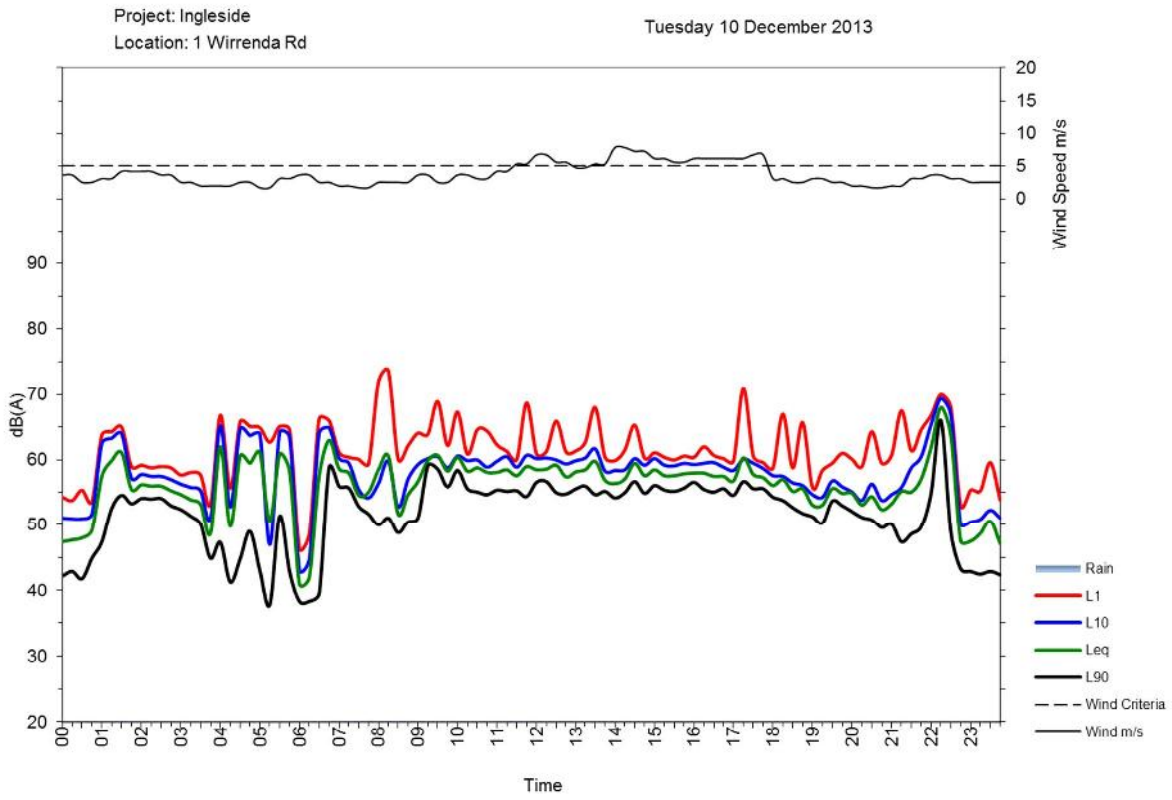
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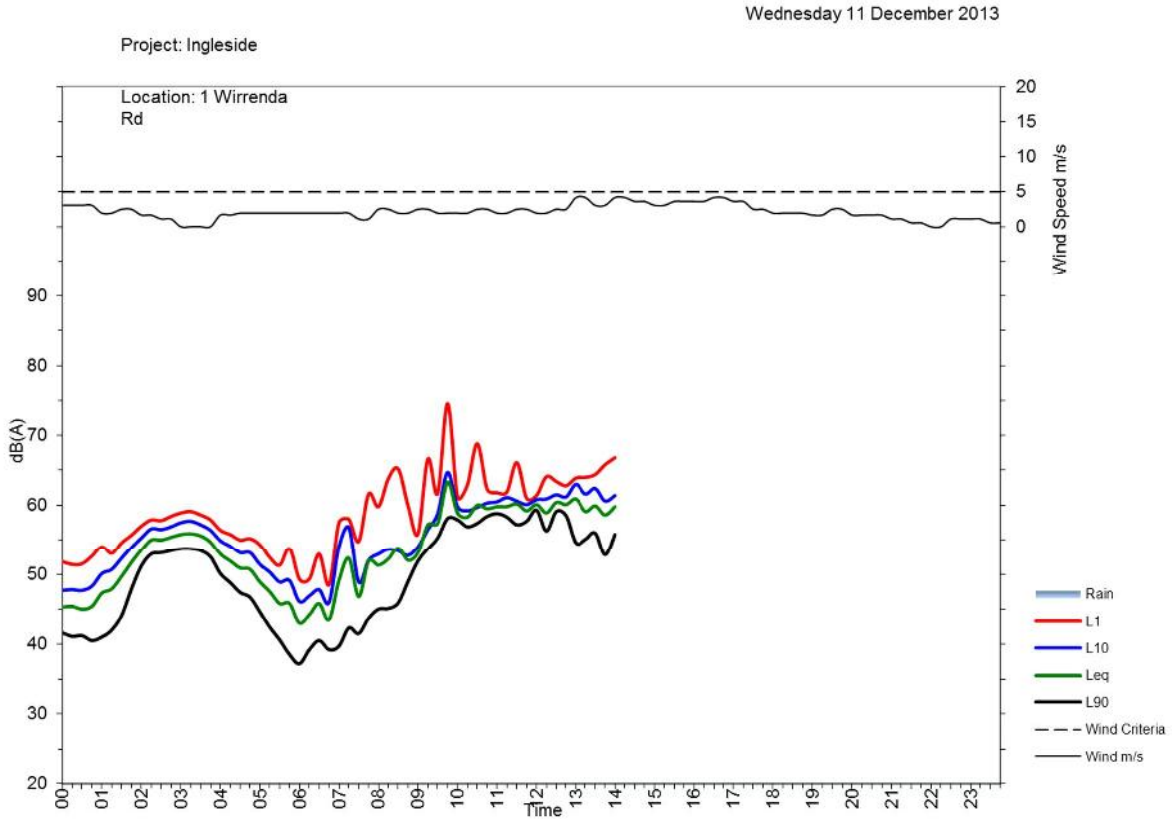
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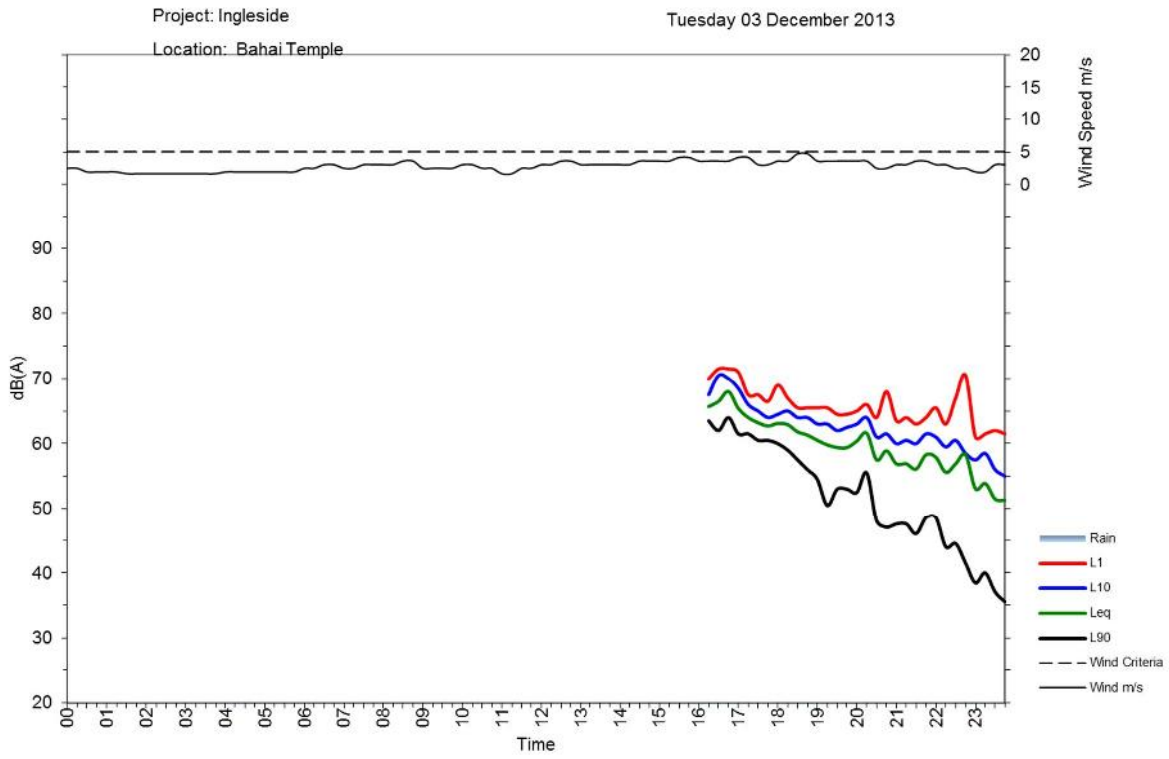
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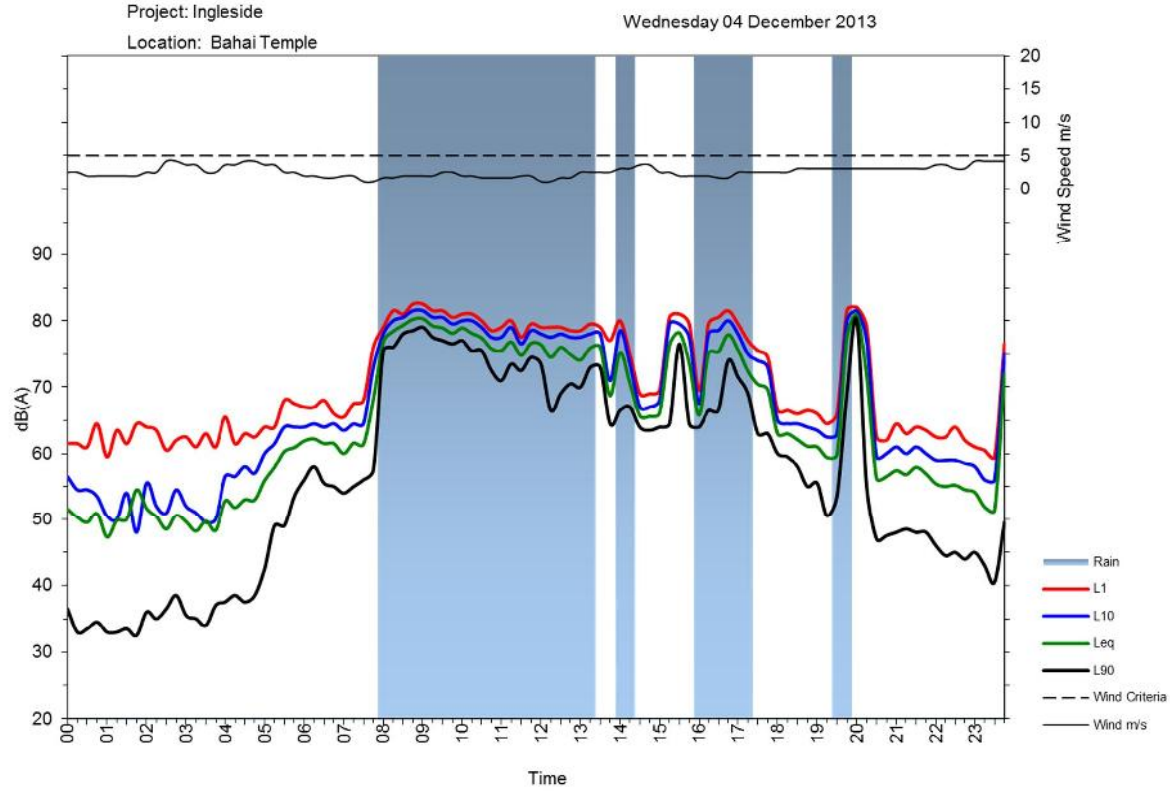
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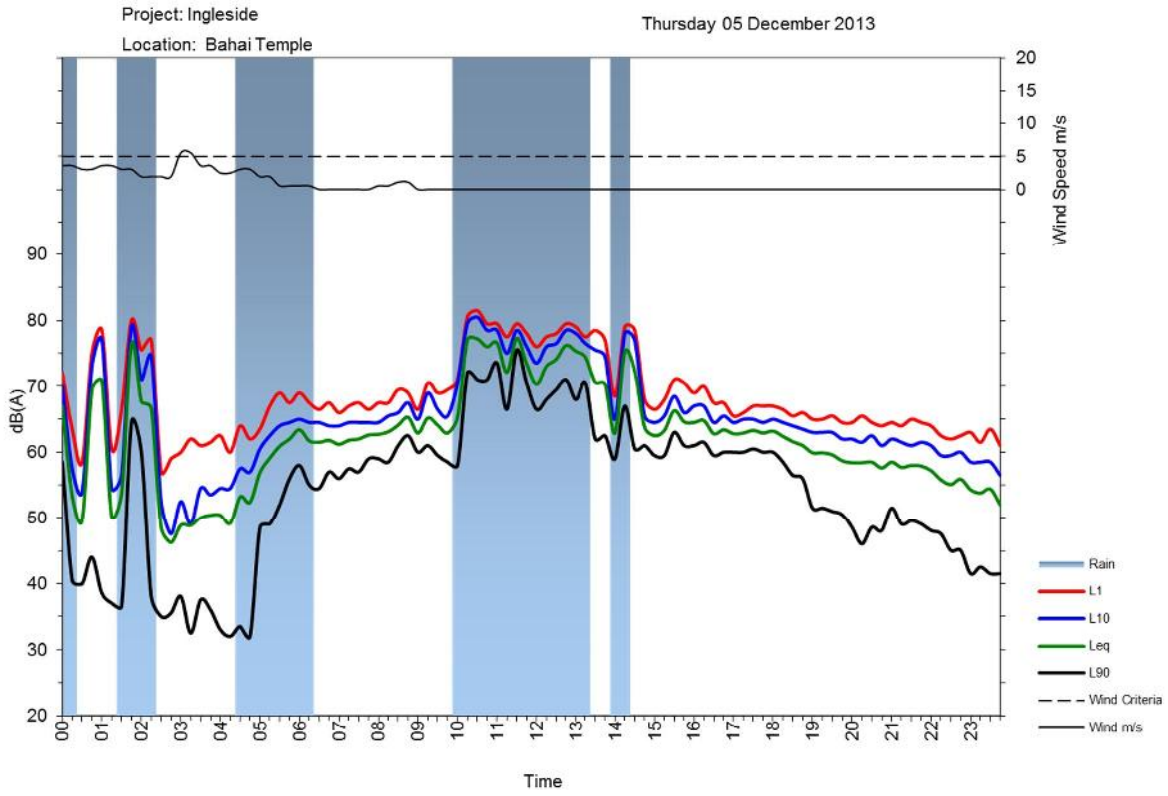
