Pacific Highway Kundabung to Kempsey

Post construction noise assessment

Roads and Maritime Services | April 2019

NSW GOVERNMENT

DOCUMENT CONTROL

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Glossary of acoustic terms

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) - The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} - The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} - The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

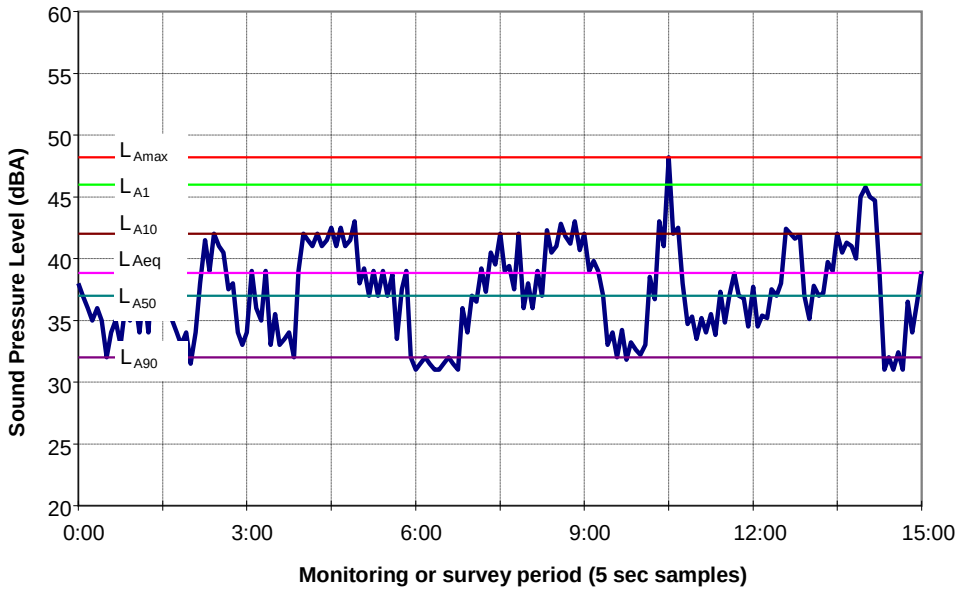
L_{A90} - The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} - The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL - The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL - The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period **-** daytime, evening and night time.

Typical graph of sound pressure level vs time



Executive summary

The Kundabung to Kempsey project (K2K) is Stage 2 of the Oxley Highway to Kempsey Pacific Highway upgrade project and comprises 14 kilometres of dual carriageway including building of an interchange at Kundabung Road, new intersections for local access roads, bus stops and new rest areas at Ballengarra State Forest. The project connects to the Oxley Highway to Kundabung (OH2Ku) project to the south near Barrys Creek and the Kempsey bypass to the north at Stumpy Creek. Construction of the project started in 2014, opening to traffic in September 2017, with highway traffic speed increased to 110km/h on 28 May 2018.

During the detailed design phase of the project, predictive modelling was carried out to determine the likely road traffic noise levels expected once the project opened to traffic. The results of modelling for K2K project were detailed in the Operational Noise Management Report, dated October 2013.

Roads and Maritime Services (Roads and Maritime) engaged Wilkinson Murray Pty Limited (WM) to carry out a Post Construction Operational Noise Assessment of the project, which is covered in this report.

Noise criteria

Operational noise requirements for K2K were developed in accordance with the Minister's Conditions of Approval, the Environment Protection Authority's (EPA's) Environmental Criteria for Road Traffic Noise (ECRTN) and Road and Maritime's Environmental Noise Management Manual (ENMM).

Unattended noise measurements

Unattended noise monitoring was carried out at a total of 10 locations using an automated noise logger placed at each location for 12 days to record noise data. The results of the noise monitoring have been processed in accordance with the procedures contained in the ECRTN and ENMM and are presented within the body of this report.

Attended noise measurements

Attended noise measurements were taken by a technician manually operating a sound level meter at each receiver location to allow for real-time identification of noise sources. Measurements were also carried out at two additional receiver locations nearest to the Barrys Creek rest areas to assess the noise emitted from Barrys Creek rest area.

Noise modelling

Road traffic noise levels for K2K were calculated using procedures based on the Calculation of Road Traffic Noise (CoRTN) prediction algorithms. The UK Department of Transport devised the CoRTN algorithm, and with suitable corrections this method has been shown to provide accurate predictions of traffic noise levels under Australian conditions. All modelling inputs and methodology used in the K2K noise assessments have been in accordance with the requirements of the ENMM.

Scenarios modelled for the K2K noise assessments include existing 'year of opening' (2018) and 'design year' (2028) for both daytime and night-time periods. Pavement types used along the extent of the highway have also been incorporated into the modelling.

Noise modelling elements as part of this assessment report included:

- day and night traffic flows
- ground and air absorption
- travel speed
- heavy and light vehicle percentages
- surface corrections
- road alignment gradients
- topography.

Traffic counts

NTS was engaged to carry out traffic counting at 12 locations along the alignment. Traffic counting was taken at the same time as noise logging for validation of the existing traffic noise model.

Model validation and additional noise mitigation requirements

The measured road traffic noise level was compared to the predicted levels. The results of noise measurements undertaken following the opening of K2K to traffic have correlated well with the predicted noise levels, particularly in monitoring locations close to the highway. Receivers further from the highway where highway noise may have been affected by dense vegetation, temperature inversion or wind conditions recorded noise measurements differing by more than 3dB from the noise prediction in some instances.

The average difference between the measured and predicted noise level, excluding any outliers, show the measured level is below the predicted level, leading to the conclusion the model marginally over predicts. The average difference between measured and predicted noise levels showed an average over-prediction of less than 1.0dBA at daytime and an average over-prediction of 0.7dBA at night time when outliers have been removed.

The 'year of opening' and 'design year' road traffic noise was modelled using predicted 2018 and 2028 traffic flows. Road traffic noise levels modelled for these years were compared against the noise levels detailed in the Operational Noise Management Report (ONMR). This was completed to determine if the design stage noise modelling was accurate and subsequently confirm that previously recommended noise mitigation measures were adequate.

Conclusion

Based on the revised future road traffic noise prediction for 2028, it was noted a majority of the receivers would be affected by a small increase in noise level compared to the 2026 noise prediction. This small increase in road traffic noise has resulted in an additional four receivers requiring at house noise mitigation treatments.

1 Introduction

1.1 Overview

The Kundabung to Kempsey project (K2K) is Stage 2 of the Oxley Highway to Kempsey Pacific Highway upgrade project and comprises 14 kilometres of dual carriageway including building of an interchange at Kundabung Road, new intersections for local access roads, bus stops and new rest areas at Ballengarra State Forest. The project connects the Oxley Highway to Kundabung (OH2Ku) project to the south near Barrys Creek and the Kempsey bypass to the north at Stumpy Creek as shown in Figure 1-1. Major works of the project started in 2014, opening to traffic in September 2017 with highway traffic speed increased to 110km/h in 28 May 2018.

Indicative noise mitigation measures were identified at the Environmental Assessment stage in the "Oxley Highway to Kempsey Environmental Assessment, Volume 3 – Noise and Vibration Working Paper" prepared by Wilkinson Murray, September 2010.

The noise mitigation measures were reviewed during the detailed design stage and presented in the Operational Noise Management Report prepared by Wilkinson Murray in "Pacific Highway Upgrade Kundabung to Kempsey: Operational Noise Management Report Version G" (WM Report No. 12063 Version G, October 2013)". The ONMR measured and modelled the road traffic noise for K2K project in 2012. This model was used to predict road traffic noise for 2016 (opening year of the project) and for 2026 (10 years after opening) based on the detailed design and predicted traffic volumes and speeds.

Roads and Maritime engaged Wilkinson Murray to carry out the Post Construction Operational Noise Assessment of the K2K project.

1.2 Purpose

The purpose of this report is to review the traffic noise levels from the K2K Pacific Highway upgrade and compare them against the predicted noise levels in the detailed design stage to assess the adequacy of the recommended and installed road traffic noise mitigation measures. This report also fulfils the requirements of Condition E1 of the Ministers Conditions of Approval (MCoA) for the project.

1.3 Assessment approach

The assessment has been carried out with reference to the following documents:

- Condition E1 of the Ministers Conditions of Approval (MCoA) (DP&I, 2008)
- Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999)
- Environmental Noise Management Manual (ENMM) (RTA, 2001)
- Roads and Maritime Procedure – Preparing a Post Construction Noise Assessment Report (PCNA) (Roads and Maritime, 2014)
- Austroads: An Approach to the Validation of Road Traffic Noise Models (Austroads, 2002)
- Australian Standard AS 2702 1984 – Acoustic Methods of Measurement of Road Traffic Noise
- Industrial Noise Policy (INP) (EPA, 2000)
- Oxley Highway to Kempsey Environmental Assessment, Volume 3 – Noise and Vibration Working Paper" prepared by Wilkinson Murray (September 2010)
- Pacific Highway Upgrade Kundabung to Kempsey: Operational Noise Management Report Version G" (WM Report No. 12063 Version G, October 2013).

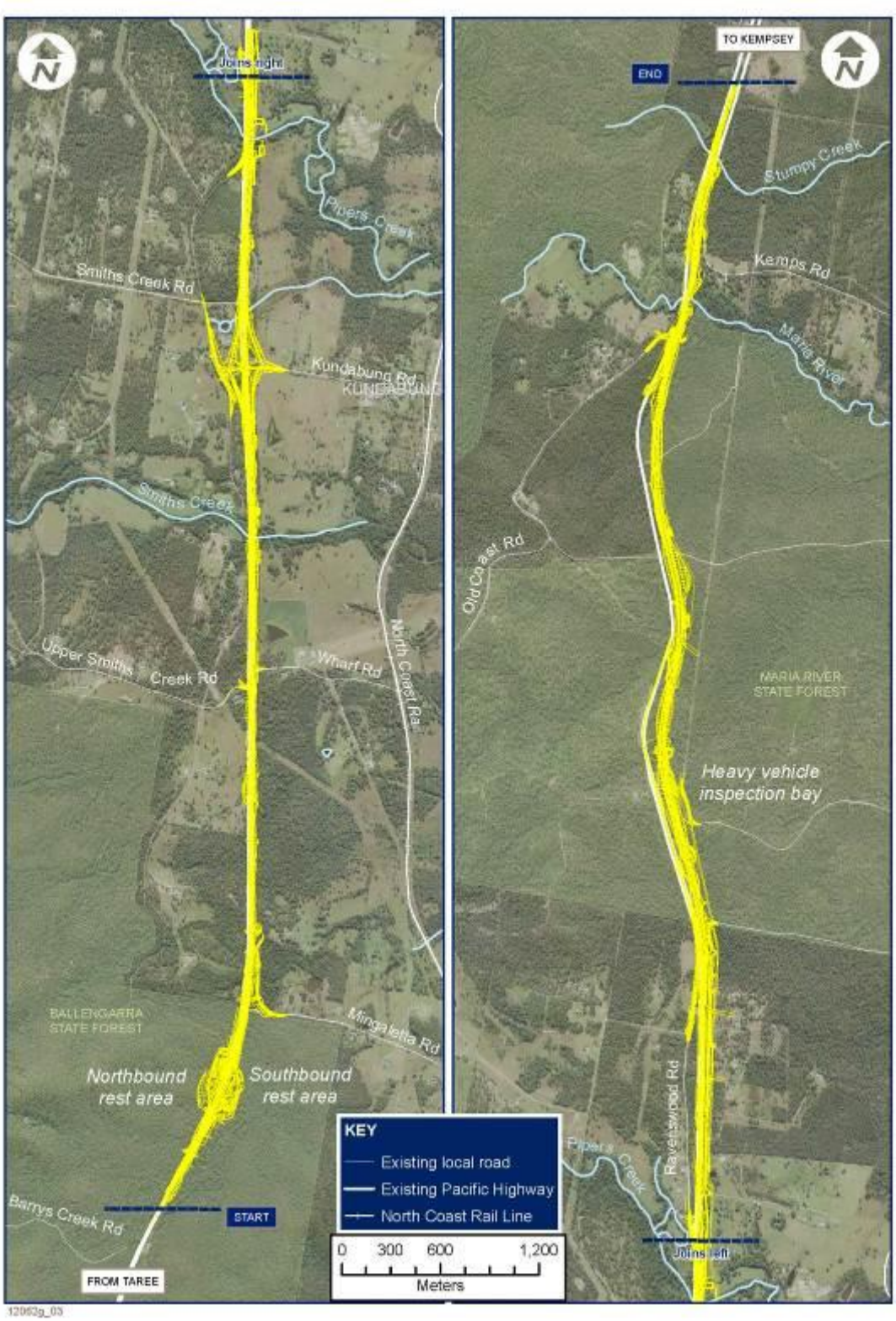
The assessment includes the following aspects:

- measurement of traffic noise at representative noise sensitive receivers along the project. This included long-term noise monitoring at 10 residential noise-sensitive locations as well as two 15-minute interval attended noise measurements taken at the 10 monitoring locations
- simultaneous traffic counts
- validation of the noise model developed during detailed design used to predict noise impact due to the upgrade
- evaluation of compliance against the Environmental Criteria for Road Traffic Noise (ECRTN)
- evaluation of the mitigation measures determined during detailed design stage.

The Environmental Criteria for Road Traffic Noise (ECRTN) requires the assessment and measurement of road traffic noise immediately after opening the upgrade and the prediction of traffic noise levels 10 years after opening. The ONMR was prepared using an opening date of 2016. The prediction model has been revised to reflect the traffic volume and speed measured in 2018 for the upgraded highway. Changes in the traffic volume and the upgrade project design since the completion of the ONMR are discussed in Section 6 of this report.

Road traffic noise prediction results for 2018 and 2028 are presented in Appendix A of this report.

Figure 1-1 Kundabung to Kempsey Pacific Highway upgrade section



2 Minister's conditions of approval

Operational noise requirements for the project are detailed in the Minister for Planning and Infrastructure Conditions of Approval. Details of this condition are provided below:

E1. Within 12 months of the commencement of operation of the project, or as otherwise agreed by the Director General, the Proponent shall undertake operational noise monitoring to compare actual noise performance of the project against noise performance predicted in the review of noise mitigation measures required by condition C13, and prepare an Operational Noise Report to document this monitoring. The Report shall include, but not necessarily be limited to:

a) noise monitoring to assess compliance with the operational noise levels predicted in the review of operational noise mitigation measures required under condition C13 and documents specified under condition A1 of this approval;
b) a review of the operational noise levels in terms of criteria and noise goals established in the Environmental Criteria for Road Traffic Noise (Environment Protection Authority, 1999);
c) methodology, location and frequency of noise monitoring undertaken, including monitoring sites at which project noise levels are ascertained, with specific reference to locations indicative of impact on sensitive receivers;
d) details of any complaints and enquiries received in relation to operational noise generated by the project between the date of commencement of operation and the date the report was prepared;
e) any required recalibrations of the noise model taking into consideration factors such as actual traffic numbers and proportions;
f) an assessment of the performance and effectiveness of applied noise mitigation measures together with a review and if necessary, reassessment of all feasible and reasonable mitigation measures; and
g) identification of additional feasible and reasonable measures to those identified in the review of noise mitigation measures required by condition C13, that would be implemented with the objective of meeting the criteria outlined in the Environmental Criteria for Road Traffic Noise (Environment Protection Authority, 1999), when these measures would be implemented and how their effectiveness would be measured and reported to the Director General and the EPA.

The Proponent shall provide the Director General and the EPA with a copy of the Operational Noise Report within 60 days of completing the operational noise monitoring referred to in (a) above or as otherwise agreed by the Director General.

3 Operational noise criteria

3.1 Road traffic noise criteria

The K2K project was approved by the Minister for Planning and Infrastructure in February 2012. The conditions of approval for the project require the road traffic noise to be assessed in accordance with the NSW Government's Environmental Criteria for Road Traffic Noise (ECRTN).

The ECRTN defines highway development as either "new freeway" or "redevelopment of an existing freeway". Table 3-1 contains the road traffic noise criteria for existing residential land use developments affected by traffic noise from new and redeveloped freeways. The K2K project is assessed as a "redevelopment of an existing freeway".

Table 3-1 *Environmental Criteria for Road Traffic Noise* criteria for operational traffic noise – residences

Type of development	Noise level criterion		Where criteria are already exceeded
	Day (7am-10pm)	Night (10pm-7am)	
New Highway or arterial road corridor	$L_{Aeq,15hr}$ 55dBA	$L_{Aeq,9hr}$ 50dBA	The new road should be designed so as not to increase existing noise levels by more than 0.5dB. *Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies …*
Redevelopment of existing Highway/ arterial road	$L_{Aeq,15hr}$ 60dBA	$L_{Aeq,9hr}$ 55dBA	In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2dB. *Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies …*

Roads and Maritime published the Environmental Noise Management Manual (ENMM) to assist with the implementation of the ECRTN. The ENMM discusses what is deemed to be "feasible and reasonable" in terms of additional noise mitigation where the ECRTN base criteria are exceeded and all "feasible and reasonable" traffic management and other road design opportunities have been exhausted. This includes at house noise treatment of private dwellings.

The ENMM states for redeveloped freeways where existing noise levels already exceed the base criteria in Table 3-1 for it is generally not considered reasonable to apply additional treatments if the predicted design year noise levels:

- within 2 dBA of "future existing" noise levels (as defined in Phase 2(b) of ENMM)
- will not be 'acute' (ie do not exceed 65dBA $L_{Aeq,15hr}$ and 60dBA $L_{Aeq,9hr}$).

The noise level criterion contained in Table 3-1 applies to the predicted noise level at opening of the project (design year, 2018) and at 10 years after opening the project (2028).

3.2 Rest area noise criteria

The ECRTN primarily provides requirements for the assessment of noise from continually flowing traffic and is not relevant to the noise from the Barrys Creek rest areas next to the motorway in Ballengarra State Forest.

The Industrial Noise Policy (INP) is the relevant procedure to consider the noise generated from the rest areas as the location is fixed. The noise is assessed as if it were an "industrial" activity. The INP establishes Intrusiveness Criteria to limit the permissible level of noise from mechanical plant at the industrial premises to no more than 5dBA above the background noise when measured over a 15-minute period ($L_{Aeq,15\ min}$).

The noise levels measured at 61 Mingaletta Road are indicative of the background levels at the rest area and nearby residences. The Rating Background Levels (RBLs) measured during the unattended monitoring at this residence are shown in Table 3-2.

Table 3-2 Summary of background noise monitoring for Barrys Creek rest areas

Time period	RBL (dBA)
Daytime (7.00am–6.00pm)	38
Evening (6.00–10.00pm)	40
Night time (10.00pm–7.00am)	37

For night time use of the rest area it is also appropriate to consider the Department of Environment and Climate Change sleep arousal guidelines contained in the Environmental Noise Control Manual (ENCM). This requires the typical maximum noise level (denoted as $L_{A1,1min}$ in the ENCM) associated with noise from heavy vehicles at the rest area (engines starting/doors closing) should not exceed the background L_{A90} noise level by more than 15dBA.

Table 3-3 provides the summary of the Intrusiveness and Sleep Arousal criteria established using the measured background noise level and applying the procedures in the INP application notes.

Table 3-3 Residential noise criteria

Time period	Intrusiveness criteria ($L_{Aeq,15\ min}$ dBA)	Sleep arousal (L_{Amax} dBA)
Daytime (7.00am–6.00pm)	43	-
Evening (6.00–10.00pm)	43	-
Night time (10.00pm–7.00am)	42	52

4 Traffic noise mitigation

The ONMR recommends the most "feasible" and "reasonable" mitigation, as defined within the ENMM, in the form of architectural treatments at the property be considered for affected residences. For properties where the exceedances of the base criteria are up to 10dB, provision of fresh air ventilation, sealing of wall vents and upgraded window and door seals is generally considered appropriate.

The EA contains information, as a guide, which cross-references the noise control options with the level of noise reduction required.

The aim of at-property acoustic mitigation is to provide the internal noise level which would have prevailed had the external traffic noise criteria been able to be achieved. The criteria detailed in Table 4-1 are to be used by Roads and Maritime as a general guideline when scoping the acoustic treatments for each property.

Table 4-1 Architectural treatment guide

Treatment type	Predicted noise exceedance above the acceptable noise criteria dBA	Acoustic treatments to be considered
1	<5dBA reduction	Air conditioning with fresh air mechanical ventilation.
2	6-10dBA reduction	Air conditioning with fresh air mechanical ventilation plus consideration of upgraded doors and windows, acoustic seals, and acoustic treatment of wall vents to the most-impacted facade(s) where significant benefit can be demonstrated.
3	>10dBA reduction	Air conditioning with fresh air mechanical ventilation plus upgraded doors and windows, acoustic seals, and acoustic treatment of wall vents to all impacted facades where significant benefit can be demonstrated.

Each residence which requires acoustic treatment needs to be considered on a case by case basis to determine the type of treatment. The available options need to be tailored with consideration to the following:

- the magnitude of the traffic noise at the residence
- the type and condition of the property to be treated
- the orientation of the dwelling to the noise source
- the internal room layout
- specific requirements of the resident.

Based on the *ENMM's* process of determining mitigation (as outlined in Section 3) and the 2026 noise prediction outcome, the ONMR (WM Report No. 12063 Version G) outlined a total of 49 receiver buildings which required mitigation.

5 Operational noise monitoring

5.1 Methodology

Long-term unattended noise monitoring was carried out between 13 and 24 August 2018 at 10 residential properties, with simultaneous traffic counts. Short-term attended noise measurements were also conducted at the 10 assigned unattended noise monitoring locations.

As per the ECRTN traffic noise monitoring conditions, the long-term noise monitors were installed one metre from the building façade most exposed to traffic noise, or at the most relevant location on the residential property. In addition to this, the noise monitors were installed about one and half metres above the ground level.

Long-term noise measurements were carried out with the ARL NGARA noise loggers at all monitored receiver locations, with the exception of 132 Rodeo Drive, Kundabung where a SVAN 977 noise logger was used. The noise monitoring equipment was set to A-weighted, fast response, continuously monitoring over 15-minute sampling periods. The equipment calibration was checked before and after the survey and no significant drift was noted.

The primary purpose of the noise monitoring is to assess the road traffic noise of the K2K upgrade and check whether the noise measurements meet the criteria established for this project. Noise monitoring also allows validation of the traffic noise computer model for the project, as required by the ENMM. This requires a spread of locations along the length of the project and a range of setback distances. In addition to this, the monitoring locations were selected to assess receivers most affected by the Pacific Highway noise within each Noise Catchment Area (NCA).

The loggers determine L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10} and L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Glossary of Acoustic Terms for definitions). The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle. This is used for the assessment of sleep disturbance. The L_{A90} level is normally taken as the background noise level.

Table 5-1 provides a list of the unattended noise monitoring receiver locations, along with the relevant NCA as outlined in the ONMR prepared by Wilkinson Murray (Report No. 12063 Version G, dated October 2013).

Table 5-1 Noise monitoring locations

NCA	Receiver location	Distance (m) from Pacific Highway	Distance (m) from nearest local road
10	22 Mobbs Drive, Kundabung	200	280m from Mingaletta Road
08	35 Old Pacific Highway, Kundabung	250	90m from Old Pacific Highway
09	27 Wharf Road, Kundabung	270	90m from Wharf Road
05	132 Rodeo Drive, Kundabung	240	150m from Rodeo Drive
07	25 Kundabung Road, Kundabung	220	85m from Kundabung Road
04	161 Carlyle Road, Kundabung	650	640m from Carlyle Road
03	106 Ravenswood Road, Kundabung	100	50m from Ravenswood Road
04	41 Carlyle Road, Kundabung	160	140m from Carlyle Road
01	50 Old Coast Road, South Kempsey	410	210m from Old Coast Road
01	180 Scrubby Creek Road, South Kempsey	130	75m from Scrubby Creek Road

The attended noise measurement was carried out using the Brüel & Kjær 2260-A sound level meter at each monitored residential property. 15-minutes noise measurements were taken at each assigned location during the day and night period and notes were taken of the typical sources of ambient noise. The purpose of the short-term measurement was to get an understanding of the noise environment of each selected receiver location, including any repeatable traffic noise such as regular use of engine brakes at specific locations.

Short-term noise measurements were also carried out at the two additional receiver locations situated nearest to the Barrys Creek rest areas. The receivers at 61 Mingaletta Road, Kundabung, located 490 metres north-east of the rest area, and 183 Old Pacific Highway, Kundabung, located 430 metres north-west are nearest to the rest area. The purpose of this measurement was to assess the noise emitted from Barrys Creek rest area.

Table 5-2 presents the measured rain and the average temperature and wind conditions during the noise monitoring period. The weather data was obtained from the onsite Kundabung weather station.

Table 5-2 Weather conditions during the road noise monitoring period

Date	Daytime (7am-10pm)			Night time (10pm-7am)		
	Temp (c°)	Rain (mm)	Wind (m/s)	Temp (c°)	Rain (mm)	Wind (m/s)
13/08/2018	12.5	0.0	0.9	1.3	0.0	0.1
14/08/2018	13.5	0.0	0.8	1.8	0.0	0.2
15/08/2018	16.7	0.0	0.9	1.8	0.0	0.4
16/08/2018	16.5	0.0	1.0	9.1	0.0	0.4
17/08/2018	15.2	0.0	0.9	3.4	0.0	0.1
18/08/2018	14.5	0.0	1.3	3.1	0.0	0.2
19/08/2018	14.9	0.0	1.6	9.8	0.0	1.3
20/08/2018	13.0	0.0	2.2	-1.0	0.0	0.2
21/08/2018	12.1	0.0	1.0	0.0	0.0	0.2
22/08/2018	13.5	0.0	1.2	4.4	0.0	0.4
23/08/2018	14.1	0.0	1.0	5.5	0.0	0.1
24/08/2018	16.0	0.0	1.3	13.1	1.6	0.3

All monitoring locations are shown from Figure 5-1 to Figure 5-3. Photographs of the noise loggers in contrast to the building façade and highway are also found in Appendix G of this report. A list of the noise complaint registries and details of the Roads and Maritime responses are provided in Appendix E.

Figure 5-1 Noise monitoring locations – NCA 01 and 02

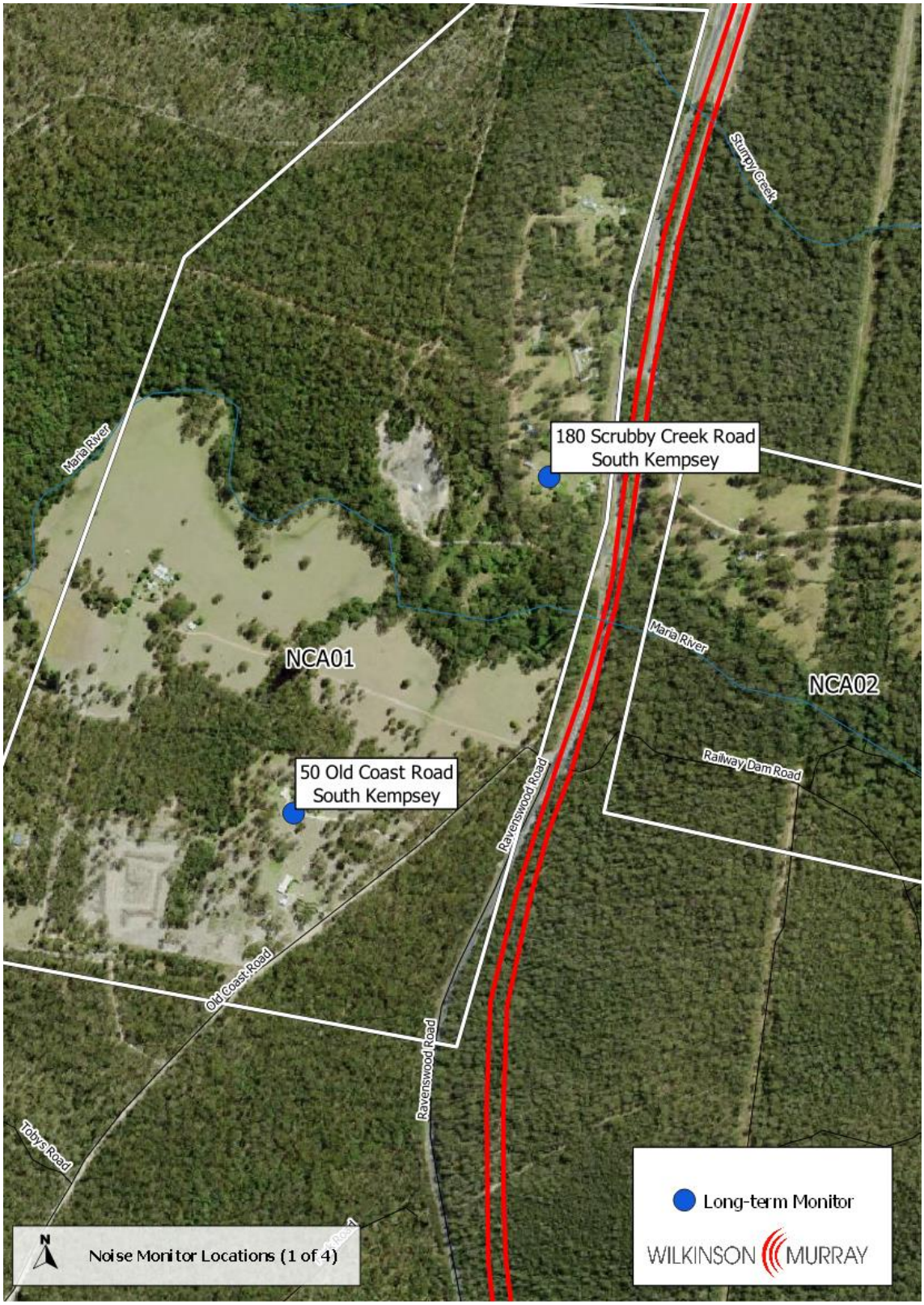


Figure 5-2 Noise monitoring locations – NCA 03, 04 and 05

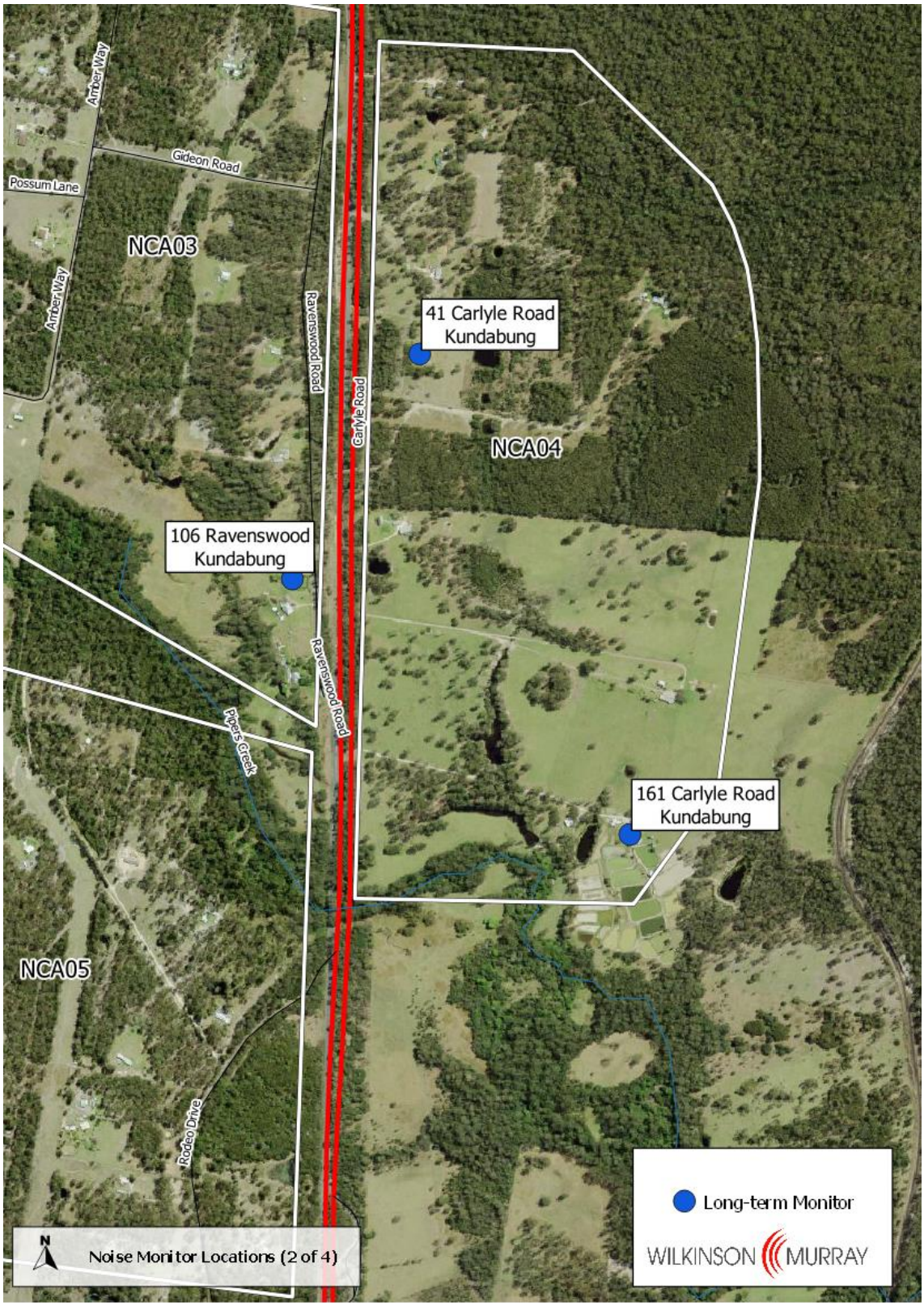
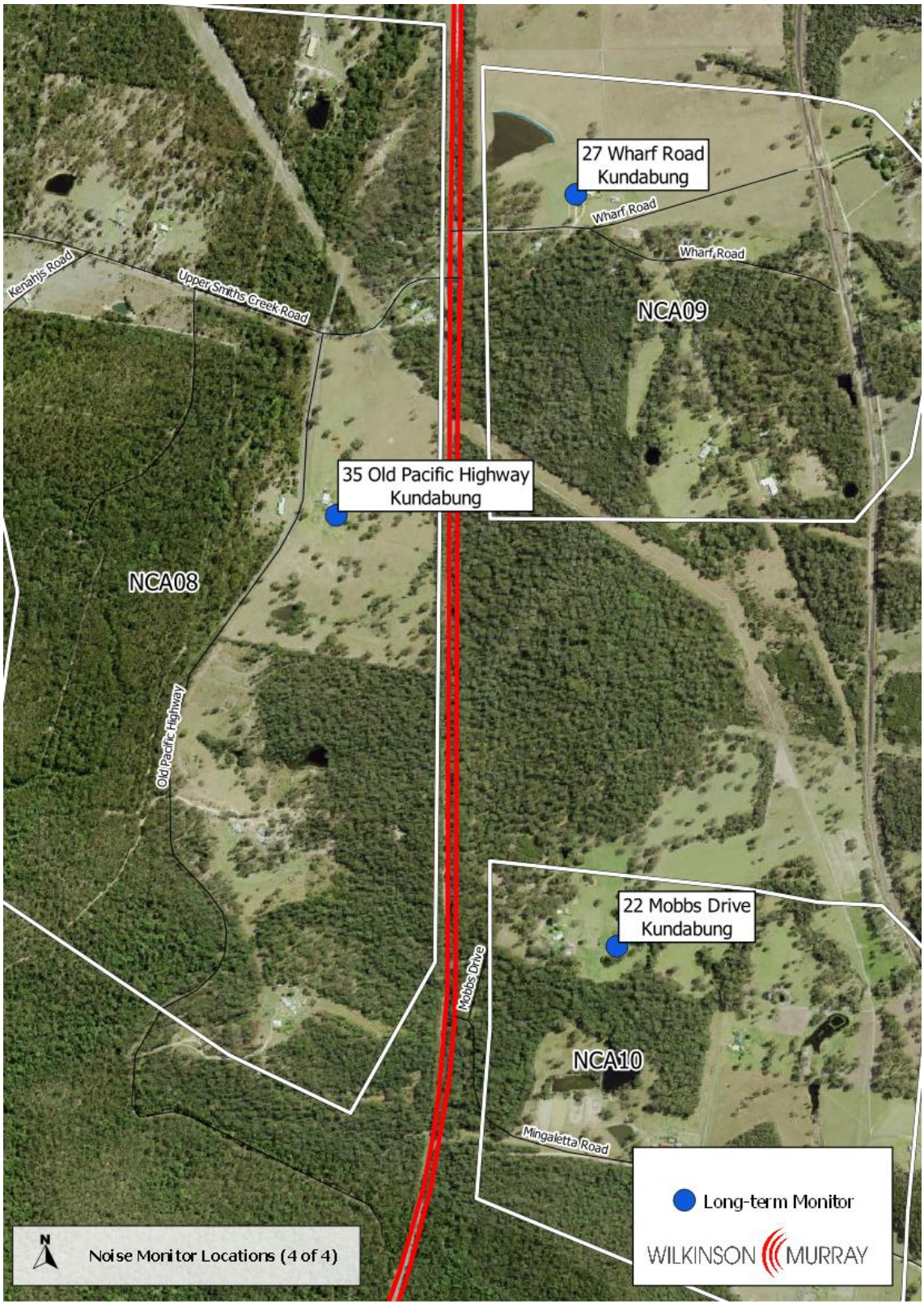


Figure 5-3 Noise monitoring locations – NCA 06 and 07

Figure 5-4 Noise monitoring locations – NCA 08, 09 and 10



5.2 Measured noise levels

In order to validate a traffic noise model, it is necessary to compare the predicted noise levels for known traffic volumes to the noise levels measured during the same periods. The long-term noise monitoring locations were situated 100 metres and greater from the highway. The initial analysis of the noise data indicated truck volumes were much lower on the weekends compared with the weekdays. Therefore, the most robust validation process would be to use the 5-day traffic volumes and corresponding 5-day noise levels to achieve better correlation.

Table 5-3 shows the measured level at each location, for the 5-day average and 7-day average (for information purposes), with only periods of inclement weather excluded per NSW EPA requirements.

Table 5-3 Long-term unattended noise monitoring raw results

ID	Address	Measured noise level			
		7-day average		5-day average	
		Day	Night	Day	Night
		$L_{Aeq,15hr}$	$L_{Aeq,9hr}$	$L_{Aeq,15hr}$	$L_{Aeq,9hr}$
638	22 Mobbs Drive, Kundabung	58.2	52.4	58.7	52.8
695	35 Old Pacific Highway, Kundabung	57.8	56.9	58.2	57.6
405	27 Wharf Road, Kundabung	58.6	58.8	58.8	59.4
809	132 Rodeo Drive, Kundabung	58.7	54.1	58.2	54.8
488	25 Kundabung Road, Kundabung	56.8	57.7	57.0	58.4
1021	161 Carlyle Road, Kundabung	57.0	58.2	57.0	58.9
1016	106 Ravenswood, Kundabung	58.1	57.4	58.2	58.0
480	41 Carlyle Road, Kundabung	60.1	60.0	60.3	60.6
492	50 Old Coast Road, South Kempsey	48.4	56.8	48.4	57.7
502	180 Scrubby Creek Road, South Kempsey	56.3	55.4	56.3	56.0

Noise monitoring at location IDs 638, 1016, 492 and 502 started on 13 August 2018. All remaining noise monitors were installed on 14 August 2018. All noise loggers were collected on the 24 August 2018.

Because the measured noise levels at each receiver include a combination of road traffic noise and other extraneous noise (birds, insects, local activities etc.), it is necessary to exclude extraneous noise from the measured noise levels.

The table in Appendix D provides a list of all extraneous noise events which were excluded from the monitoring assessment. The table includes the time, date, location and a description of the event. The daily noise level plots in Appendix G show the periods excluded due to inclement weather and extraneous noise.

Table 5-4 shows the 'estimated road traffic noise level' at each location. This level is obtained by removing any readily identifiable extraneous noise sources from the long-term unattended noise measurement data by analysing the data and listening to audio recordings as required.