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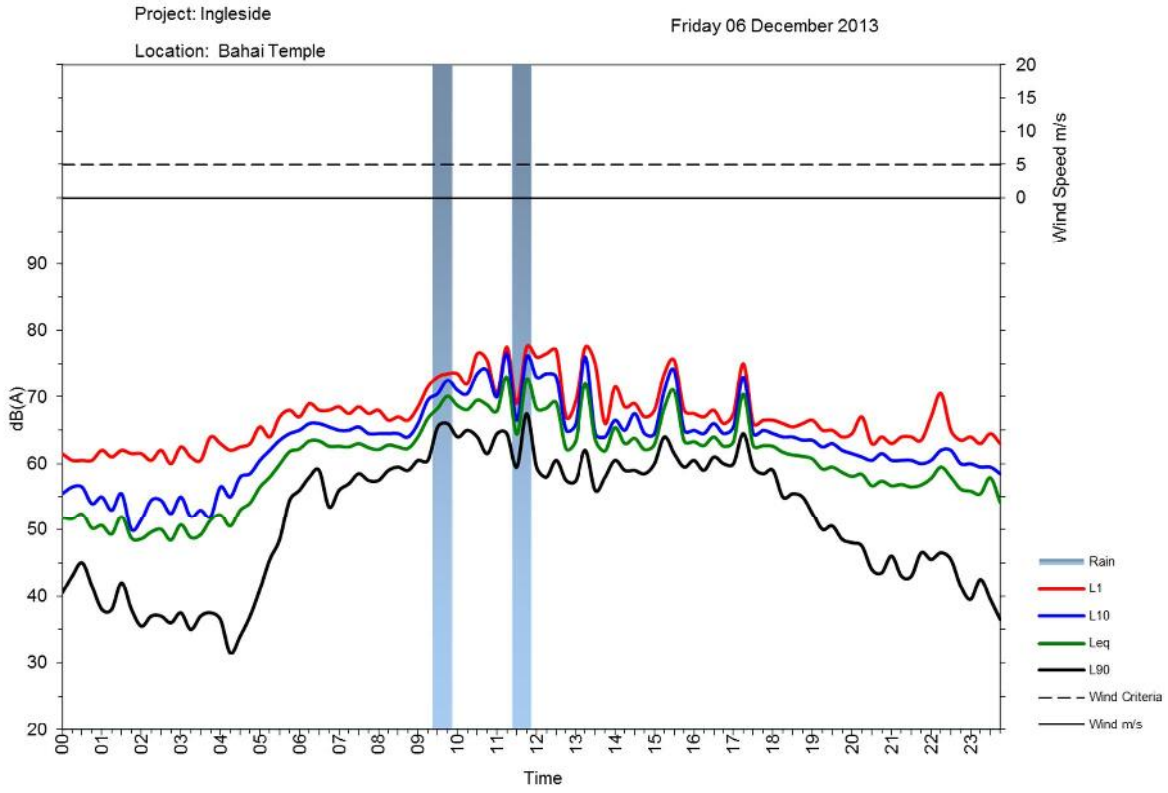
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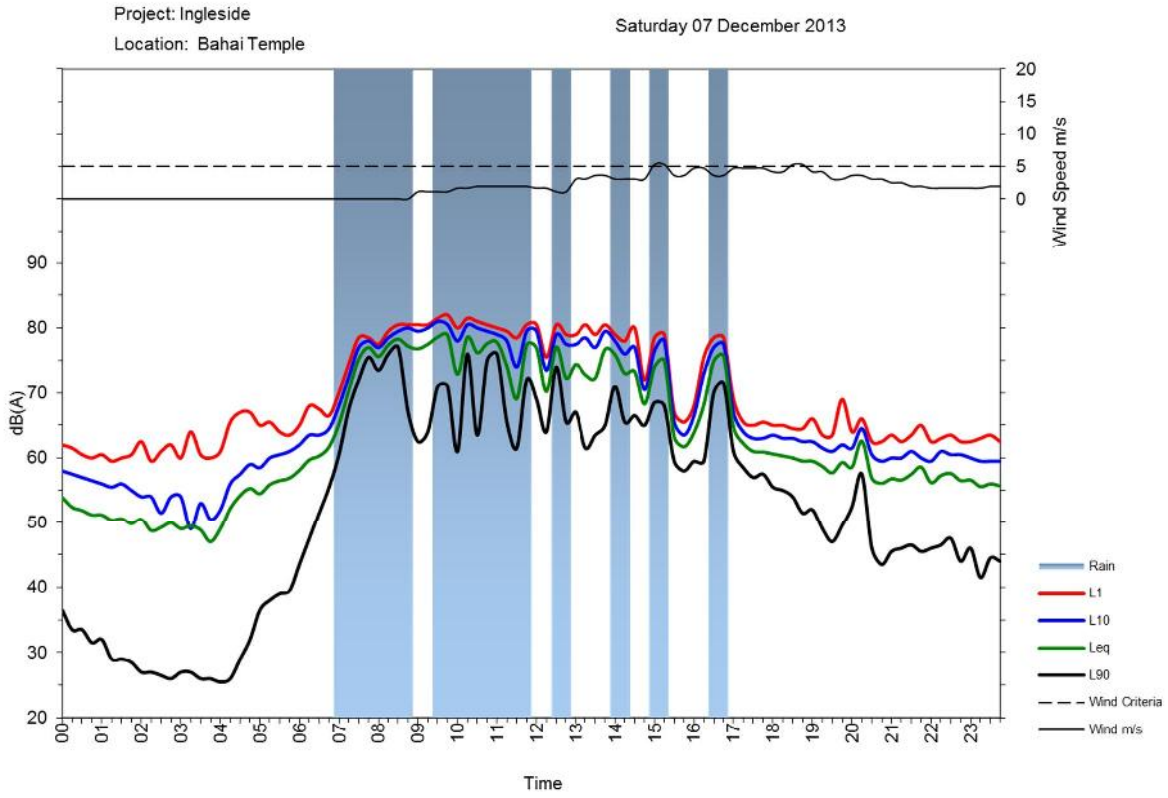
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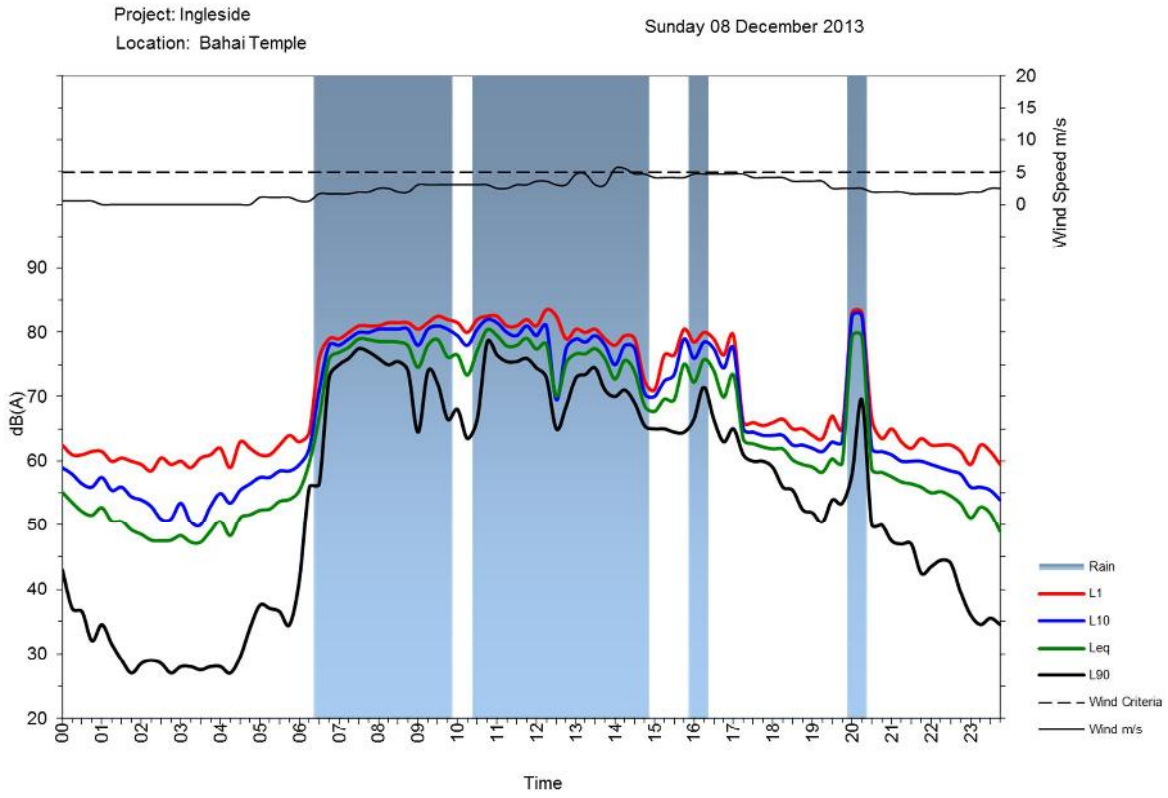
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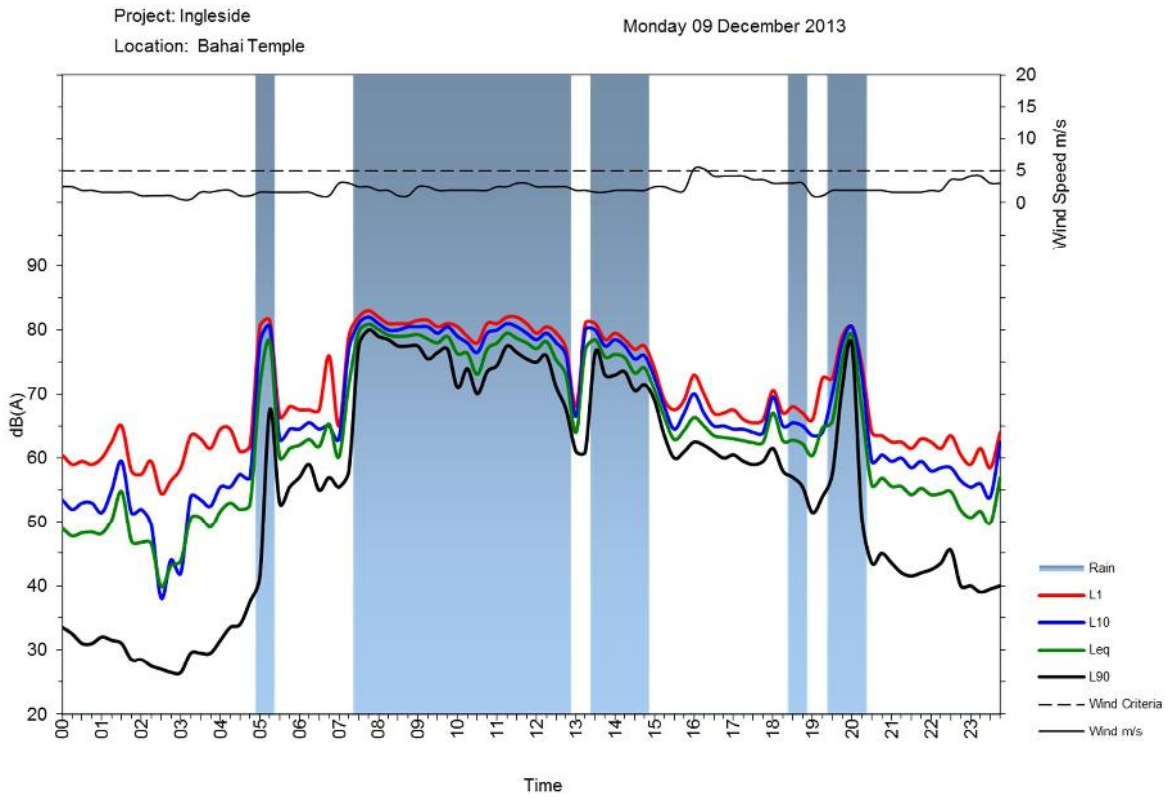
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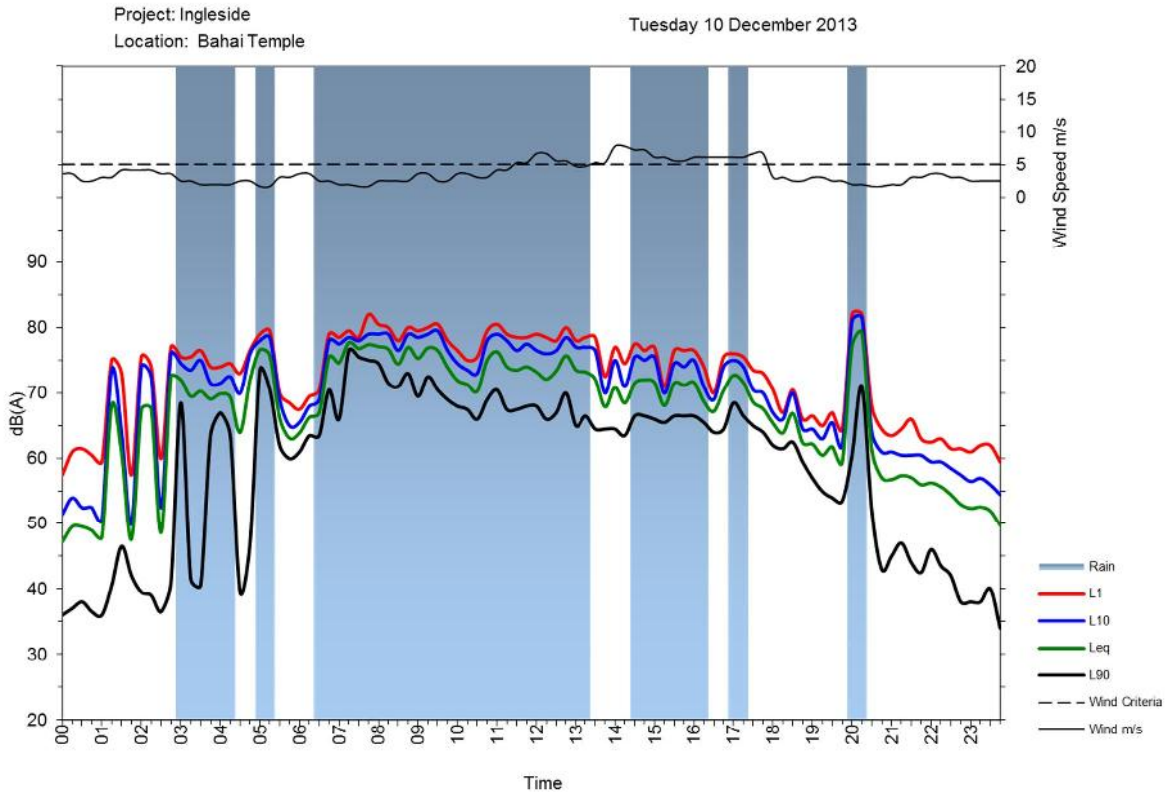
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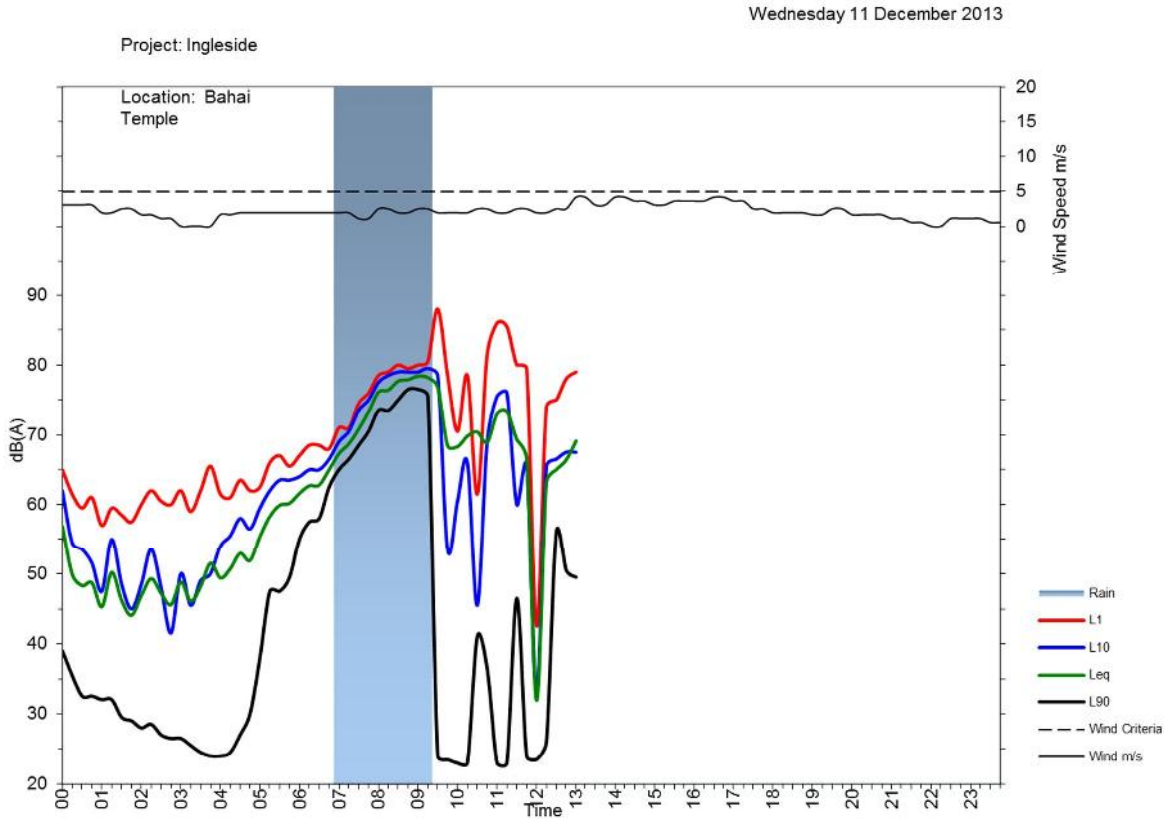
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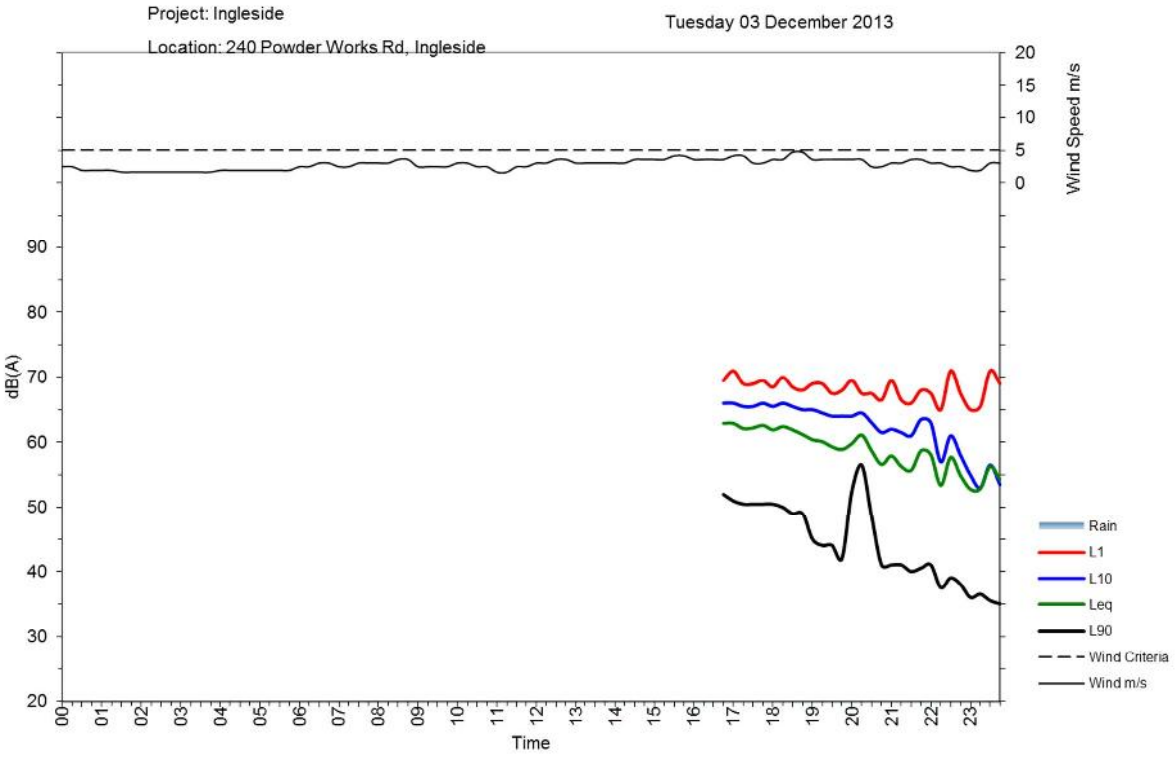
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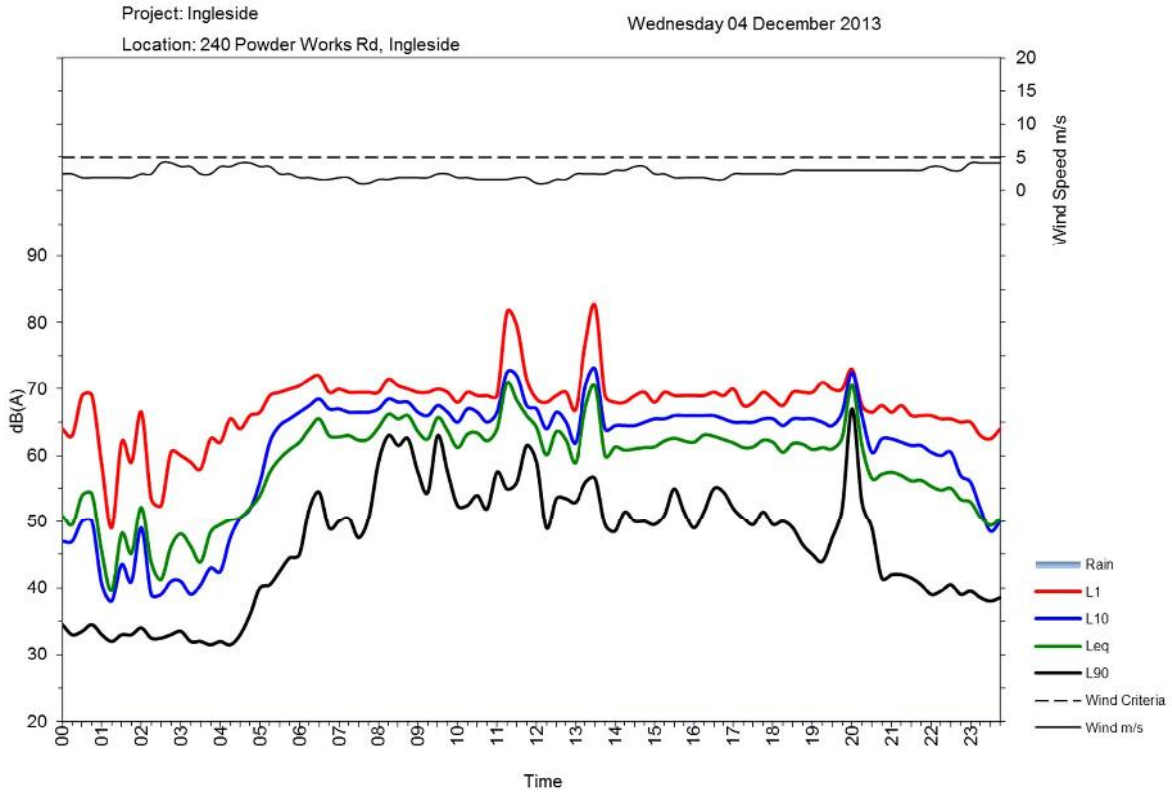
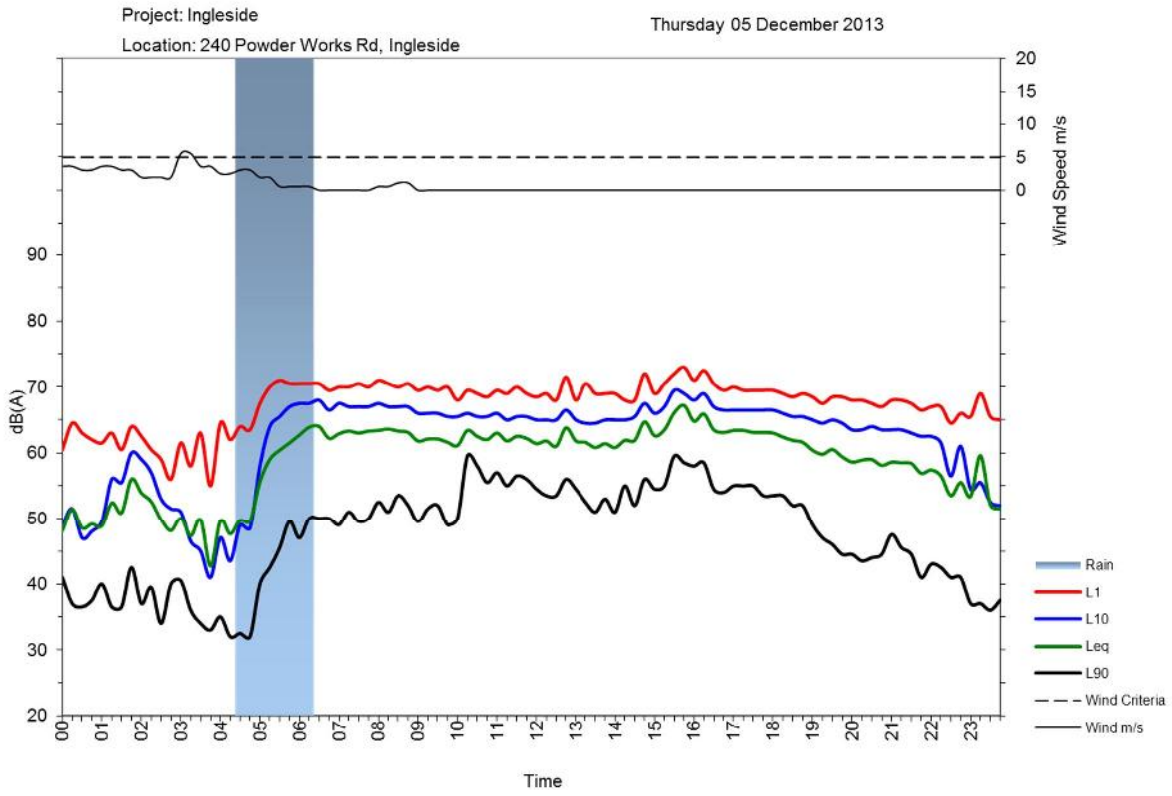
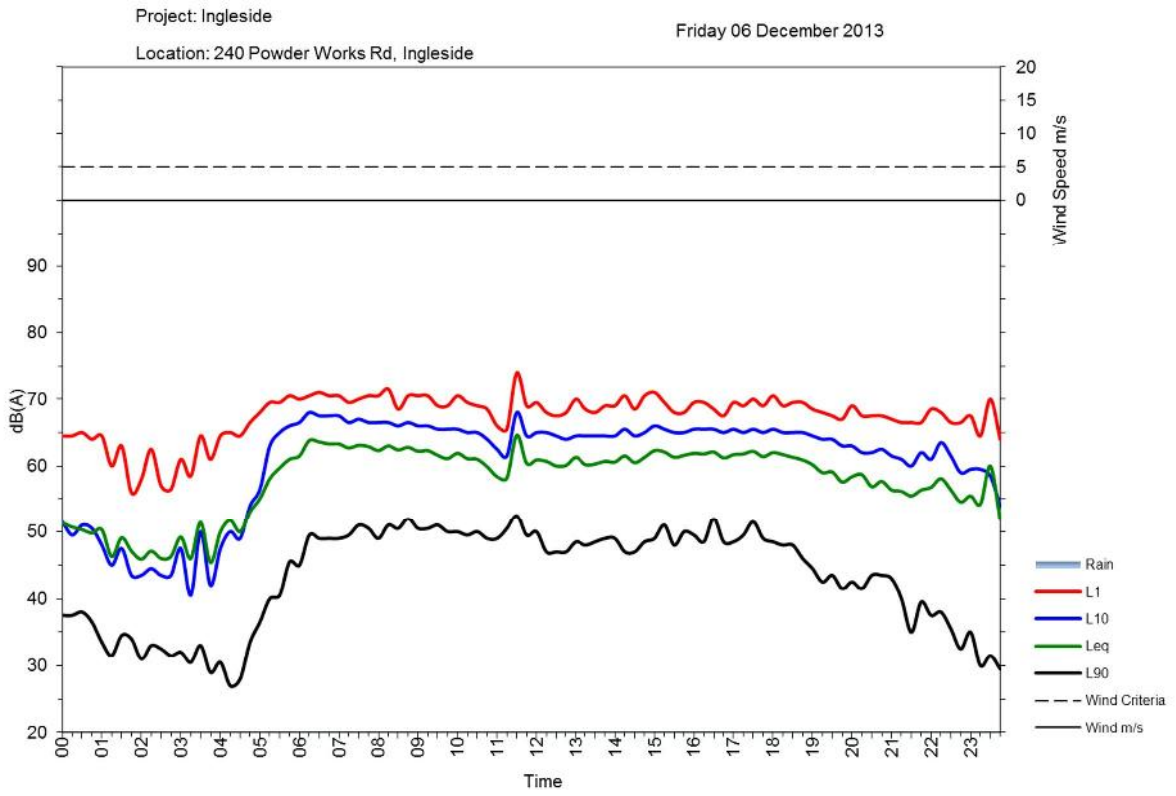
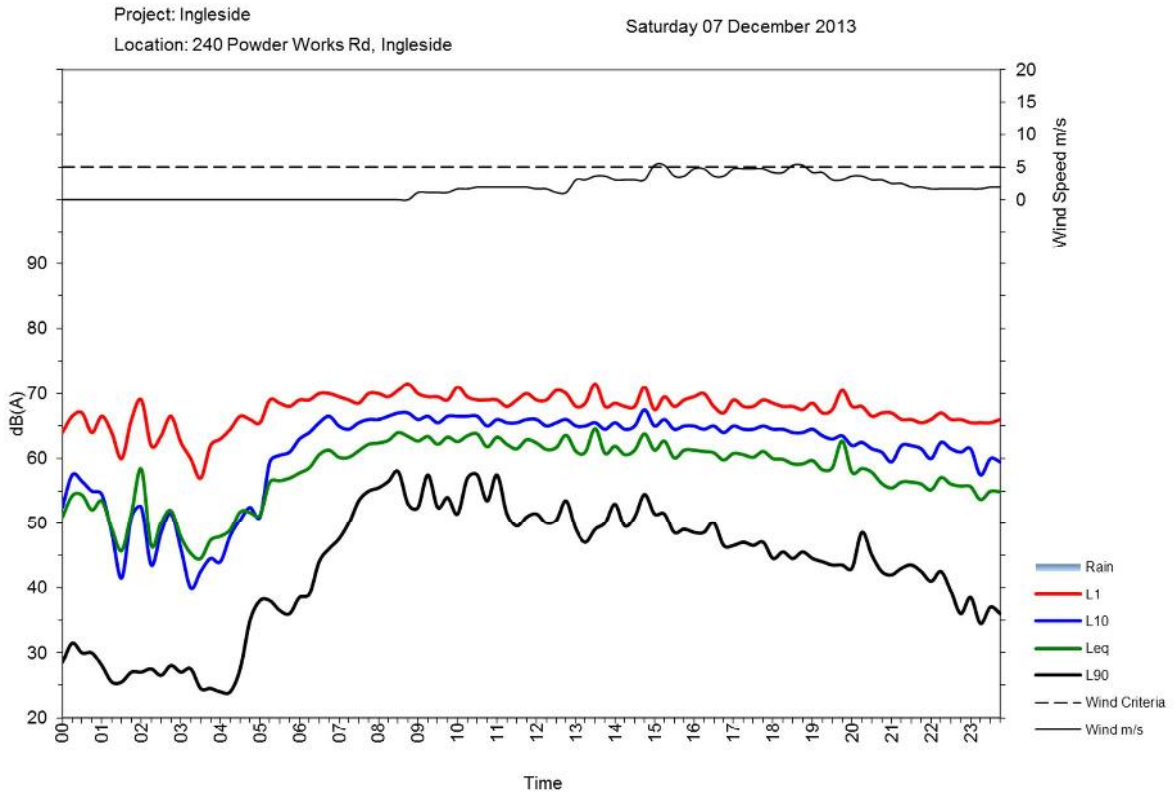
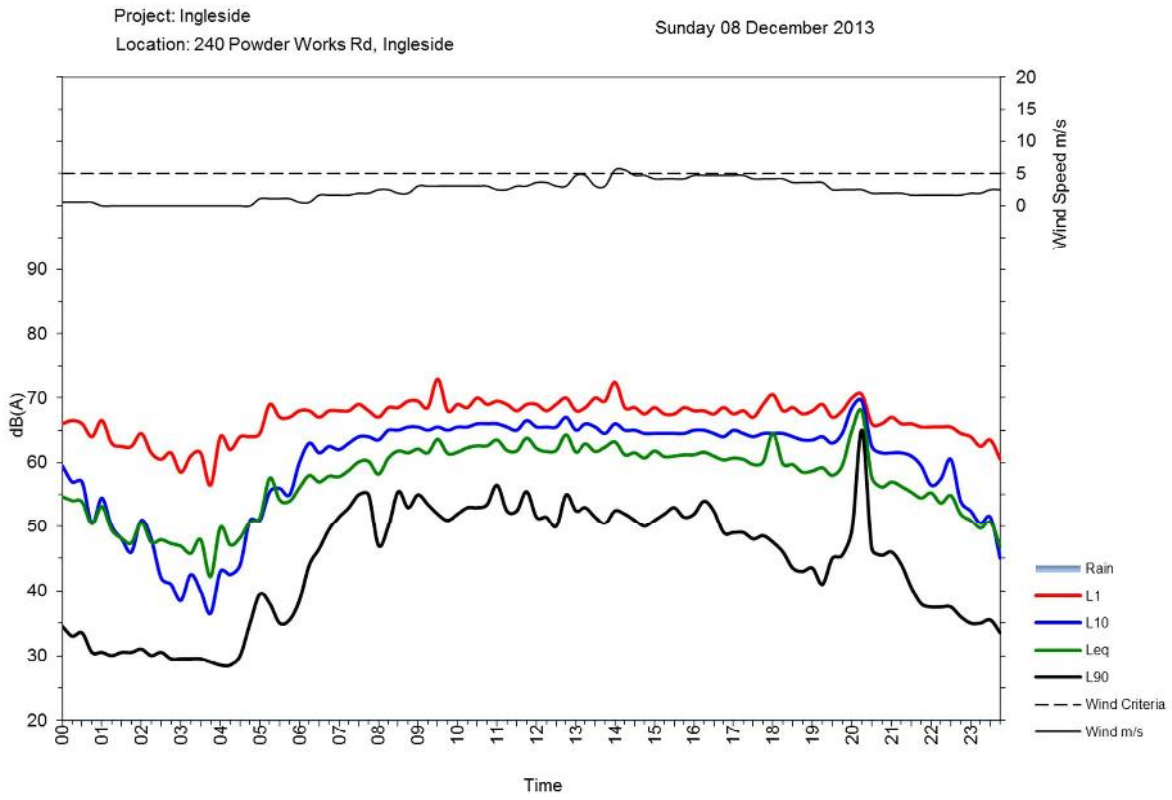
Wind Criteria
Wind m/s