The 'estimated road traffic noise level' refers to the omission of any significant extraneous noise which may influence the overall noise result. The omitted extraneous noise events are shown in

Appendix D of this report. It should be noted, other minor extraneous noise may still impact the overall result, hence the term 'estimated' is used in this context.

At 161 Carlyle Road, the road traffic noise level cannot be estimated with sufficient accuracy due to the significant external noise sources during the daytime. The long-term unattended noise monitoring contains varying large periods of human activities, nearby vehicle and wildlife noise which is louder than traffic noise at times. However, the night time measurements were influenced by trucks passing along the Pacific Highway, with minimal extraneous noise.

Table 5-4 Estimated road traffic noise level

ID	Address	Measured noise level (5-day)		Estimated traffic noise level (5-day)		Comment on extraneous noise
		Day $L_{Aeq,15hr}$	Night $L_{Aeq,9hr}$	Day $L_{Aeq,15hr}$	Night $L_{Aeq,9hr}$	
638	22 Mobbs Drive, Kundabung	58.7	52.8	52.8	51.9	Several exclusions of wildlife (ie. birds and horses), including periods of construction work and lawn mowing. Minimal exclusions during the night time period.
695	35 Old Pacific Highway, Kundabung	58.2	57.6	57.8	57.6	Multiple exclusions of wildlife noise (ie. birds and horses).
405	27 Wharf Road, Kundabung	58.8	59.4	58.4	59.4	Multiple exclusions of dog barking and lawn mowing.
809	132 Rodeo Drive, Kundabung	58.2	54.8	54.6	54.8	High noise peaks were recorded on the 15 August 2018 between 6-8pm, likely caused by vehicle onsite and doors shutting. Additional noise peaks were recorded at these hours throughout the week.
438	25 Kundabung Road, Kundabung	57.0	58.4	56.7	58.3	Multiple exclusions of wildlife (ie. dogs barking and bird noise). Minimal exclusions during the night time period.
1021	161 Carlyle Road, Kundabung	57.0	58.9	55.4	58.9	Several exclusions of wildlife (ie. birds and horses). Multiple occasions of tractor operating and other work-related activities. Minimal exclusions during the night time period.
1015	106 Ravenswood, Kundabung	58.2	58.0	58.1	57.5	Several exclusions of wildlife (ie. birds and dogs barking). Multiple occasions of engine operating and idling.

ID	Address	Measured noise level (5-day)		Estimated traffic noise level (5-day)		Comment on extraneous noise
		Day $L_{Aeq,15hr}$	Night $L_{Aeq,9hr}$	Day $L_{Aeq,15hr}$	Night $L_{Aeq,9hr}$	
						Minimal exclusions during the night time period.
480	41 Carlyle Road, Kundabung	60.3	60.6	60.3	60.6	Few exclusions of wildlife (ie. birds) and local activities (lawn mowing and activities with peak noises).
492	50 Old Coast Road, South Kempsey	48.4	57.7	48.4	49.6	Several exclusions of wildlife (ie. birds and horses). Some periods of local activities and car idling.
502	180 Scrubby Creek Road, South Kempsey	56.3	56.0	56.0	56.0	Several exclusions of wildlife (ie. birds and dog barking).

5.3 Short-term attended noise monitoring

In addition to the long-term unattended noise monitoring presented above, short-term attended noise measurements were also carried out at the assigned monitoring location at both daytime and night time. A description summary of the attended noise measurements conducted onsite is shown in Appendix F.

Short-term measurements at 61 Mingaletta Road and 183 Old Pacific Highway were taken to assess the noise impact from Barrys Creek rest areas, for the reasons as outlined in Section 5.1. The results of the short-term measurements are presented in Table 5-5.

Table 5-5 Attended Short-term measurement of receivers nearest to the Barrys Creek rest area

Location	Date measurement taken	Time	L_{Aeq}	Comment
61 Mingaletta Road, Kundabung	13/08/2018	14:25-14:40	43.0	Highway was audible, intermittent noise from cows (50-54dB) and birds (46-59dB). Trucks passing by ranged from 47-56dB.
	13/08/2018	23:18-23:33	54.4	Background noise ranged from 39-46dB, influenced by distant Highway noise. Trucks passing by ranged from 61-67dB.
	16/08/2018	00:47-01:45	55.6	Background noise ranged from 37-45dB, due to distant Highway noise. Majority of trucks passing by (61-67dB) appeared to originate

Location	Date measurement taken	Time	L_{Aeq}	Comment
				from the west and north. It should be noted, vehicle noise (ie engine start, vehicle idling etc.) from the Barrys Creek Rest Area was inaudible.
183 Old Pacific Highway, Kundabung	13/08/2018	15:15-15:30	49.1	Highway noise was constant, with truck noise to range from 48-55dB. Intermittent bird noise was also present (48-57dB).
	14/08/2018	00:05-00:20	54.8	Background noise, with minimal vehicles passing-by, ranged from 42-44dB. Trucks passing by ranged from 61-67dB.
	16/08/2018	02:11-03:11	53.4	Background noise, with minimal vehicles passing-by, ranged from 29-40dB. Trucks passing by ranged from 45-65dB. Truck slowing down south-east (potentially at the rest area) from the receiver site was audible during low background noise period and the truck noise ranged from 35-40dB for a short period of time.

Noise from the Barrys Creek rest areas at the two nearest receiver locations – 61 Mingaletta Road and 183 Old Pacific Highway, Kundabung - were either inaudible or barely audible. The major ambient noise at the two receiver locations were the road traffic noise from the Pacific Highway.

The L_{max} noise peaks from the rest areas could not be determined as door slamming or engine starting/idling could not be heard. Based on the two night time measurements conducted at the nearest receivers from the rest area, it can be concluded the noise emissions from the Barrys Creek rest areas comply with the relevant noise standard.

5.4 Maximum noise assessment

A maximum noise assessment of K2K at the two nearest noise measured receivers – 106 Ravenswood Road, Kundabung (100m away) and 180 Scrubby Creek Road (130m away) – was carried out in accordance with the *ENMM* and *ECRTN*. The nearest noise receivers are likely to represent the worst-case scenarios of sleep disturbance along the K2K Pacific Highway.

For the purpose of this assessment, the L_{AMAX} noise descriptor was compared against the $L_{Aeq,1hr}$ +15dBA noise criteria to determine any vehicles passing-by likely to cause sleep disturbance.

The *ECRTN* also states the review of international sleep disturbance research indicates 'one or two noise events per night with maximum internal noise levels of 65-70dB(A) are not likely to significantly affect health and wellbeing.' This internal noise guideline criterion is also considered in the sleep disturbance noise assessment and equates to 75-80dBA externally.

The assessment analysis consists of reviewing the short-term night measurements taken at the two nearest receivers from the K2K. Table 5-6 presents the short-term measurement L_{AMAX} results compared against the $L_{Aeq,1hr}$ + 15dB.

Table 5-6 Short-term measurements and sleep disturbance

NCA	Receiver location	Distance (m) from Pacific Hwy	Time and date	L_{Amax} truck typical range	L_{Amax}	$L_{Aeq,1hr}$ + 15dB
03	106 Ravenswood Road, Kundabung	100	14/08/2018 00:45am	58-63	67	73
			13/08/2018 16:15pm	58-66	66	76
01	180 Scrubby Creek Road, South Kempsey	130	15/08/2018 00:30am	55-64	68	72
			13/08/2018 17:15pm	57-62	68	71

It was noted during the attended measurement the trucks passing by typically ranged from 58-66dBA at 106 Ravenswood Road and 55-64dBA at 180 Scrubby Creek Road. According to the attended measurement, the L_{Amax} noise peaks would generally be 5-13dB above the $L_{Aeq,1hr}$.

The typical noise reduction of outdoor noise transmitting inside a room with the windows open is 10dB. Based on this noise reduction assumption and the measured noise level, the maximum truck noise level inside the property with windows open is likely to be below 60dBA. Therefore, the maximum noise levels are below the 65-70dBA sleep disturbance noise guideline contained in the *ECRTN*.

A review of the road plans and site road inspection showed no steep hills. During the attended noise measurement, engine brake noise was not observed. Based on the review of the plans and the attended noise measurements it is concluded the regular use of truck engine brakes along the K2K is unlikely.

Based on the analysis outlined above, noise peaks (L_{AMAX}) from vehicles passing-by are found to be less than $L_{Aeq,1hr}$ +15dB.

6 Traffic volumes, classification and speed monitoring

6.1 Measured traffic volumes

Traffic counts were taken at 12 locations for Roads and Maritime by National Traffic Survey Pty Ltd from 13 to 24 August 2018. The locations of the traffic count in reference to the noise monitoring carried out are shown in Figure 6-1 to Figure 6-3.

The average daytime (7.00am-10.00pm) and night time (10.00pm-7.00am) hourly vehicle counts are shown in Table 6-1 for all days of the week (7 day) and for the weekdays only (5 day).

Table 6-1 Traffic counts for the period 13/08/2018 to 24/08/2018

Traffic count number	Location	Period	Daytime (15hr)		Night time (9hr)	
			Total	% Heavy	Total	% Heavy
1	South of Kundabung Intersection – Northbound Carriageway	7 day	6187	21%	986	46%
		5 day	6335	22%	1059	49%
2	South of Kundabung Intersection – Southbound Carriageway	7 day	6362	20%	985	42%
		5 day	6464	21%	1049	45%
3	Kundabung Interchange – North Exit	7 day	188	16%	14	8%
		5 day	194	18%	12	9%
4	Kundabung Interchange – South Exit	7 day	171	11%	15	7%
		5 day	178	11%	15	7%
5	Kundabung Interchange – North Entry	7 day	166	9%	25	4%
		5 day	170	10%	27	5%
6	Kundabung Interchange – South Entry	7 day	172	14%	30	8%
		5 day	179	15%	29	9%
7	Rodeo Drive – Northbound Carriageway	7 day	219	10%	11	5%
		5 day	243	10%	12	6%
8	Rodeo Drive – Northbound Carriageway	7 day	223	12%	35	7%
		5 day	234	14%	40	7%
9	North of Kundabung Intersection – Northbound Carriageway	7 day	6100	19%	901	50%
		5 day	6240	20%	968	52%
10	North of Kundabung Intersection – Southbound Carriageway	7 day	6365	21%	993	39%
		5 day	6471	21%	1065	40%
11	Ravenswood Road – Northbound Carriageway	7 day	106	9%	8	5%
		5 day	110	10%	9	5%
12	Ravenswood Road – Southbound Carriageway	7 day	107	11%	9	4%
		5 day	113	13%	10	4%

Figure 6-1 Traffic count locations – Traffic count 9–12

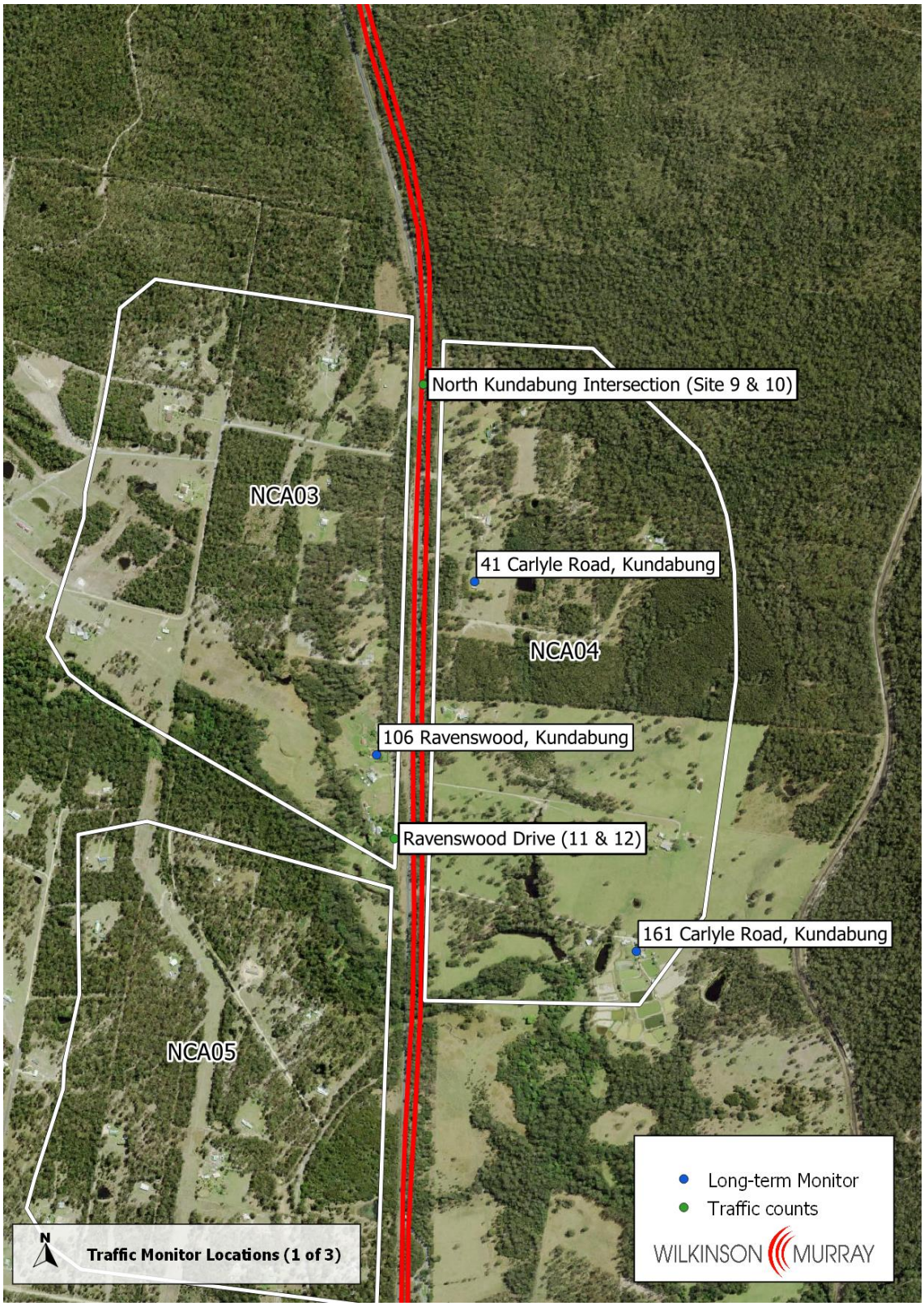


Figure 6-2 Traffic count locations – Traffic count 3–8, 11 and 12

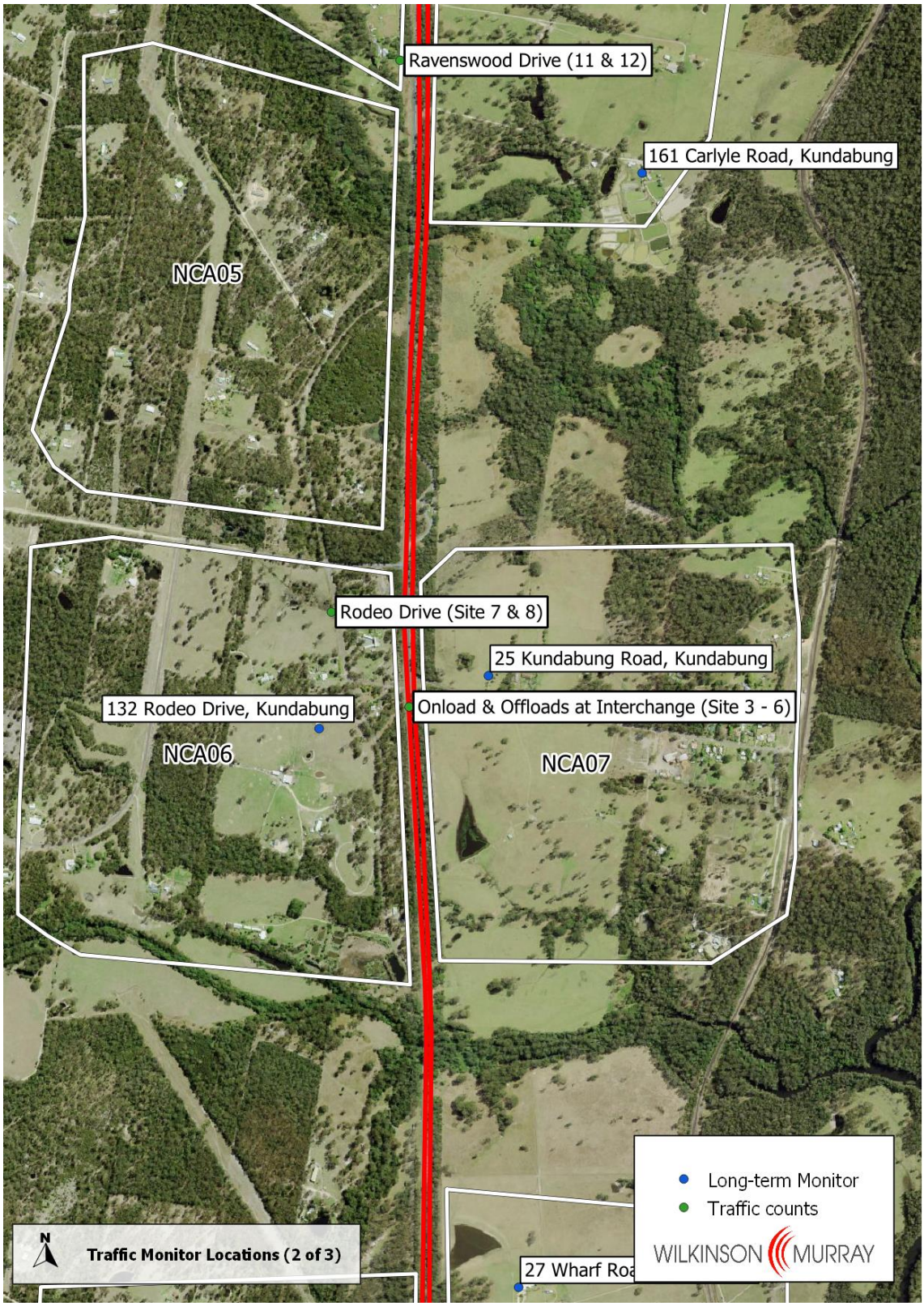
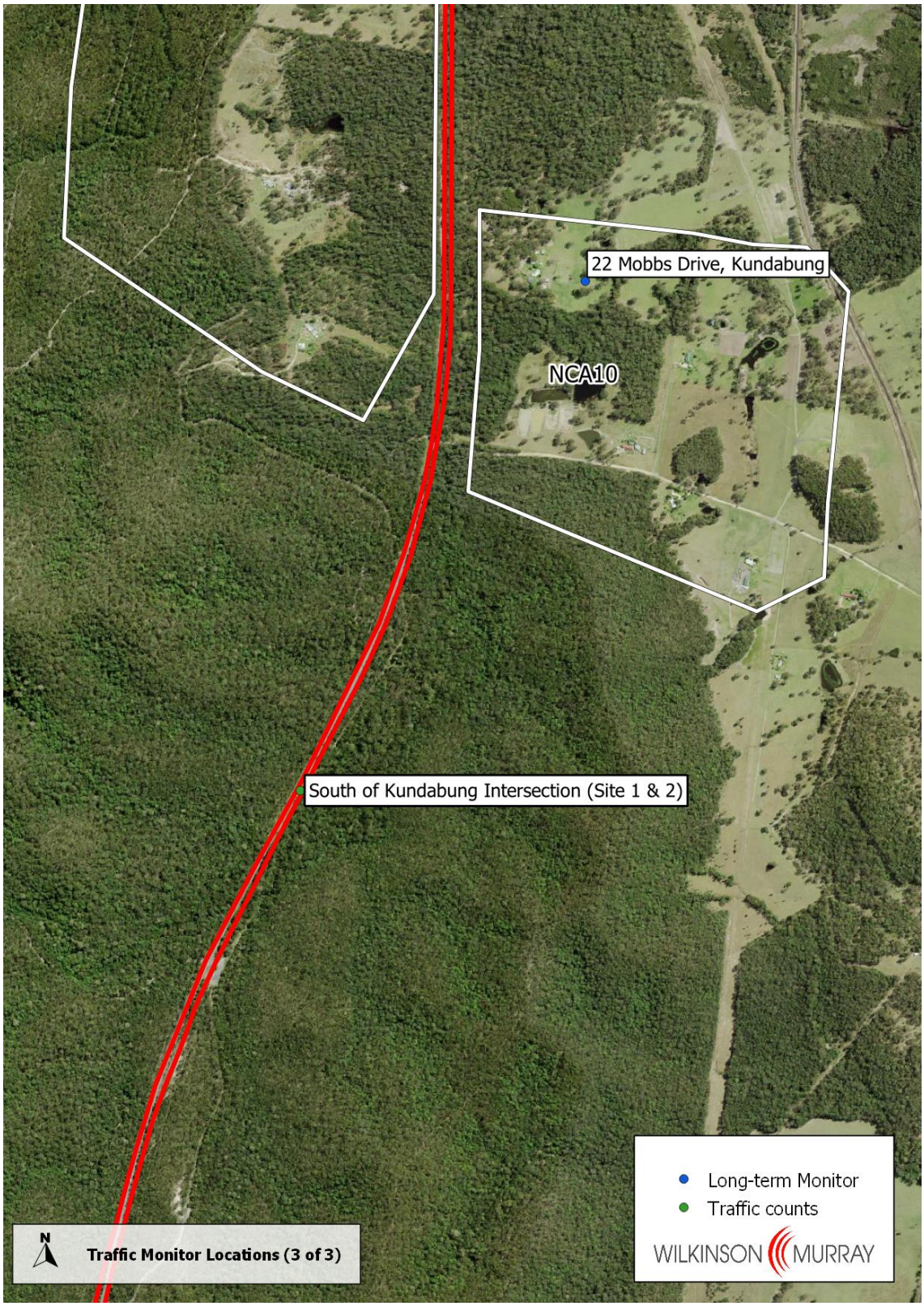


Figure 6-3 Traffic count locations – Traffic count 1 and 2



6.2 Predicted traffic volumes

The predicted road traffic volumes used in the detailed design modelling carried out in the ONMR by Wilkinson Murray entitled *Pacific Highway Upgrade Kundabung to Kempsey Operational Noise Management Report Version G* (WM Report No. 12063, dated October 2013) are presented in Table 6-2.

Table 6-2 Predicted road traffic volumes – 2016 year after opening

Location	Daytime (15hr)		Night time (9hr)	
	Total	% Heavy	Total	% Heavy
South of Kundabung Intersection – Northbound	5190	19%	970	43%
South of Kundabung Intersection – Southbound	5270	18%	790	53%
Kundabung Interchange – North Exit	220	18%	130	38%
Kundabung Interchange – South Exit	480	10%	120	25%
Kundabung Interchange – North Entry	670	12%	140	29%
Kundabung Interchange – South Entry	420	19%	230	52%
North of Kundabung Intersection – Northbound	5460	18%	950	41%
North of Kundabung Intersection – Southbound	5520	18%	720	49%
Pipers Creek Service Road – Northbound	50	20%	20	50%
Pipers Creek Service Road – Southbound	160	19%	90	56%

Based on the 2018 measured traffic volume, the future Pacific Highway traffic volume in 2028 has been calculated by Roads and Maritime. The 2028 traffic volume forecast was submitted to Wilkinson Murray for the purpose of preparing the future noise prediction model. Table 6-3 presents the 2028 traffic volume forecast used within the noise prediction.

Table 6-3 Predicted road traffic volumes – 2028

Location	Daytime (15hr)		Night time (9hr)	
	Total	% Heavy	Total	% Heavy
South of Kundabung Intersection – Northbound	9063	18%	1696	41%
South of Kundabung Intersection – Southbound	9202	18%	1706	39%
Kundabung Interchange – North Exit	199	8%	38	12%
Kundabung Interchange – South Exit	198	8%	24	14%
Kundabung Interchange – North Entry	208	12%	19	18%
Kundabung Interchange – South Entry	206	13%	31	19%
North of Kundabung Intersection – Northbound	8947	17%	1553	47%
North of Kundabung Intersection – Southbound	9229	20%	1720	40%
Rodeo Drive (Pipers Creek Service Road) – Northbound	258	9%	18	16%
Rodeo Drive (Pipers Creek Service Road) – Southbound	221	14%	37	18%
Ravenswood Drive – Northbound	479	3%	9	23%
Ravenswood Drive - Northbound	476	15%	10	15%

6.3 Comparison of measured (2018) and predicted traffic volumes (2016)

Table 6-4 details a comparison of the Pacific Highway measured traffic counts (2018) with the 2016 predicted road traffic volumes as used in the detailed design modelling. The table also includes the traffic speed used in the noise prediction and the measured traffic speed.

Table 6-4 Comparison of measured and predicted traffic volumes on the main carriageway

Location	Period	Daytime (15hr)			Speed km/h	Night time (9hr)			Speed km/h
		LV	HV	% HV		LV	HV	% HV	
South of Kundabung Intersection – Northbound	2018 Measured – 5 Day	4915	1420	22%	111	542	517	49%	110
South of Kundabung Intersection – Northbound	2016 Predicted	4210	980	19%	115	550	420	43%	120
Difference		+17%	+45%		-4	-2%	+23%		-10
South of Kundabung Intersection – Southbound	2018 Measured – 5 Day	5087	1377	21%	113	580	469	45%	110
South of Kundabung Intersection – Southbound	2016 Predicted	4300	970	18%	115	370	420	53%	120
Difference		+18%	+42%		-2	+57%	+12%		-10

Generally, the forecasts determined in this assessment are higher than those calculated for the ONMR but are less than those predicted in the project EA forecasts. This difference can be attributed to the following:

- The EA growth assumptions for the Pacific Highway were significantly higher than those adopted in the ONMR and this assessment (4% per annum versus 2.8% per annum used in both this assessment and the ONMR)
- The forecasts have been based on updated 2012 light and heavy vehicle data obtained from three years of pattern data collected along the corridor, this was not available for use in the ONMR
- The ONMR assumed a liner growth in the traffic, whereas a better correlation of the data obtained from the 'The Infra-Red Traffic Logger' (TIRTL) system fitted to several sites along the Pacific Highway TIRTL's showed an exponential growth pattern.

6.4 Review of road design changes

A review of the Pacific Highway design plan was taken and the following changes made since the ONMR have been noted:

- Some sections of the highway have a slightly different elevation height compared to the previous plans. The changes in road elevation from 2026 to 2028 ranges from about 0.1m-1m in height
- Pacific Highway consists of 16 material reuse earth-mounds, located at various locations along the east and west side of the K2K. The earth-mound heights ranges from around 1m-7m in height, with the exception of Material Reuse site 16 with a height of about 10m. The length of the earth-mound vary from around 100m – 170m
- Road surface between at Barrys Creek rest area and CH27775 on the northbound carriageway has been changed from spray seal to Stone Mastic Asphalt
- The Upper Smiths Creek Road intersection with the Pacific Motorway has been moved approximately 130 metres south. Right turning lanes from the Motorway were also provided to Upper Smiths Creek Road and Wharf Road.

7 Operational noise modelling

The noise model developed during the detailed design stage has been updated to reflect the design changes and also consider the changes in traffic volumes. The model output has been modified to incorporate the measured traffic volumes conducted in-conjunction with the long-term unattended noise monitoring (Chapter 6). The noise prediction results of 2018 and 2028 are shown in Appendix A.

7.1 Model inputs

Noise levels from the proposed road designs were calculated using procedures based on the *CoRTN (Calculation of Road Traffic Noise)* (UK Department of Transport, 1988) prediction algorithms. The standard prediction procedures were modified in the following ways:

- L_{Aeq} values were calculated from the L_{A10} values predicted by the *CoRTN* algorithms using the well-validated approximation $L_{Aeq,1hour} = L_{A10,1hr} - 3$ (NSW RTA, 2001). It is worth noting the predicted $L_{Aeq,1hr}$ is equivalent to the $L_{Aeq,period}$ as required by the noise criteria since the input is the "average" traffic flow per hour over the given daytime and night time periods;
- Noise source heights were set at 0.5m for cars, 1.5m for heavy vehicle engines and 3.6m for heavy vehicle exhausts, representative of typical values for Australian vehicles (Road Traffic Noise: Interim Traffic Noise Policy, 1992); and
- Noise from a heavy vehicle exhaust is 8dBA lower than the (steady continuous) noise from the engine.

The model was implemented using SoundPLAN software (Version 8). Road design information was based on data supplied by Roads and Maritime.

A summary of the inputs and model settings are provided in Table 7-1. The traffic speed inputs for the 2018 noise model were obtained from the traffic survey data recorded during the noise monitoring assessment. The 2028 traffic volume and speed inputs are assumptions provided by the Roads and Maritime.

Table 7-1 Summary of modelling inputs

Parameter		2018 Inputs	2028 Inputs
Traffic speed	Main carriageway:	112 km/h Daytime 110 km/h Night time	115 km/h Daytime 120 km/h Night time
	Local roads:	71 km/h on service roads 54 km/h on access roads	80 km/h on service roads 60 km/h on access roads
	Ramps:	62 km/h	80 km/h
Road surface	Main carriageway:	+3dB for concrete	+3dB for concrete
	Change in road surface – Northbound main carriageway between Barrys Creek rest area and section CH 27775	-2dB for Stone Mastic Asphalt (SMA)	-2dB for Stone Mastic Asphalt (SMA)
	Ramps:	+3dB for concrete	+3dB for concrete

Parameter		2018 assumptions	2028 assumptions
	Bridge decks:	-2dB for Stone Mastic Asphalt (SMA)	-2dB for Stone Mastic Asphalt (SMA)
	Overpasses:	+0dB for Dense Graded Asphalt (DGA)	+0dB for Dense Graded Asphalt (DGA)
Receivers	Single storey:	1.5m	1.5m
	Double storey:	4.5m	4.5m
Façade correction	+2.5dB in accordance with *CoRTN*		
Safety factor adjustments	+1.8dBA total adjustment to accommodate +1dBA risk allowance required by Pacific Highway projects and +0.8dBA for 20% adjustment of traffic volumes as requested by Roads and Maritime.		
Calibration adjustments	-2.5dBA to daytime results to accommodate measured average day/night difference of 0.8dBA as requested by Roads and Maritime.		
Australian condition correction	The Australian correction of -1.7dB was applied to facade predictions and -0.7dB to free field predictions (April 1983 Australian Road Research Board report – Research Report ARR No.122)		
Traffic volumes		Measured Traffic Volumes as per Table 6-2	Predicted Traffic Volumes as per Table 6-3
Terrain	Combination of 0.5m and 10m interval contours supplied by SHJV and Roads and Maritime		
Ground absorption	Ground absorption factor was set to 75% and has been applied over the full length of the K2K project site.		
Calculation setting	Grid space of 20m Height above ground = 1.5m Grid interpretation field size = 9 x 9 Grid interpretation min/max = 2dBA Grid interpretation difference = 0.1dBA Angle increment = 1 degree Reflection depth = 0 Number of reflections = 0 Maximal search radius = 3000m		

7.2 Comparison of receiver locations used in model and during survey

A review of the actual long-term unattended measurement locations against the locations used for predictions in the detailed design report has been conducted.

180 Scrubby Creek Road had the prediction point on the façade facing east, in front of the garage. An alternative monitoring location was selected for the reasons outlined below:

- Water tank situated on the east side of the structure, next to the garage roller door, would have provided noise shielding from the north side of the highway. In addition to this, the neighbouring property situated on the east side may have provided some additional noise shielding as well.

- The site consisted of dense vegetation on the south and east sides of the residential property which would have likely attenuated road traffic noise. It was noted, the view of the of the Pacific Highway was less obstructed on the north side compared to the east and south sides of the residential structure.
- According to the previous acoustic assessment report, the residential receiver was also assigned to have noise control implemented on their property. The noise monitor was installed on the north side of the residential property, next to the kitchen/living room window, to assess the road noise impact on the habitable space.
- The noise logger also needed to be in a secure location to ensure animal (ie kangaroos and dogs) would not impact with the noise logger.

In addition to this, the noise prediction point for 25 Kundabung Road was also moved from the west façade to the north side of the residential structure to reflect the noise monitoring location.

It was noted the façade facing the Pacific Highway was the garage wall with no window. The noise monitor was installed on the bedroom window facing north. The alternative monitoring location was selected for the following reasons:

- Water tank situated on the west side of the structure, next to the garage wall, would have provided noise shielding from road noise.
- The west and south side of the Pacific Highway was not visible from the west and south sides of the property due to elevation and interchange bridge obstructing the view of the highway. It was noted the Pacific Highway was more visible from the northern side of the residence than from the eastern and southern sides. The tenant confirmed traffic noise seems to be worse from the northern side of the residence.
- According to the previous acoustic assessment report, the residential receiver was also assigned to have noise control implemented on their property. The noise monitor was installed on the north side of the residential property, next to the bedroom window, to assess the road noise impact on the habitable space.
- Monitoring location also needed to be in a secure position to ensure the cow and dog on the property could not impact with the noise logger.

The relative location of previous predicted and measured locations for 180 Scrubby Creek Road and 25 Kundabung Road are shown in Figure 7-1 and Figure 7-2. The noise prediction with the correct location has been incorporated in the model and the results are presented in Table 8-1.

Figure 7-1 Relative location of long-term monitoring location and ONMR predicted location – 180 Scrubby Creek Road, South Kempsey

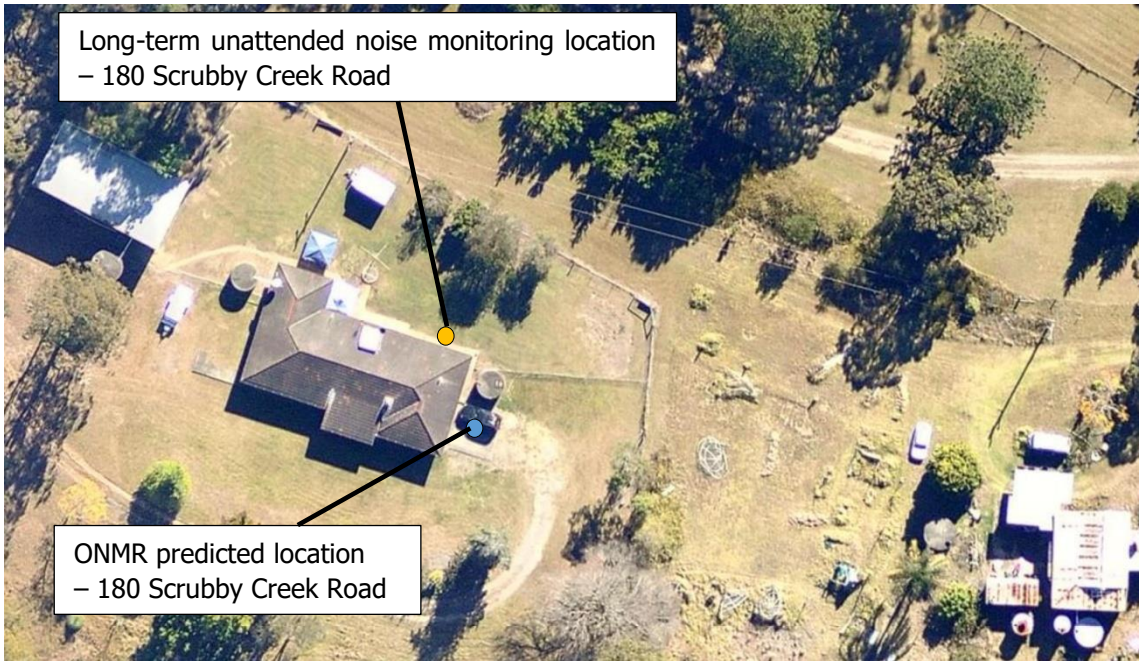


Figure 7-2 Relative location of long-term monitoring location and ONMR predicted location – 25 Kundabung Road, Kundabung

8 Traffic noise assessment

8.1 Validation of noise model

The noise modelling process used to predict existing and future noise levels is validated against existing noise levels. The SoundPLAN noise model (using CoRTN) has been established primarily on this basis. Measured results are compared with model predictions for the existing road using current traffic volumes provided by and using logarithmically weighted equivalent vehicle speeds based on each hour of the day and night to generate an average daytime or night time speed. The measured noise levels will include traffic noise and possible other extraneous noise. Extraneous noise typically increases with distance from the road.

Table 8-1 details a comparison of the measured road traffic noise against the revised 2018 road noise prediction model (inclusive of measured traffic volume, speed and highway plans). The average difference between the measurement and prediction is also shown. The 'Notes' refers to summary of the correlation between the noise measurement and prediction.

Table 8-1 Comparison of 2018 measured and predicted noise levels

NCA	Address	2018 measured road traffic noise level		2018 predicted noise level		Difference		Notes
		Day $L_{Aeq,15hr}$	Night $L_{Aeq,9hr}$	Day $L_{Aeq,15hr}$	Night $L_{Aeq,9hr}$	Day	Night	
Long-term unattended measurement results								
10	22 Mobbs Drive	52.8	51.9	58.5	57.3	**-5.7**	**-5.4**	See Section 8.2.1
08	35 Old Pacific Highway	57.8	57.6	57.8	56.6	0.0	1.0	-
09	27 Wharf Road	58.4	59.4	58.5	57.3	-0.1	2.1	See Section 8.3.1
05	132 Rodeo Drive	54.6	54.8	59.1	57.7	**-4.5**	-2.9	See Section 8.2.4
07	25 Kundabung Road	56.7	58.3	58.3	57.9	-1.6	0.4	-
04	161 Carlyle Road	55.4	58.9	53.4	52.1	2.0	**6.8**	See Section 8.3.1
03	106 Ravenswood	58.1	57.5	62.5	61.5	-4.4	-4.0	See Section 8.2.4
04	41 Carlyle Road	60.3	60.6	62.1	61.4	-1.8	-0.8	-
01	50 Old Coast Road	48.4	49.6	55.6	54.4	**-7.2**	**-4.8**	See Section 8.2.2
01	180 Scrubby Creek Road	56.0	56.0	59.7	58.6	**-3.7**	**-2.6**	See Section 8.2.3
Averaged differences								
Average – entire dataset						**-2.8**	**-1.1**	
Average – excluding outliers (bold)						**-1.0**	**-0.7**	

8.2 Factors affecting over-prediction

Large sections of the highway project pass through sections of dense bush between the road verge and various noise monitoring locations. *Calculation of Road Traffic Noise* (*CoRTN*) does not include the effects of vegetation to be integrated into the noise prediction model. Based on similar project experience, dense vegetation can provide additional attenuation of up to 6dB, depending on the depth and density of the vegetation.

For example, if there is only a single row of trees situated parallel to the road/highway, the vegetation would provide little to no noise attenuation. However, a large radius of vegetation is capable of attenuating greater amount of noise. This is due to the scattering of noise between multiple trunks within a wide and dense vegetation area which interrupts the direct noise between the road and the receiver.

8.2.1 22 Mobbs Drive, Kundabung

The receiver at 22 Mobbs Drive is about 200 metres east from the highway. Based on the site inspection and aerial photos, it was noted the residential property is surrounded by dense vegetation. It is likely the vegetation attenuated the noise from the Pacific Highway, causing an over-prediction in the model.

8.2.2 50 Old Coast Road, Kundabung

The residential property at 50 Old Coast Road, Kundabung is about 410 metres west from the highway. An over-prediction of 7.2dB daytime road noise and 4.8dB for the night time was calculated. Factors attributing to this is likely due to the dense vegetation surrounding the site. It should also be noted, the CoRTN algorithm does not predict as well for receivers found further than 300 metres from the highway.

8.2.3 180 Scrubby Creek Road, Kundabung

The residential property at 180 Scrubby Creek Road is about 100 metres west from the highway. Based on the site inspection and aerial photos, it was noted the residential property is surrounded by dense vegetation, particularly on the south and east side of the property. It was noted the north section of the highway from the property was partially visible.

8.2.4 132 Rodeo Drive and 106 Ravenswood Road, Kundabung

Based on the site visit and the aerial photos, the residential properties at 132 Rodeo Drive and 106 Ravenswood are surrounded by dense vegetation. The vegetation is located south-east of 132 Rodeo Drive and located north and south of 106 Ravenswood Road, Kundabung. The vegetation is likely to have contributed to additional noise attenuation not accounted for in the noise prediction model.

8.3 Factors affecting under-prediction

8.3.1 161 Carlyle Road, Kundabung

Road traffic noise measurement at 161 Carlyle Road was recorded 2dB above the daytime prediction and 6.8dB night time prediction. This receiver is located about 650 metres from the

Pacific Highway and the night time noise emission from the highway during the monitoring period were likely influenced by multiple factors which could not be accounted for within the noise prediction model based on the CoRTN algorithm.

As noted earlier, the receiver is located 650 metres east of the Pacific Highway and the accuracy of the *CoRTN* algorithm is not as well validated for receivers located further than 300 metres from the highway. This factor would have an impact on the difference in the noise measurement and the prediction.

The 2016 and 2018 noise prediction for 161 Carlyle Road would not have accounted for the change in vegetation clearing, as the CoRTN algorithm does not factor in noise attenuation from dense vegetation areas.

It is noted in the Pipers Creek and Smiths Creek areas the road traffic noise measurement for the receivers along the east side of the highway had a higher noise level at night time compared to the daytime noise level. Only two of the five receivers located on the west side of the highway had a night time noise level greater than the daytime noise level.

The higher night time noise level on the east side of the highway is likely influenced by temperature inversion and the wind conditions at night during the noise monitoring period. Temperature inversion is the meteorological condition where temperature is coolest to the ground and is warmer as it increases in height, causing sound waves to refract downwards and in effect causing distant noise to be louder. Wind blowing towards the receiver can also increase noise level at the receiver's location.

According to the Bearau of Meteorology's Port Macquarie weather station data, majority wind direction at night time was westerly during the monitoring period, which may have affected highway noise propagating east.

A review of the onsite Kundabung weather station data was also carried out and indicate noise level during the night could have been influenced by a temperature inversion.

An average of the measured hourly traffic volume along the Pacific Highway and the hourly noise level at 161 Carlyle Road, between 13 and 24 August 2018, is presented in Table 8-1. In addition to this, the hourly average recorded temperature obtained from the Kundabung project weather station is presented in Table 8-2.

Figure 8-1 Average hourly measured traffic noise and volume

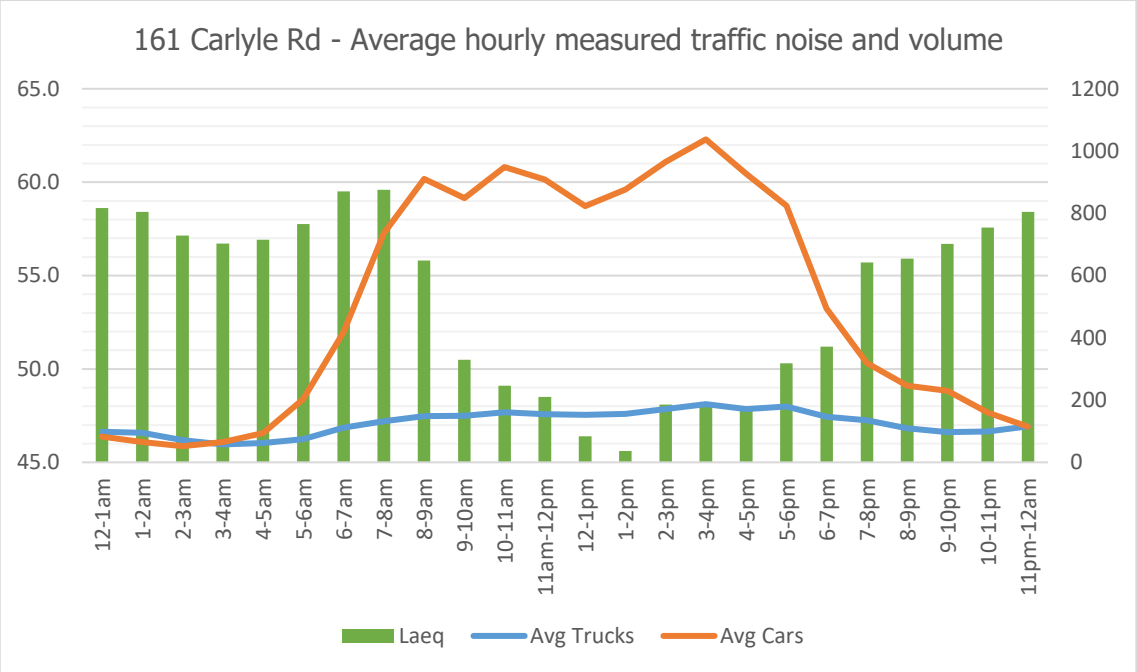


Table 8-2 Average hourly temperature during noise monitoring period

Time	Average temperature °C	Time	Average temperature °C
12-1am	5.0	12-1pm	20.6
1-2am	4.2	1-2pm	21.0
2-3am	3.2	2-3pm	20.4
3-4am	2.5	3-4pm	19.5
4-5am	2.1	4-5pm	18.0
5-6am	1.7	5-6pm	14.8
6-7am	1.3	6-7pm	11.5
7-8am	3.2	7-8pm	9.6
8-9am	9.1	8-9pm	8.1
9-10am	15.2	9-10pm	7.0
10-11am	18.1	10-11pm	6.5
11am-12pm	19.5	11pm-12am	6.0

As mentioned above, multiple factors have influenced the noise measurement on site and caused the difference between measurement and prediction noise level to be greater than 3dB. Some of the factors that can cause difference between the measured and predicted levels include:

- Ability of the CoRTN algorithm to predict noise levels for a receiver at greater distances from the highway
- The measured noise levels being affected by temperature inversion and wind conditions on site.

8.4 Noise prediction difference

Discussion of noise predictions difference greater than 3dB compared to the measured results were provided in Sections 8.2 and 8.3. If measurement locations which feature a large over-prediction (>3dB) are excluded from the difference average, the average closely matches the predicted levels, at 1.0dB margin. The predicted levels would therefore be in close agreement of the measured levels.

The average difference considering datasets excluding the outliers shows the measured level is below the predicted level, leading to the conclusion the model marginally over predicts.

8.5 Predicted future operational noise levels – 2028

The 2028 road traffic noise prediction for all receiver locations identified as residential structures with a habitable space is presented in Appendix A. The 2028A (Assessed) noise prediction results presented in Appendix A, comprises of the following formulae at all the receiver locations:

$$2028A = (2018\ M - 2018\ C) + 2028\ F$$

Where:

- 2018 M = "Measured 2018" – the raw noise level measured over the noise survey period relevant to each assessment location
- 2018 C = "Computed 2018" – this involves entering the actual traffic volumes, compositions and speeds measured during the noise survey period into the Project's SoundPLAN model used during the design stage and computing the raw (uncorrected) traffic noise level at each assessment location
- 2028 F = "Forecast 2028" – the noise level from the Project design model with the post-construction forecast 2028 traffic volumes, compositions and speeds at each assessment location, 10 years after opening.

The table in Appendix A also provides variance/difference found between the 2028A noise prediction results and the project 2026 D (Design) noise prediction as was provided in the ONMR.

Based on the determination of noise mitigation requirement for residential receivers in 2028, an additional four receivers require noise mitigation and is presented in Appendix B. The main cause of additional noise mitigation is due to the predicted traffic volume increase from 2026 to 2028, particularly during the night-period which results in these receivers' noise levels increasing from just below to above $L_{Aeq,9hr}$ 55dB. As noted earlier, the noise prediction model is found to marginally over-predict.

9 Summary and conclusion

This report presents a review of the road traffic noise levels associated with the opening of the Pacific Highway upgrade between Kundabung and Kempsey (2018).

Long-term unattended noise monitoring was conducted at 10 noise-sensitive receivers between 13 and 24 August 2018, with simultaneous traffic counts. In addition to the long-term unattended noise monitoring, short-term attended noise measurements were also carried out to provide an understanding of the noise environment at the monitored receiver locations.

The road traffic prediction model has been revised to reflect the 2018 measured traffic conditions (volume and speed) and includes the design changes during construction provided in a revised K2K plan layout. For a subset of the receivers the average difference between measured and predicted noise levels showed an average over-prediction of 1.0dBA at daytime and an average over-prediction of 0.7dBA at night time.

The average difference considering of the predictions excluding any outliers show the measured level is below the predicted level, leading to the conclusion the model marginally over predicts.

Road traffic noise prediction results for the Post Construction Noise Assessment (PCNA) 2018 and 2028 are presented in Appendix A of this report. Appendix C presents the PCNA 2018 and 2028 noise contours.

APPENDIX A

NOISE PREDICTION RESULTS 2018 AND 2028

NCA	Receiver No.	Noise Goal		Year of Opening				Design Year				*Variance (2028A - 2026D)*		*ONMR Mitigation Required (Y/N)*	*Additional Treatment Required (Y/N)*
				ONMR (Design) 2016		PCNA (Post Construction) 2018		ONMR (Design) 2026D		PCNA (Post Construction) 2028A					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	*Day*	*Night*		
1	492	60	55	55	54	56	54	56	55	56	56	0.3	0.7	*N*	*Y*
1	493	60	55	49	48	49	48	50	49	50	49	0	0.5	*N*	*N*
1	502	60	55	61	61	60	59	62	62	60	60	-1.9	-1.8	*Y*	*N*
1	503	60	55	67	67	68	67	68	68	69	68	0.8	0.9	*Y*	*N*
1	767	60	55	50	49	51	50	51	50	52	51	0.5	1.1	*N*	*N*
1	816	60	55	50	49	51	50	51	50	51	51	0.3	0.6	*N*	*N*
1	1000	60	55	60	59	61	60	61	60	61	61	0.5	0.7	*Y*	*N*
1	1027	60	55	63	62	64	63	64	63	64	64	0.4	0.8	*Y*	*N*
1	1028	60	55	61	60	62	61	62	61	62	62	0.4	0.7	*Y*	*N*
1	1044	60	55	49	49	50	49	50	49	51	50	0.3	0.7	*N*	*N*
1	1045	60	55	49	48	50	49	50	49	50	50	0.2	0.6	*N*	*N*
1	1055	60	55	48	47	49	47	49	48	49	49	0.4	0.8	*N*	*N*
2	495	60	55	49	49	50	49	50	49	51	50	0.7	1	*N*	*N*
2	498	60	55	60	60	61	60	61	61	62	61	0.4	0.8	*Y*	*N*
2	500	60	55	54	54	55	54	55	54	56	55	0.4	0.7	*N*	*N*
3	466	60	55	64	64	65	64	65	65	66	66	0.7	0.8	*Y*	*N*
3	467	60	55	62	62	64	63	63	63	64	64	1.3	1.6	*Y*	*N*
3	475	60	55	61	61	62	61	62	62	63	62	0.4	0.4	*Y*	*N*
3	482	60	55	53	52	54	53	54	53	54	54	0.3	1.1	*N*	*N*
3	483	60	55	54	53	55	54	55	54	55	55	0.4	1.3	*Y*	*N*
3	488	60	55	59	59	60	59	60	59	60	60	0.1	0.8	*Y*	*N*
3	490	60	55	54	53	55	53	55	54	55	55	0.4	1.3	*N*	*N*
3	746	60	55	64	65	66	65	65	65	67	66	1.2	1.1	*Y*	*N*

NCA	Receiver No.	Noise Goal		Year of Opening				Design Year				*Variance (2028A - 2026D)*		*ONMR Mitigation Required (Y/N)*	*Additional Treatment Required (Y/N)*
				ONMR (Design) 2016		PCNA (Post Construction) 2018		ONMR (Design) 2026D		PCNA (Post Construction) 2028A					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	*Day*	*Night*		
3	818	60	55	58	58	59	58	59	59	59	59	-0.1	0.7	*Y*	*N*
3	821	60	55	61	62	62	61	62	62	63	63	0.6	0.4	*Y*	*N*
3	822	60	55	51	50	52	51	52	51	53	53	0.7	1.6	*N*	*N*
3	1013	60	55	56	55	57	56	57	56	57	57	0.4	1.1	*Y*	*N*
3	1014	60	55	56	56	57	56	57	57	58	58	0.3	1	*Y*	*N*
3	1015	60	55	62	62	63	62	63	62	63	63	0.3	0.6	*Y*	*N*
3	1016	60	55	58	58	59	58	59	58	60	60	0.9	1.4	*Y*	*N*
4	471	60	55	65	65	67	66	66	66	68	68	1.4	2.2	*Y*	*N*
4	478	60	55	60	59	61	60	61	60	61	61	0.4	1.3	*Y*	*N*
4	480	60	55	61	61	62	61	62	61	63	63	0.6	1.4	*Y*	*N*
4	484	60	55	61	61	62	61	62	61	63	63	0.3	1.1	*Y*	*N*
4	486	60	55	63	62	64	62	64	63	64	64	0.3	1.1	*Y*	*N*
4	763	60	55	57	57	58	57	58	57	59	59	0.5	1.3	*Y*	*N*
4	1009	60	55	59	59	60	59	60	59	61	61	0.5	1.3	*Y*	*N*
4	1010	60	55	62	61	63	62	63	62	63	63	0.4	1.2	*Y*	*N*
4	1019	60	55	53	52	54	52	53	53	54	54	0.5	1.3	*N*	*N*
4	1021	60	55	52	51	53	52	53	52	53	53	0.7	1.4	*N*	*Y**
4	1043	60	55	50	49	51	50	51	49	51	51	0.5	1.8	*N*	*N*
5	446	60	55	54	54	55	54	54	54	56	55	1.4	1.2	*N*	*N*
5	448	60	55	61	60	63	62	62	61	63	63	1.3	2.2	*Y*	*N*
5	450	60	55	54	53	55	54	55	54	55	55	0.8	1.6	*Y*	*N*
5	455	60	55	51	50	52	51	52	50	53	52	0.9	2.2	*N*	*N*
5	459	60	55	58	58	58	57	59	59	59	59	0.4	0	*Y*	*N*

NCA	Receiver No.	Noise Goal		Year of Opening				Design Year				*Variance (2028A - 2026D)*		*ONMR Mitigation Required (Y/N)*	*Additional Treatment Required (Y/N)*
				ONMR (Design) 2016		PCNA (Post Construction) 2018		ONMR (Design) 2026D		PCNA (Post Construction) 2028A					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	*Day*	*Night*		
5	462	60	55	53	52	54	53	53	53	54	54	0.8	1.4	*N*	*N*
5	735	60	55	53	53	54	53	53	53	54	54	1	1.2	*N*	*N*
5	1003	60	55	55	55	56	55	56	55	56	56	0.5	0.9	*Y*	*N*
5	1039	60	55	56	55	57	56	57	56	57	57	0.4	1.2	*Y*	*N*
5	1040	60	55	57	57	58	57	58	57	58	58	0.3	0.9	*Y*	*N*
5	1050	60	55	54	53	55	54	55	54	55	55	0.4	1.3	*Y*	*N*
5	1051	60	55	53	53	54	53	54	53	55	54	0.4	1.2	*N*	*N*
5	1052	60	55	50	50	51	50	51	50	52	51	0.4	1.7	*N*	*N*
5	1053	60	55	51	51	52	51	52	51	53	53	0.4	1.6	*N*	*N*
5	1054	60	55	51	50	52	51	52	51	52	52	0.4	1.5	*N*	*N*
6	407	60	55	49	49	52	50	50	49	52	52	2	2.3	*N*	*N*
6	408	60	55	53	53	56	55	54	53	56	56	2.1	2.3	*N*	*Y*
6	409	60	55	64	63	67	66	65	64	68	67	3.1	3.2	*Y*	*N*
6	413	60	55	52	51	54	53	53	52	55	54	2	2.3	*N*	*N*
6	414	60	55	49	48	51	50	50	49	52	51	1.9	2.4	*N*	*N*
6	435	60	55	53	53	56	54	54	53	56	56	1.9	2.5	*N*	*Y*
6	443	60	55	49	49	51	50	50	49	51	51	1.4	2.4	*N*	*N*
6	704	60	55	49	49	52	51	50	49	53	52	2.5	2.9	*N*	*N*
6	705	60	55	51	50	54	53	52	51	54	54	2.5	2.9	*N*	*N*
6	712	60	55	55	55	58	57	56	56	59	58	2.6	2.8	*Y*	*N*
6	729	60	55	58	58	60	58	58	59	60	59	1.4	0.9	*Y*	*N*
6	809	60	55	56	56	59	58	57	57	59	59	1.8	2.3	*Y*	*N*
6	830	60	55	51	51	54	53	52	51	54	54	1.9	2.6	*N*	*N*

NCA	Receiver No.	Noise Goal		Year of Opening				Design Year				*Variance (2028A - 2026D)*		*ONMR Mitigation Required (Y/N)*	*Additional Treatment Required (Y/N)*
				ONMR (Design) 2016		PCNA (Post Construction) 2018		ONMR (Design) 2026D		PCNA (Post Construction) 2028A					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	*Day*	*Night*		
6	1004	60	55	62	61	62	61	63	62	62	63	-0.3	0.4	*Y*	*N*
6	1036	60	55	48	47	50	49	49	47	50	50	1.9	2.6	*N*	*N*
6	1048	60	55	47	47	49	48	48	46	49	49	1.4	3.3	*N*	*N*
6	1049	60	55	48	48	50	49	49	47	51	50	1.3	3.1	*N*	*N*
7	434	60	55	48	48	50	49	49	48	51	50	1.5	2.8	*N*	*N*
7	438	60	55	59	59	59	58	60	59	59	59	-0.5	-0.1	*Y*	*N*
7	439	60	55	56	55	58	57	56	56	58	58	1.4	2	*Y*	*N*
8	384	60	55	53	53	53	52	54	54	54	53	-0.6	-0.7	*N*	*N*
8	388	60	55	53	53	53	52	54	54	53	53	-1.1	-1	*N*	*N*
8	390	60	55	51	51	52	51	52	51	52	52	0.1	0.7	*N*	*N*
8	397	60	55	60	59	60	58	61	60	60	59	-0.6	-0.7	*Y*	*N*
8	399	60	55	65	65	66	65	66	66	66	66	-0.2	-0.1	*Y*	*N*
8	402	60	55	51	51	52	51	52	51	52	52	0.4	0.7	*N*	*N*
8	404	60	55	52	52	53	52	53	53	53	53	0.1	0.2	*N*	*N*
8	695	60	55	58	58	58	57	59	58	58	58	-1	-0.8	*Y*	*N*
8	1033	60	55	48	48	49	48	49	48	50	49	0.8	1.5	*N*	*N*
8	1034	60	55	56	56	57	55	57	57	57	56	-0.1	-0.1	*Y*	*N*
9	392	60	55	52	52	52	50	53	52	52	51	-1.2	-0.9	*N*	*N*
9	394	60	55	52	52	53	52	53	53	53	53	0.1	0.1	*N*	*N*
9	395	60	55	52	52	53	52	53	53	54	53	0.2	0.1	*N*	*N*
9	396	60	55	61	61	62	60	62	62	62	61	-0.1	-0.6	*Y*	*N*
9	405	60	55	58	58	59	57	59	58	59	58	0.1	-0.2	*Y*	*N*
9	406	60	55	49	49	50	49	50	49	51	50	0.4	0.8	*N*	*N*

NCA	Receiver No.	Noise Goal		Year of Opening				Design Year				*Variance (2028A - 2026D)*		*ONMR Mitigation Required (Y/N)*	*Additional Treatment Required (Y/N)*
				ONMR (Design) 2016		PCNA (Post Construction) 2018		ONMR (Design) 2026D		PCNA (Post Construction) 2028A					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	*Day*	*Night*		
9	1035	60	55	51	51	51	50	52	51	51	51	-0.8	-0.5	*N*	*N*
10	381	60	55	46	46	46	45	47	46	47	47	-0.2	0.2	*N*	*N*
10	382	60	55	50	51	51	50	51	51	51	50	0.3	-1.6	*N*	*N*
10	383	60	55	53	53	54	52	54	54	53	53	-0.1	-1	*N*	*N*
10	386	60	55	51	51	51	50	52	52	51	50	-1.0	-1.2	*N*	*N*
10	688	60	55	59	59	59	57	60	59	59	58	-1.2	-1.2	*Y*	*N*

*Mitigation requirement is based on the measured road traffic noise level, as per Table 5-4.

APPENDIX B

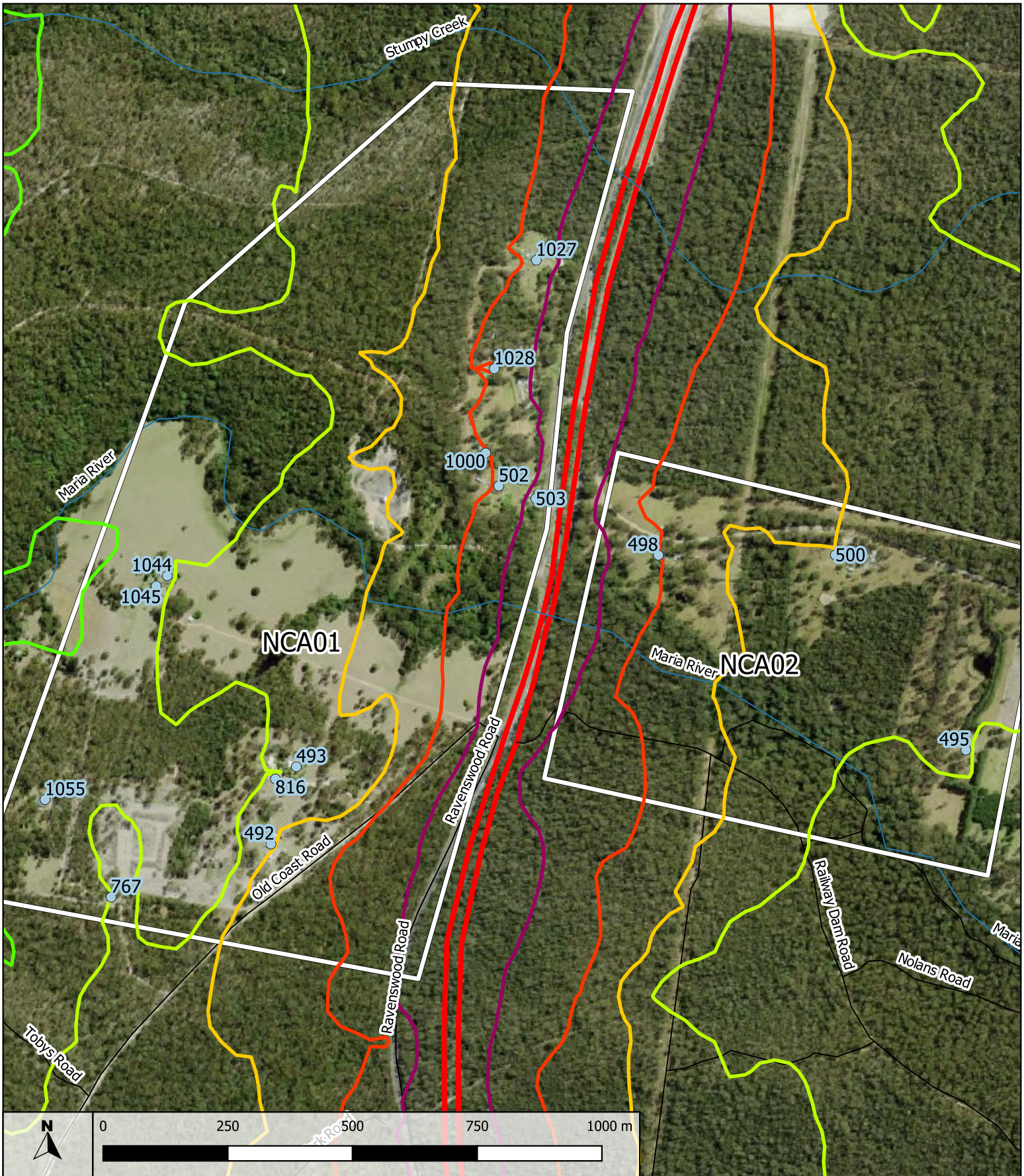
ADDITIONAL NOISE MITIGATION REQUIREMENT

NCA	Receiver No	Noise Goal		2028A Design Noise Levels	
		Day	Night	Day	Night
1	492	60	55	56	56
4	1021*	60	55	53	53
6	408	60	55	56	56
6	435	60	55	56	56

*Mitigation requirement is based on the measured road traffic noise level, as per Table 5-4.

APPENDIX C

NOISE CONTOURS



PROJECT No.:	**REVISION:**
12063-ES	E
PREPARED:	**APPROVED:**
PT	BJM
EXPORTED:	**SHEET SIZE:**
7/2/2019	A4

WILKINSON MURRAY

PROJECT:

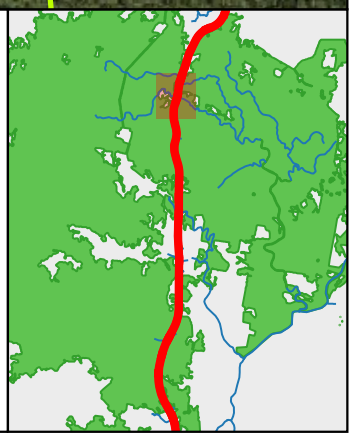
Kundabung to Kempsey

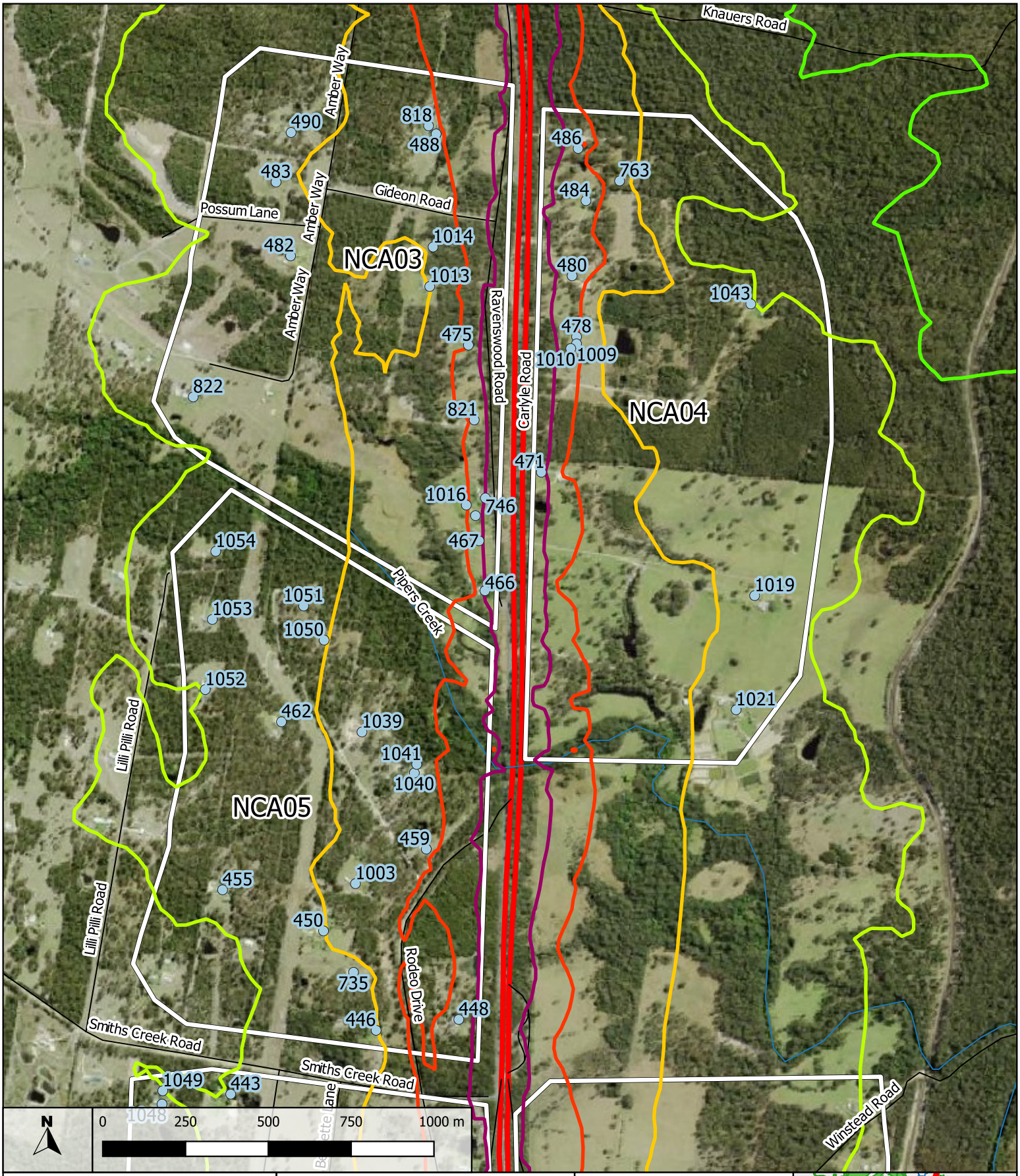
TITLE:

Post - Opening Compliance 2018 Day Noise Contours

Appendix C-1
Drawing 1 of 4

Receiver
Alignment
Noise Level in dBA
45
50
55
60
65





PROJECT No.:	REVISION:
12063-ES	E
PREPARED:	APPROVED:
PT	BJM
EXPORTED:	SHEET SIZE:
7/2/2019	A4

WILKINSON MURRAY

PROJECT:

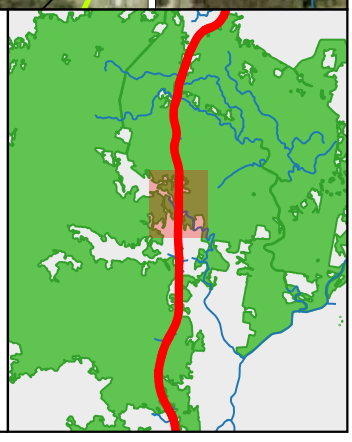
Kundabung to Kempsey

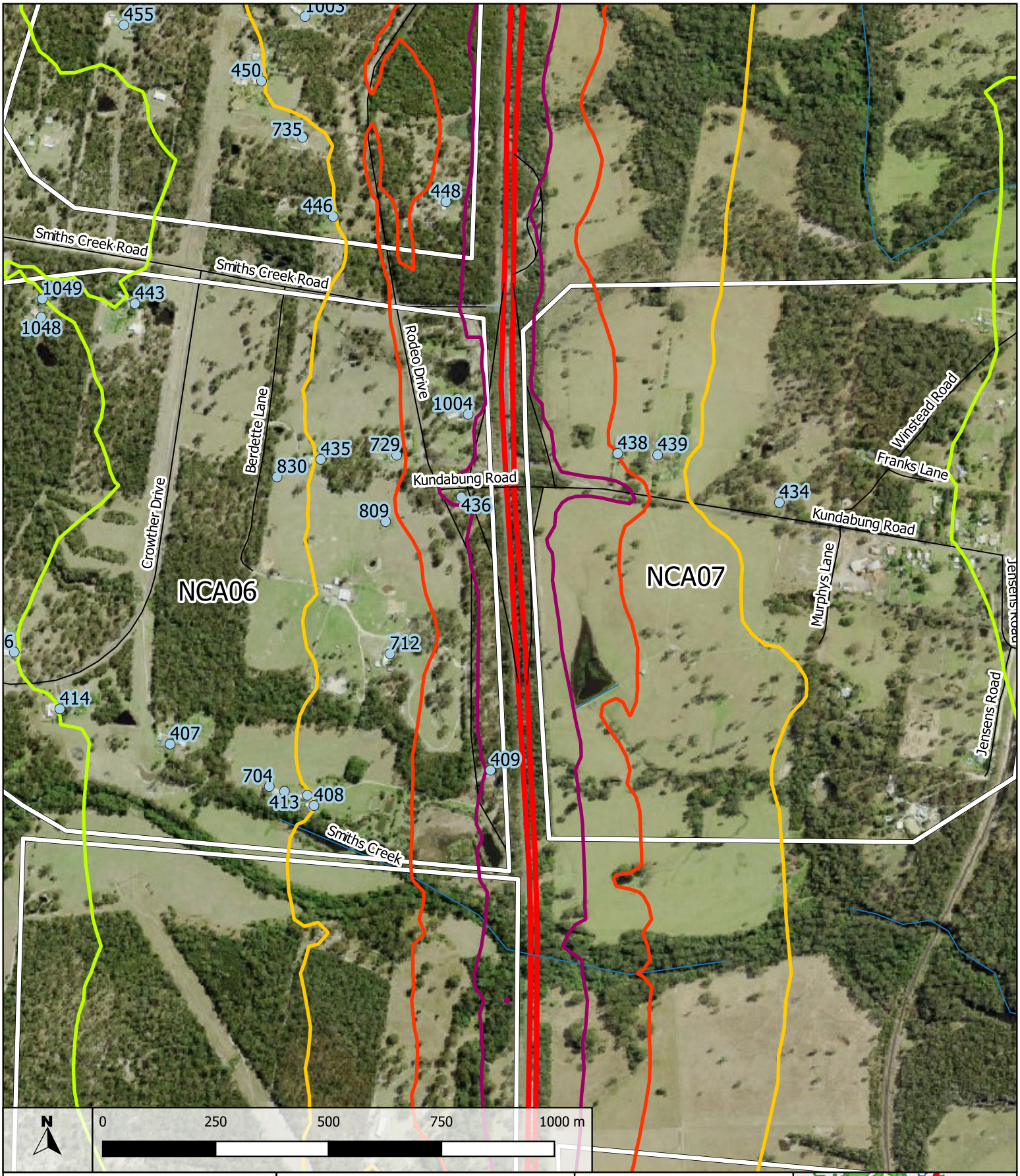
TITLE:

Post - Opening Compliance 2018 Day Noise Contours

Appendix C-1
Drawing 2 of 4

Receiver
Alignment
Noise Level in dBA
45
50
55
60
65





PROJECT No.:	**REVISION:**
12063-ES	E
PREPARED:	**APPROVED:**
PT	BJM
EXPORTED:	**SHEET SIZE:**
7/2/2019	A4

WILKINSON MURRAY

PROJECT:

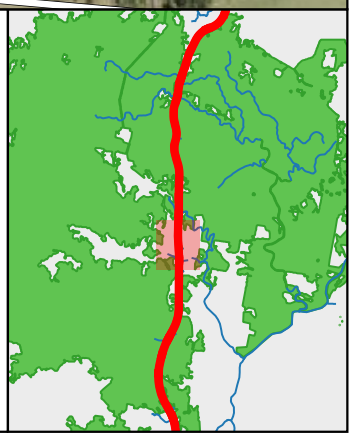
Kundabung to Kempsey

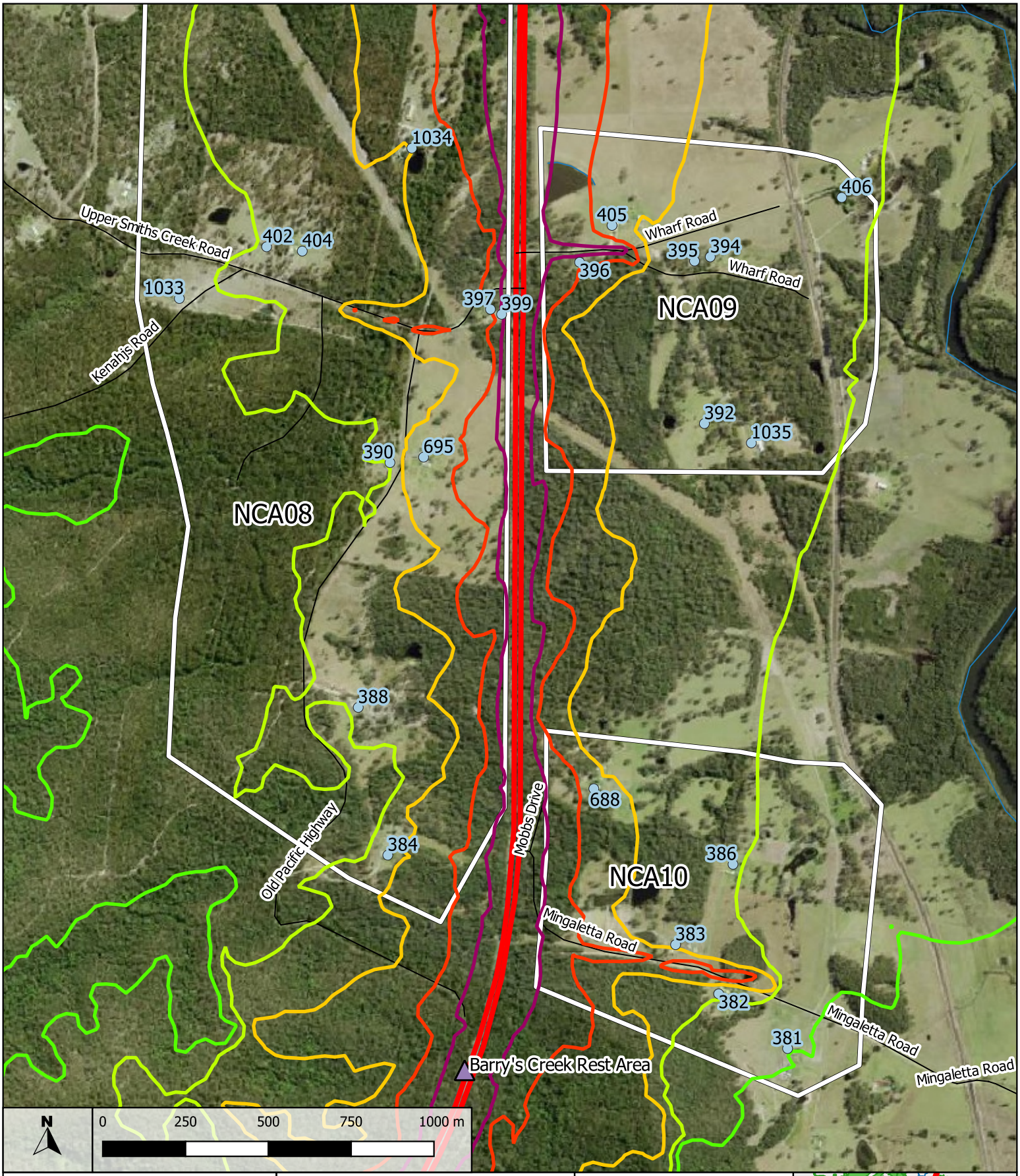
TITLE:

Post - Opening Compliance 2018 Day Noise Contours

Appendix C-1
Drawing 3 of 4

Receiver
Alignment
Noise Level in dBA
45
50
55
60
65





PROJECT No.:	REVISION:
12063-ES	E
PREPARED:	APPROVED:
PT	BJM
EXPORTED:	SHEET SIZE:
7/2/2019	A4

WILKINSON MURRAY

PROJECT:

Kundabung to Kempsey

TITLE:

Post - Opening Compliance 2018 Day Noise Contours

Appendix C-1
Drawing 4 of 4

Receiver
Alignment
Noise Level in dBA
45
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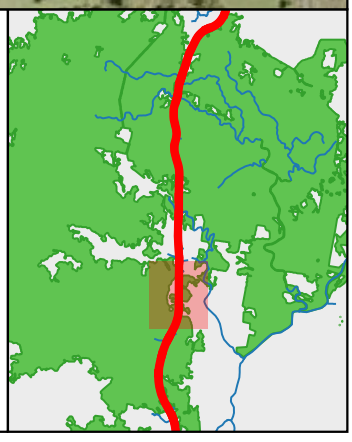