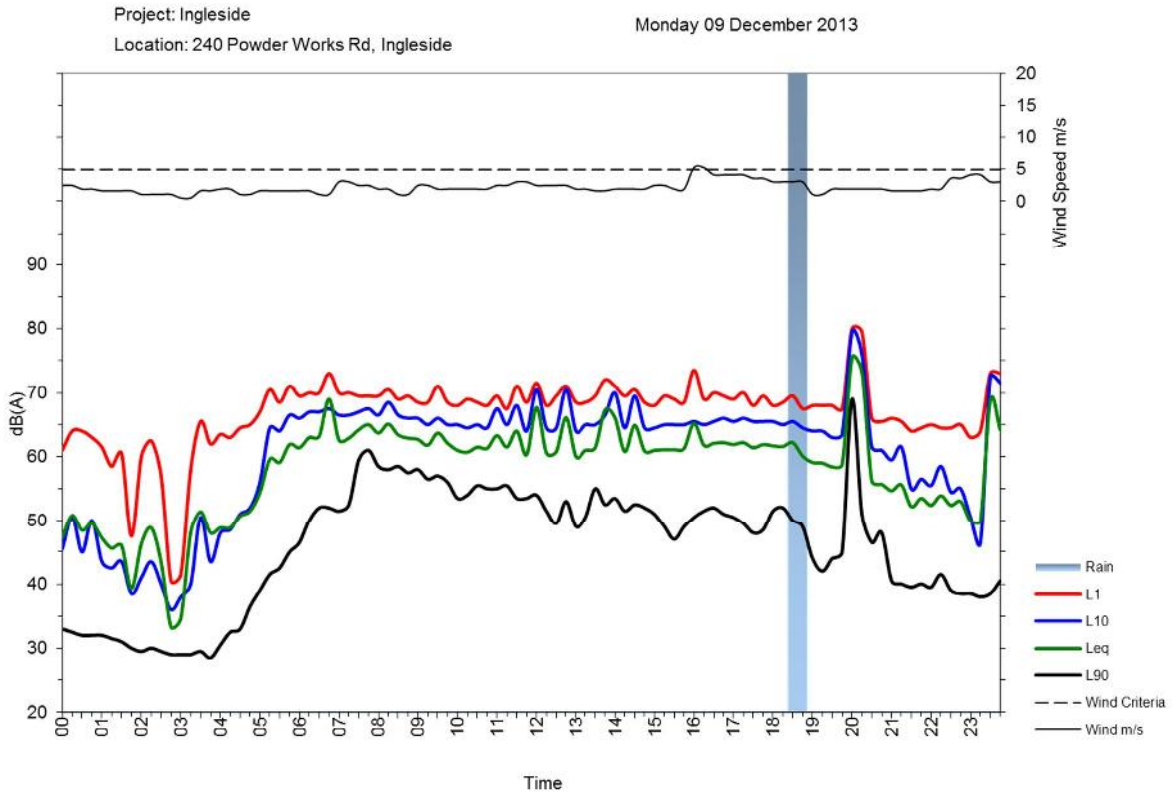

Project: Ingleside
Location: 240 Powder Works Rd, Ingleside
Wednesday 04 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

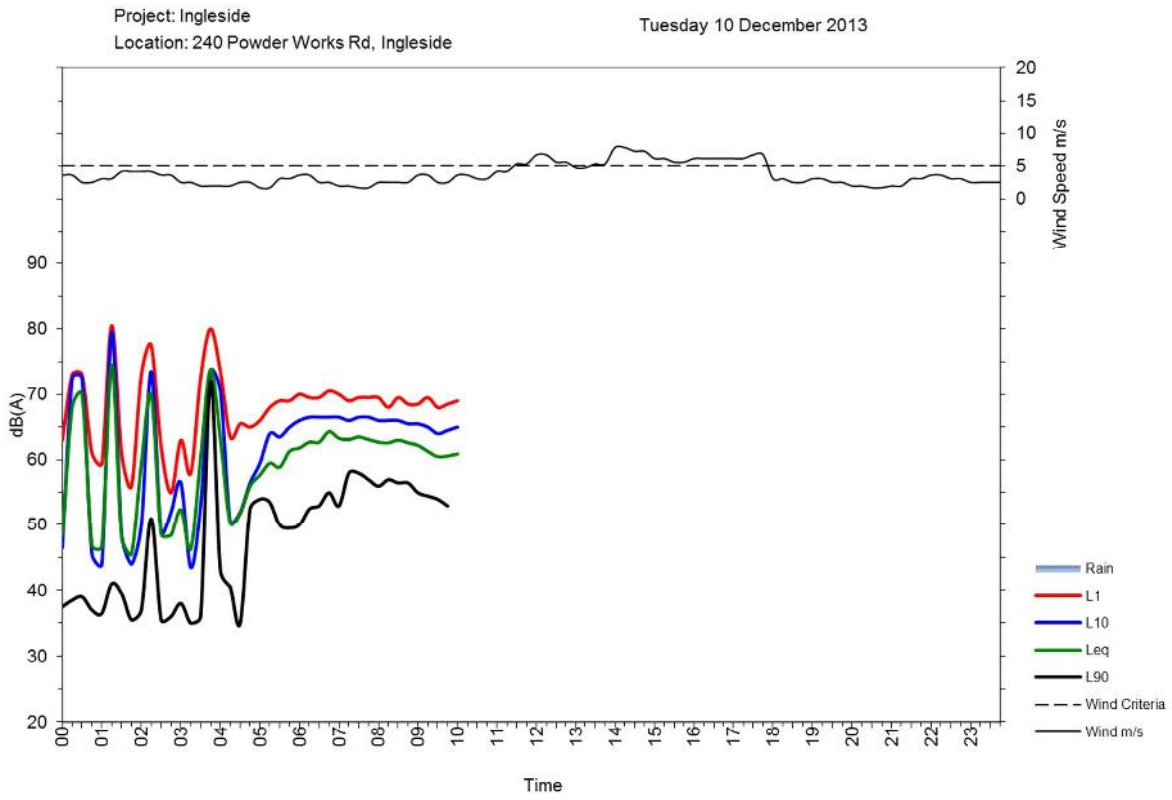

Project: Ingleside
Location: 240 Powder Works Rd, Ingleside
Thursday 05 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s


Project: Ingleside
Location: 240 Powder Works Rd, Ingleside
Friday 06 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

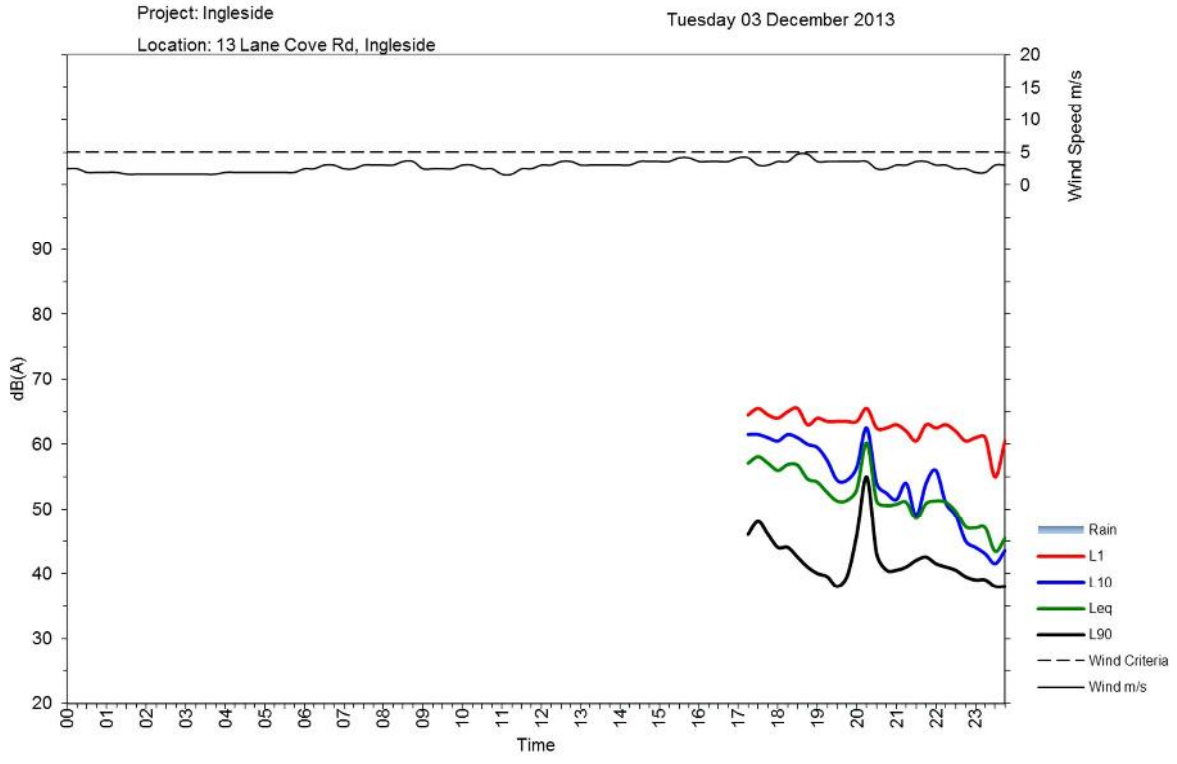

Project: Ingleside
Location: 240 Powder Works Rd, Ingleside
Saturday 07 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

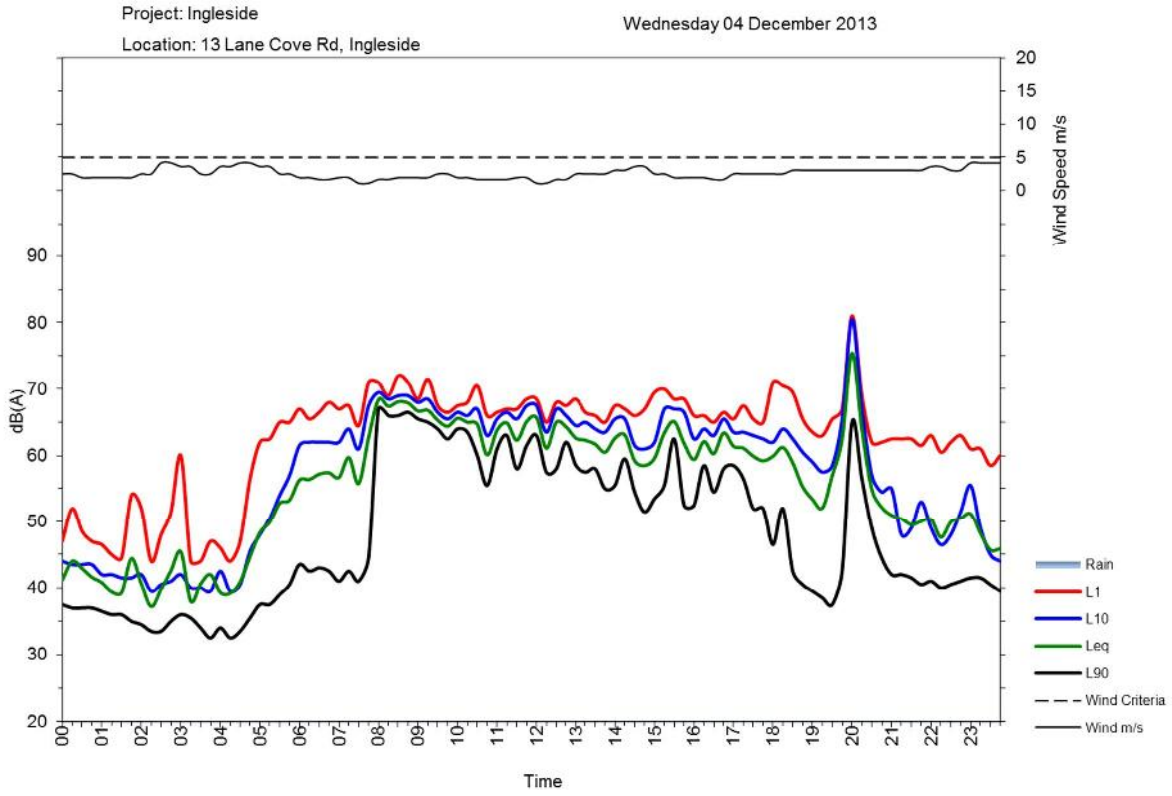

Project: Ingleside
Location: 240 Powder Works Rd, Ingleside
Sunday 08 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

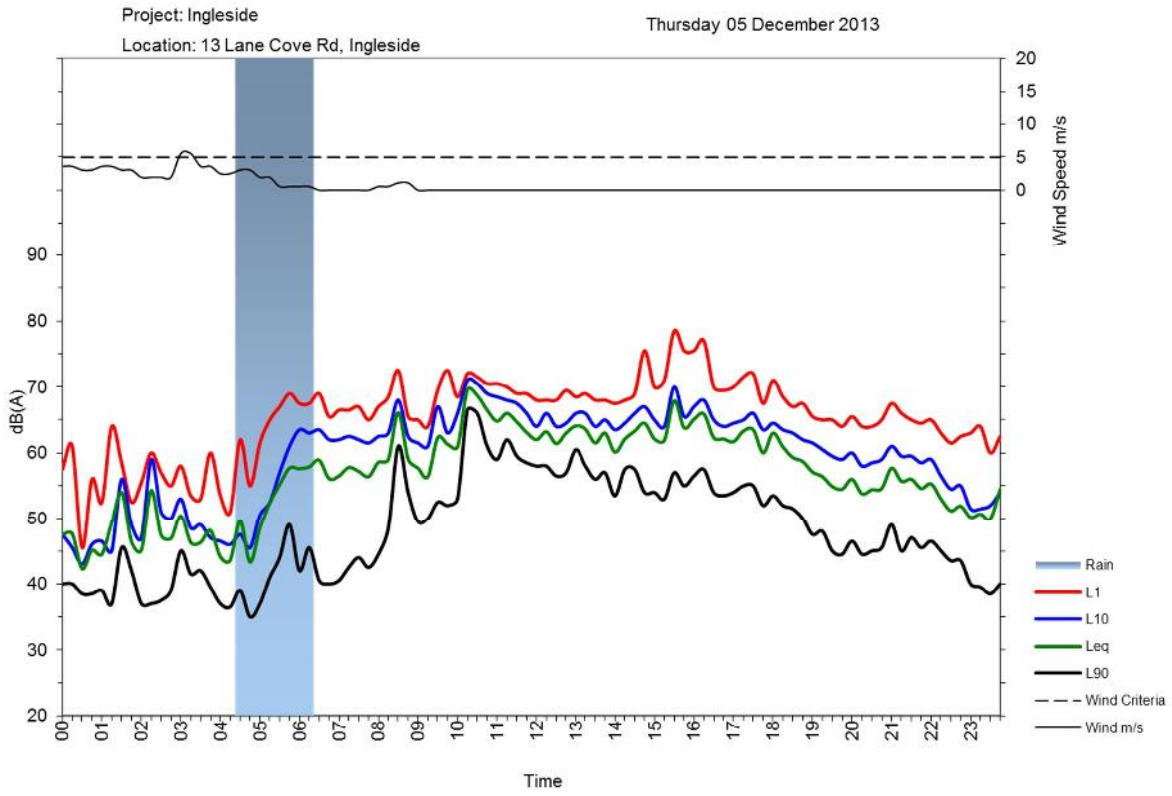

Project: Ingleside
Location: 240 Powder Works Rd, Ingleside
Monday 09 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