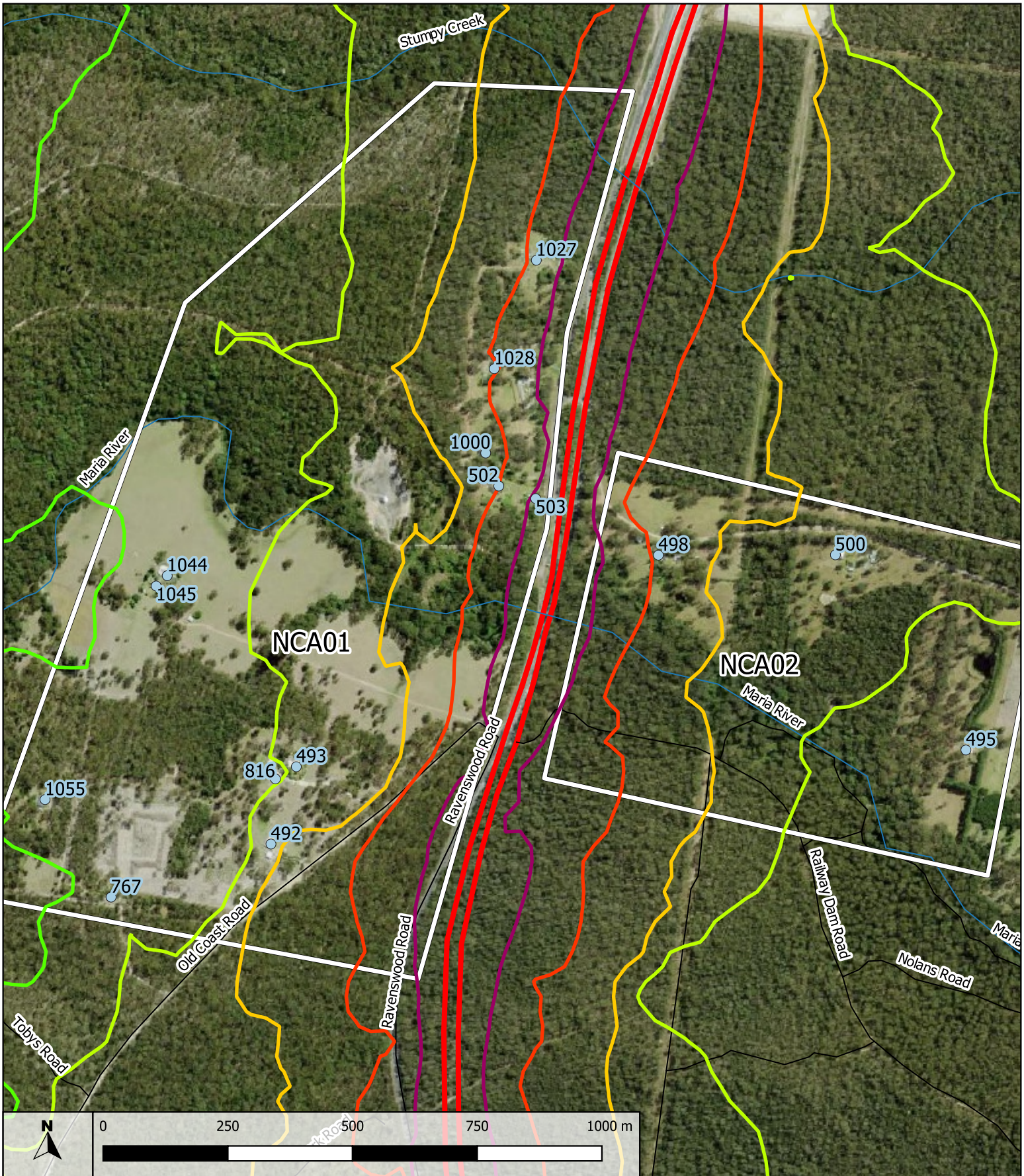

PROJECT No.:	**REVISION:**
12063-ES	E
PREPARED:	**APPROVED:**
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7/2/2019	A4

WILKINSON MURRAY

PROJECT:

Kundabung to Kempsey

TITLE:

Post - Opening Compliance 2018 Night Noise Contours

Appendix C-2
Drawing 1 of 4

Receiver
Alignment
Noise Level in dBA
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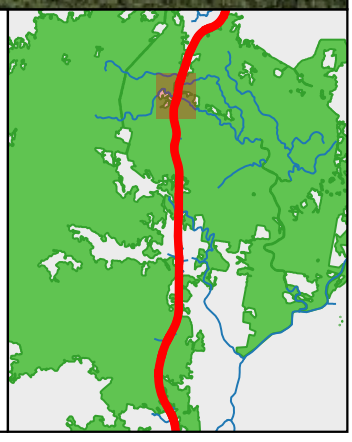

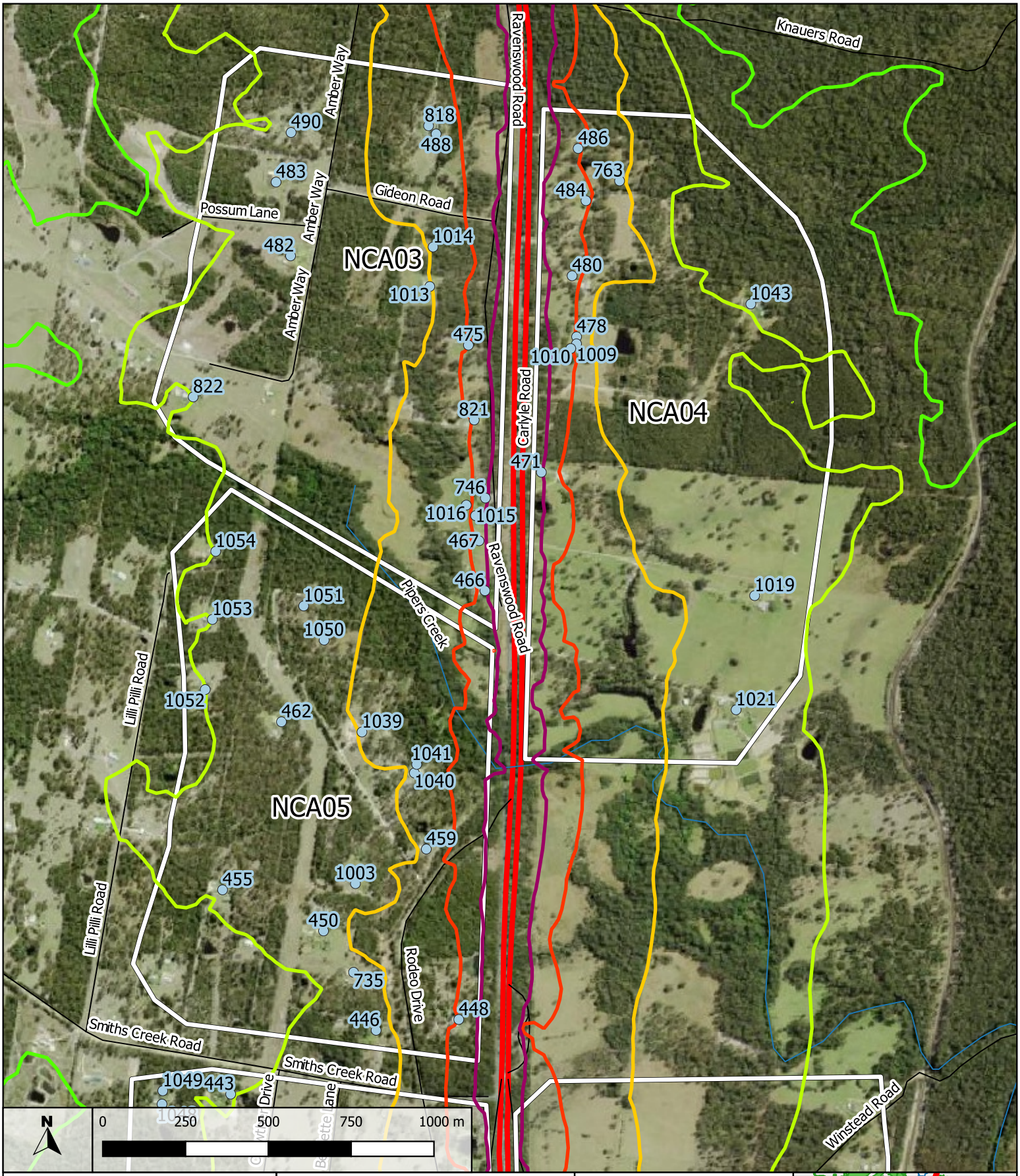

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WILKINSON MURRAY

PROJECT:

Kundabung to Kempsey

TITLE:

Post - Opening Compliance 2018 Night Noise Contours

Appendix C-2
Drawing 2 of 4

Receiver
Alignment
Noise Level in dBA
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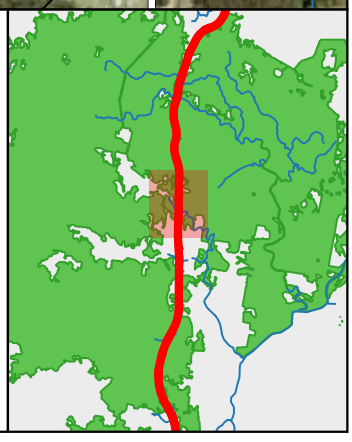

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PREPARED:	**APPROVED:**
PT	BJM
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WILKINSON MURRAY

PROJECT:

Kundabung to Kempsey

TITLE:

Post - Opening Compliance 2018 Night Noise Contours

Appendix C-2
Drawing 3 of 4

Receiver
Alignment
Noise Level in dBA
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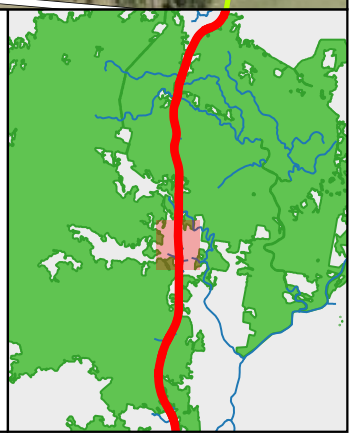

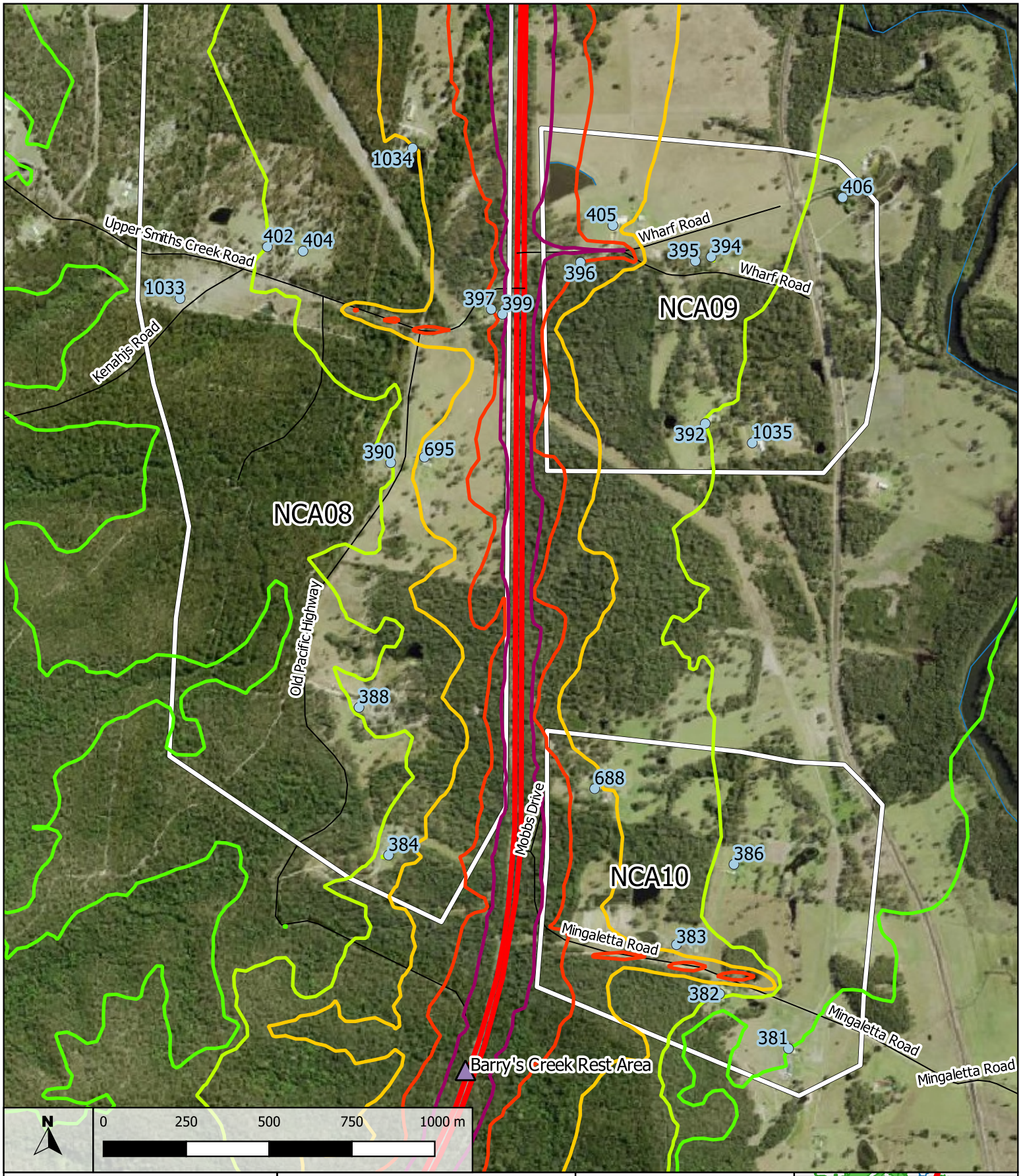

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WILKINSON MURRAY

PROJECT:

Kundabung to Kempsey

TITLE:

Post - Opening Compliance 2018 Night Noise Contours

Appendix C-2
Drawing 4 of 4

Receiver
Alignment
Noise Level in dBA
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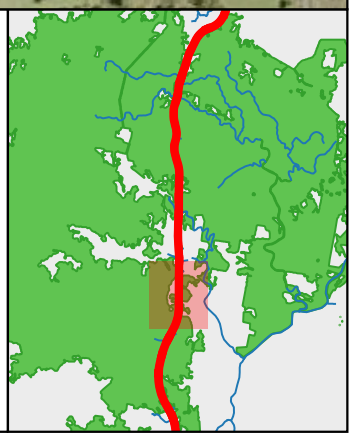

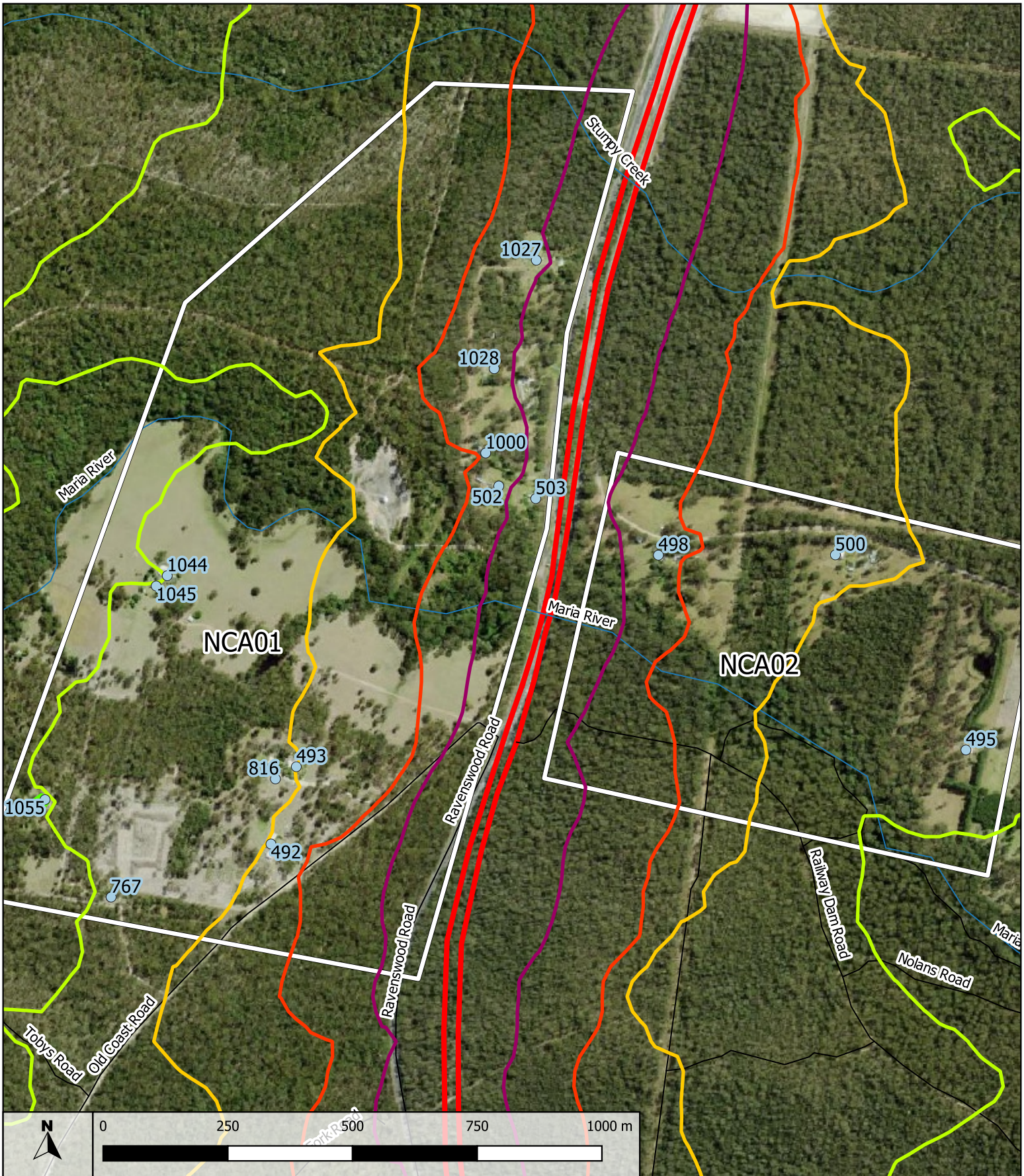

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WILKINSON MURRAY

PROJECT:

Kundabung to Kempsey

TITLE:

Post - Opening Compliance 2028 Day Noise Contours

Appendix C-3
Drawing 1 of 4

Receiver
Alignment
Noise Level in dBA
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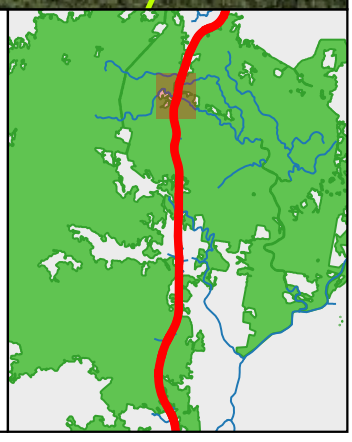

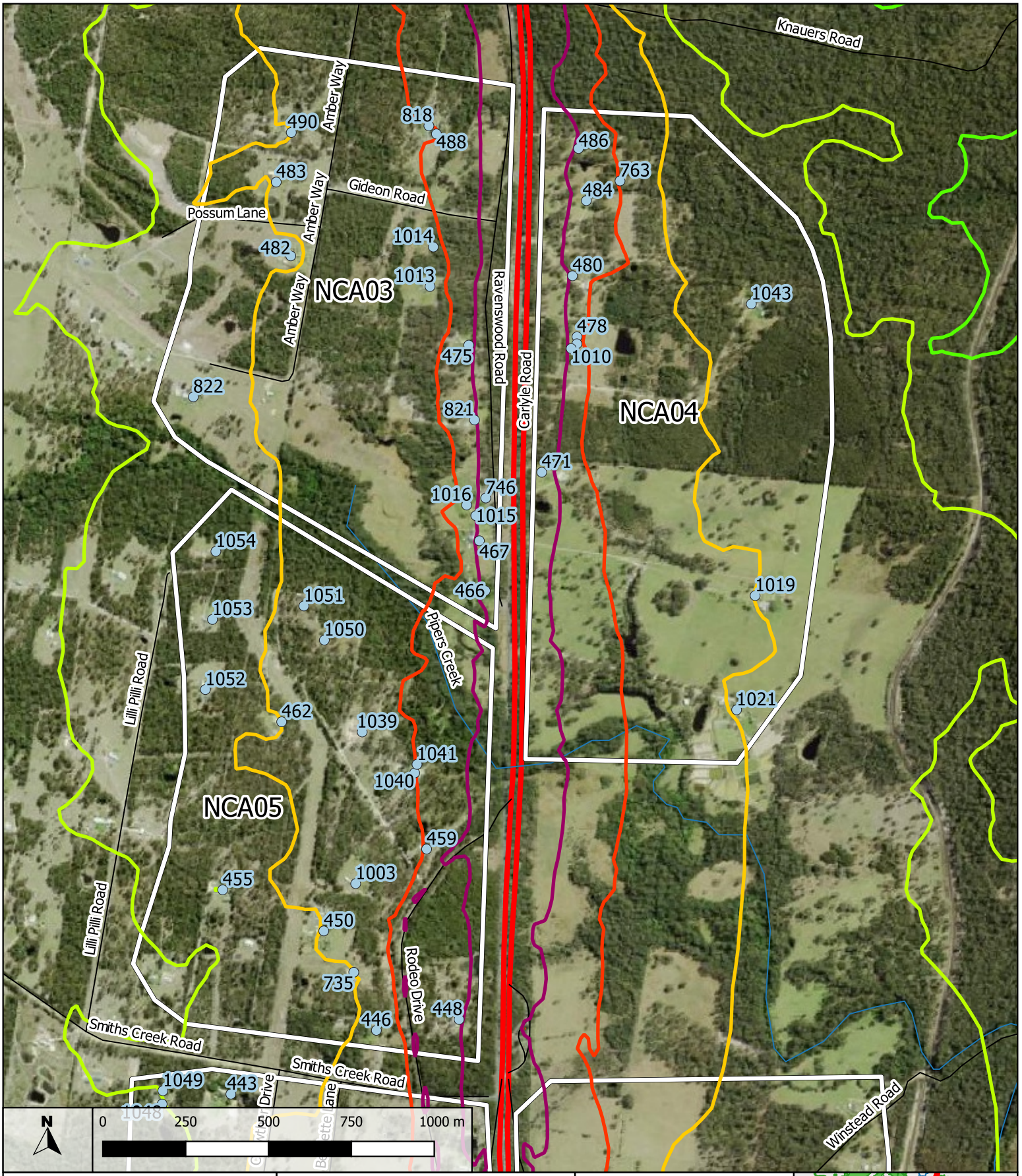

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PREPARED:	**APPROVED:**
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7/2/2019	A4

WILKINSON MURRAY

PROJECT:

Kundabung to Kempsey

TITLE:

Post - Opening Compliance 2028 Day Noise Contours

Appendix C-3
Drawing 2 of 4

Receiver
Alignment
Noise Level in dBA
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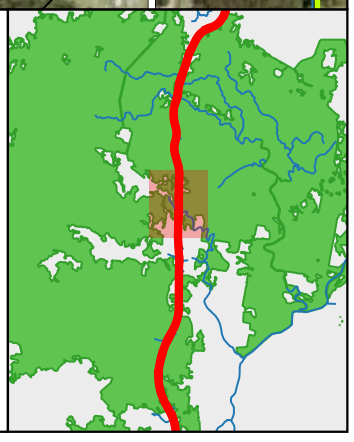

PROJECT No.:	**REVISION:**
12063-ES	**E**
PREPARED:	**APPROVED:**
PT	**BJM**
EXPORTED:	**SHEET SIZE:**
7/2/2019	**A4**

WILKINSON MURRAY

PROJECT:

Kundabung to Kempsey

TITLE:

Post - Opening Compliance 2028 Day Noise Contours

Appendix C-3
Drawing 3 of 4

Receiver
Alignment
Noise Level in dBA
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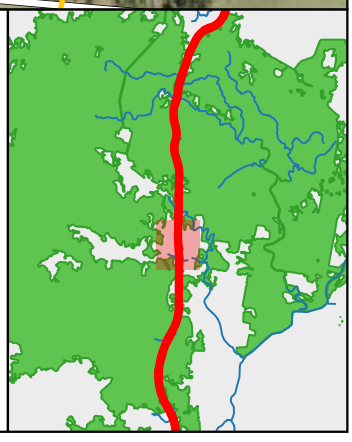

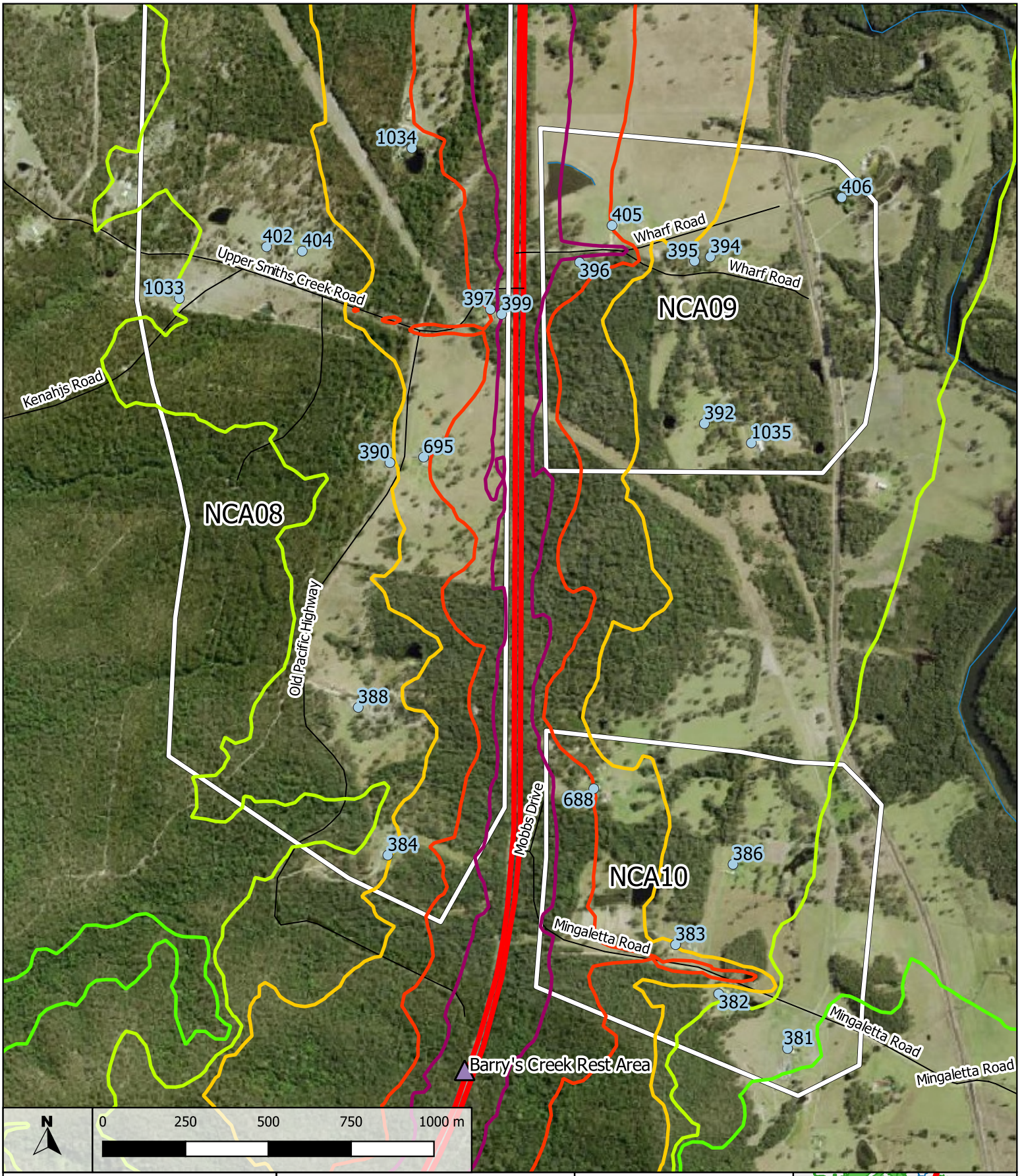

PROJECT No.:	REVISION:
12063-ES	E
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WILKINSON MURRAY

PROJECT:

Kundabung to Kempsey

TITLE:

Post - Opening Compliance 2028 Day Noise Contours

Appendix C-3
Drawing 4 of 4

Receiver
Alignment
Noise Level in dBA
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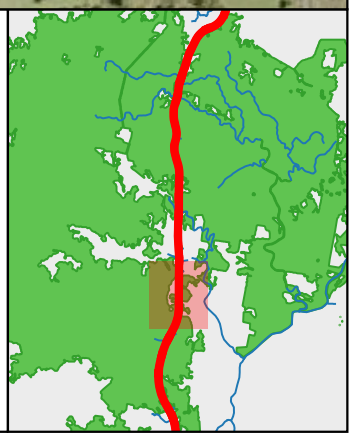

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12063-ES	E
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WILKINSON MURRAY

PROJECT:

Kundabung to Kempsey

TITLE:

Post - Opening Compliance 2028 Night Noise Contours

Appendix C-4
Drawing 1 of 4

Receiver
Alignment
Noise Level in dBA
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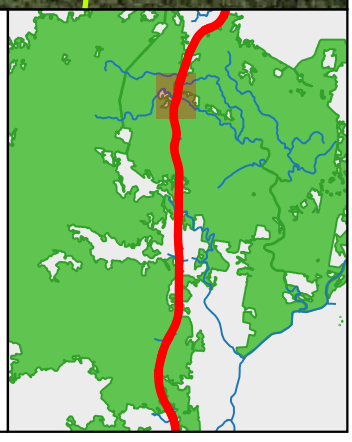

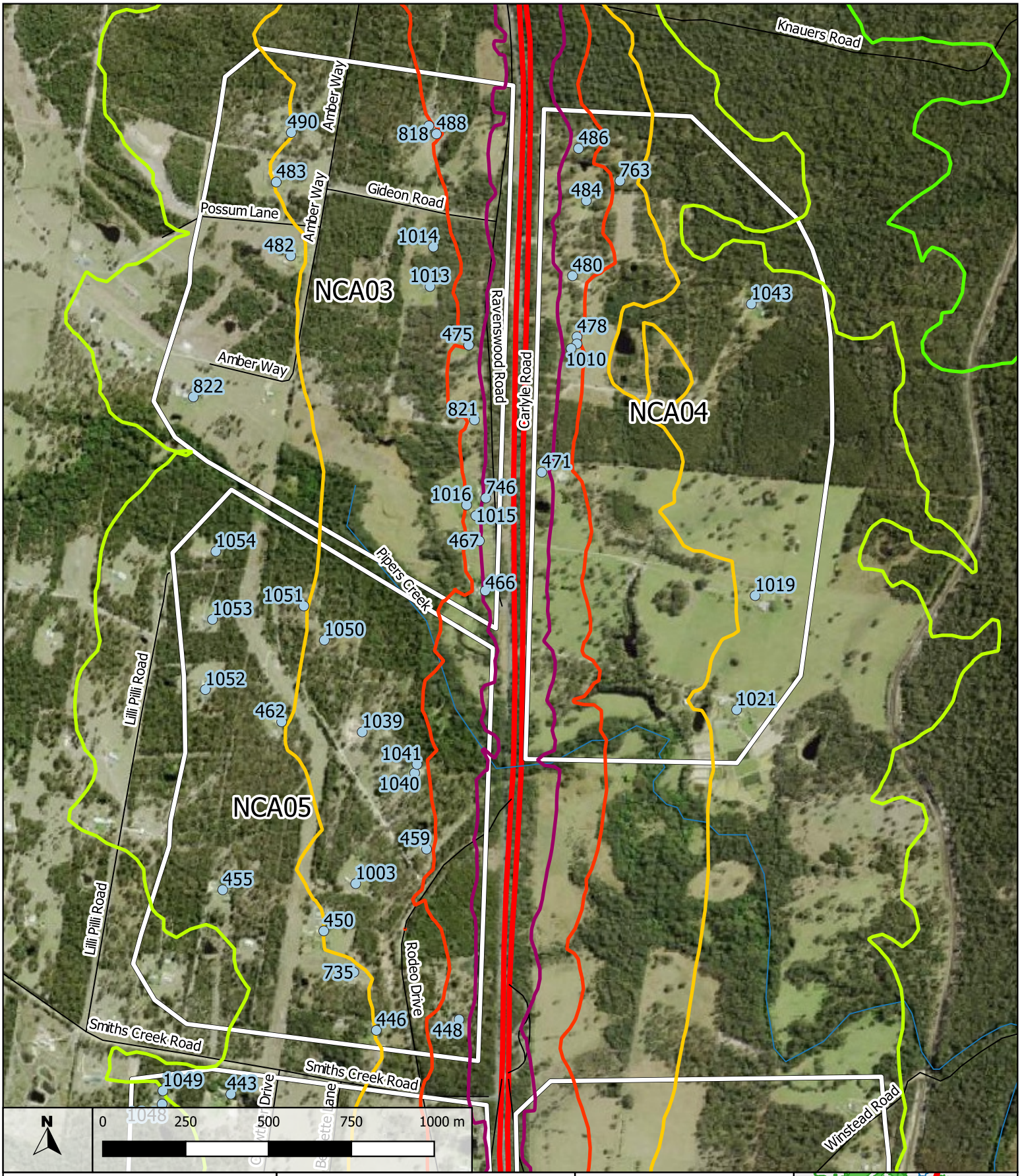

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7/2/2019	A4

WILKINSON MURRAY

PROJECT:

Kundabung to Kempsey

TITLE:

Post - Opening Compliance 2028 Night Noise Contours

Appendix C-4
Drawing 2 of 4

Receiver
Alignment
Noise Level in dBA
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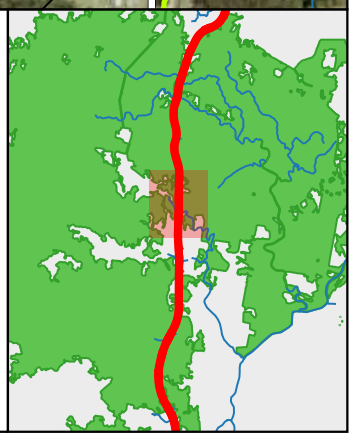

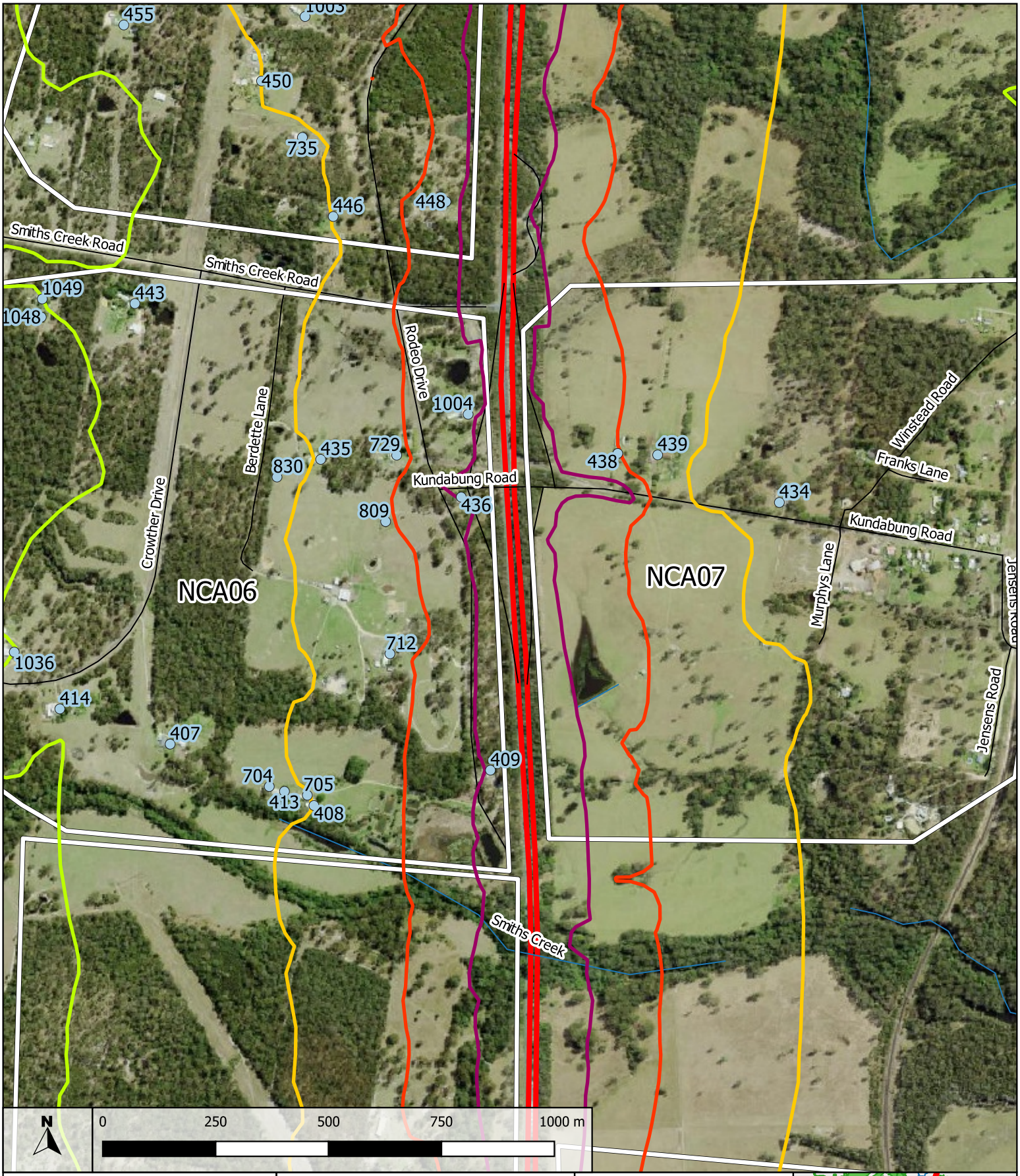

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WILKINSON MURRAY

PROJECT:

Kundabung to Kempsey

TITLE:

Post - Opening Compliance 2028 Night Noise Contours

Appendix C-4
Drawing 3 of 4

Receiver
Alignment
Noise Level in dBA
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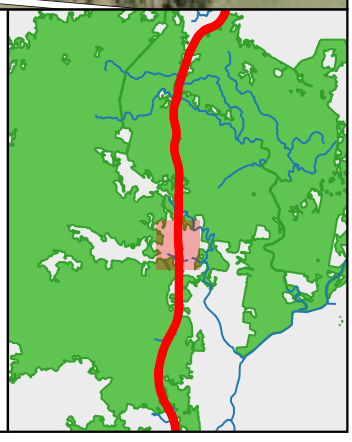

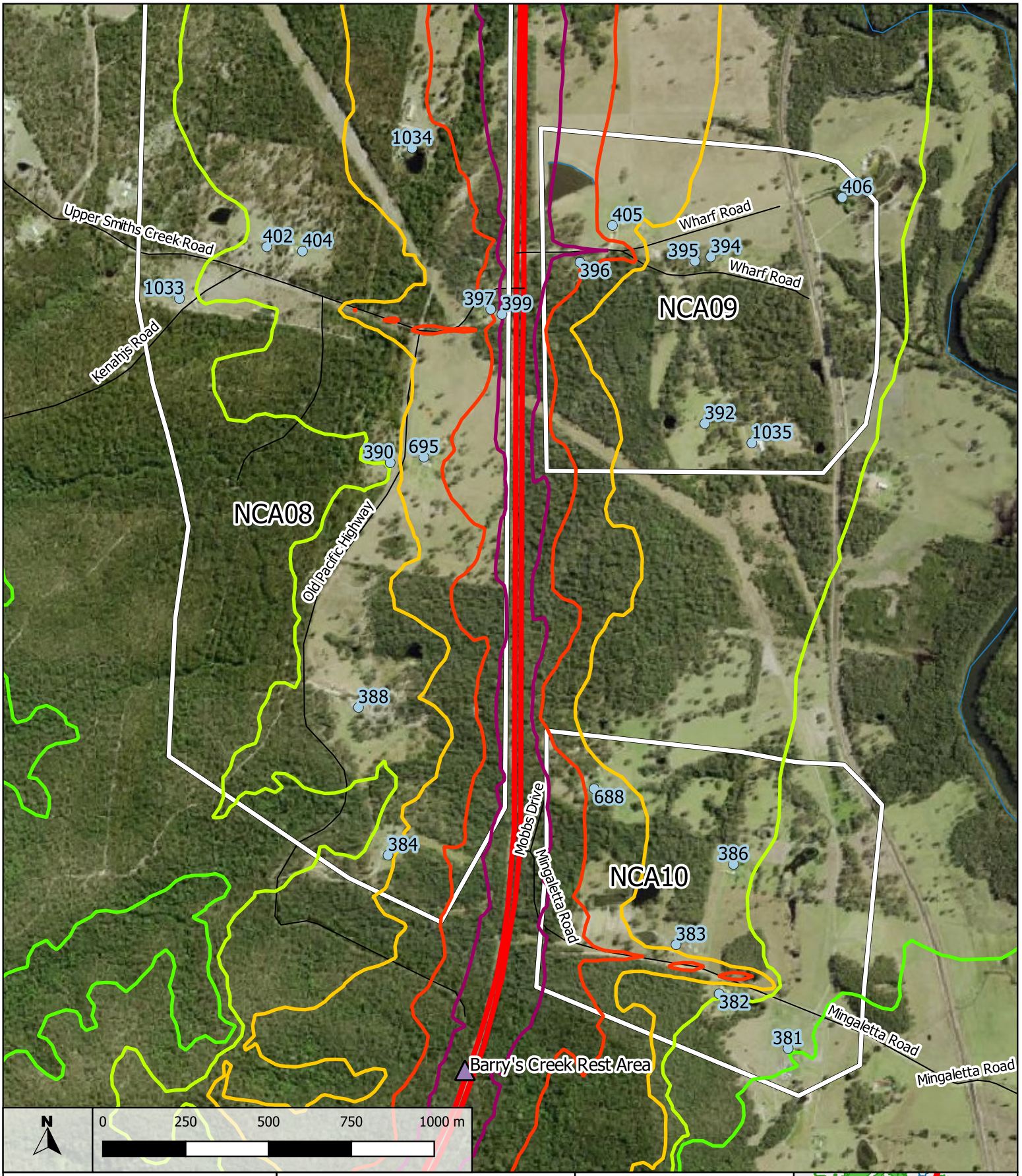

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WILKINSON MURRAY

PROJECT:

Kundabung to Kempsey

TITLE:

Post - Opening Compliance 2028 Night Noise Contours

Appendix C-4
Drawing 4 of 4

Receiver
Alignment
Noise Level in dBA
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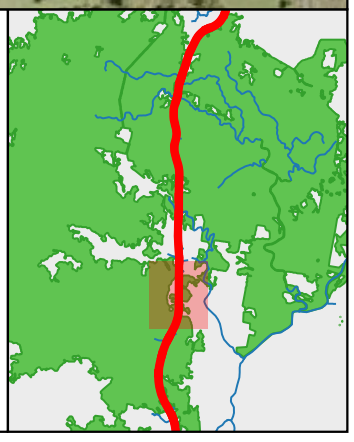


APPENDIX D

NOISE MEASUREMENT EXCLUSION LOG

Address	Date	Period Start	Period End	Event
106 Ravenswood Road, Kundabung	14/08/2018	0:45	1:15	Dog barking
	14/08/2018	6:15	6:30	Door shut
	14/08/2018	6:30	6:45	Engine start/car idle
	14/08/2018	10:30	11:00	Bird chirping near mic
	14/08/2018	15:00	15:15	Engine start/car idle
	14/08/2018	15:15	15:30	Vehicle pulling up and stopping
	14/08/2018	18:00	18:15	Dog barking
	14/08/2018	21:45	22:00	Dog barking
	15/08/2018	6:30	6:45	Engine start/car idle
	15/08/2018	6:45	7:00	Vehicle pulling up and stopping
	15/08/2018	9:30	9:45	Door shut
	15/08/2018	10:00	10:15	Bird chirping near mic
	15/08/2018	11:30	11:45	Bird chirping near mic
	15/08/2018	12:30	12:45	Whipper snipper/blower
	15/08/2018	14:00	14:30	Bird chirping near mic
	16/08/2018	6:30	6:45	Engine start/car idle
	16/08/2018	6:45	7:00	Door shut
	16/08/2018	10:00	10:15	Bird chirping near mic
	18/08/2016	8:45	9:00	Bird chirping near mic
	18/08/2016	15:45	16:00	Bird chirping near mic
	19/08/2018	4:45	5:00	Dog barking
	20/08/2018	3:30	3:45	Dog barking
	20/08/2018	19:45	20:00	Dog barking
	21/08/2018	2:45	3:00	Dog barking
	21/08/2018	15:15	15:45	Human activity, dog barking
	22/08/2018	13:30	13:45	Bird chirping near mic
	23/02/2018	6:30	6:45	Engine start/car idle
27 Wharf Road, Kundabung	15/08/2018	7:15	7:30	Dog barking
	17/08/2018	9:45	10:45	Dog barking/human activity
	17/08/2018	13:00	13:15	Dog barking
	18/08/2018	9:45	10:15	Dog barking

Address	Date	Period Start	Period End	Event
	19/08/2018	7:15	8:00	Dog barking
	21/08/2018	10:00	10:45	Dog barking
	21/08/2018	15:15	15:30	Lawn mower
	22/08/2018	15:15	15:45	Lawn mower
	23/08/2018	10:30	10:45	Dog barking
41 Carlyle Road, Kundabung	15/08/2018	15:00	15:15	Lawn mower
	18/08/2018	21:15	21:30	Hammering/shooting?
	16/08/2018	17:30	17:45	Birds chirping nearby
	17/08/2018	15:45	16:15	Birds chirping nearby
	17/08/2018	17:45	18:00	Vehicle onsite
	18/08/2018	17:30	17:45	Birds chirping nearby
	19/08/2018	2:00	2:30	Dog barking
	21/08/2018	9:00	9:45	Bird noise
	21/08/2018	17:00	17:30	Birds chirping nearby
	23/08/2018	12:15	12:30	Birds chirping nearby
	23/08/2018	17:15	17:30	Birds chirping nearby
35 Old Pacific Highway, Kundabung	14/08/2018	16:30	16:45	Bird noises
	16/08/2018	14:30	14:45	Bird noises
	17/08/2018	10:30	10:45	Bird noises
	22/08/2018	14:00	14:15	Bird noises and dog barking
50 Old Coast Road, Kundabung	17/08/2018	22:00	22:15	Vehicle pulling up and stopping, human activity
	17/08/2018	22:45	23:00	Animal noise
	18/08/2018	11:45	12:45	People conversing and vehicle onsite
	18/08/2018	18:45	19:15	Car idle
	15/08/2018	13:45	14:00	People conversing and vehicle onsite
	16/08/2018	14:00	14:15	Animal noise
	16/08/2018	15:00	15:15	Animal noise
180 Scrubby Creek Road, South Kempsey	17/08/2018	10:15	12:30	Human activity/construction work
	17/08/2018	15:00	15:45	Animal noise
	18/08/2018	7:00	8:45	Human activity/construction work
	18/08/2018	12:15	14:00	Music from radio

Address	Date	Period Start	Period End	Event
	18/08/2018	16:45	17:00	Animal noise
	18/08/2018	22:30	23:00	Animal noise
	20/08/2018	6:30	6:45	Animal noise
	20/08/2018	14:00	15:15	Animal noise
	21/08/2018	14:15	16:00	Animal noise
	22/08/2018	14:30	14:45	Animal noise
	23/08/2018	14:30	15:45	Animal noise
161 Carlyle Road, Kundabung	14/08/2018	13:30	13:45	Tractor pulling up
	14/08/2018	15:45	16:15	Engine idle/human activity
	14/08/2018	17:00	17:15	Wood chopping
	15/08/2018	7:00	8:00	On-site truck movement, door shutting and birds nearby
	15/08/2018	14:00	15:00	Dog barking, people talking and birds nearby
	15/08/2018	11:00	11:15	Item dropped
	16/08/2018	13:00	13:45	Engine/birds
	16/08/2018	18:00	18:30	Engine/wood chopping
	17/08/2018	9:00	9:45	Bird noise/human activity
	17/08/2018	17:45	18:00	Human activity
	18/08/2018	15:45	16:00	Door shut
	22/08/2018	10:00	11:00	Onsite vehicle, bird calling
	23/08/2018	15:00	15:30	Tractor pulling up
	23/08/2018	16:30	17:00	Human conversation/construction work
22 Mobbs Drive, Kundabung	14/08/2018	3:45	6:15	Rooster
	14/08/2018	10:00	11:30	Bird noise, human conversation
	14/08/2018	12:00	12:45	Bird noise
	14/08/2018	13:00	13:15	Engine start/car idle
	14/08/2018	17:30	18:00	Bird noise
	15/08/2018	3:00	5:45	Rooster
	15/08/2018	10:00	10:45	Bird noise
	15/08/2018	11:15	12:00	Bird noise, human conversation
	15/08/2018	15:00	15:45	Lawn mower
	15/08/2018	17:00	17:15	Lawn mower

Address	Date	Period Start	Period End	Event
	16/08/2018	3:30	6:15	Rooster
	16/08/2018	8:30	12:30	Construction noise
	16/08/2018	12:30	15:45	Construction noise
	16/08/2018	16:15	16:45	Bird noise
	17/08/2018	3:00	6:30	Rooster
	17/08/2018	8:45	9:15	Animal noise
	17/08/2018	9:30	10:30	Animal noise
	17/08/2018	16:00	16:30	Animal noise/human activity
	17/08/2018	17:45	18:00	Animal noise
	18/08/2018	2:30	6:00	Rooster
	18/08/2018	12:30	13:00	Animal noise
	18/08/2018	13:30	14:30	Animal noise
	18/08/2018	16:15	16:45	Door shut/animal noise
	19/08/2018	3:30	6:15	Rooster
	19/08/2018	7:15	7:30	Bird noise
	20/08/2018	3:30	6:00	Rooster
	21/08/2018	4:00	6:15	Rooster
	21/08/2018	9:45	10:15	Animal noise
	21/08/2018	11:00	13:00	Animal noise
	21/08/2018	14:00	14:30	Animal noise
	22/08/2018	3:45	6:00	Rooster
	22/08/2018	9:45	10:00	Animal noise
	22/08/2018	10:15	10:45	Animal noise
	22/08/2018	12:00	14:30	Animal noise
	23/08/2018	5:00	5:45	Rooster
	17/08/2018	15:30	16:15	Bird chirping near mic
	16/08/2018	17:30	17:45	Dogs barking
	21/08/2018	9:45	10:15	Animal noise
	21/08/2018	11:00	13:00	Animal noise

APPENDIX E

NOISE COMPLAINTS REGISTER

Noise Catchment Area	Area of Complaint	Event Type	Event Date	Details of Complaint	Details of Our Response
NCA04	Carlyle Road, Kundabung	Email in	12-Aug-15	12/08/2015 - resident emailed to complain that since trees had been removed the traffic noise has become worse and they are having trouble sleeping. 12/02/2016 - resident emailed to complain that since the mounds of gravel had been removed the noise has become worse and sleep is affected. 22/03/2016 and 31/03/2016 - resident emailed to complain about the road traffic noise they are receiving during the night and having trouble sleeping. 7/5/2016 - resident emailed a letter (in response to Roads and Maritime letter) to disagree with the premise of modelling for noise when they are experiencing lack of sleep due to the increased traffic noise. 14/12/2016 - resident emailed to complain about lack of sleep due to traffic noise. 27/7/2017 - resident e-mailed to complain about noise and was of the opinion that post construction monitoring should have been undertaken already as it has been more than 12 months since the SB has been open to traffic.	14/8/2015 Roads and Maritime organised meeting for 20/8/2015 with the residents to discuss traffic noise. 5/4/2016 – Roads and Maritime sent resident a letter to explain noise assessment process

Noise Catchment Area	Area of Complaint	Event Type	Event Date	Details of Complaint	Details of Our Response
NCA07	Kundabung Road, Kundabung	Meeting	14-Sep-15	14/9/15 - following request from the resident to meet face to face, resident complained about the increase in traffic noise since the trees where cleared, particularly truck noise.	
NCA05	Rodeo Drive, Kundabung	Email in	13-Dec-16	13/12/16 - resident complained about increase in noise since trees have been cleared and Rodeo Drive no longer being a no through road. Resident requested a review of their eligibility for acoustic treatment.	14/12/16 - Roads and Maritime followed up with phone call to discuss noise assessment process and planned post completion noise monitoring 6 to 12 months after the project is fully open to traffic and the traffic is travelling at the design speed limit.
NCA01	Old Coast Road, Kundabung	Phone in	19-Dec-16	19/12/16 - resident complained that traffic noise at the house has increased since the recent switch.	19/12/16 - MCDOHL explained previous noise assessment process and plans to undertake further monitoring once the road is fully operational to assess if the initial reports were correct. Suggested that the resident email or write to Roads and Maritime direct as Roads and Maritime are dealing with operational noise.

Noise Catchment Area	Area of Complaint	Event Type	Event Date	Details of Complaint	Details of Our Response
NCA09	Wharf Road, Kundabung	Phone in	26-Jul-16	26/7/16 - resident complained about road traffic noise increasing since the traffic switch. Noise worst coming from old HVIB and large fill south of Wharf Road, in particular 4wd tyres and trucks. 15/11/17 - Drop into site to complain about noise. Very descriptive complaint regarding tone and proximity on the highway where the noise is of concern.	29/7/16 - Roads and Maritime provided detailed email response explaining noise assessment process and plans for further post completion noise monitoring. 15/11/17 - JV explained the post completion noise assessment process.
NCA07	Kundabung Road, Kundabung	Phone in	01-Aug-17	1/8/17 - resident complained about the increased traffic noise levels from highway upgrade with noise from trucks using the highway louder since the traffic switch. He described the noise as "diff and tyre noise" from trucks and is loudest on Tuesday and Wednesday nights. He explained he can hear them coming up from Smiths Creek and through to beyond Pipers Creek. He claims he is finding it difficult to sleep.	1/8/17 - Roads and Maritime explained the noise assessment process with previous noise predictions to be checked in about 6 to 12 months after the project is fully opened to traffic and the traffic is travelling at the design speed limit.
NCA04	Carlyle Road, Kundabung	Email in	20-Sep-17	20/9/17 - resident e-mail to complain about the increase in traffic noise since the trees have been removed and traffic switched onto concrete pavement. Noted that they expect the noise to get worse when operating at 110km/hr.	22/9/17 - Roads and Maritime provided a letter to explain the noise assessment process.

Noise Catchment Area	Area of Complaint	Event Type	Event Date	Details of Complaint	Details of Our Response
NCA08	Upper Smiths Creek Road, Kundabung	Phone in	10-Oct-17	10/10/17 - resident phoned to complain about noise and asking why noise barriers aren't being constructed. 15/11/17 – The complainant called the community line to complain about the noise and also placed a friend who was visiting from Sydney on the line to confirm the noise levels.	10/10/17 - JV explained the noise assessment process and that further information is available on the website or in the project site office if required. 15/11/17 - JV explained the process for post completion noise assessments.
NCA03	Links Road, Kundabung	Site Visit	11-Oct-17	11/10/17 - resident visited site to complain about noise following removal of temp stockpile between alignment and Ravenswood Road.	11/10/17 - JV explained noise assessment process and requested resident put concerns in email.
NCA06	Rodeo Drive, Kundabung	-	12-Mar-18	12/3/18 - resident contacted the community complaints line to complain about noise and enquire as to why their property did not get double glazed windows.	13/3/18 - Roads and Maritime called back to explain the procedure for determining the applicable acoustic treatment and that monitoring will be undertaken once the speed limit is raised to 110km/hr to check actual noise levels against the model values. Roads and Maritime will be in contact once the report has been finalised.

Noise Catchment Area	Area of Complaint	Event Type	Event Date	Details of Complaint	Details of Our Response
NCA09	Wharf Road, Kundabung	-	16-Jul-18	16/7/18 - resident called to complain about the noise and enquire as to when the noise monitoring is to be undertaken.	16/7/18 - Roads and Maritime called back to explain the noise monitoring is being planned for August 2018. The process was explained, and the complainant was satisfied with the response.

APPENDIX F

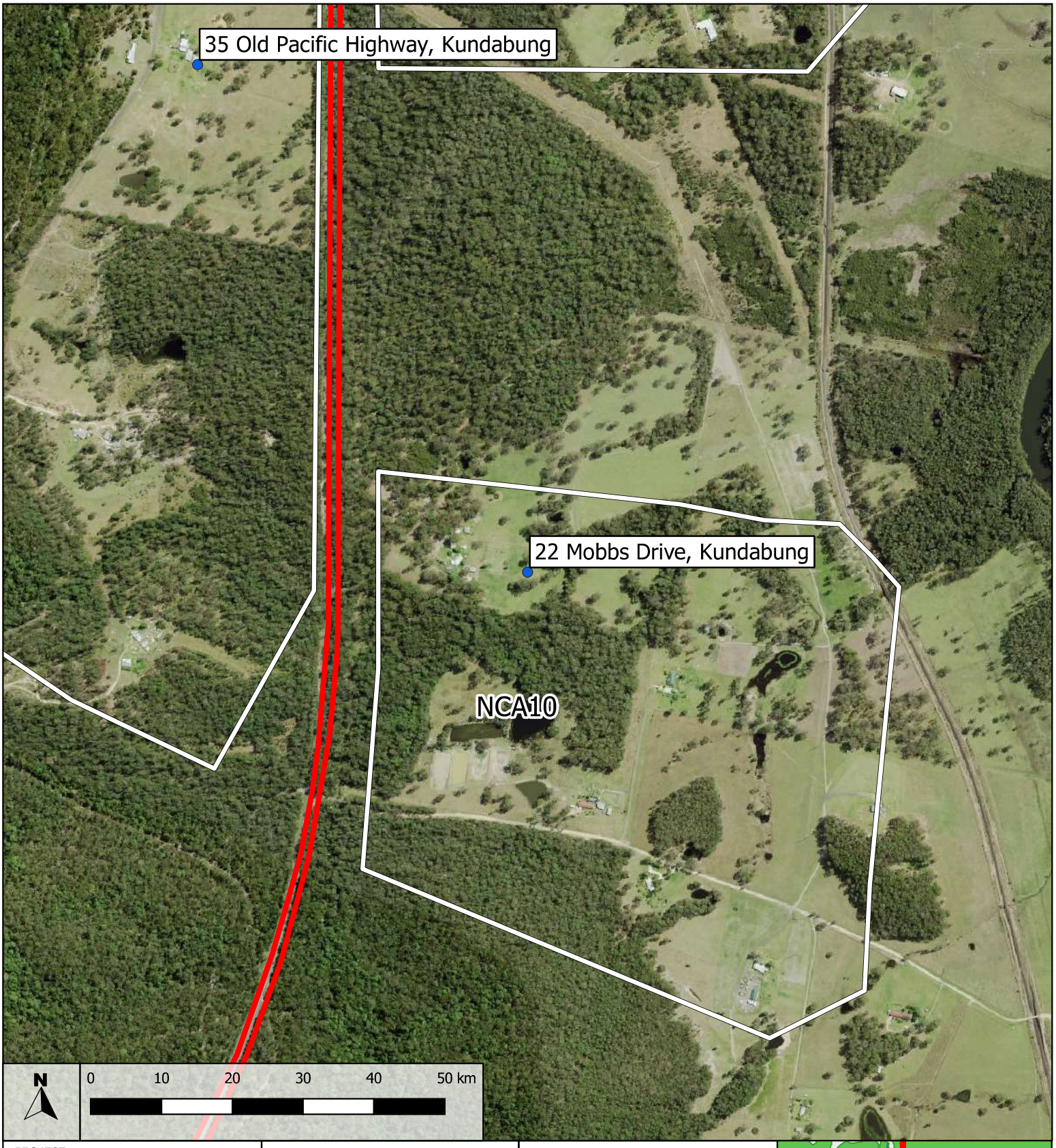
SHORT-TERM NOISE MEASUREMENT SUMMARY

Location	Date Measurement Conducted	Time	Comment
22 Mobbs Drive, Kundabung	13/08/2018	13:30-13:45	Highway was clearly audible, measurement was also affected by intermittent noise from horse (52-56dB) and birds (45-52dB). Trucks passing by ranged from 47-56dB.
	13/08/2018	22:45-23:00	Background noise ranged from 38-45dB, due to distant Highway noise. Trucks passing by likely ranged from 55-58dB.
35 Old Pacific Highway, Kundabung	14/08/2018	10:00-10:15	Highway was clearly audible, measurement was also mainly affected by noise from birds feeding nearby (63dB) and a dog barking (77dB). Trucks passing by ranged from 67-73dB.
	15/08/2018	22:30-22:45	Background noise ranged from 48-53dB, due to distant Highway noise and intermittent cricket noise. Trucks passing by ranged from 58-68dB.
27 Wharf Road, Kundabung	14/08/2018	09:00-09:15	Highway noise was clearly audible, with truck noise passing by ranging from 64-71dB.
	15/08/2018	22:00-22:15	Background noise ranged from 45-50dB, due to distant Highway noise and intermittent cricket noise. Trucks passing by ranged from 55-66dB.
132 Rodeo Drive, Kundabung	14/08/2018	13:00-13:15	Highway noise was clearly audible, with truck noise passing by ranging from 58-70dB.
	14/08/2018	23:30-23:45	Background noise ranged from 44-50dB, with minimal vehicles likely passing-by. Trucks passing by likely ranged from 50-62dB.
25 Kundabung Road, Kundabung	14/08/2018	14:30-14:45	Highway noise was audible, with truck noise passing by ranging from 50-57dB. Intermittent noise from birds (42-55dB) and distant train noise passing by (40-45dB).
	14/08/2018	23:00-23:15	Highway noise was constant, with truck noise likely to range from 54-67dB.
161 Carlyle Road, Kundabung	14/08/2018	08:15-08:30	Highway noise was constant, with truck noise likely to range from 60-62dB. Intermittent bird noise was also present (62-64dB).
	14/08/2018	22:30-22:45	Background noise ranged from 45-50dB, with minimal vehicles likely passing-by. Trucks passing by ranged from

Location	Date Measurement Conducted	Time	Comment
			52-66dB. Intermitted noise from distant bats and insects were also present.
106 Ravenswood Road, Kundabung	13/08/2018	16:15-16:30	Highway noise was clearly audible, with truck noise passing by ranging from 58-66dB. Intermittent noise from dog barking (58dB), vehicles passing by along Ravenswood Road (51dB) and engine starting from the petrol station nearest to receiver site (59dB).
	14/08/2018	00:45-01:00	Background noise ranged from 45-50dB, with minimal vehicles likely passing-by. Trucks passing by ranged from 58-63dB.
41 Carlyle Road, Kundabung	14/08/2018	13:30-13:45	Highway noise was constant, with truck noise likely to range from 69-72dB. Intermittent bird noise was also present (57-59dB).
	14/08/2018	22:00-22:15	Background noise ranged from 40-50dB, with intermittent vehicles passing by. Trucks passing by ranged from 58-65dB.
50 Old Coast Road, South Kempsey	13/08/2018	18:15-18:30	Highway noise was constant but individual vehicle noise was usually not discernible.
	15/08/2018	12:00-12:15	Background noise ranged from 40-45dB, with minimal vehicles likely passing-by. Trucks passing by ranged from 48-57dB.
180 Scrubby Creek Road, South Kempsey	13/08/2018	17:15-17:30	Highway noise was constant, with truck noise likely to range from 57-63dB. Intermittent bird noise was also present (57dB).
	15/08/2018	00:30-00:45	Background noise ranged from 50-56dB, with intermittent vehicles passing by. Trucks passing by ranged from 55-65dB.

APPENDIX G

NOISE GRAPHS AND PHOTOGRAPHS



PROJECT:

Kundabung to Kempsey

TITLE:

Noise Monitoring Locations

Post - Opening Compliance

PROJECT No.: 12063-ES

REVISION: A

PREPARED: PT

APPROVED: BJM

EXPORTED: 16/10/2018

SHEET SIZE: A4

Appendix D

Drawing 1 of 10

WILKINSON MURRAY

ADDRESS:

22 Mobbs Drive, Kundabung

START DATE:

13/08/2018

STOP DATE:

23/08/2018

Overall Noise - LAeq, Period

LAeq, 15 Hour

53.1

LAeq, 9 Hour

49.9

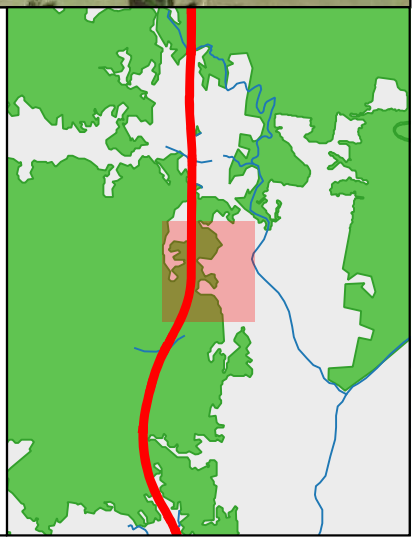
Estimated Traffic Noise - LAeq, Period

LAeq, 15 Hour

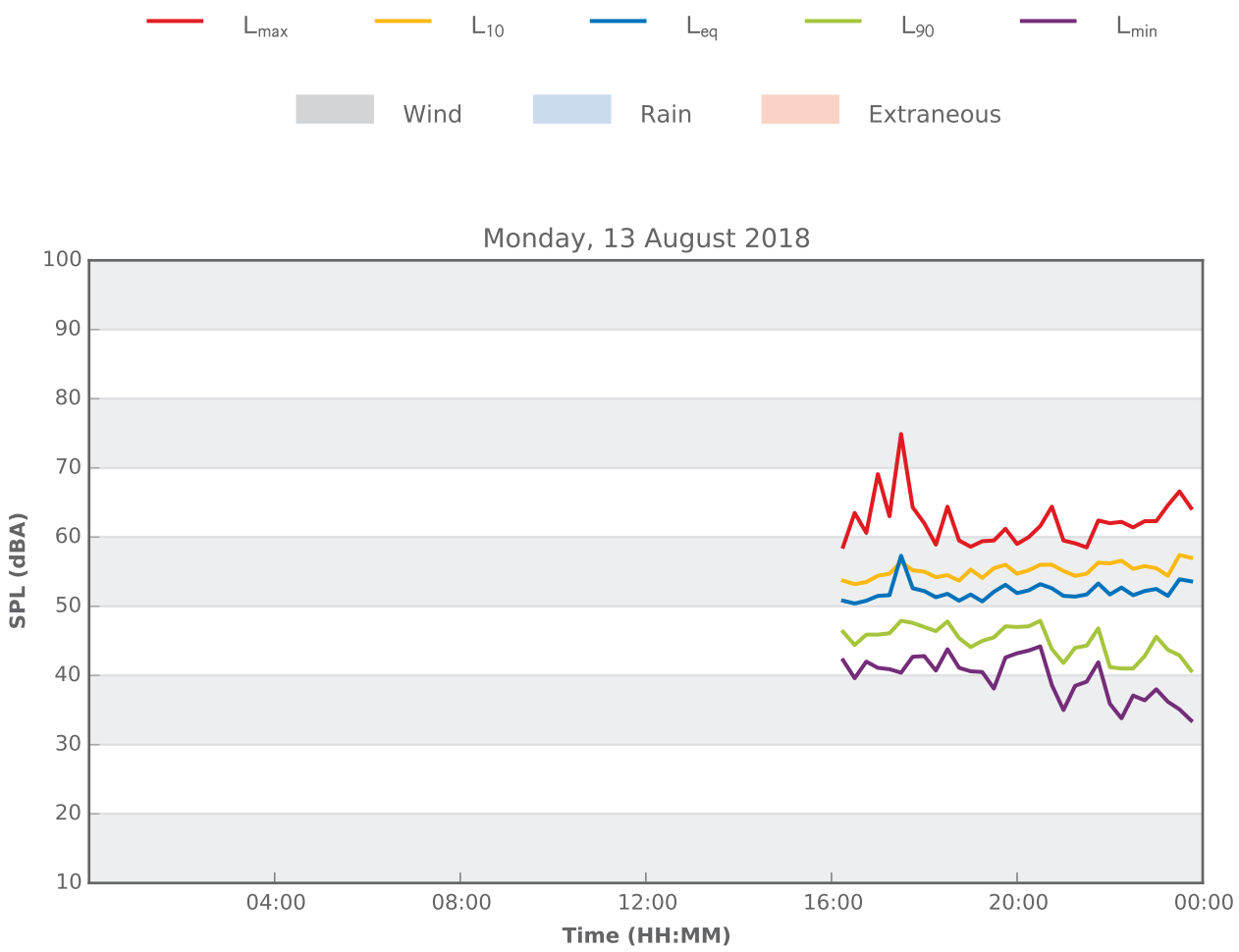
52.8

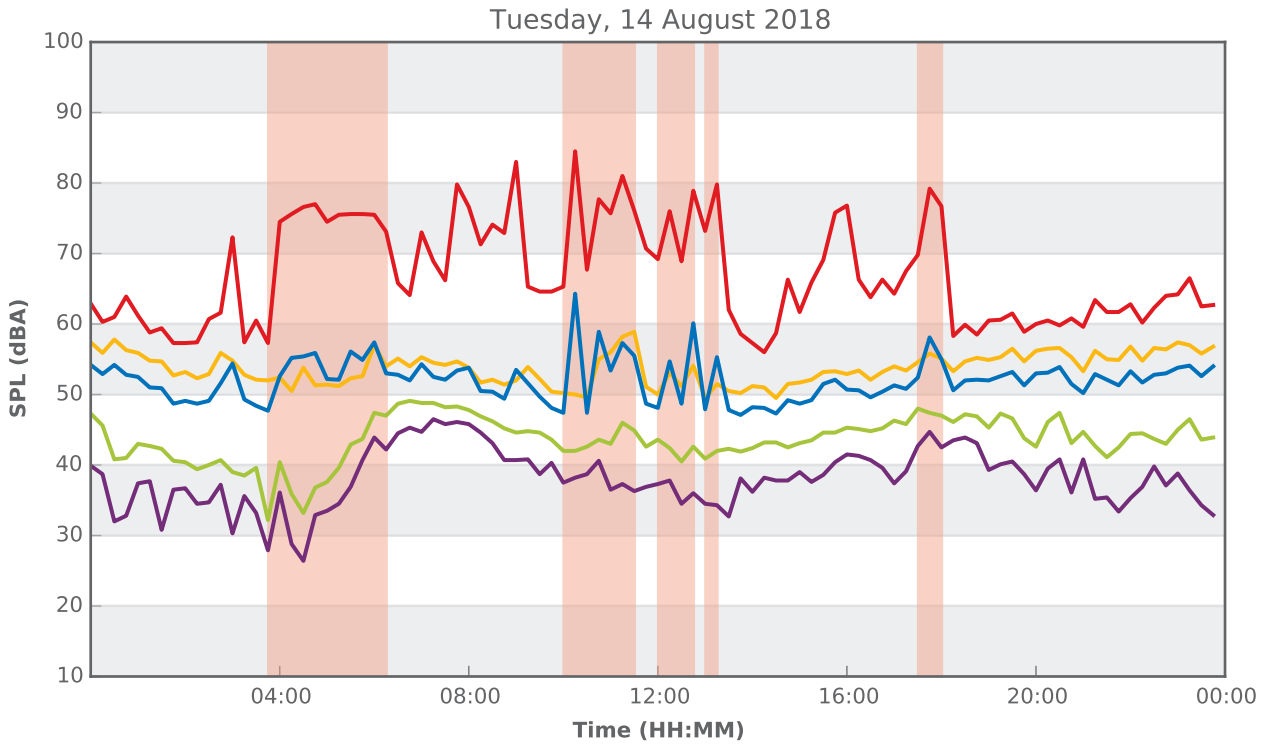
LAeq, 9 Hour

51.9



22 Mobbs Drive, Kundabung





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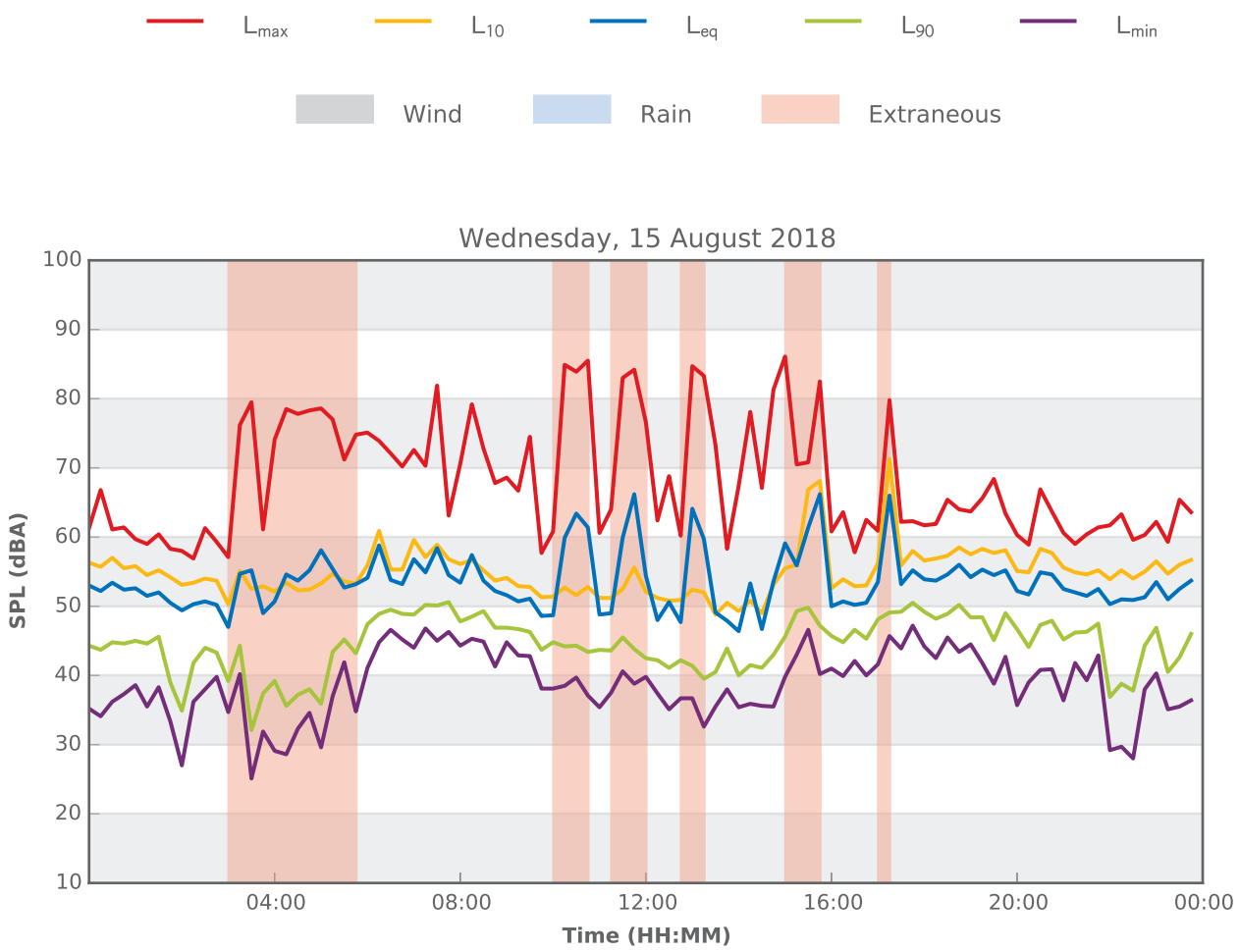