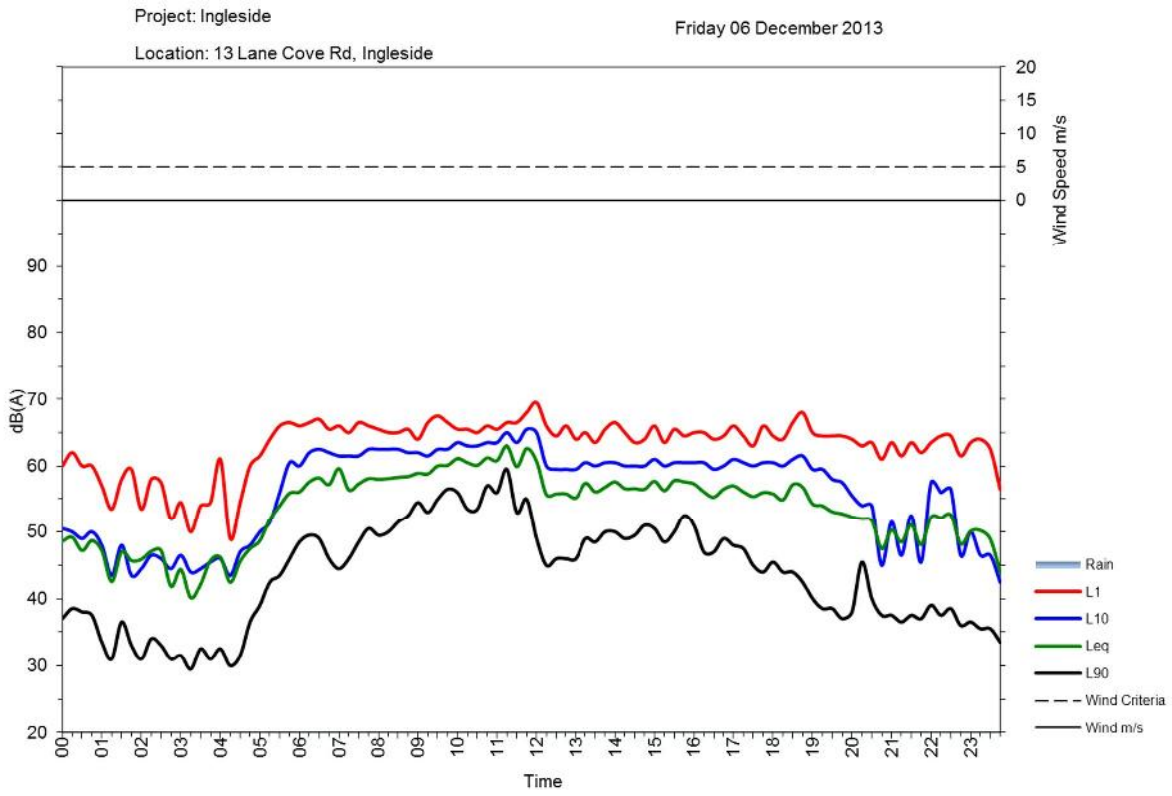

Project: Ingleside
Location: 240 Powder Works Rd, Ingleside
Tuesday 10 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

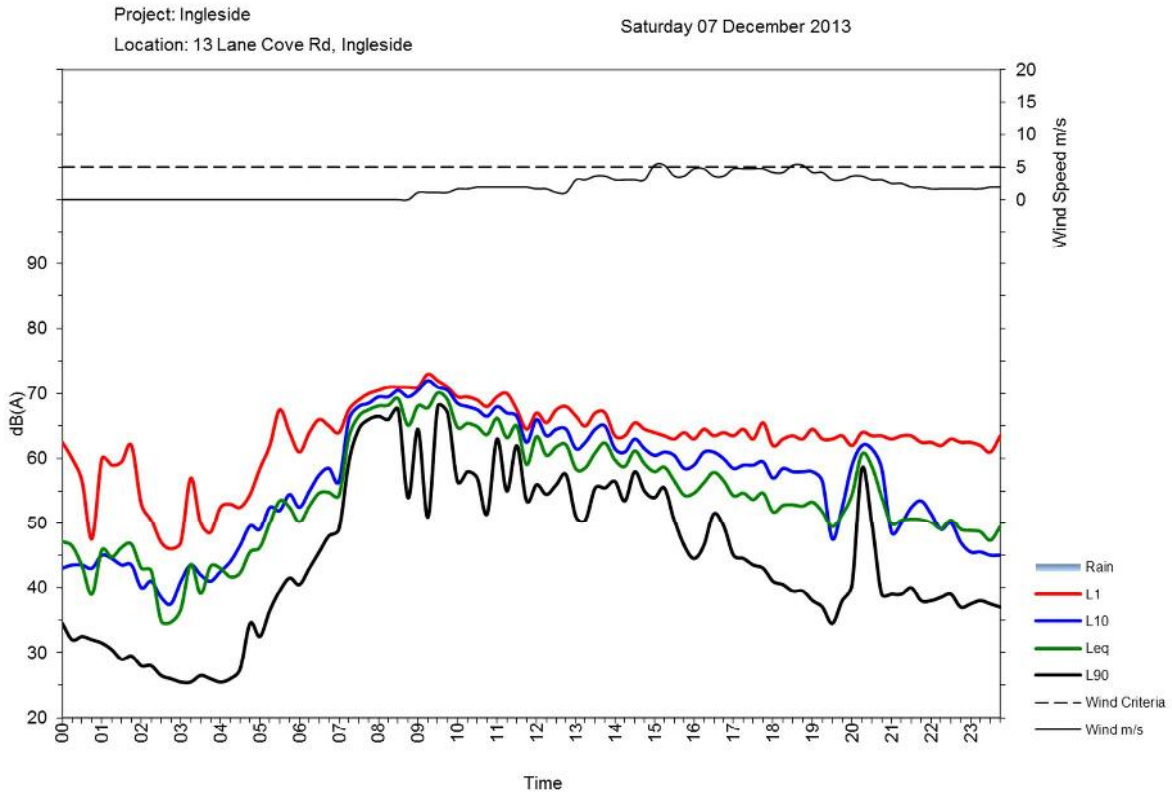
NL4

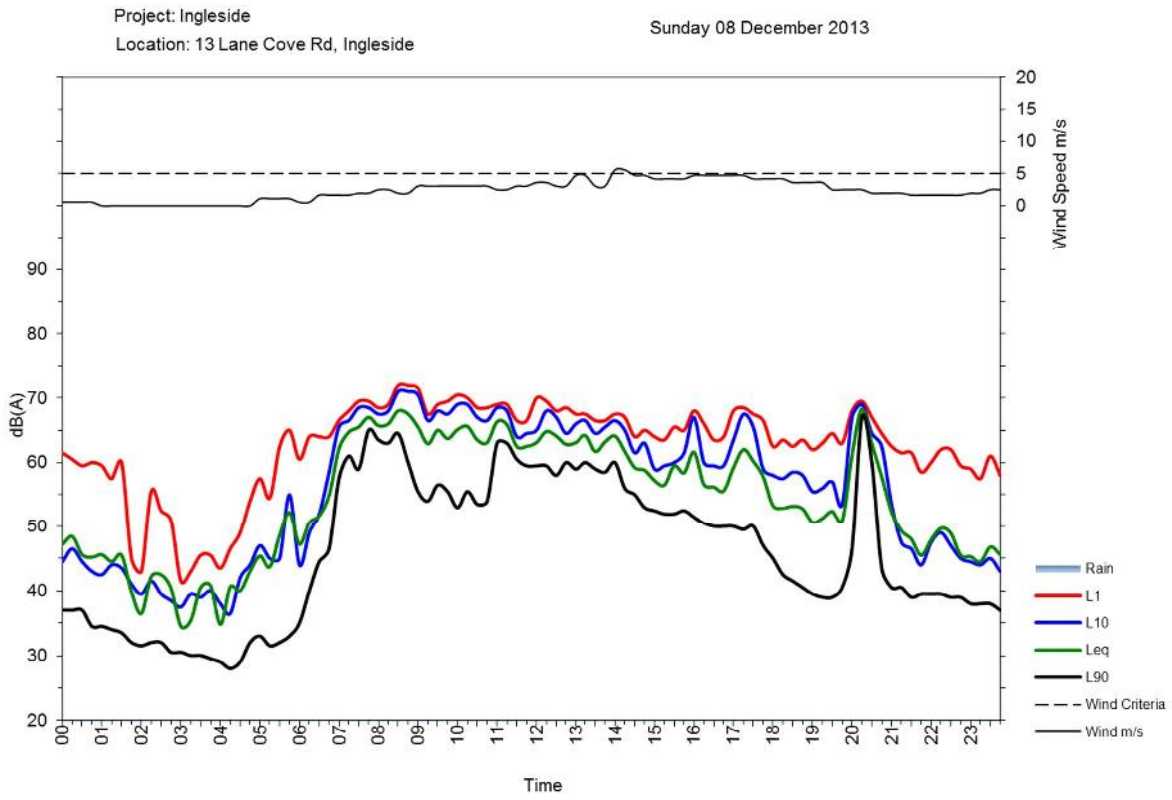

Project: Ingleside
Location: 13 Lane Cove Rd, Ingleside
Tuesday 03 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

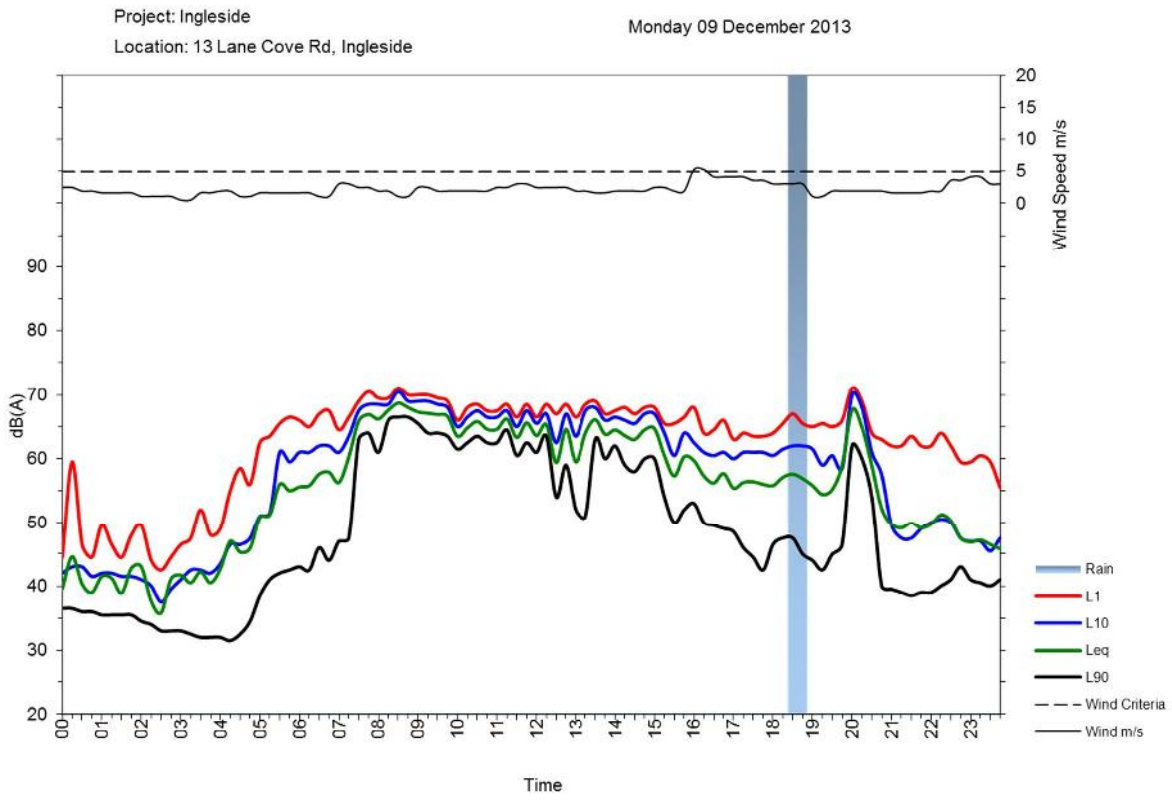

Project: Ingleside
Location: 13 Lane Cove Rd, Ingleside
Wednesday 04 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

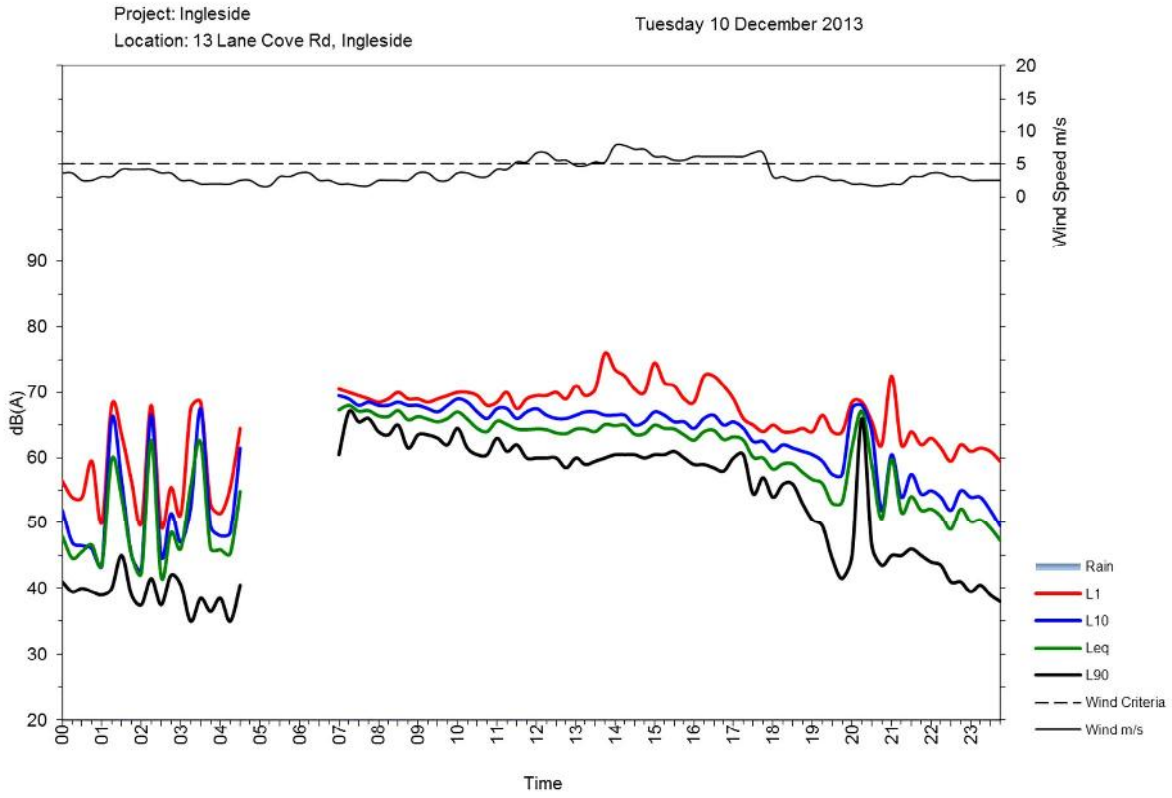

Project: Ingleside
Location: 13 Lane Cove Rd, Ingleside
Thursday 05 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

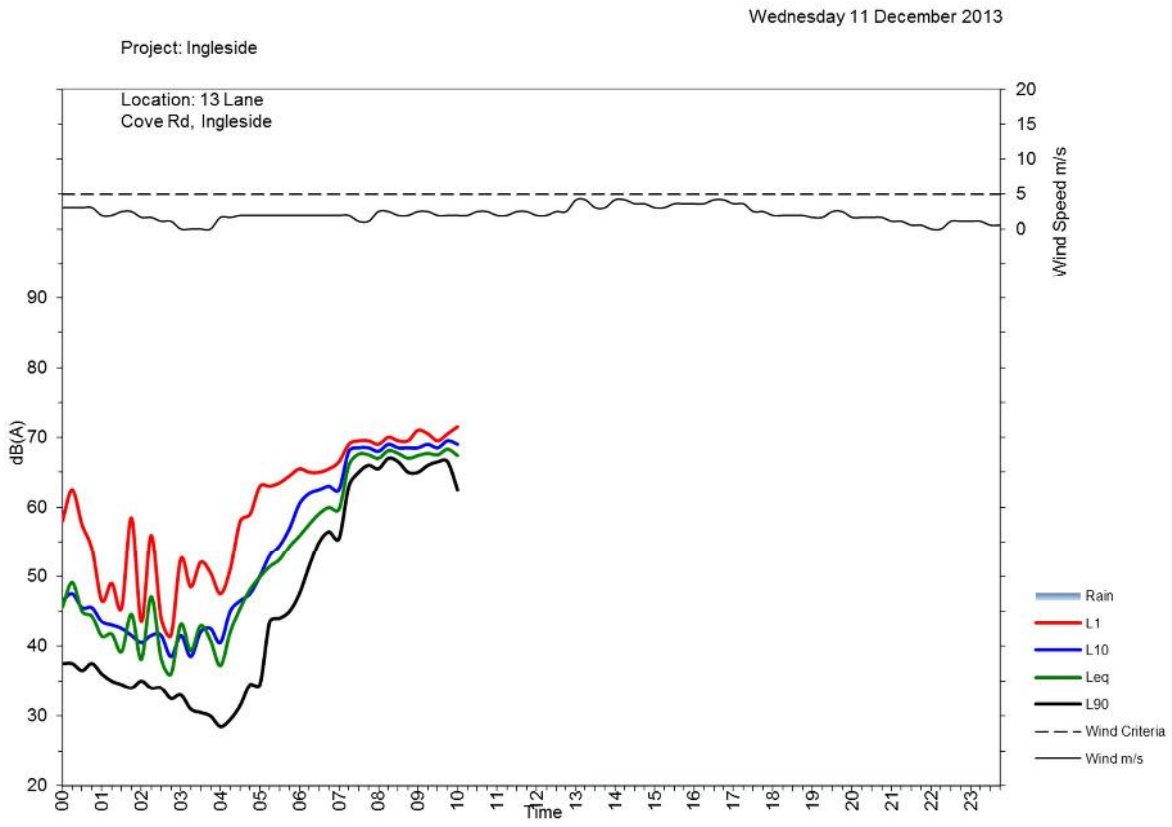

Project: Ingleside
Location: 13 Lane Cove Rd, Ingleside
Friday 06 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s


Project: Ingleside
Location: 13 Lane Cove Rd, Ingleside
Saturday 07 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s


Project: Ingleside
Location: 13 Lane Cove Rd, Ingleside
Sunday 08 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

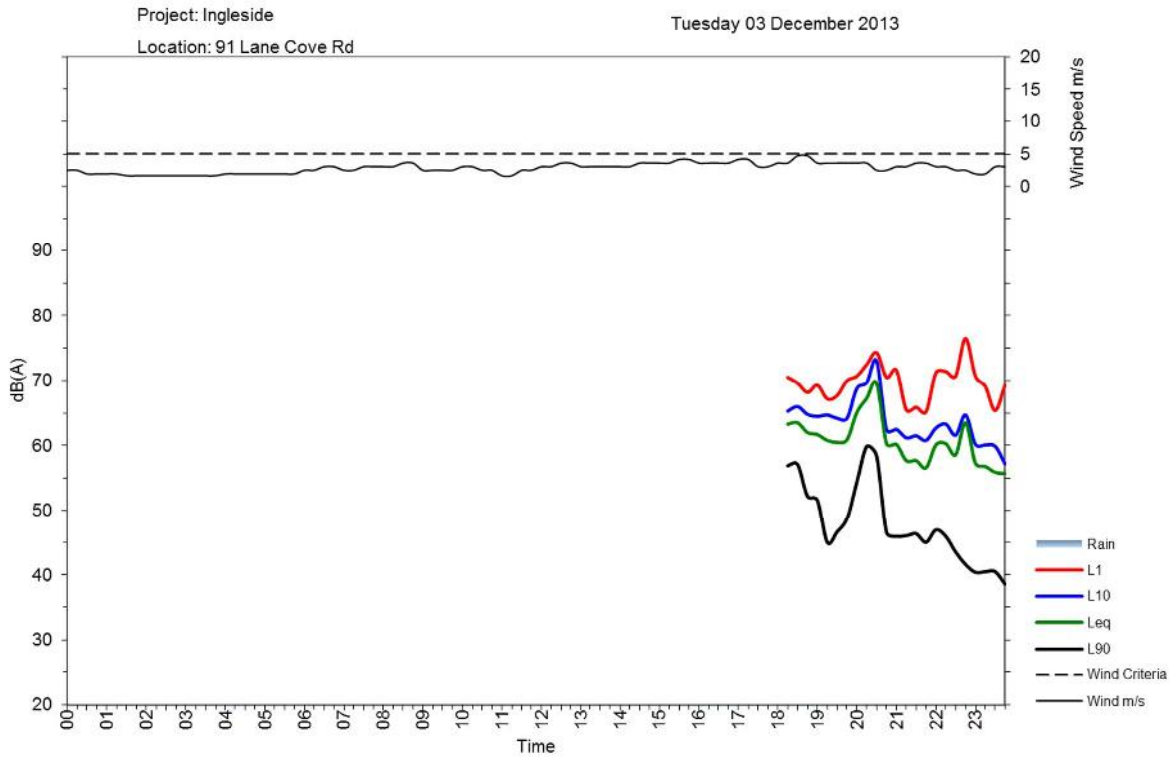

Project: Ingleside
Location: 13 Lane Cove Rd, Ingleside
Monday 09 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