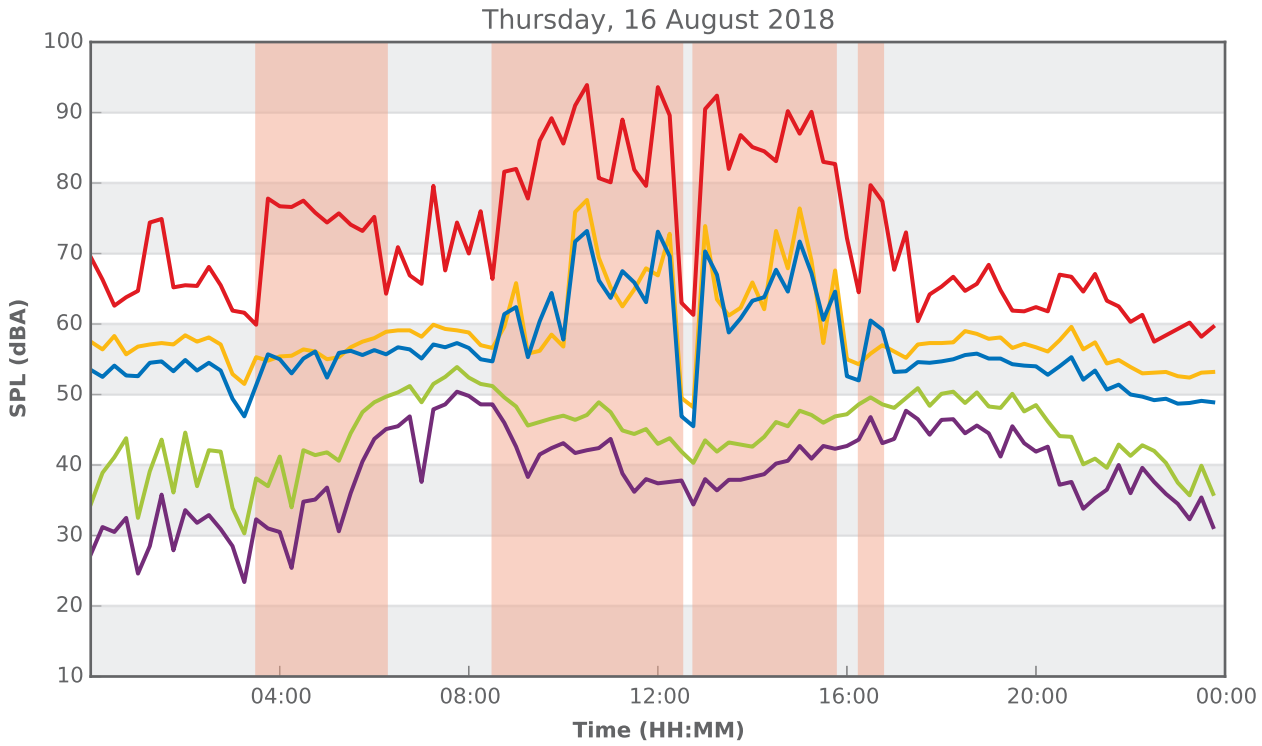

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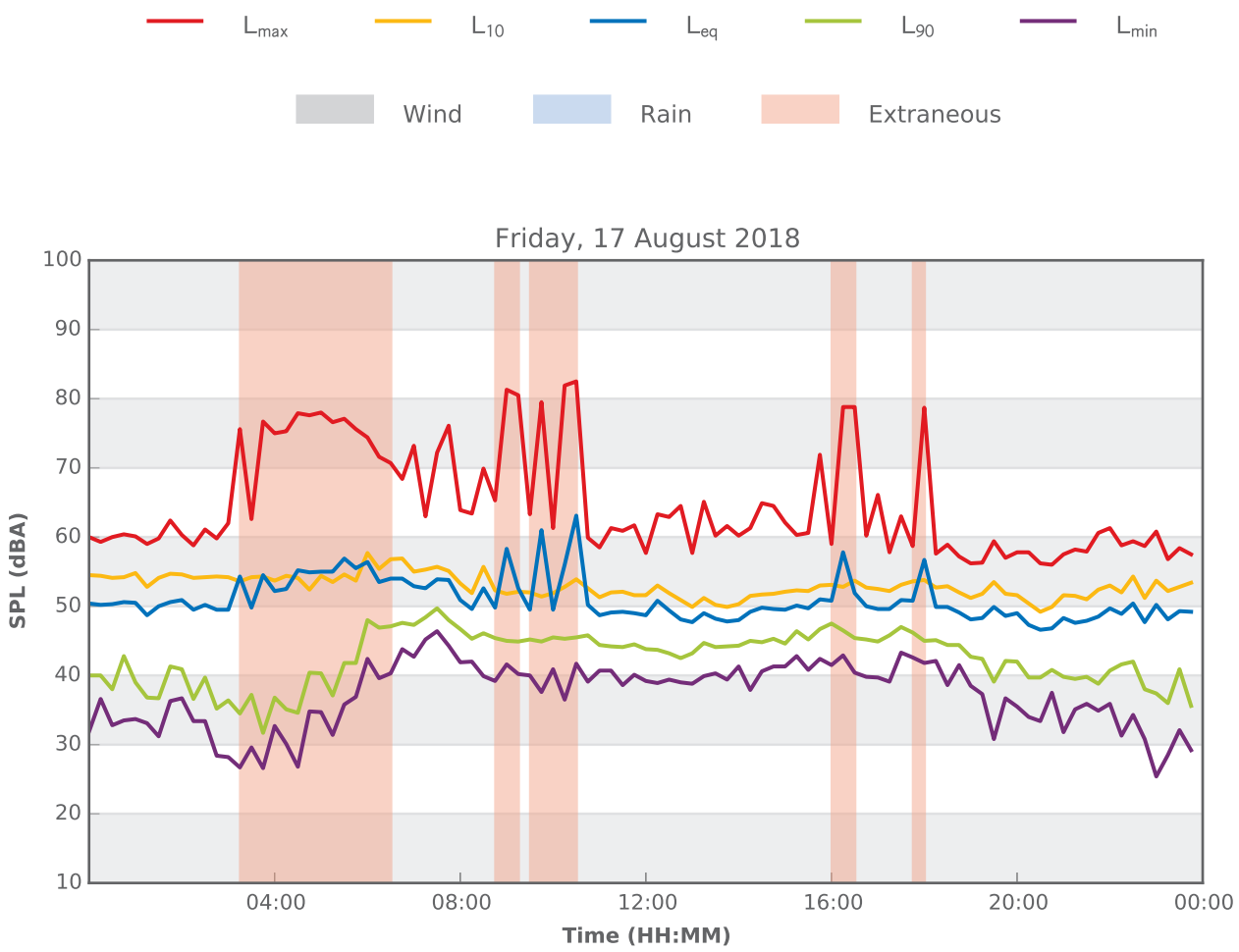
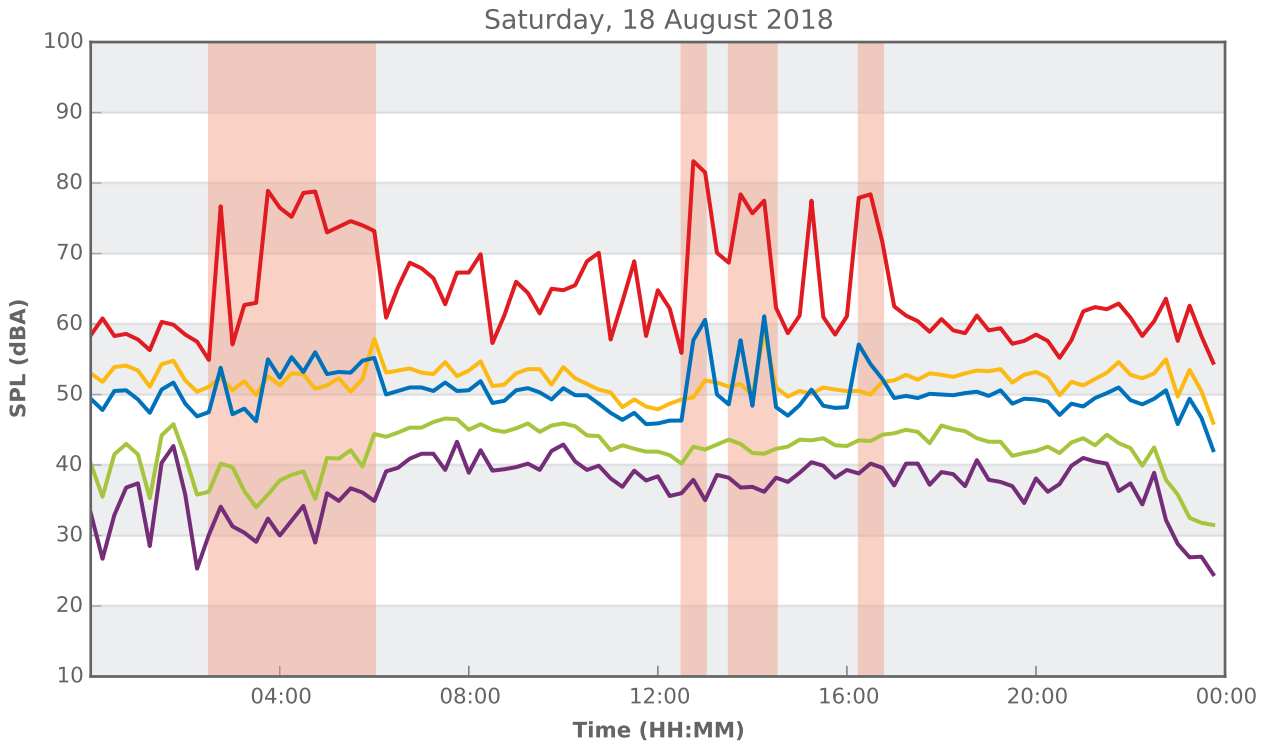
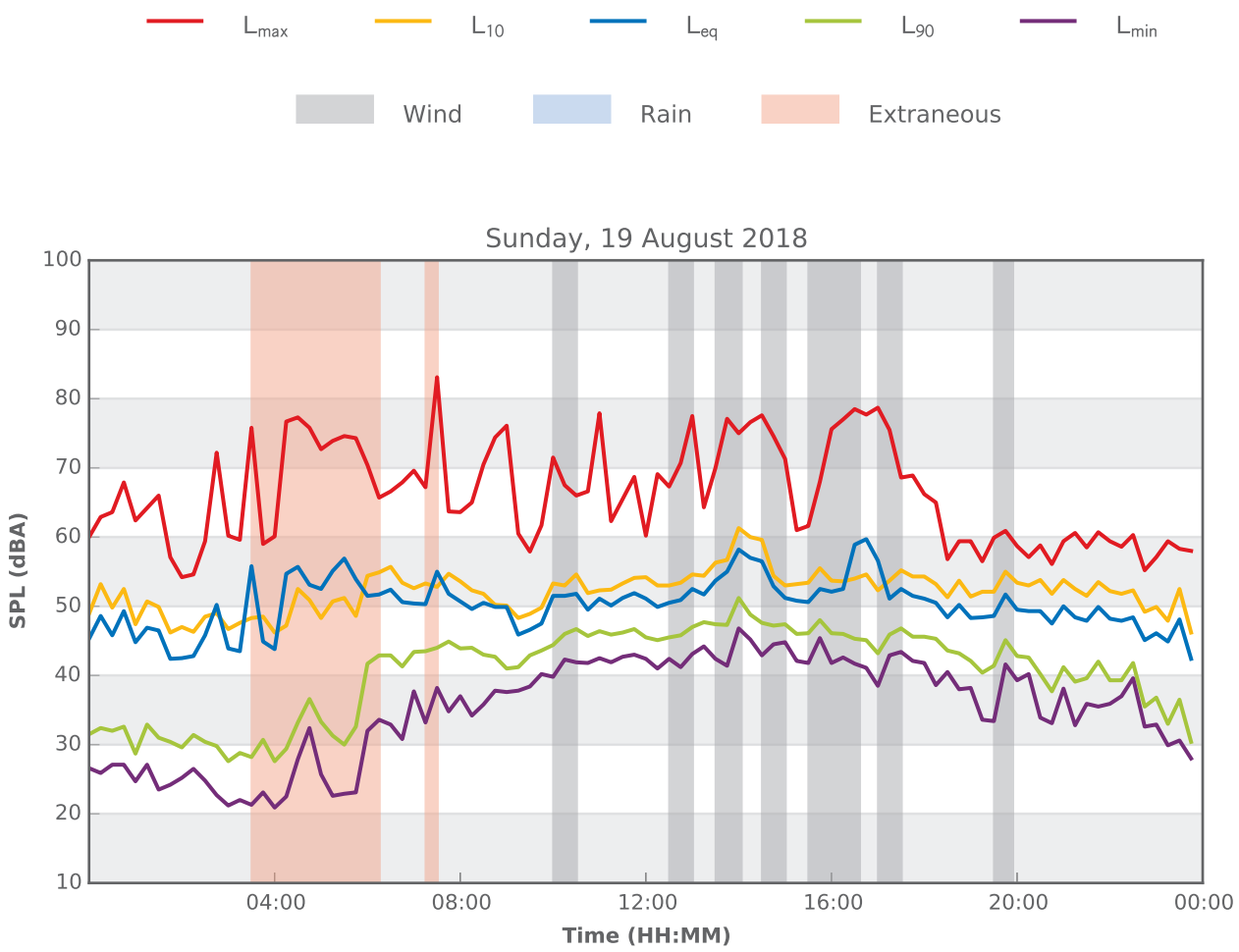
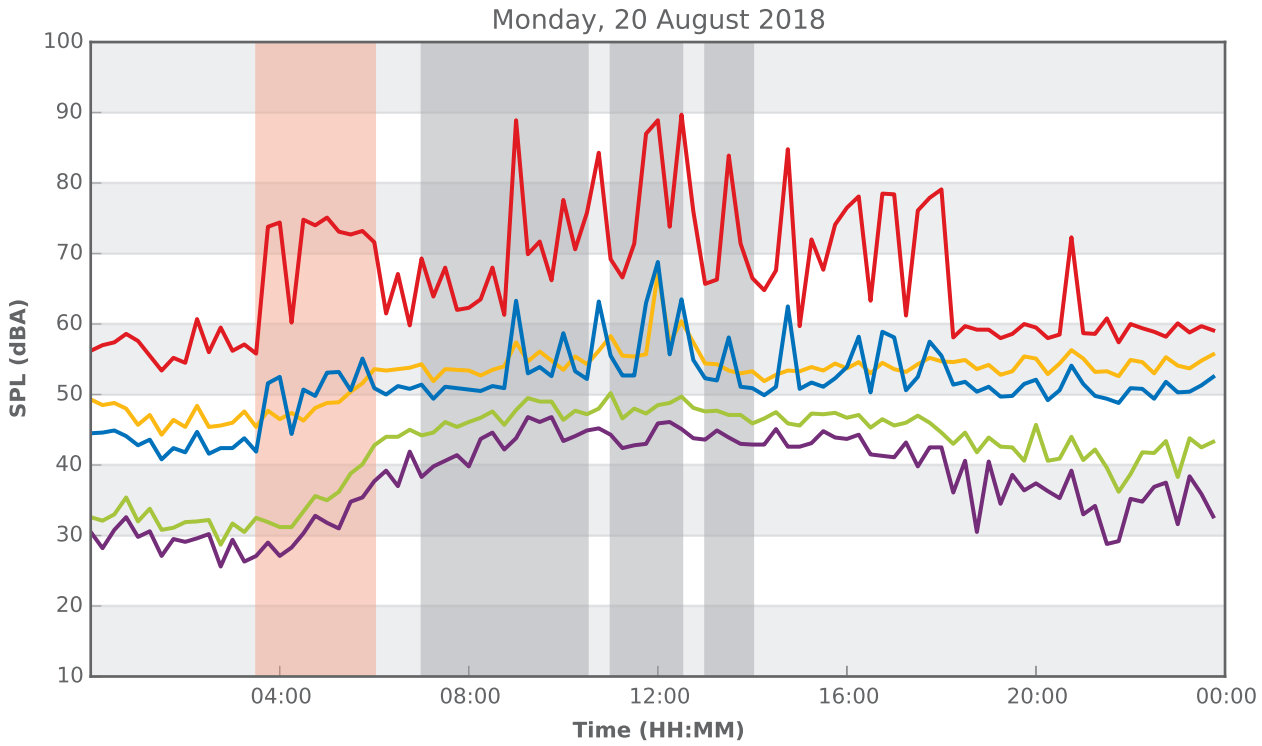




22 Mobbs Drive, Kundabung





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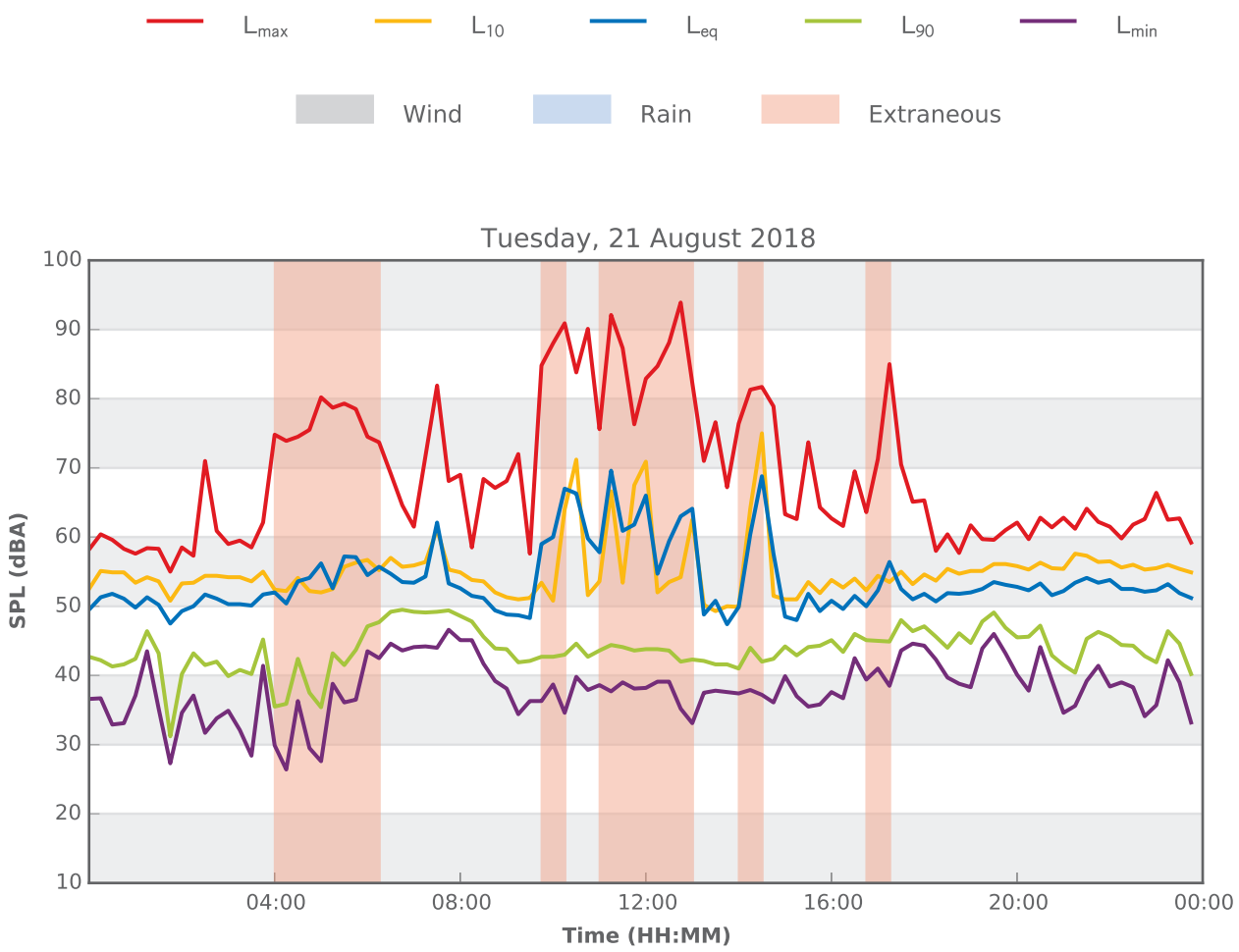

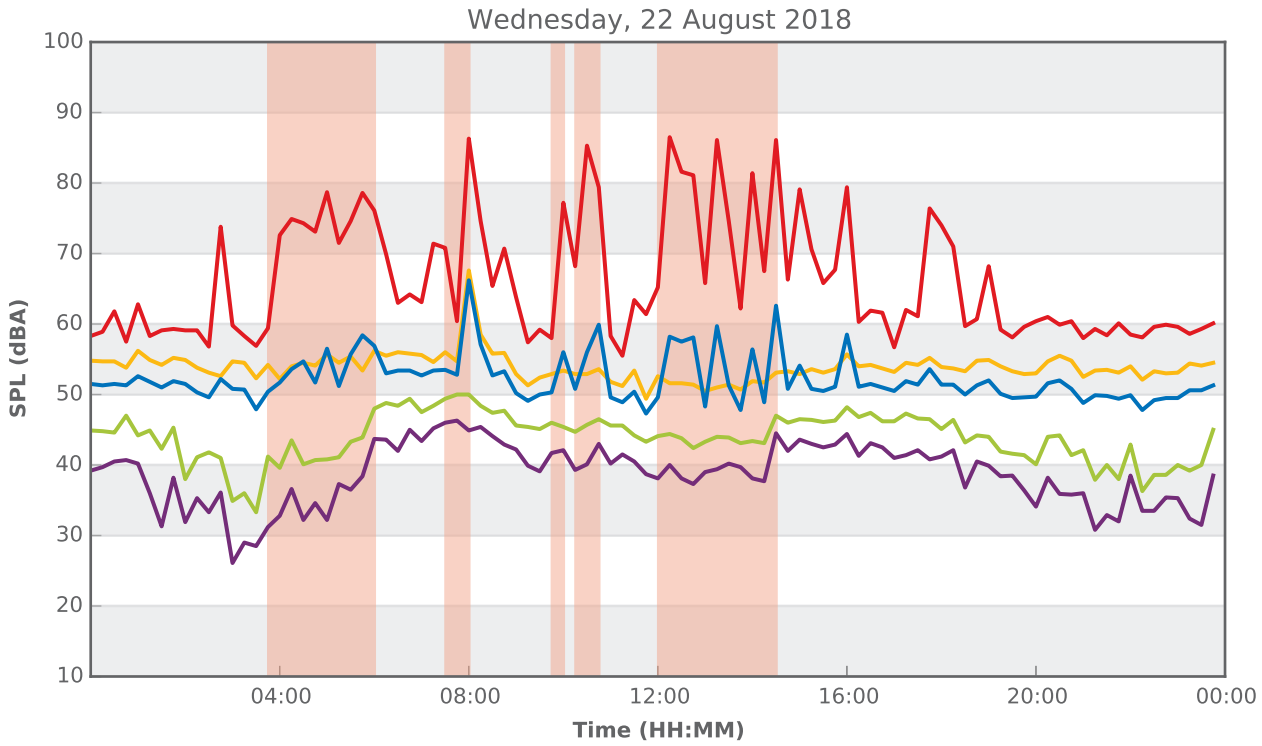

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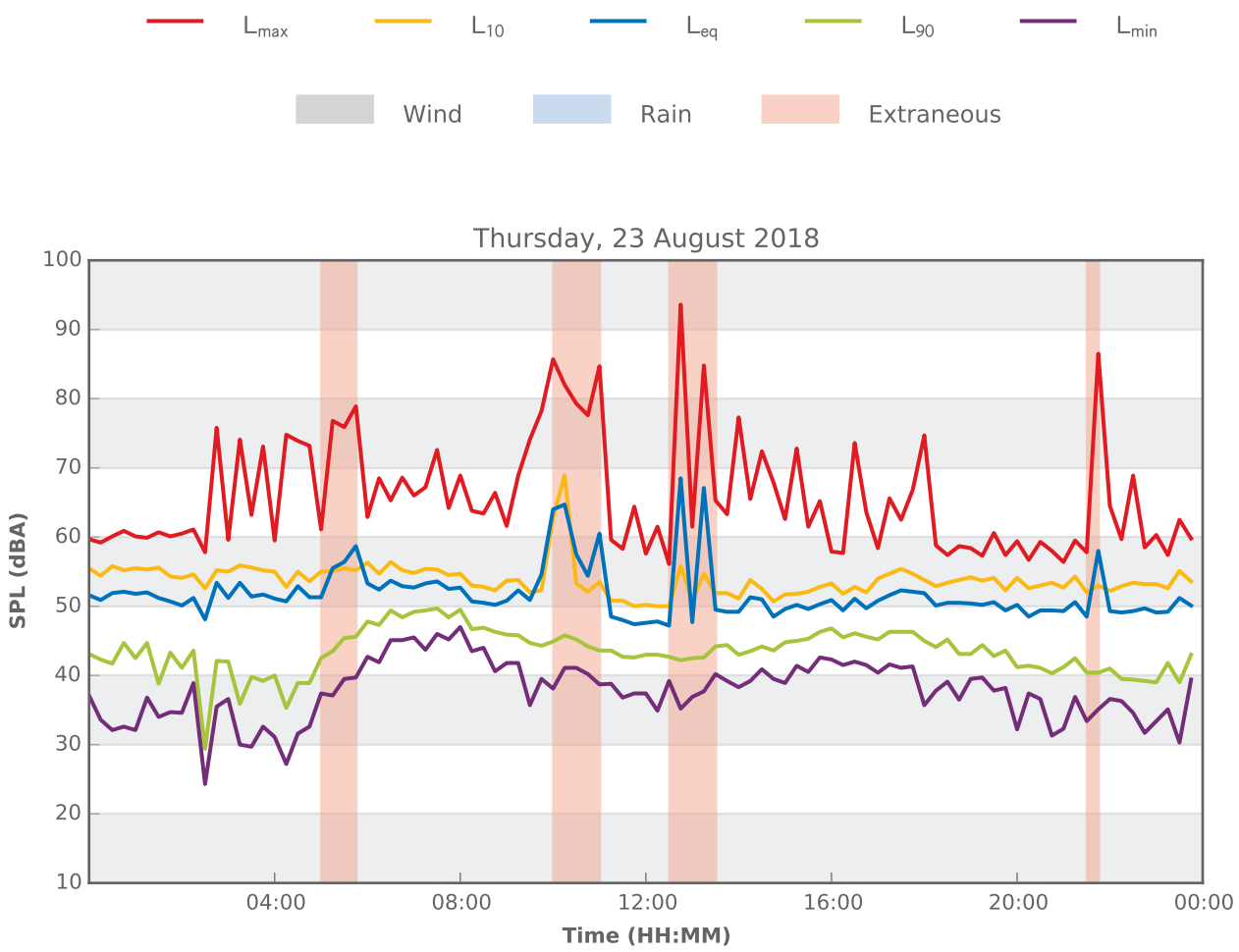
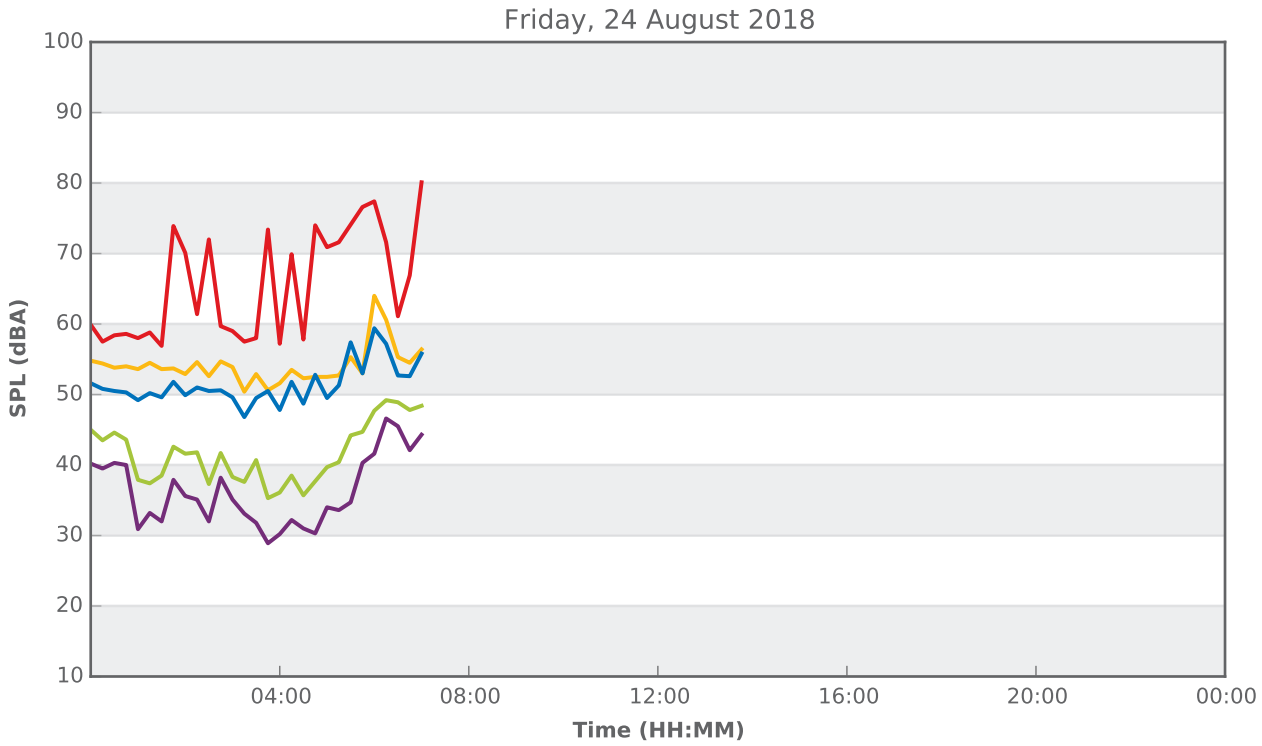
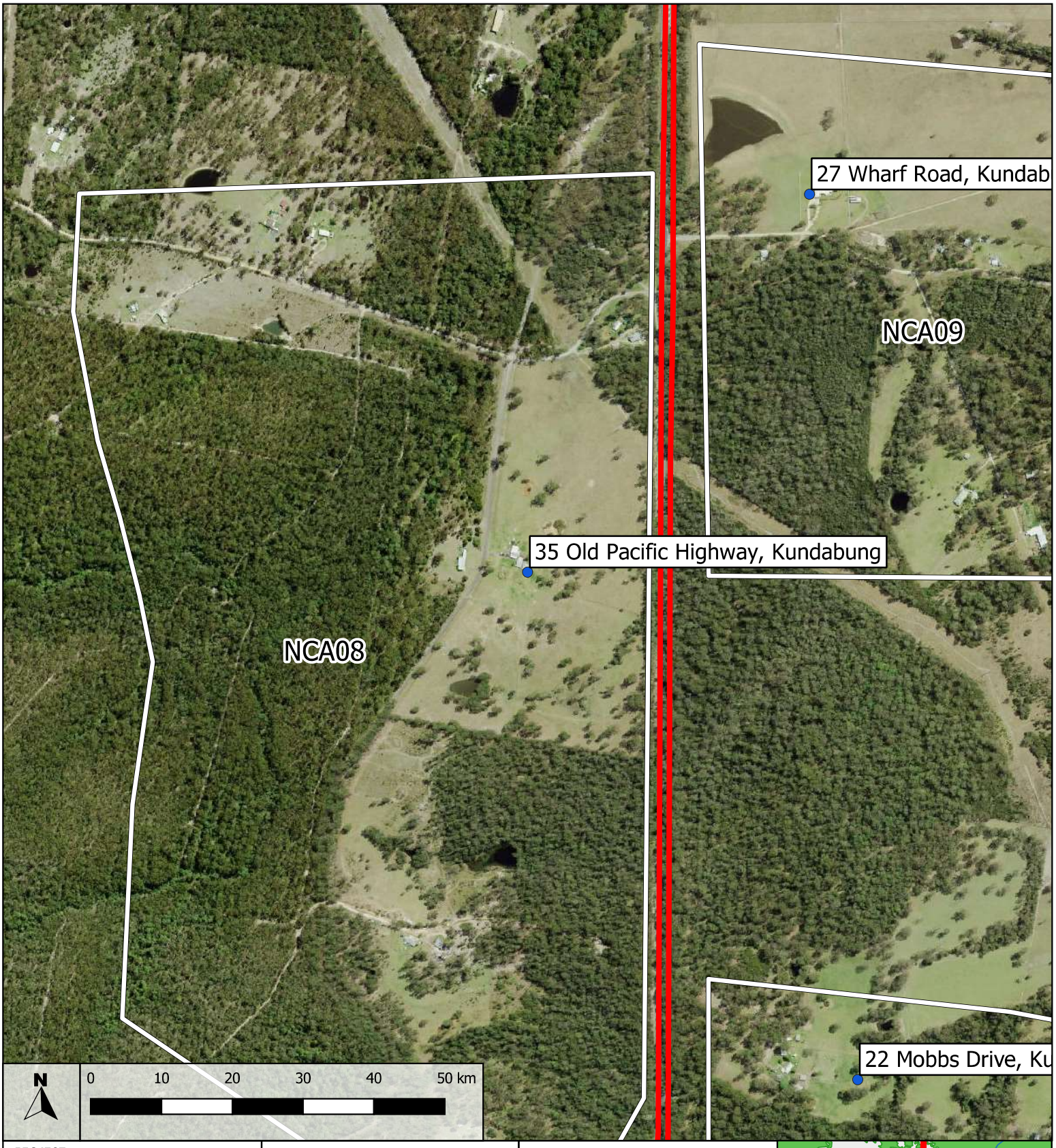






PROJECT:

Kundabung to Kempsey

TITLE:

Noise Monitoring Locations

Post - Opening Compliance

PROJECT No.: 12063-ES

REVISION: A

PREPARED: PT

APPROVED: BJM

EXPORTED: 16/10/2018

SHEET SIZE: A4

Appendix D

Drawing 2 of 10

WILKINSON MURRAY

ADDRESS:

35 Old Pacific Highway, Kundabung

START DATE:

14/08/2018

STOP DATE:

23/08/2018

Overall Noise - LAeq, Period

LAeq, 15 Hour

58.2

LAeq, 9 Hour

57.6

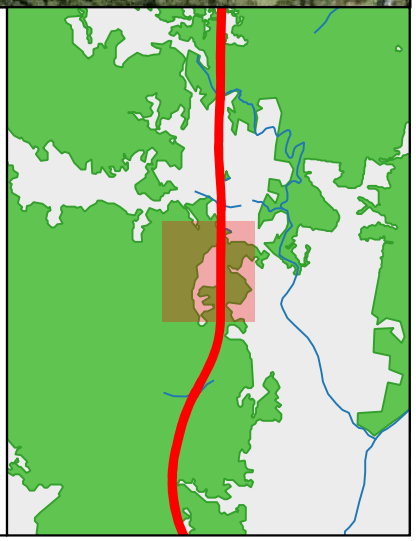
Estimated Traffic Noise - LAeq, Period

LAeq, 15 Hour

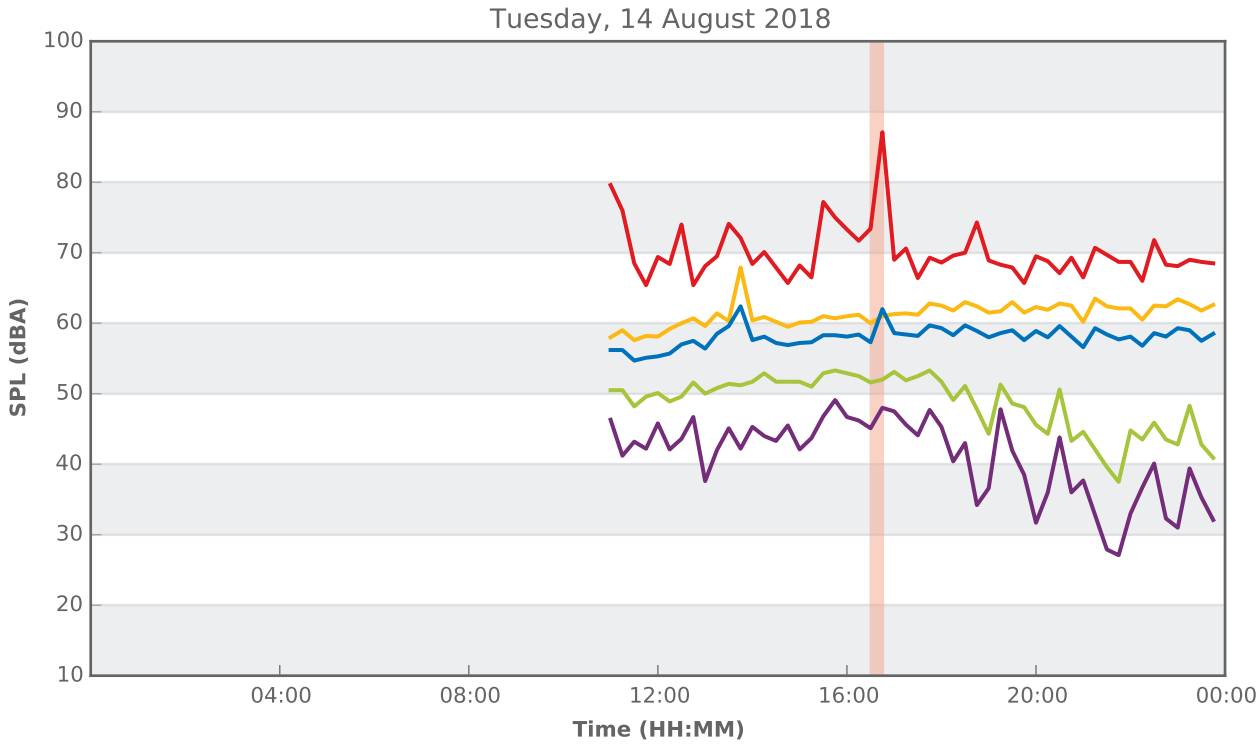
57.8

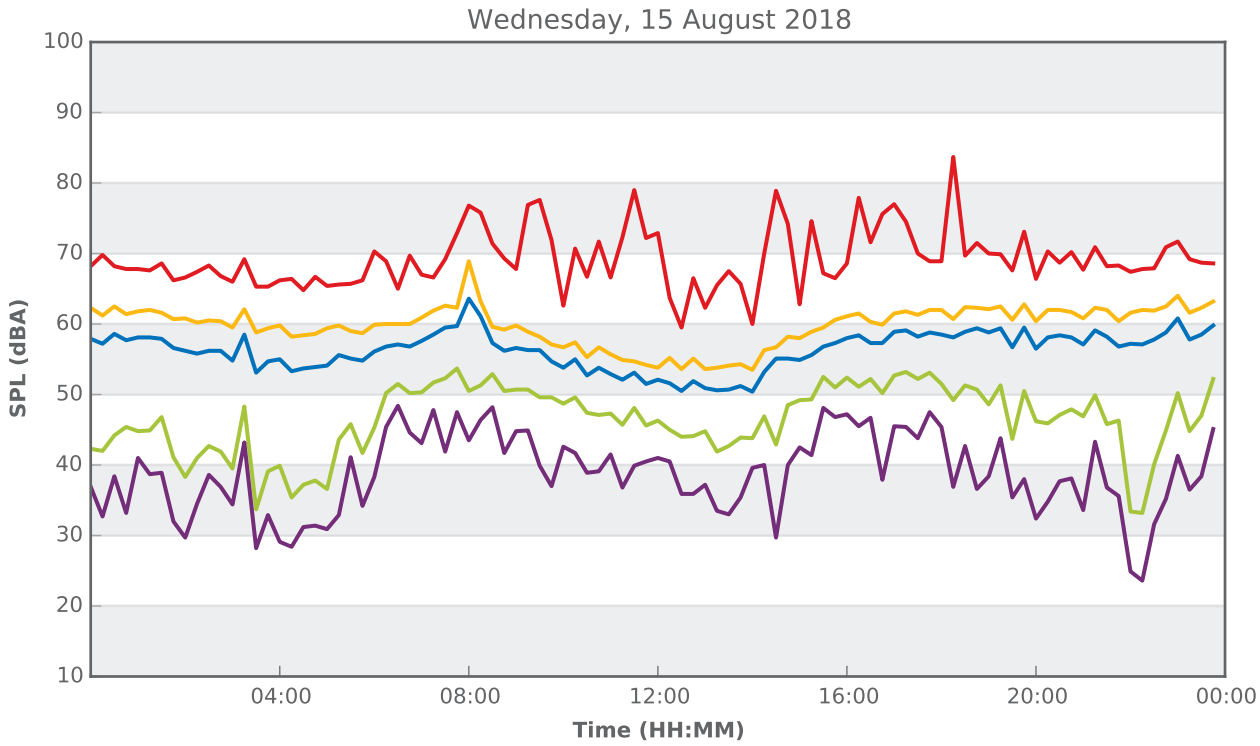
LAeq, 9 Hour

57.6

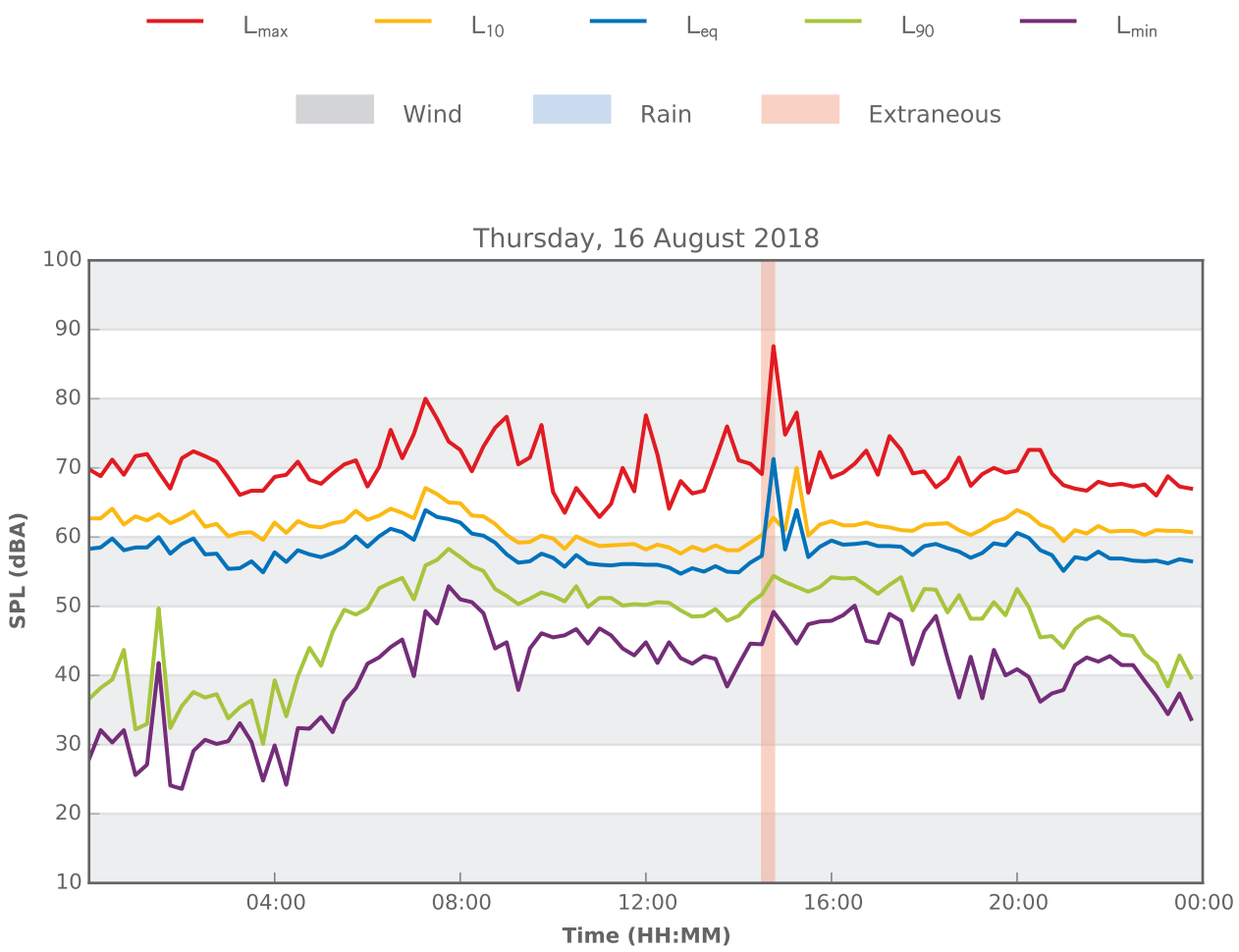


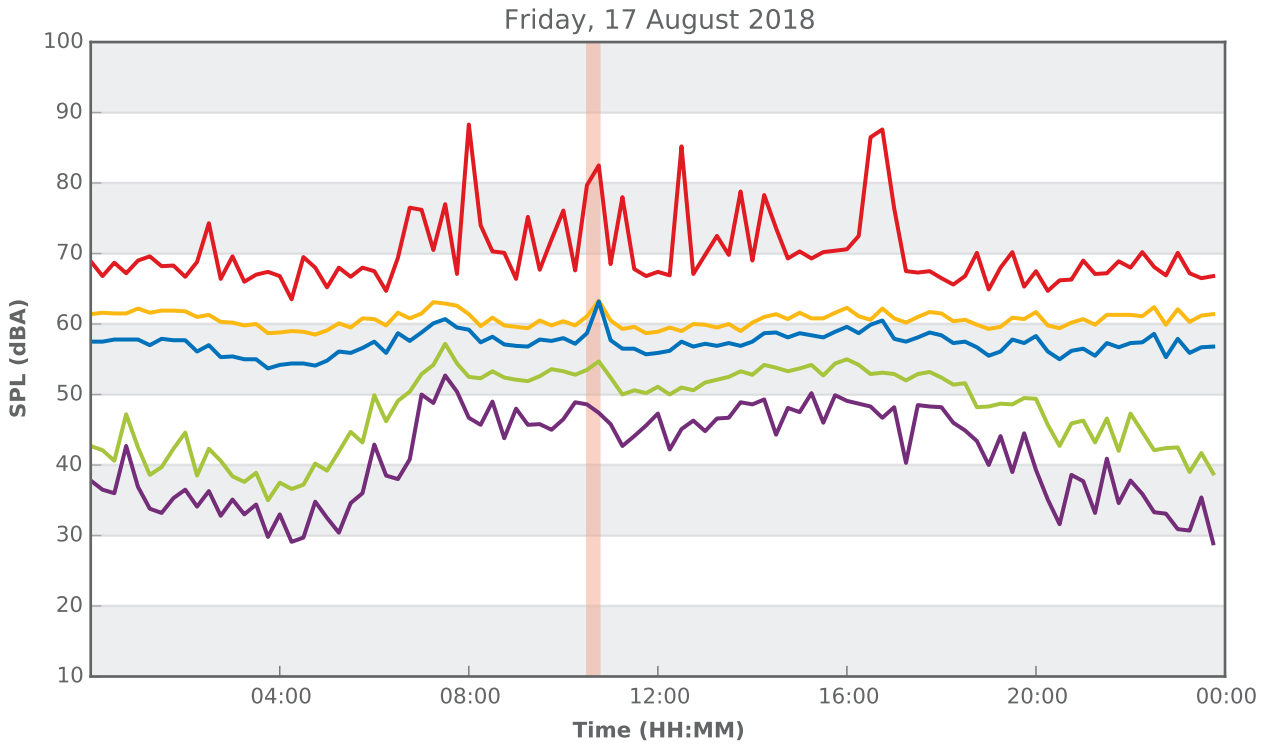
35 Old Pacific Highway, Kundabung





35 Old Pacific Highway, Kundabung





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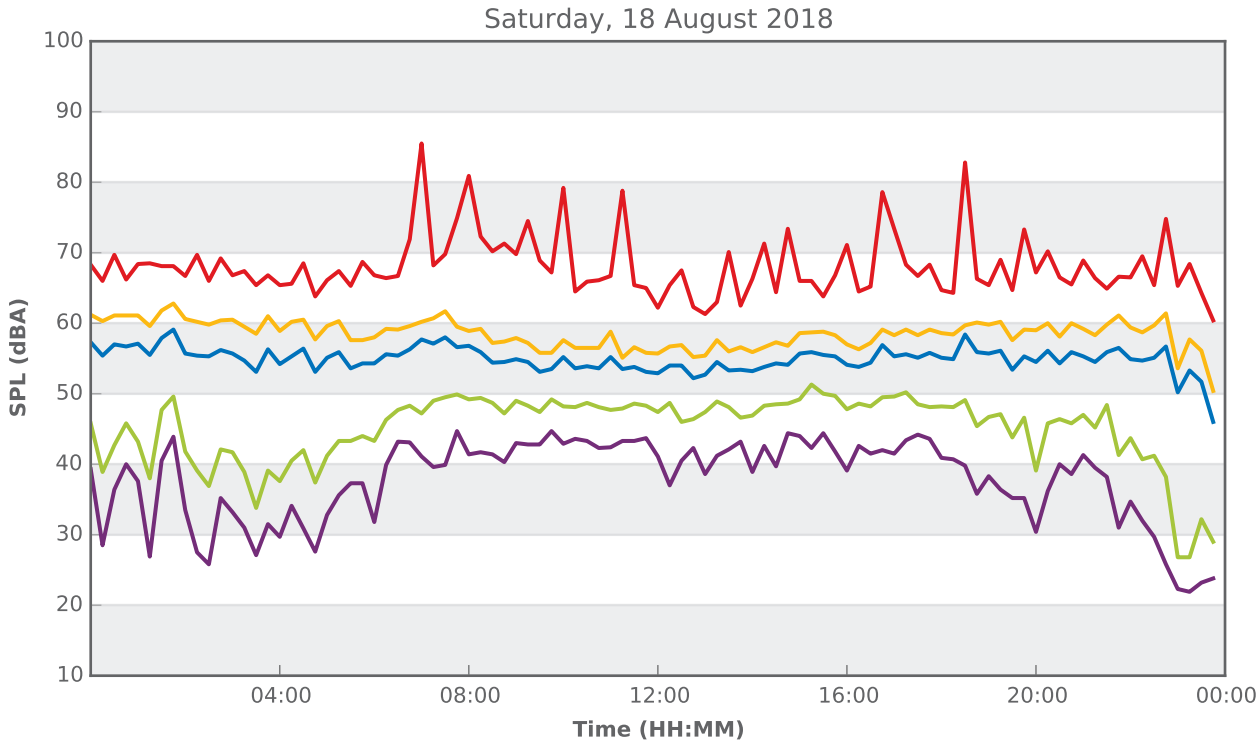