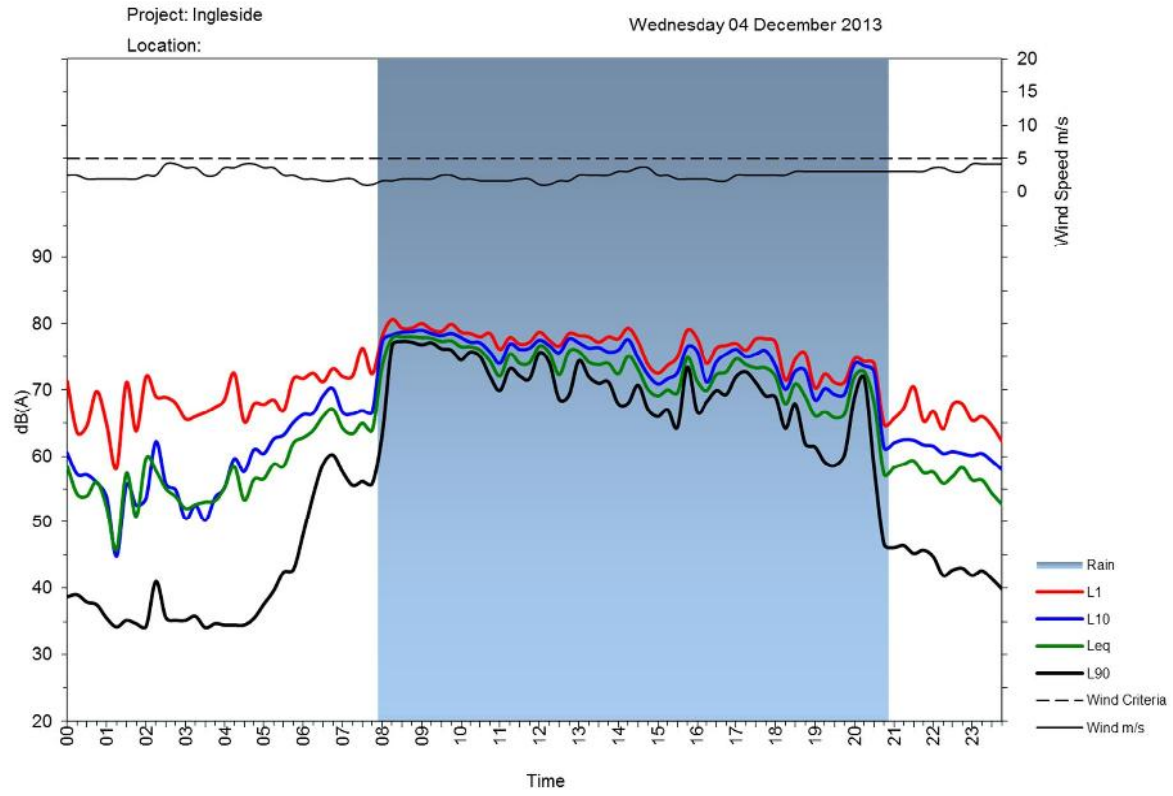


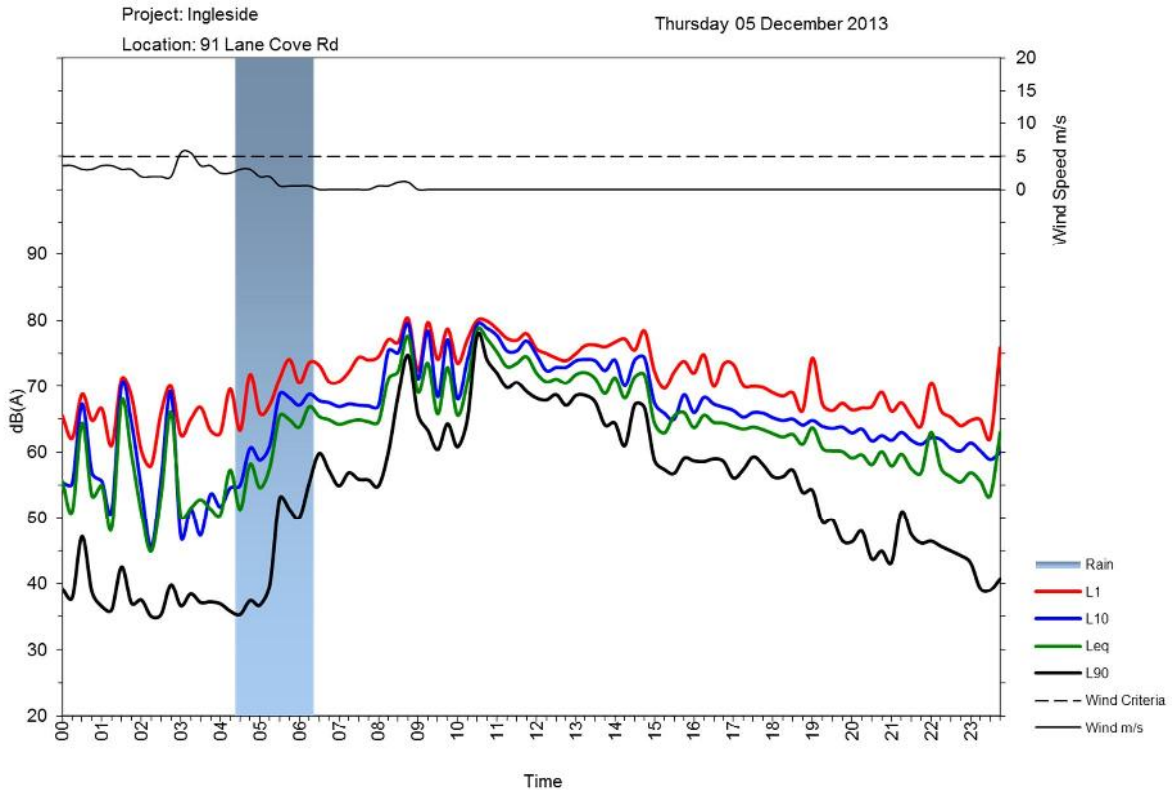


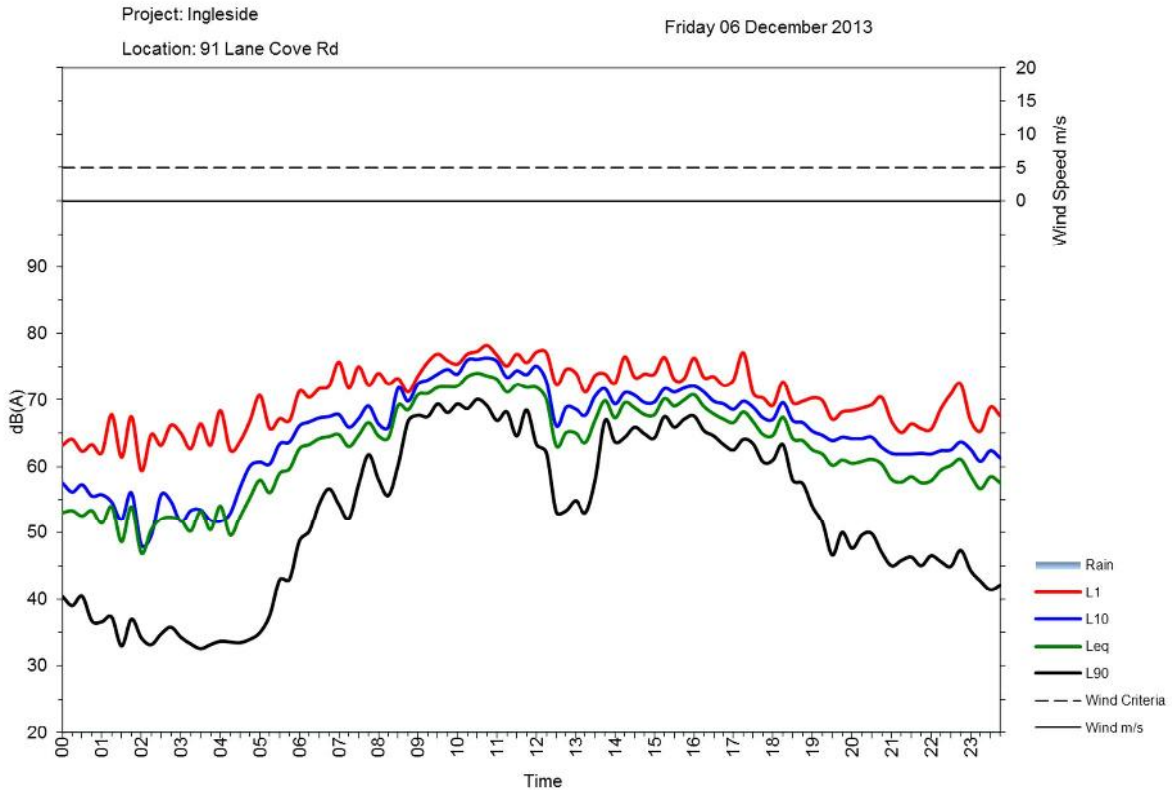
NL5 – No results due to logger failure

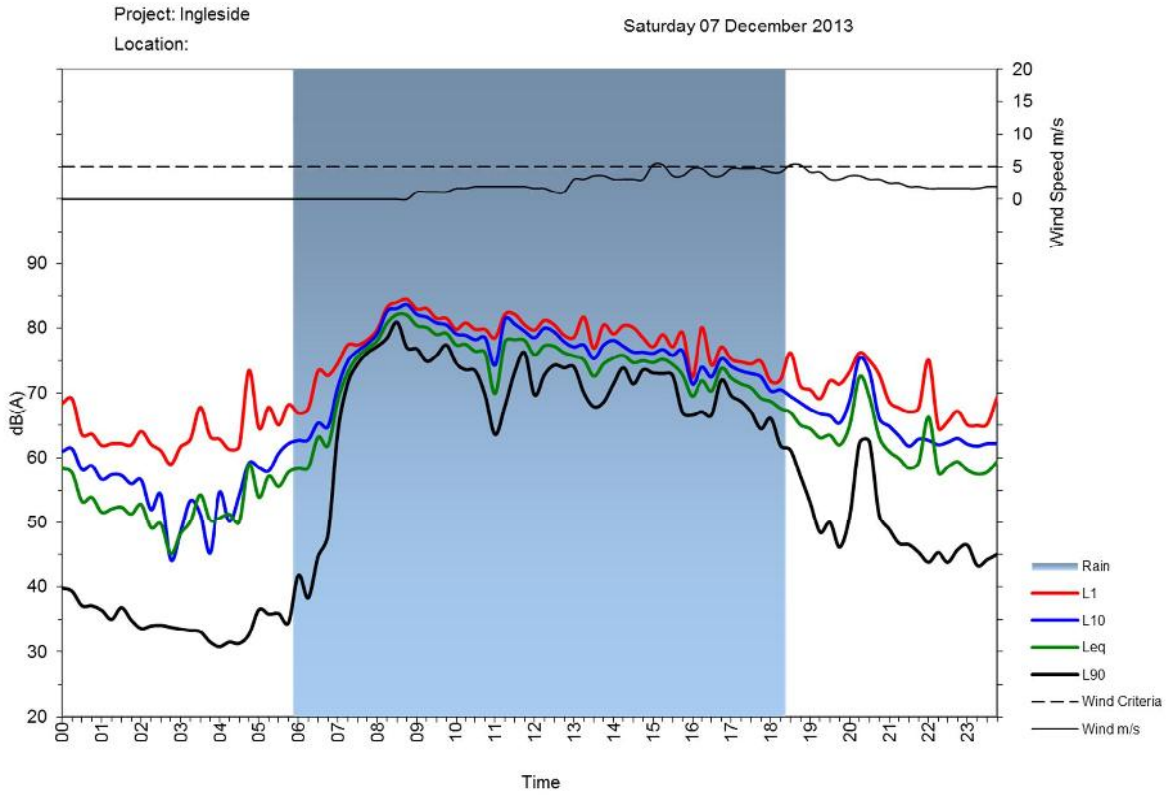
NL6

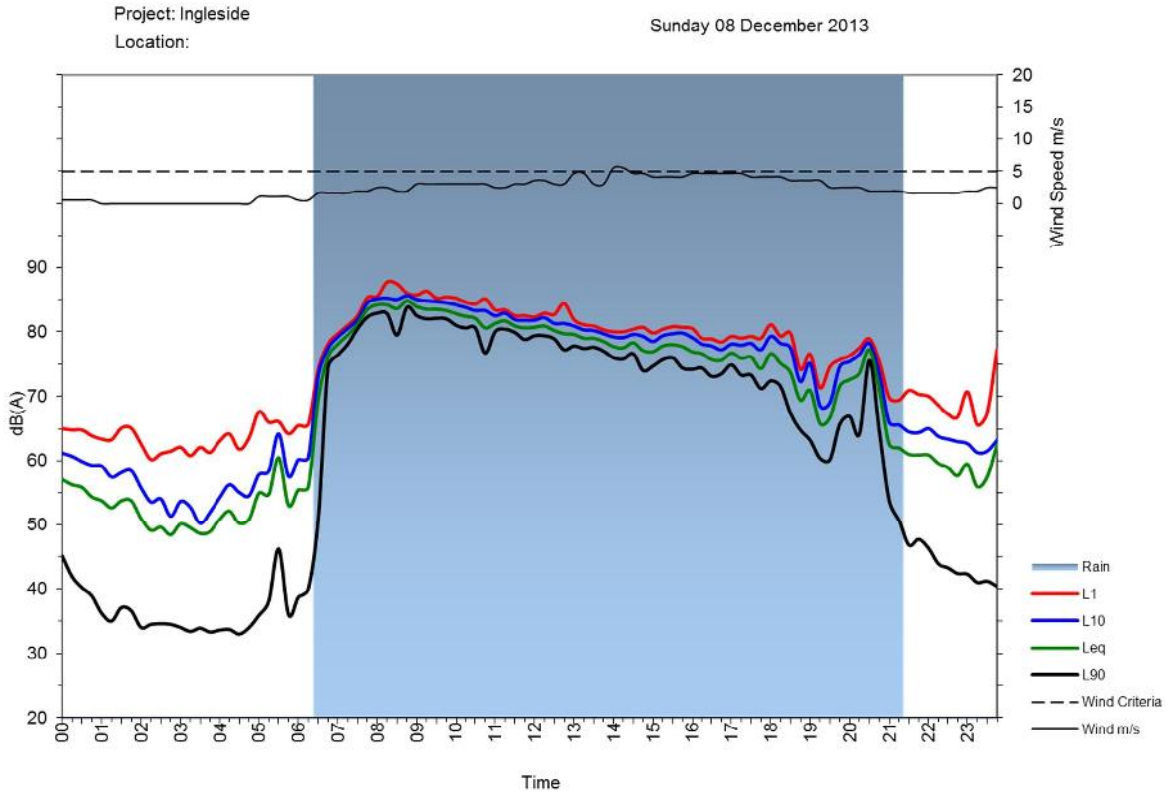

Project: Ingleside
Location: 91 Lane Cove Rd
Tuesday 03 December 2013
Wind Speed m/s
dB(A)
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

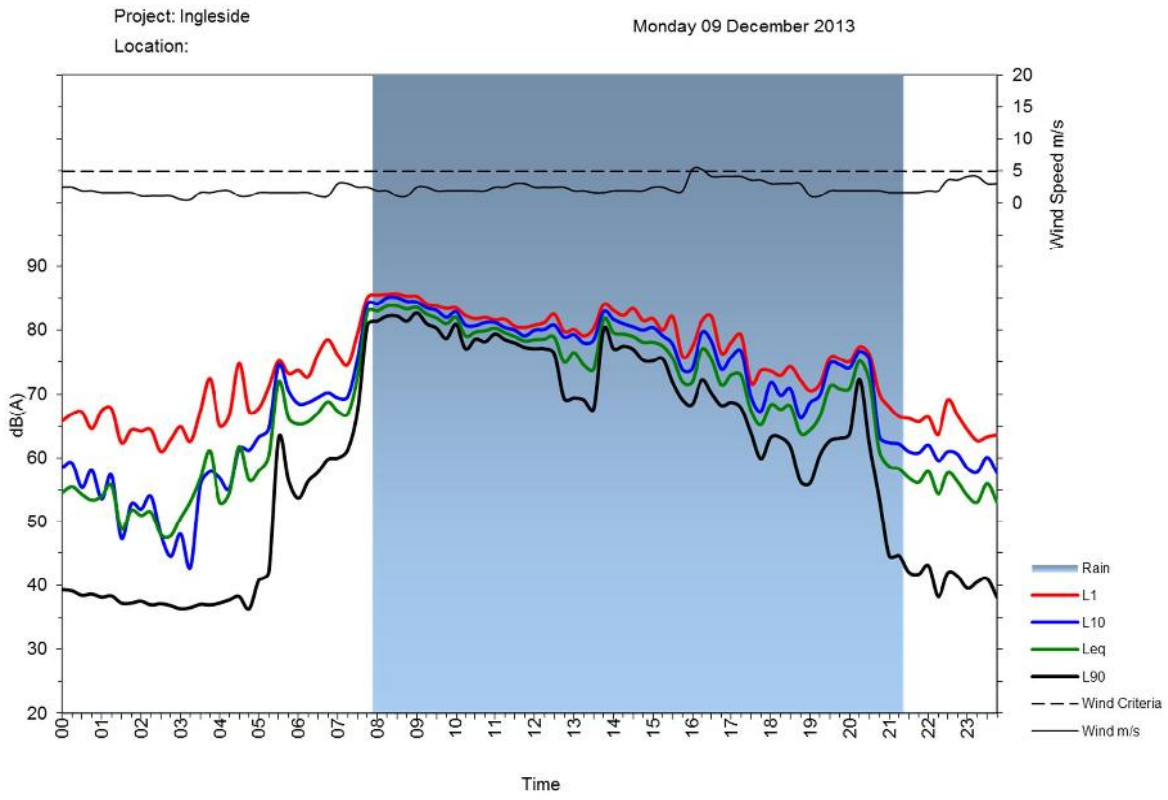

Project: Ingleside
Location:
Wednesday 04 December 2013
Wind Speed m/s
dB(A)
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

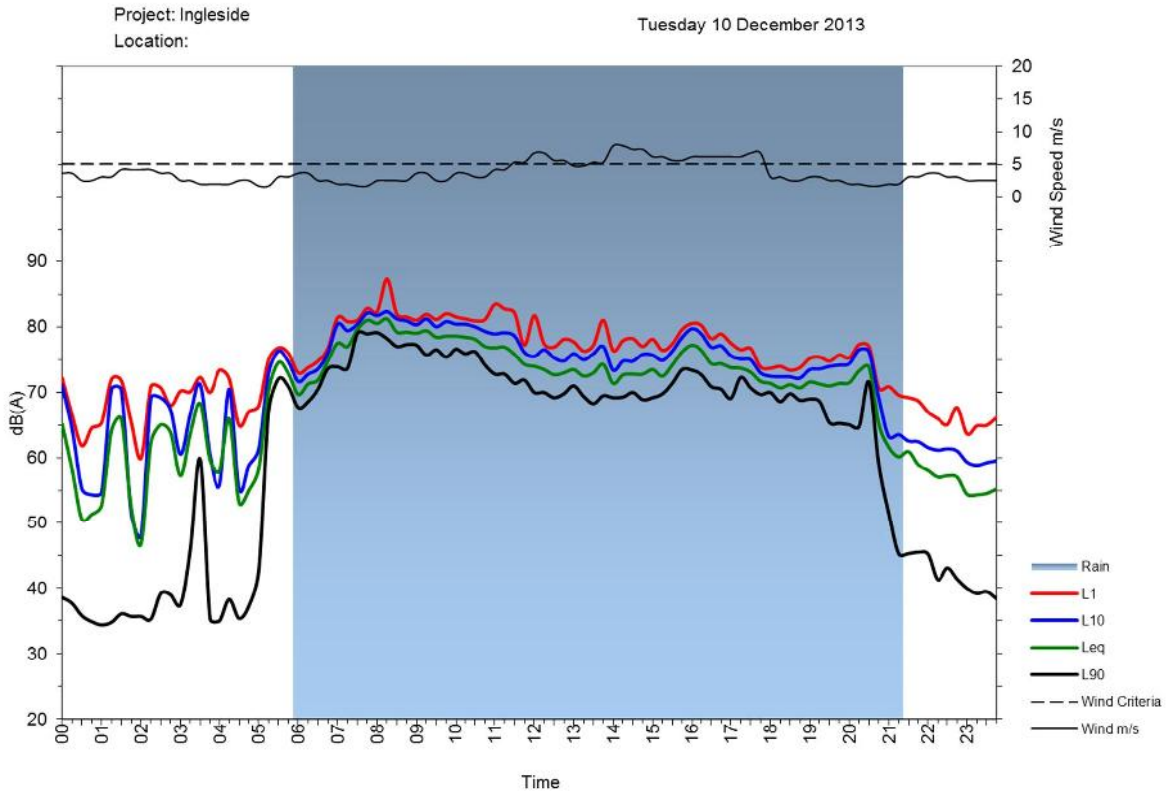

Project: Ingleside
Location: 91 Lane Cove Rd
Thursday 05 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

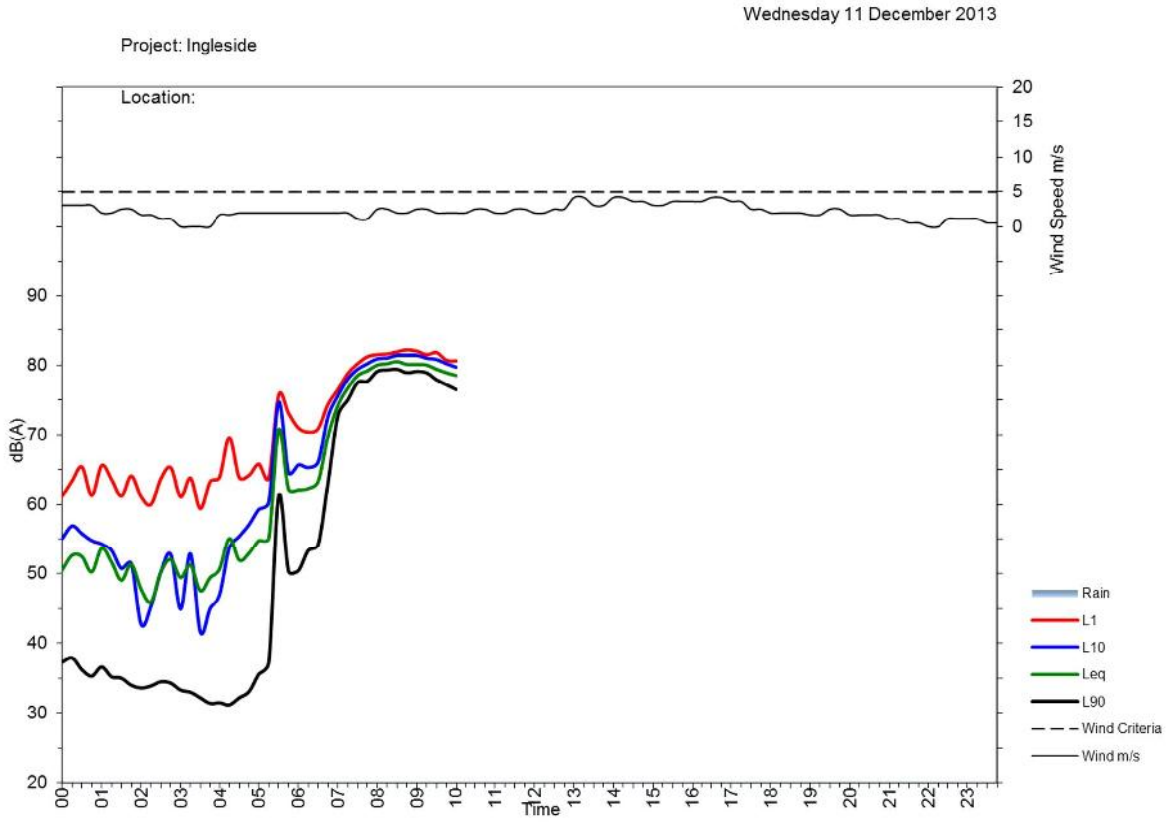

Project: Ingleside
Location: 91 Lane Cove Rd
Friday 06 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s


Project: Ingleside
Location:
Saturday 07 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s


Project: Ingleside
Location:
Sunday 08 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s


Project: Ingleside
Location:
Monday 09 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s


Project: Ingleside
Location:
Tuesday 10 December 2013
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s


Wednesday 11 December 2013
Project: Ingleside
Location:
dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

Appendix C

Traffic Volumes

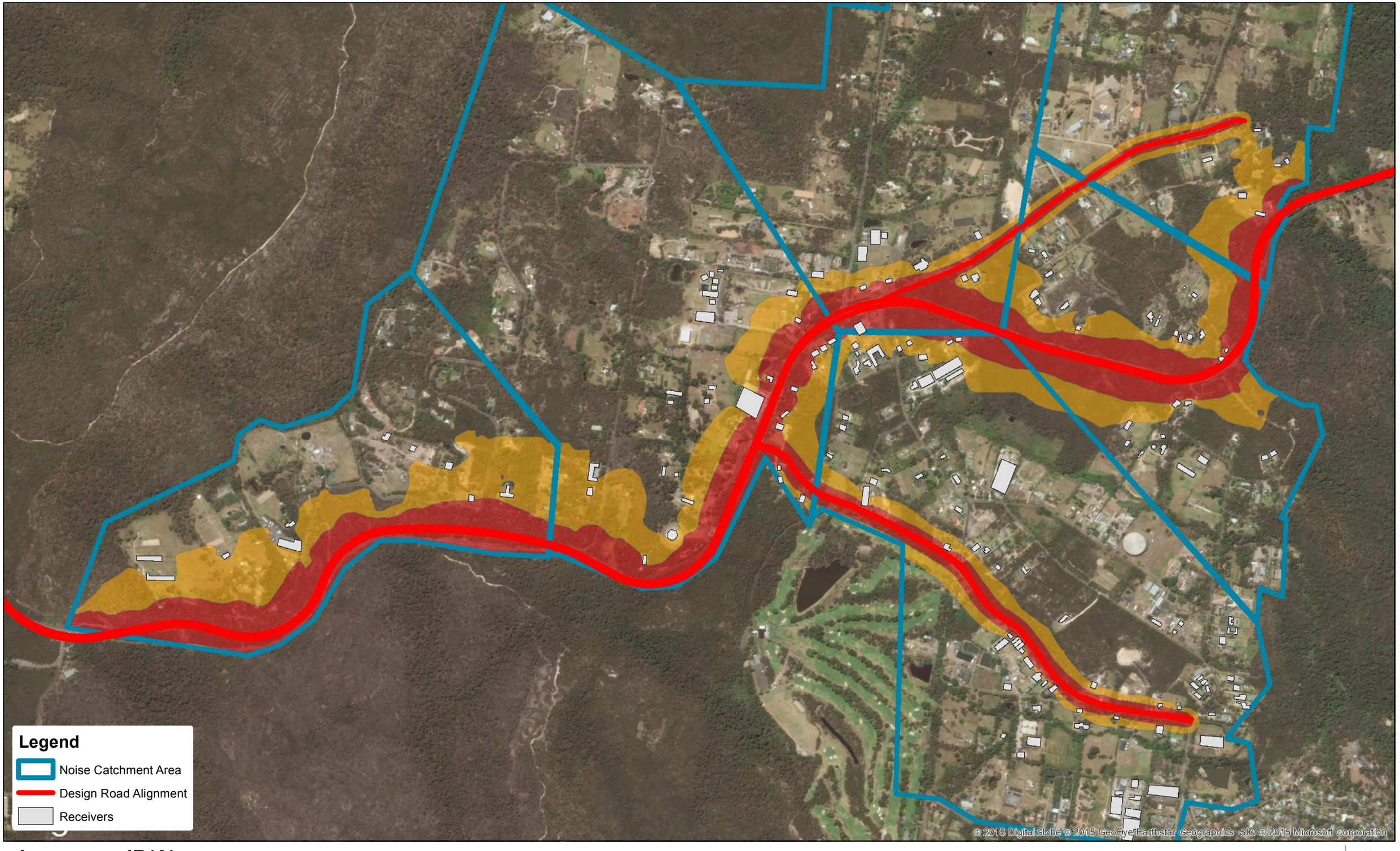
Appendix C Traffic Volumes

Road	Day 15 hour		Night 9 hour		Speed, km/h
	Light vehicles	Heavy vehicles	Light vehicles	Heavy vehicles	
2013 Existing					
Mona Vale Road, 150 m east of Tumburra St	15075	1020	1494	153	75
Mona Vale Road, 500 m east of Lane Cove Rd	9000	660	963	108	60
Mona Vale Road, Btwn Foley St and Oliver Way	9570	615	882	99	60
Mona Vale Road, 150 m east of Tumburra St	14595	1140	2115	198	75
Mona Vale Road, 500 m east of Lane Cove Rd	8610	720	1296	90	60
Mona Vale Road, Btwn Foley St and Oliver Way	8850	1020	1026	135	60
Powderworks Road, Btwn Wattle Rd and Wilson Ave	5130	225	405	18	60
Powderworks Road, Btwn Wattle Rd and Wilson Ave	4980	180	756	36	60
Lane Cove Rd	3015	75	306	9	55
2036 No Build					
Mona Vale Road, west of Powderworks Road EB	21765	1770	2304	279	75
Mona Vale Road, west of Powderworks Road WB	21090	2025	3618	360	75
Mona Vale Road, East of Manor / Lane Cove Road EB	17265	1575	1998	270	60
Mona Vale Road, East of Manor / Lane Cove Road WB	15900	1665	2871	207	60
Powderworks Road, south of Mona Vale Rd EB	4455	285	378	0	60
Powderworks Road, south of Mona Vale Rd WB	5850	60	1035	18	60
Lane Cove Rd, North of Mona Vale Road both directions	3195	135	459	9	55
2036 Build					
Mona Vale Road, west of Powderworks Road EB	21915	1785	2313	279	75
Mona Vale Road, west of Powderworks Road WB	21540	2070	3690	369	75
Mona Vale Road, East of Manor / Lane Cove Road EB	17655	1605	2043	279	60
Mona Vale Road, East of Manor / Lane Cove Road WB	16200	1710	2925	207	60
Powderworks Road, south of Mona Vale Rd EB	5505	345	468	9	60
Powderworks Road, south of Mona Vale Rd WB	7050	75	1251	27	60
Lane Cove Rd, North of Mona Vale Road both directions	6135	285	837	9	55

Appendix D

Noise Contour Maps

AECOM



$L_{Aeq\ (15hour)}$ dB(A)

60 65

INGLESIDE RELEASE AREA

Operational Noise Contours - 2036 Daytime

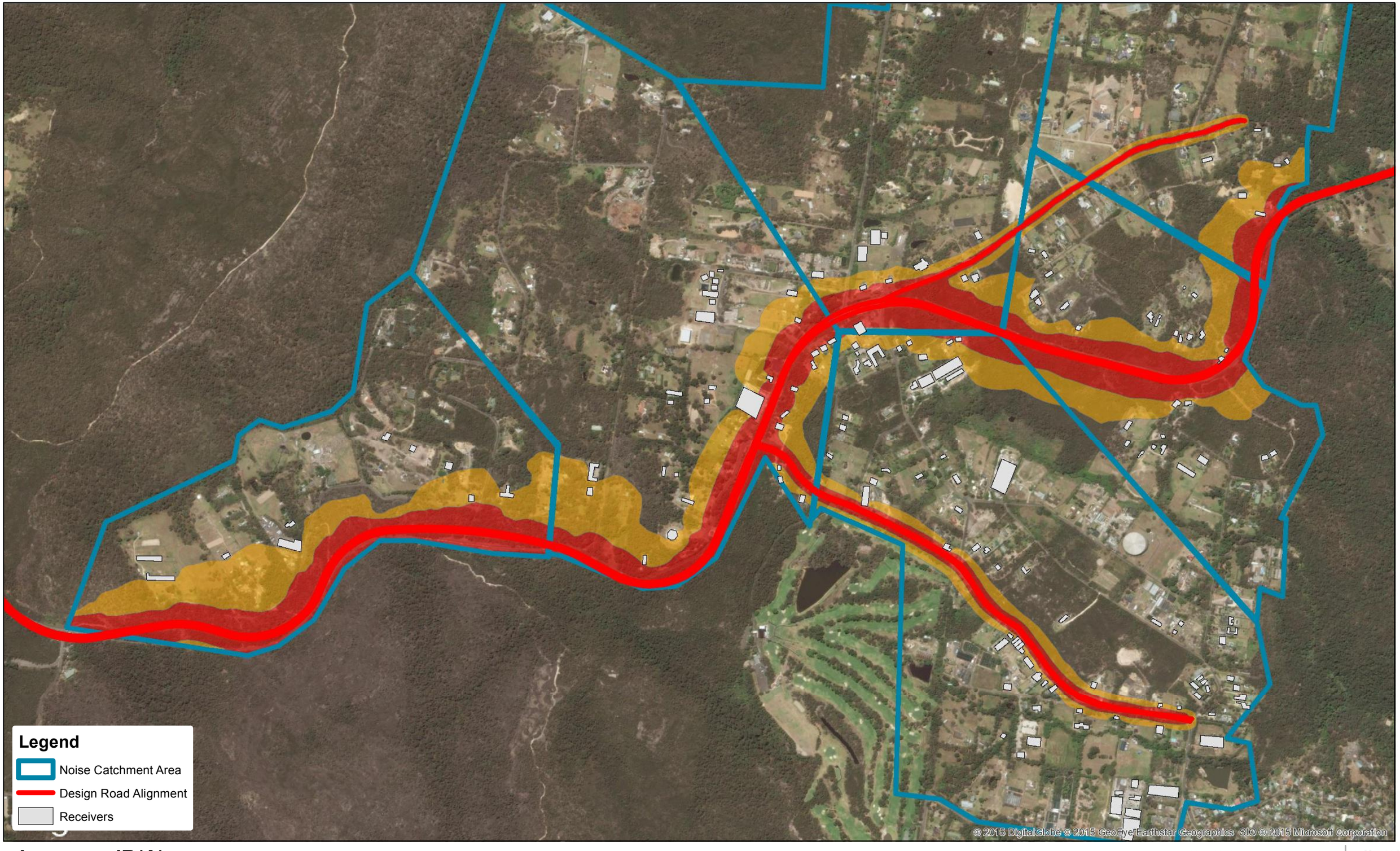
0 250 500 1,000 m

Mar 2015

60312114

Fig. 1

AECOM



$L_{Aeq(9hour)}$ dB(A)

55 60

INGLESIDE RELEASE AREA

Operational Noise Contours - 2036 Night-time

0 250 500 1,000 m

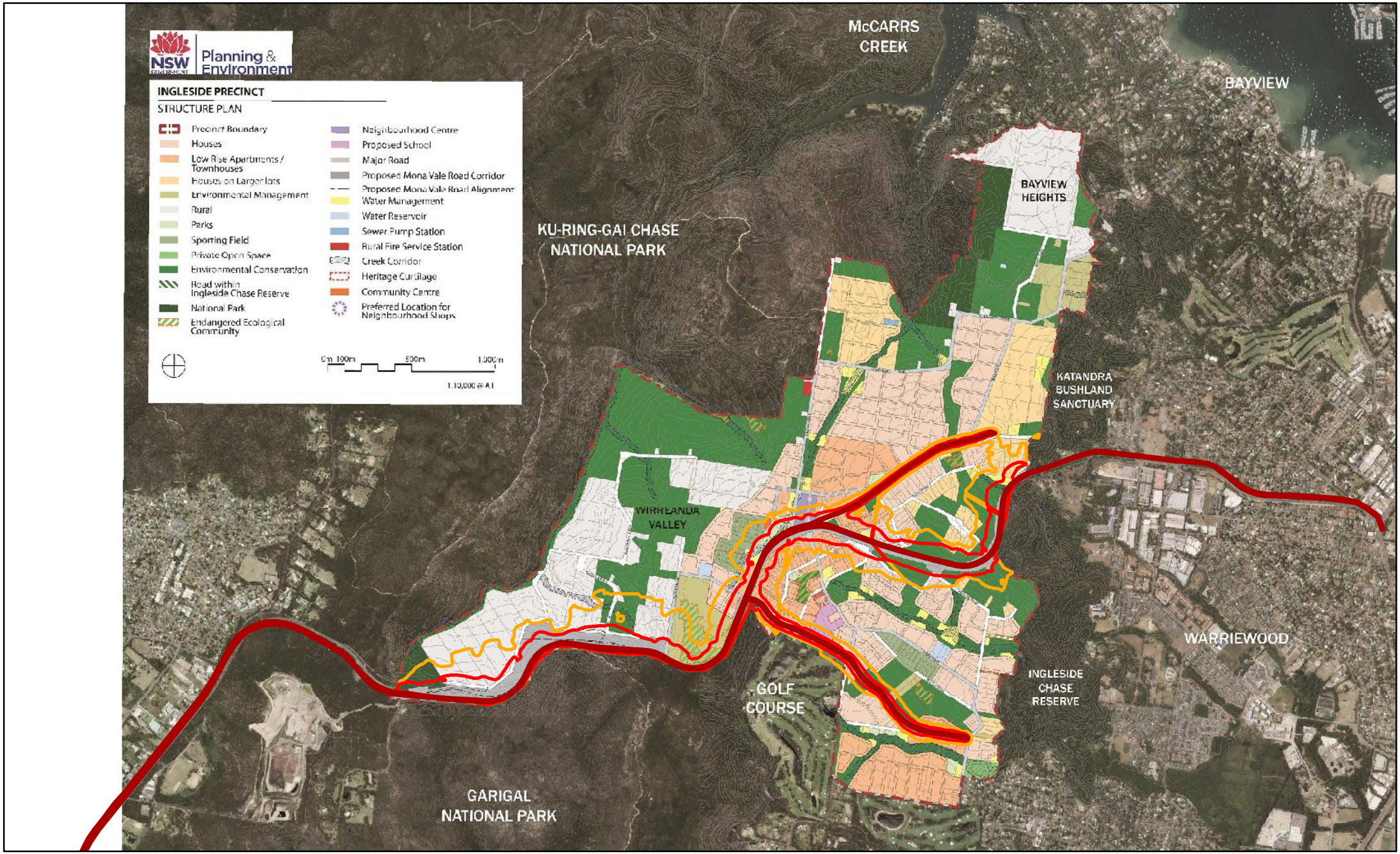
Mar 2015

60312114

Fig. 2

Appendix E

Draft Plan with Predicted Road Traffic Noise Levels



$L_{Aeq\ (15hour)}$ dB(A)

60 65

INGLESIDE RELEASE AREA

Operational Noise Contours - 2036 Daytime

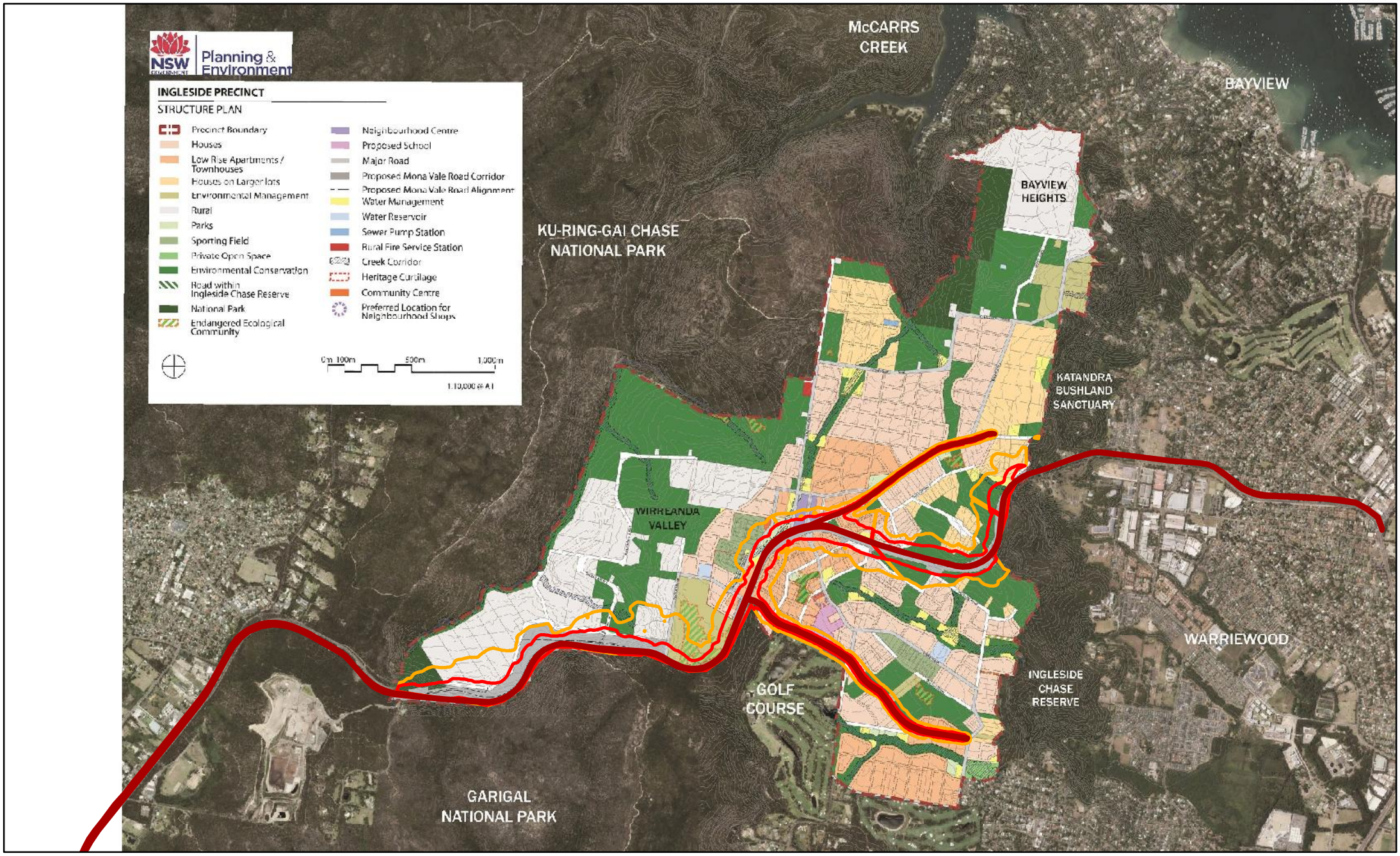
0 500 1,000 2,000 m

N

Oct 2016

60312114

Fig. **1**



$L_{Aeq(9hour)}$ dB(A)

55 60

INGLESIDE RELEASE AREA

Operational Noise Contours - 2036 Night-time

0 500 1,000 2,000 m

N

Oct 2016

60312114

Fig. **2**