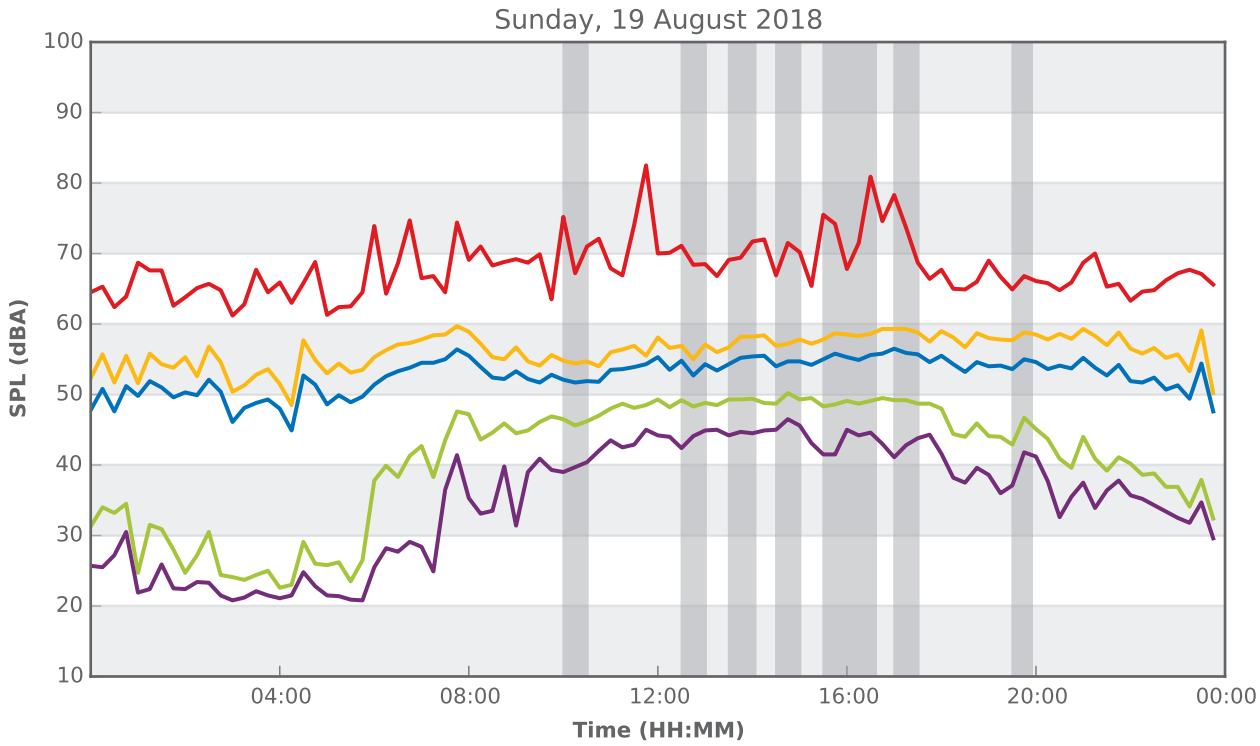

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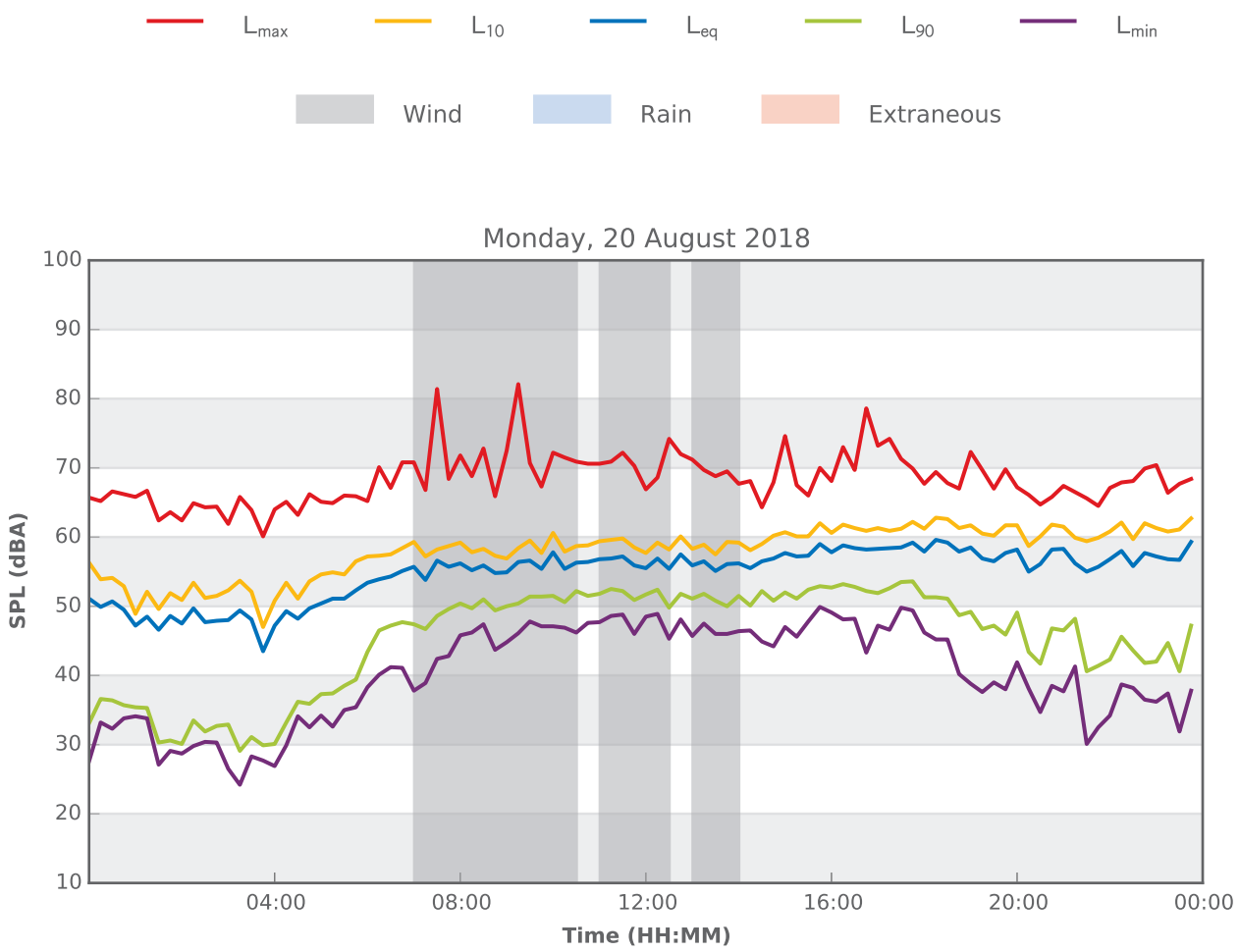

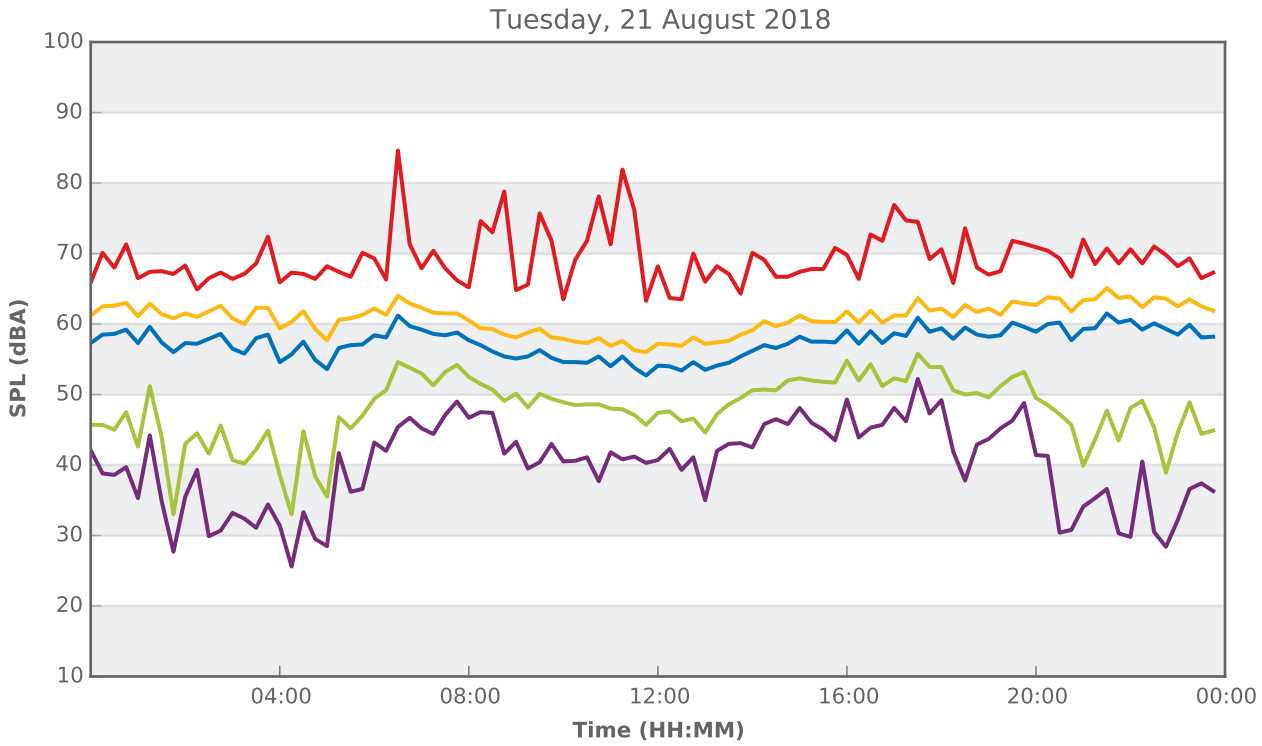

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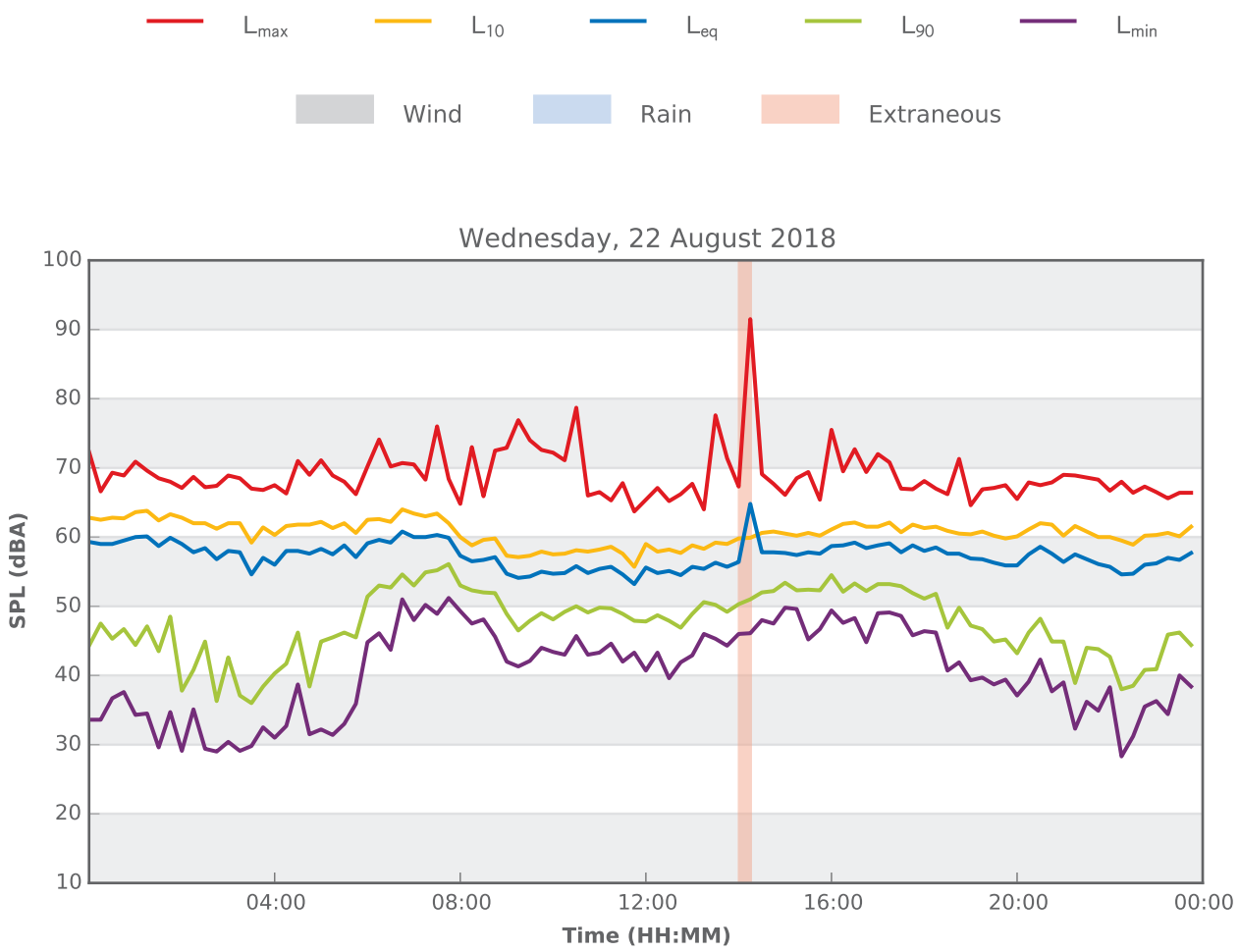

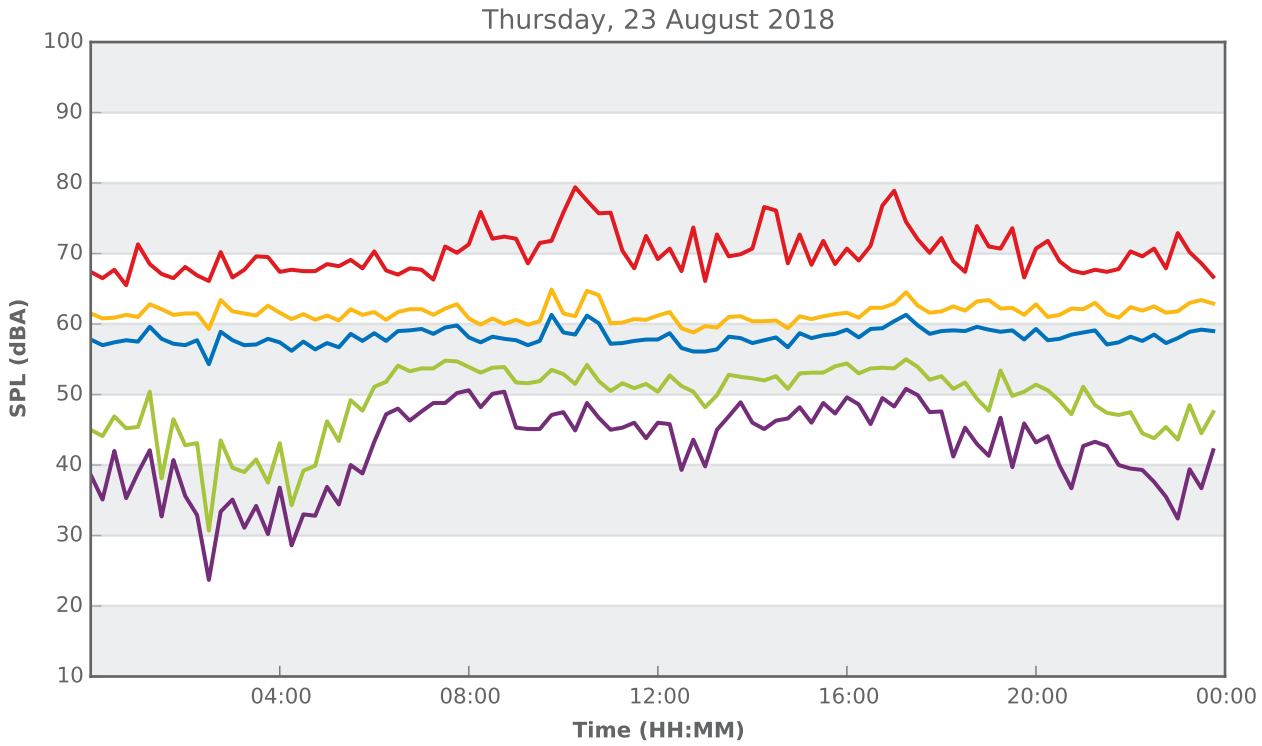

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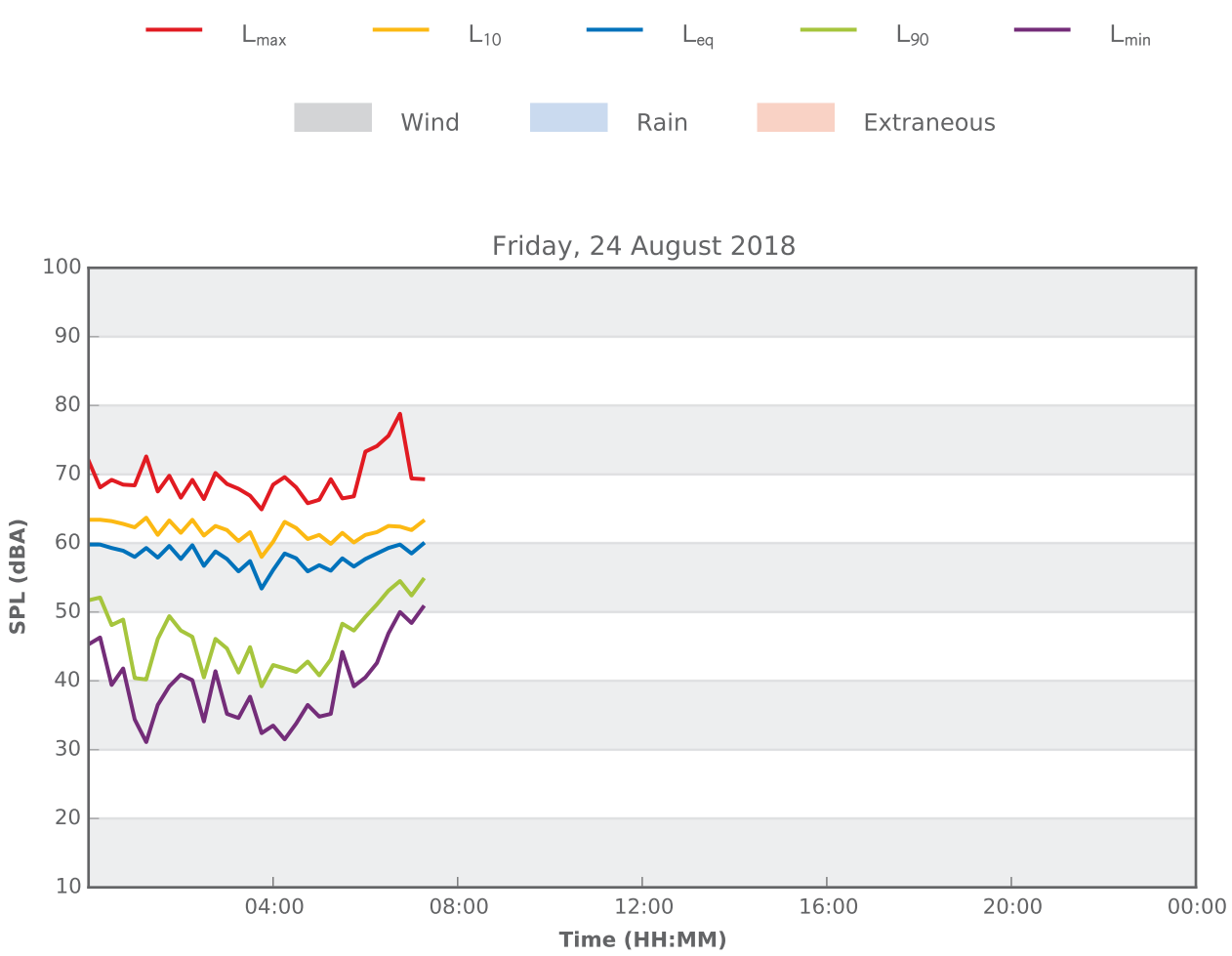

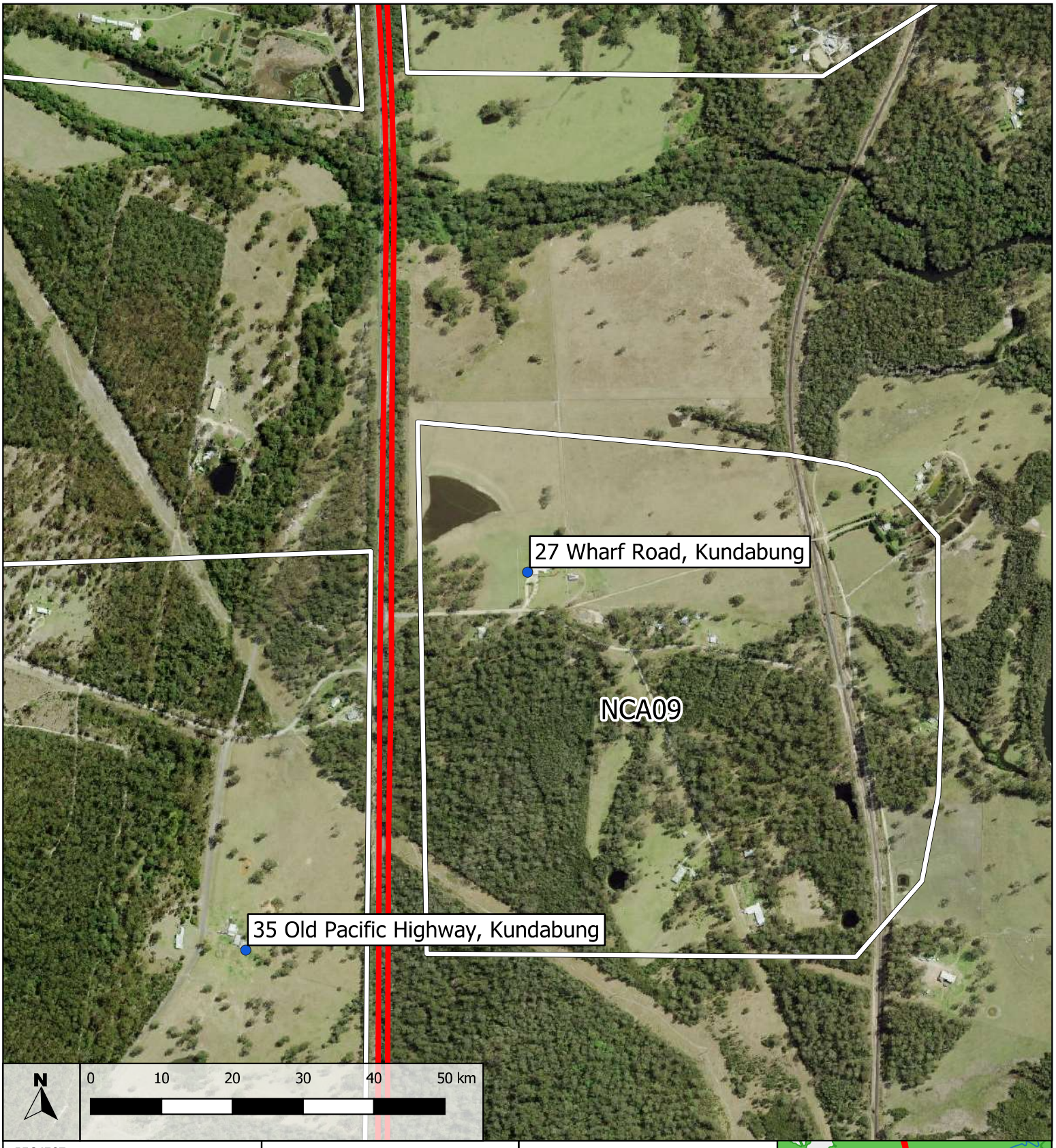

PROJECT:

Kundabung to Kempsey

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PROJECT No.: 12063-ES

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Appendix D

Drawing 3 of 10

WILKINSON MURRAY

ADDRESS:

27 Wharf Road, Kundabung

START DATE:

14/08/2018

STOP DATE:

23/08/2018

Overall Noise - LAeq, Period

LAeq, 15 Hour

58.8

LAeq, 9 Hour

59.4

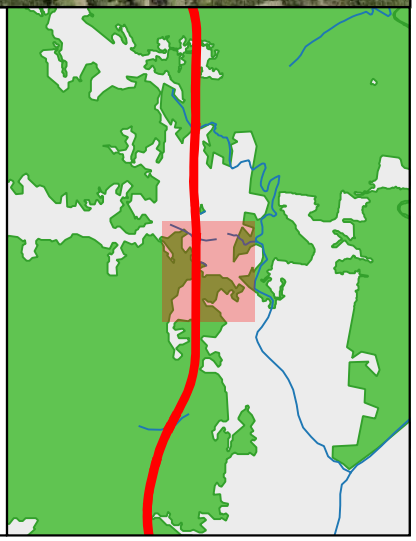
Estimated Traffic Noise - LAeq, Period

LAeq, 15 Hour

58.4

LAeq, 9 Hour

59.4



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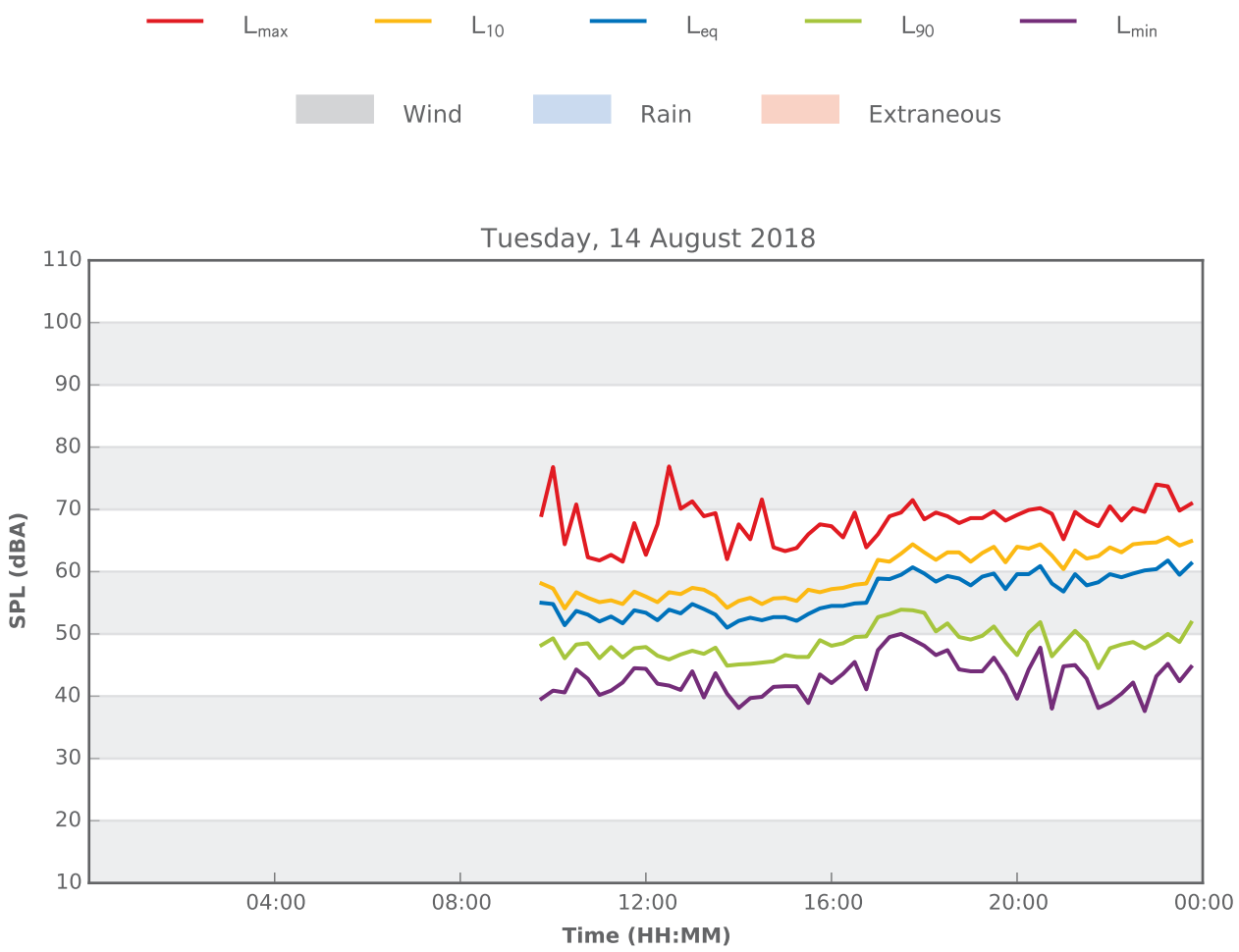
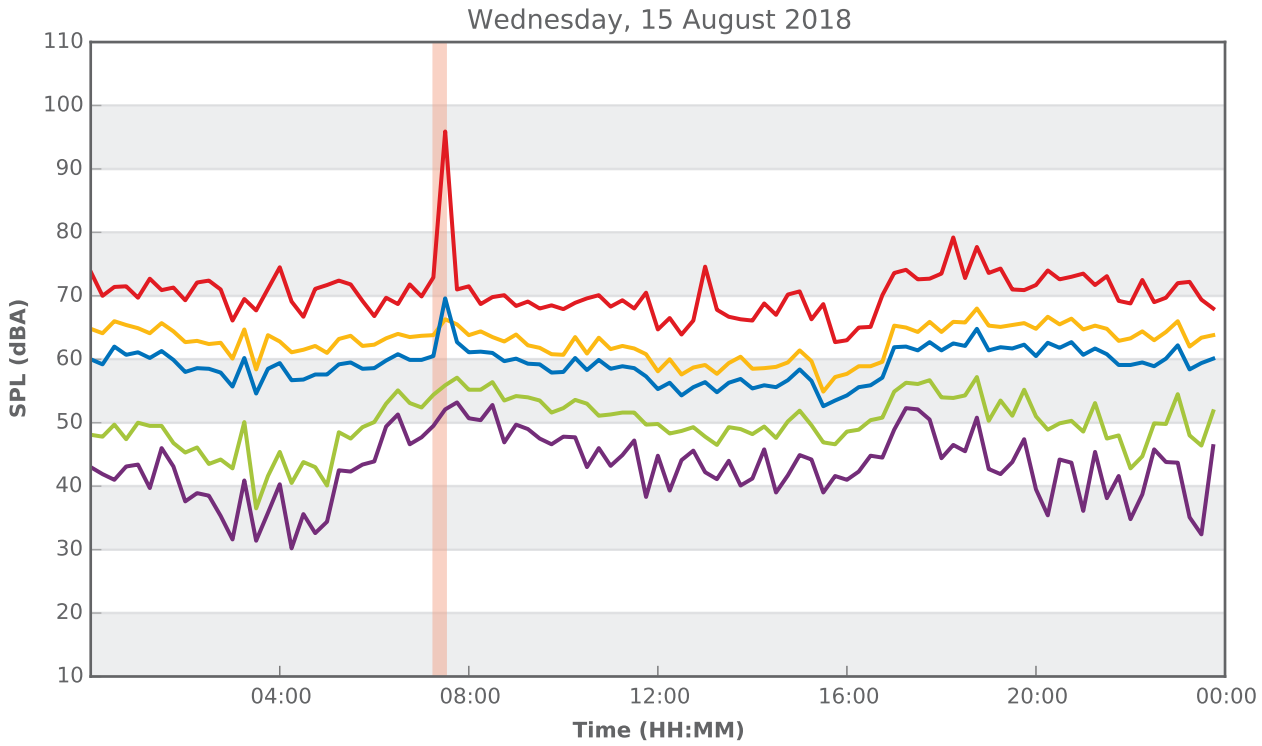
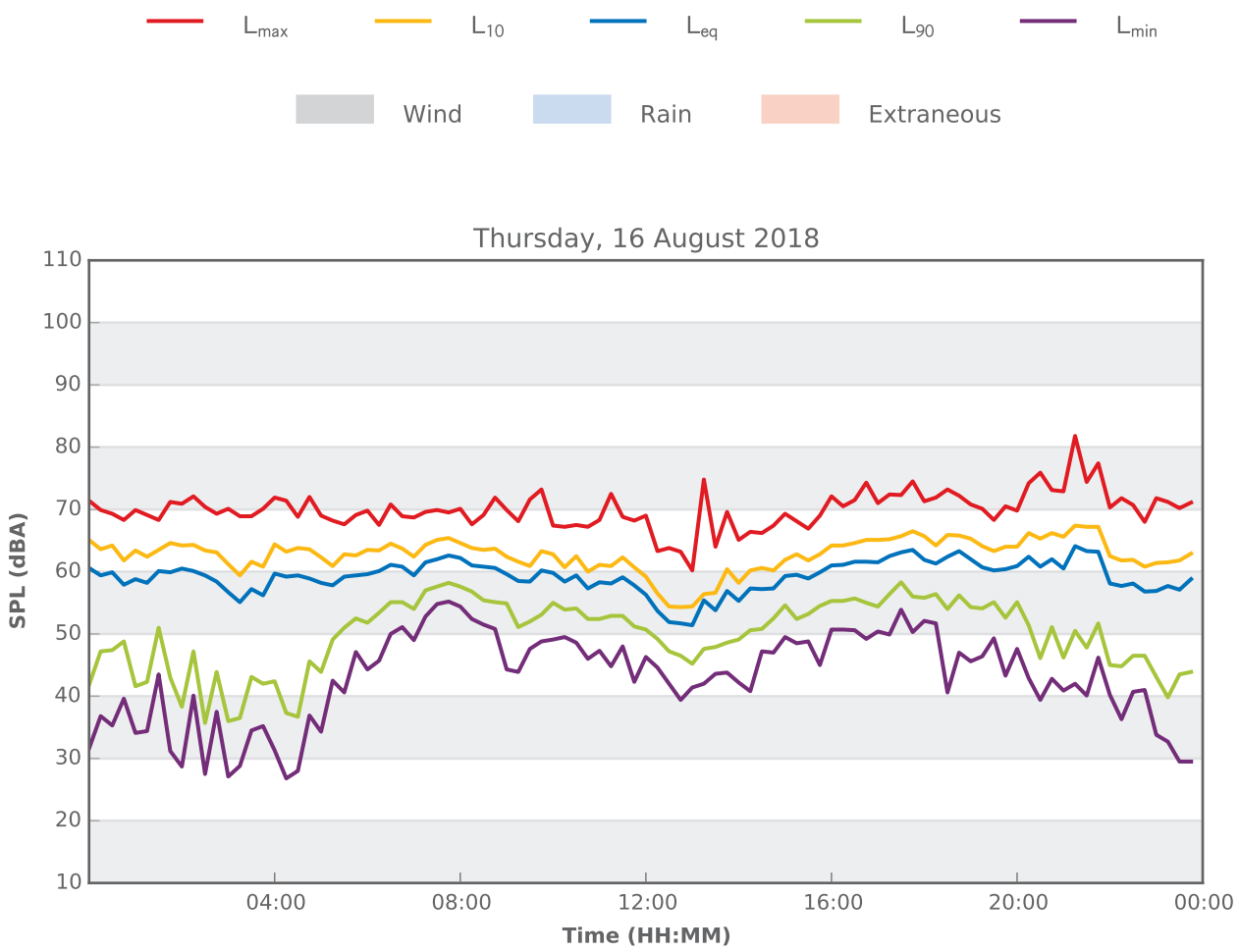
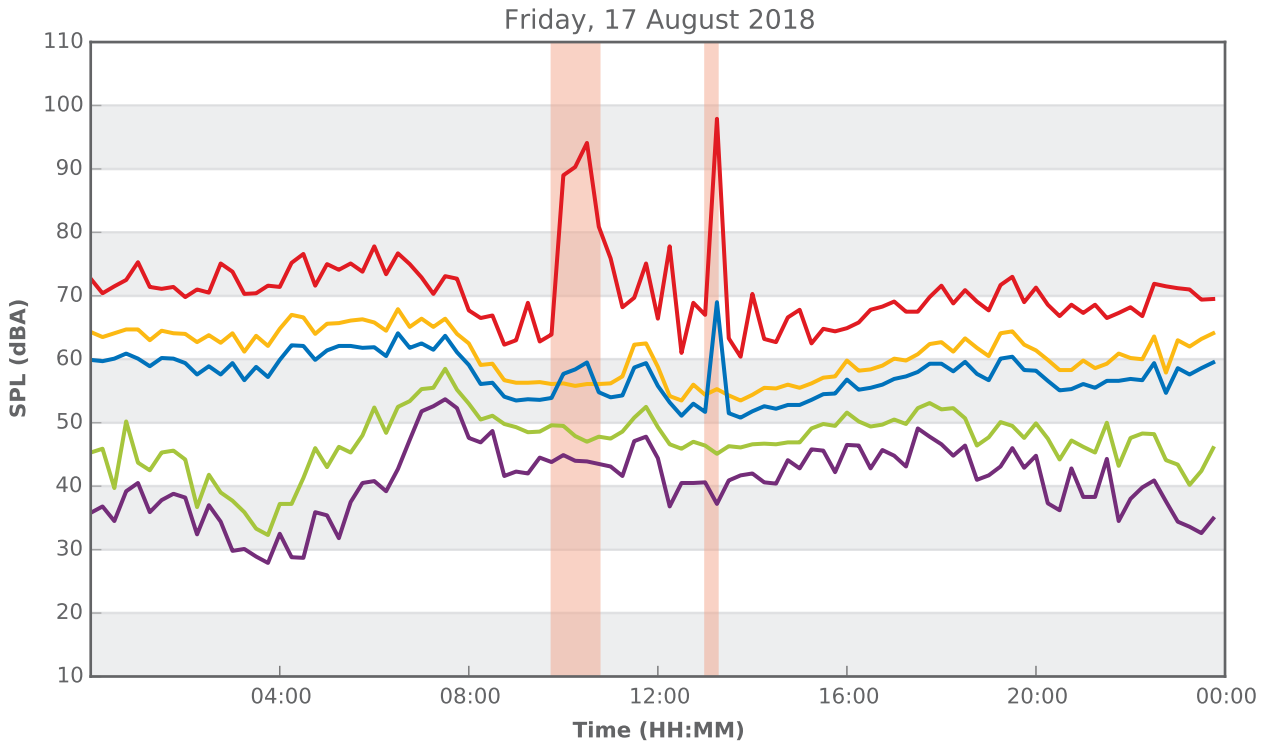


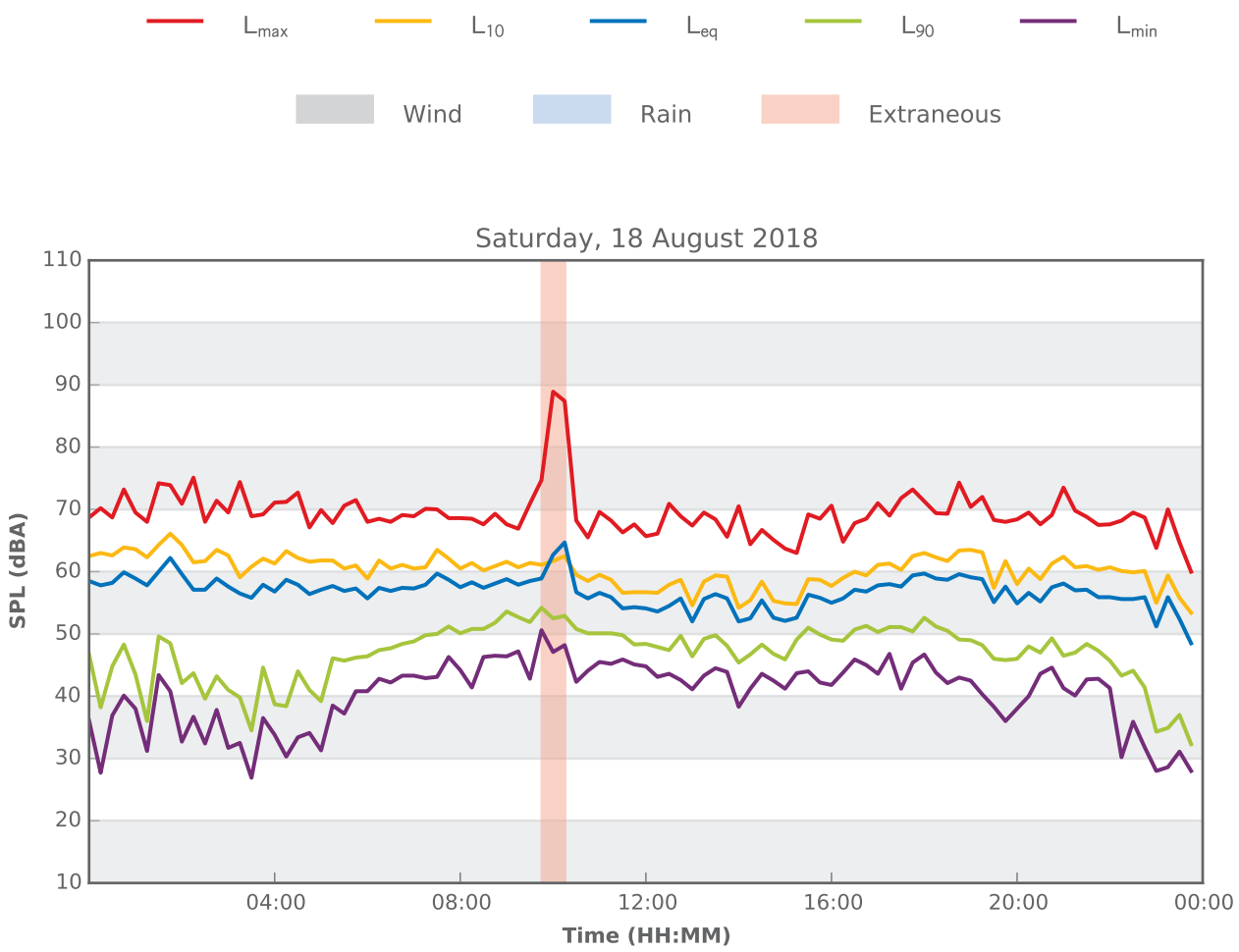


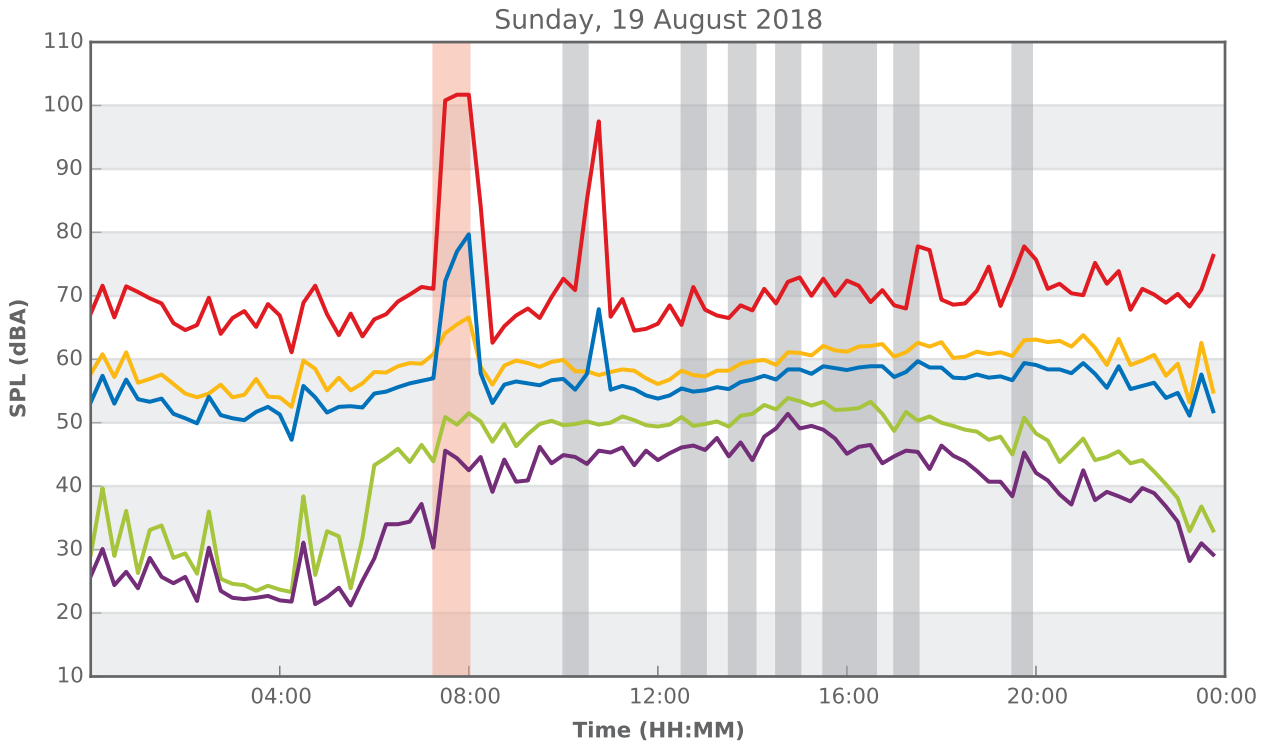
27 Wharf Road, Kundabung



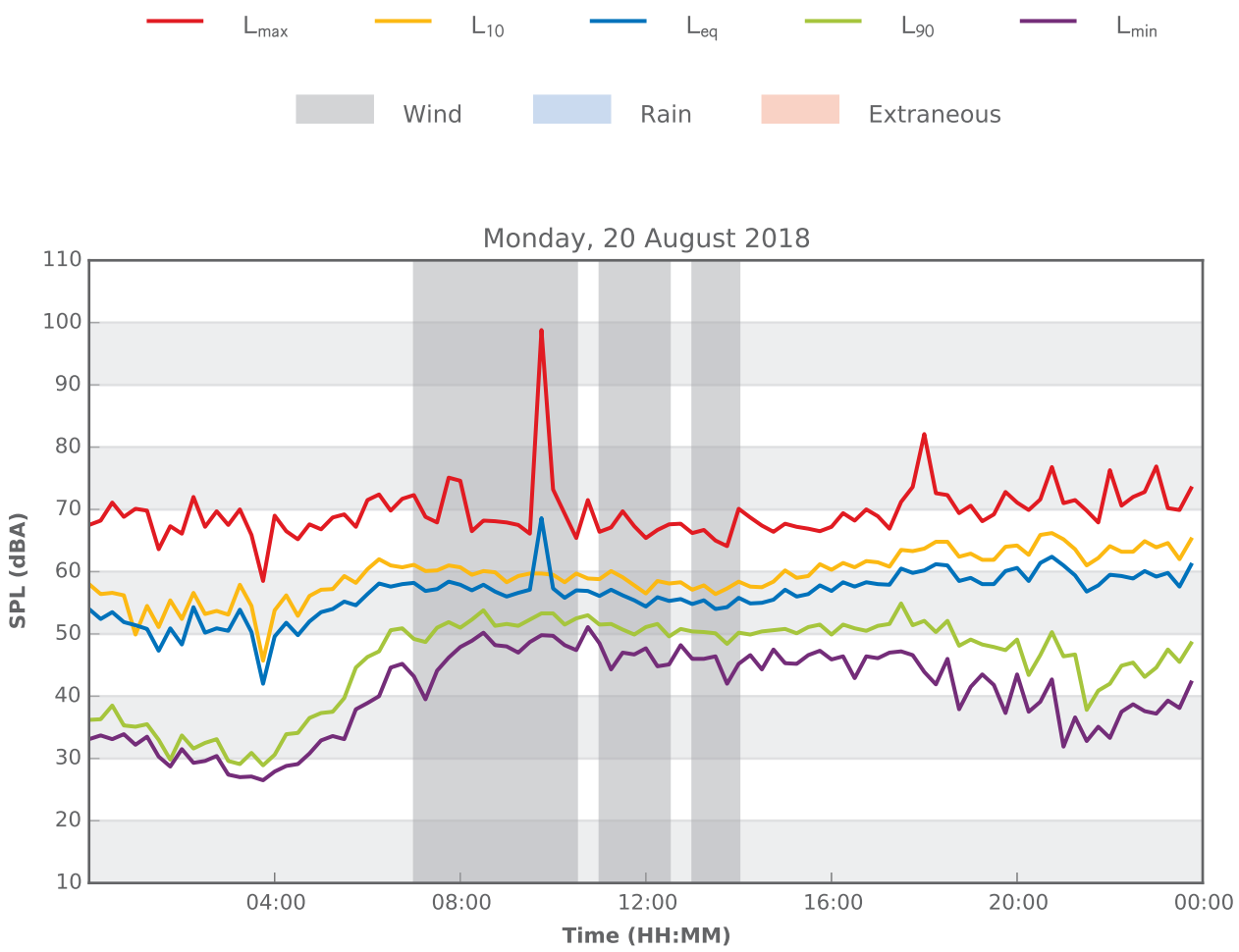


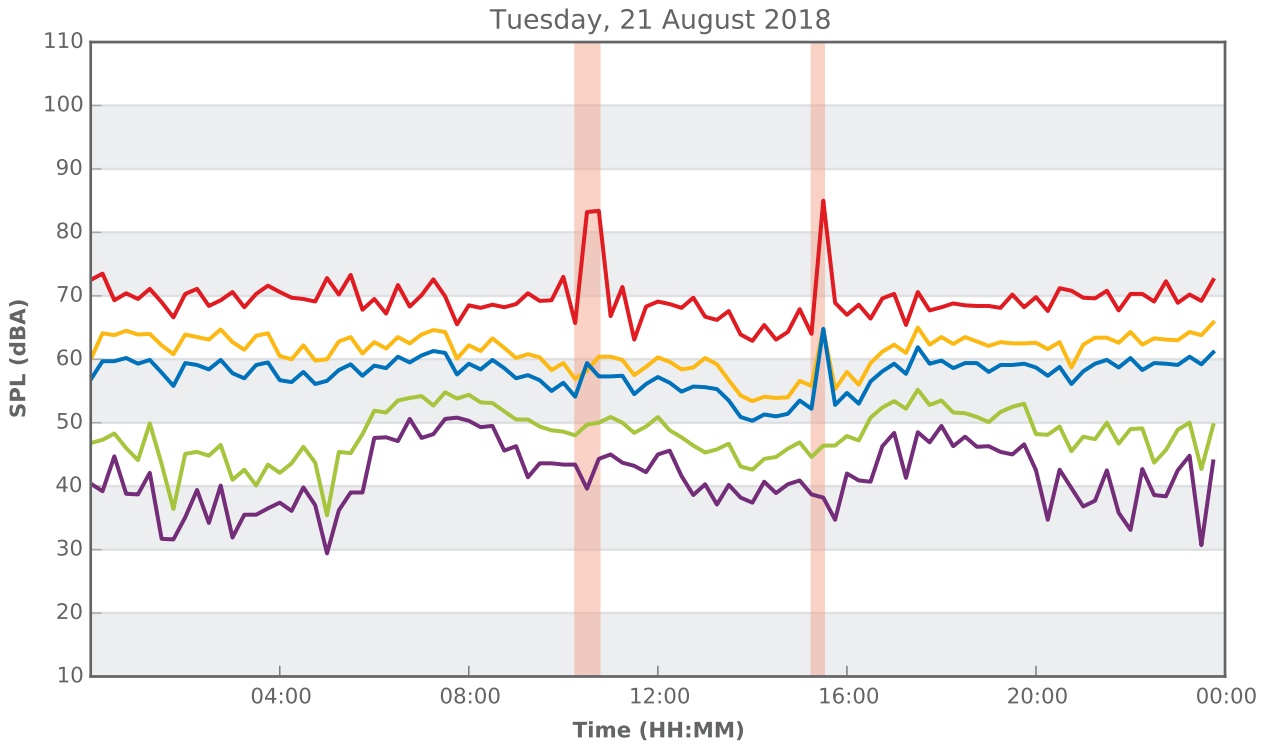
27 Wharf Road, Kundabung





27 Wharf Road, Kundabung





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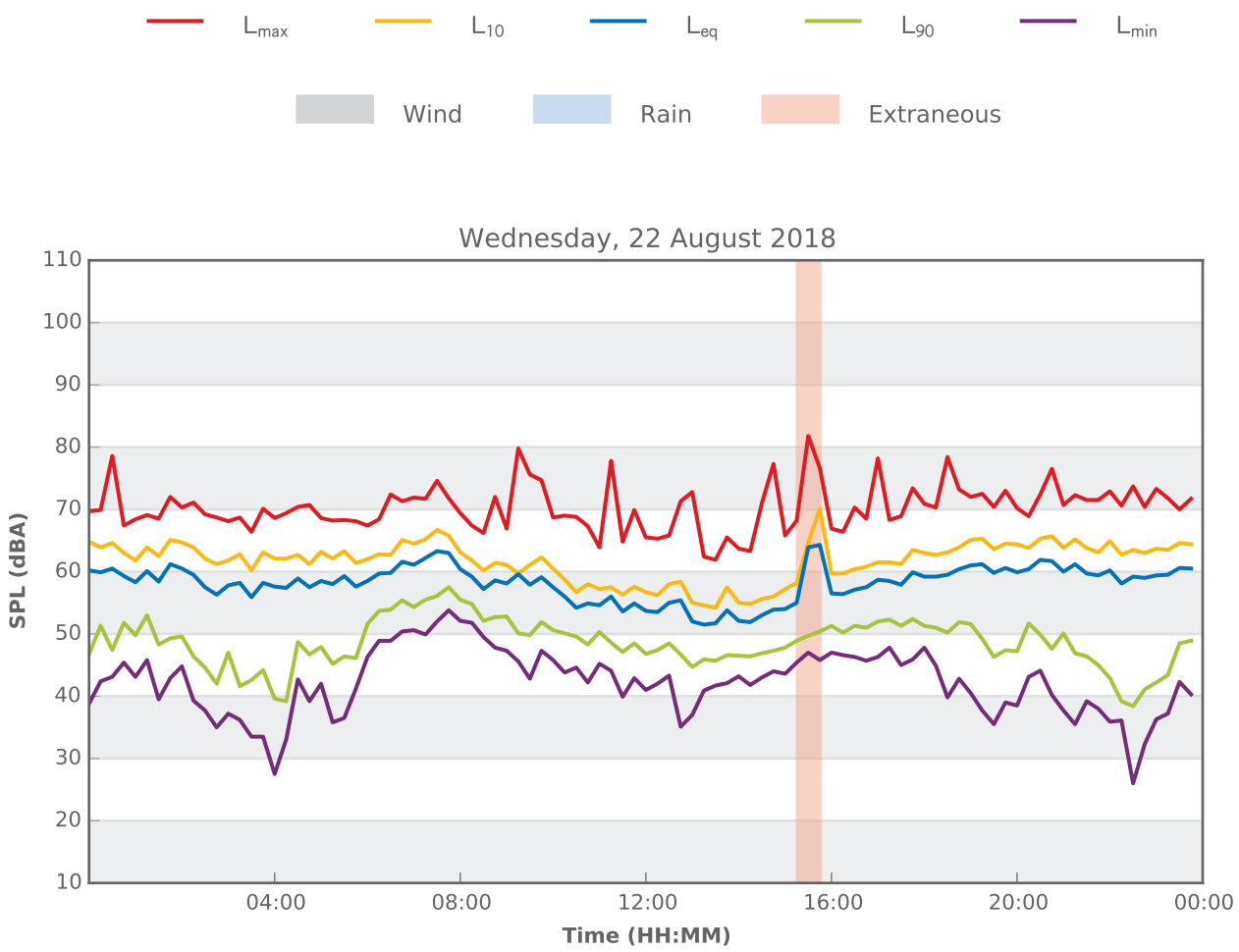
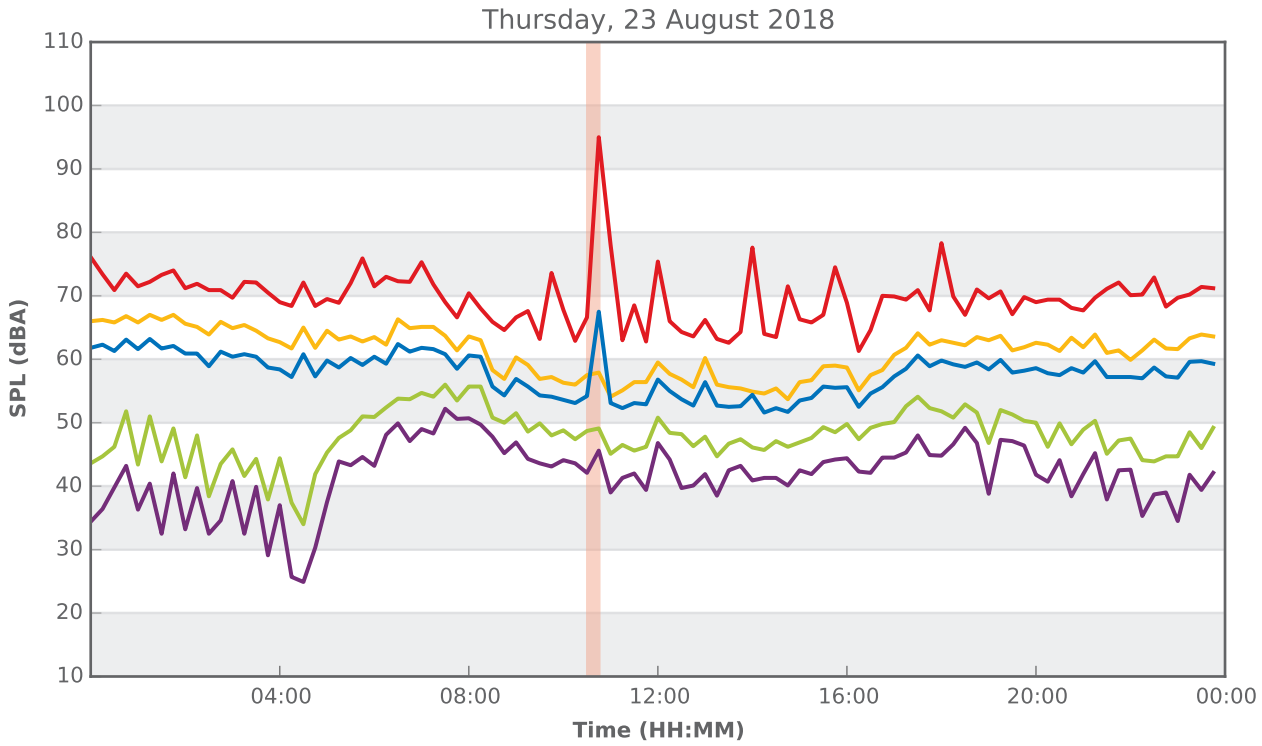
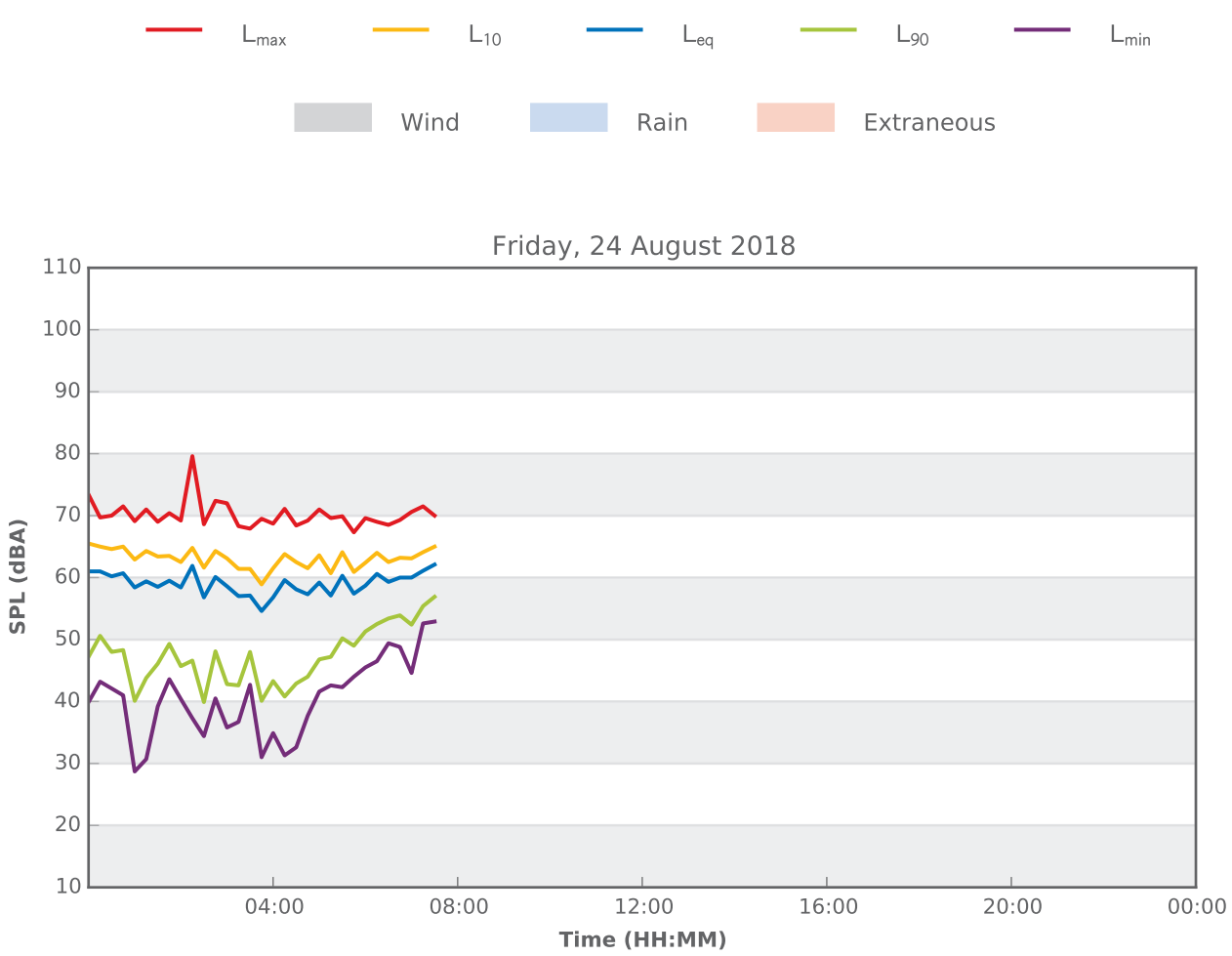
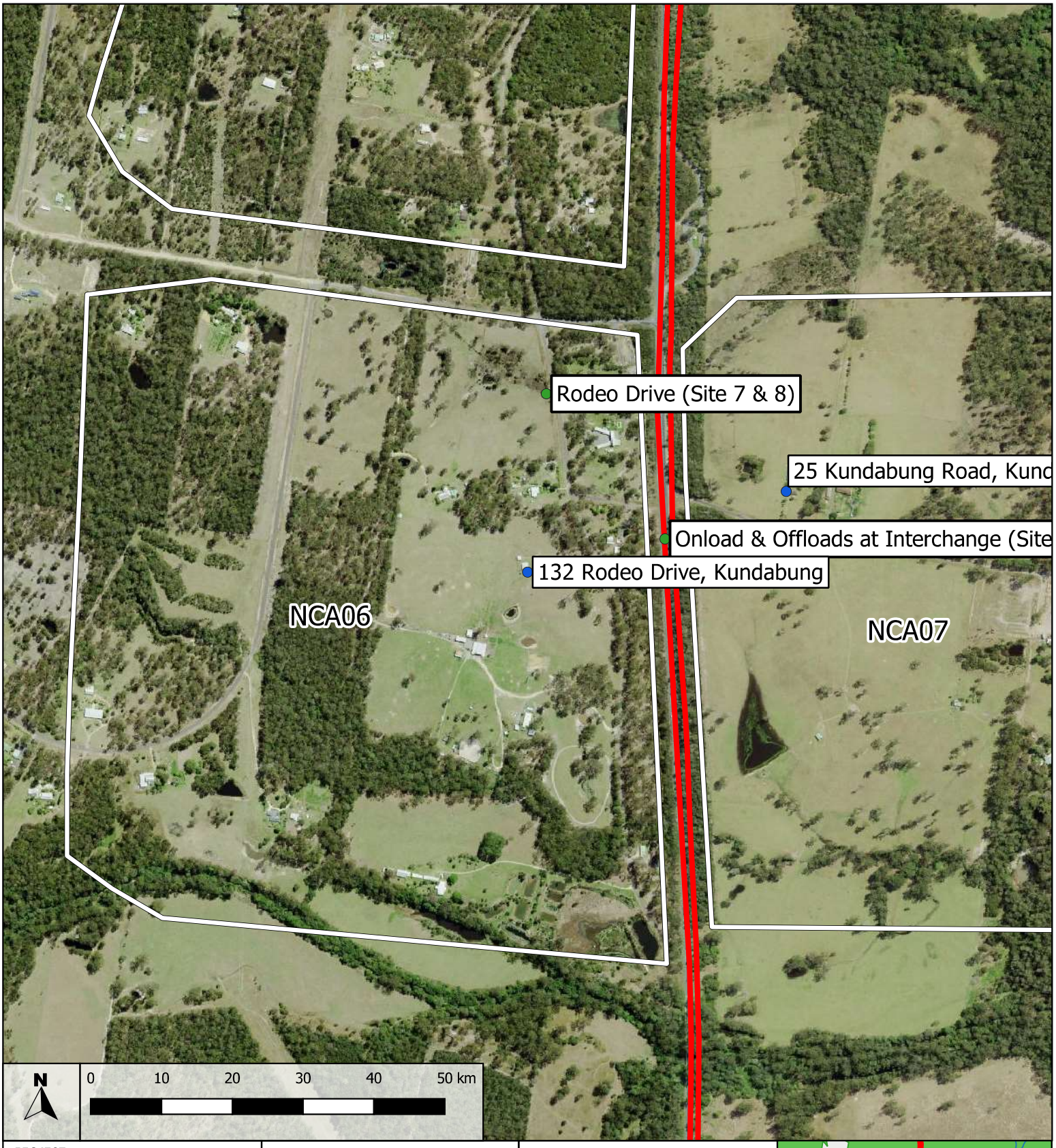




27 Wharf Road, Kundabung





PROJECT:

Kundabung to Kempsey

TITLE:

Noise Monitoring Locations

Post - Opening Compliance

PROJECT No.: 12063-ES

REVISION: A

PREPARED: PT

APPROVED: BJM

EXPORTED: 16/10/2018

SHEET SIZE: A4

Appendix D

Drawing 4 of 10

WILKINSON MURRAY

ADDRESS:

132 Rodeo Drive, Kundabung

START DATE:

14/08/2018

STOP DATE:

23/08/2018

Overall Noise - LAeq, Period

LAeq, 15 Hour

58.2

LAeq, 9 Hour

54.8

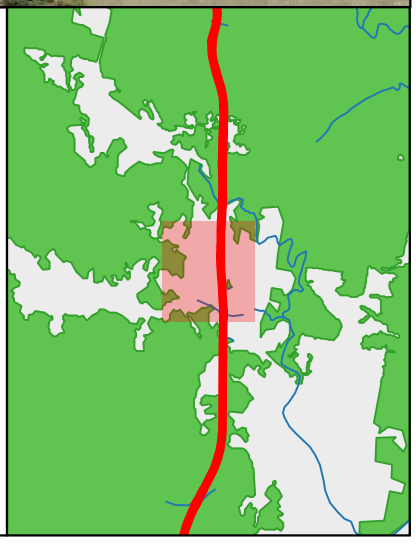
Estimated Traffic Noise - LAeq, Period

LAeq, 15 Hour

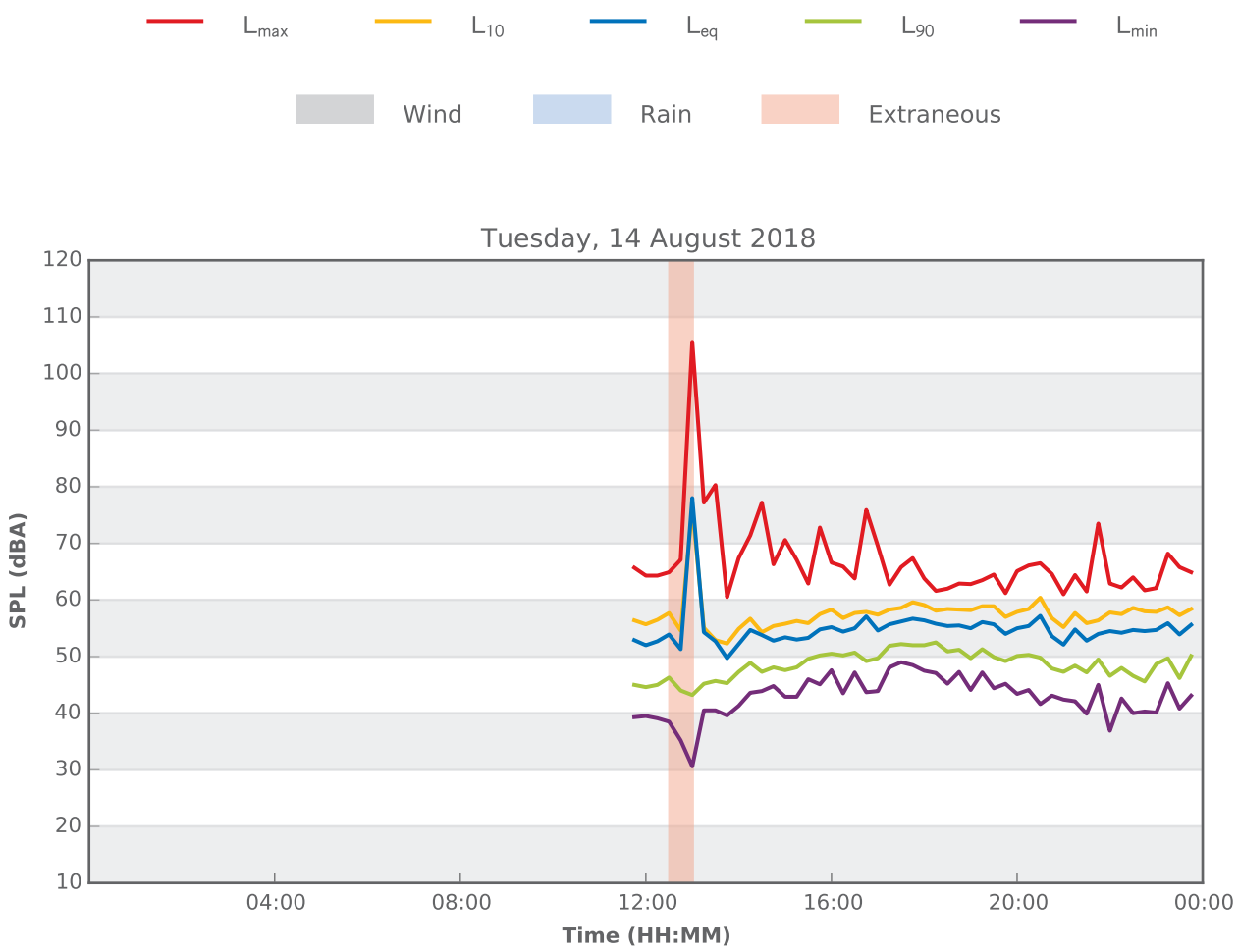
54.6

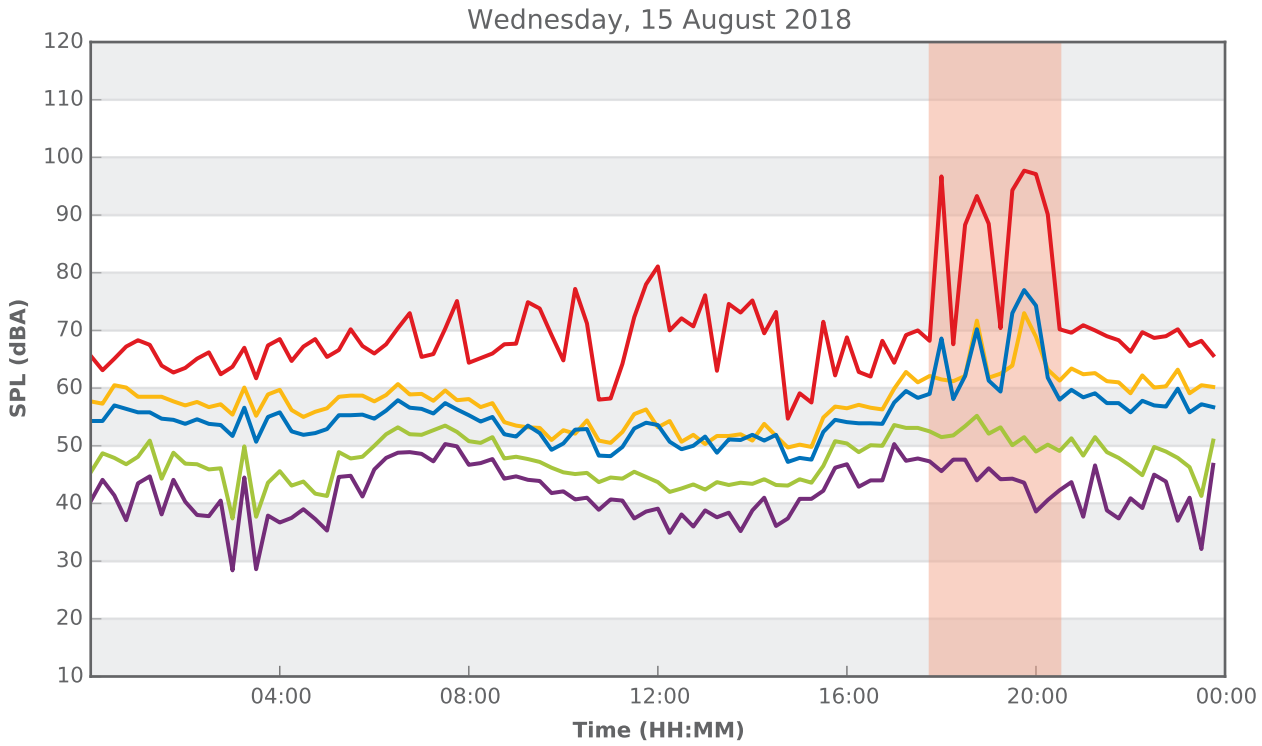
LAeq, 9 Hour

54.8

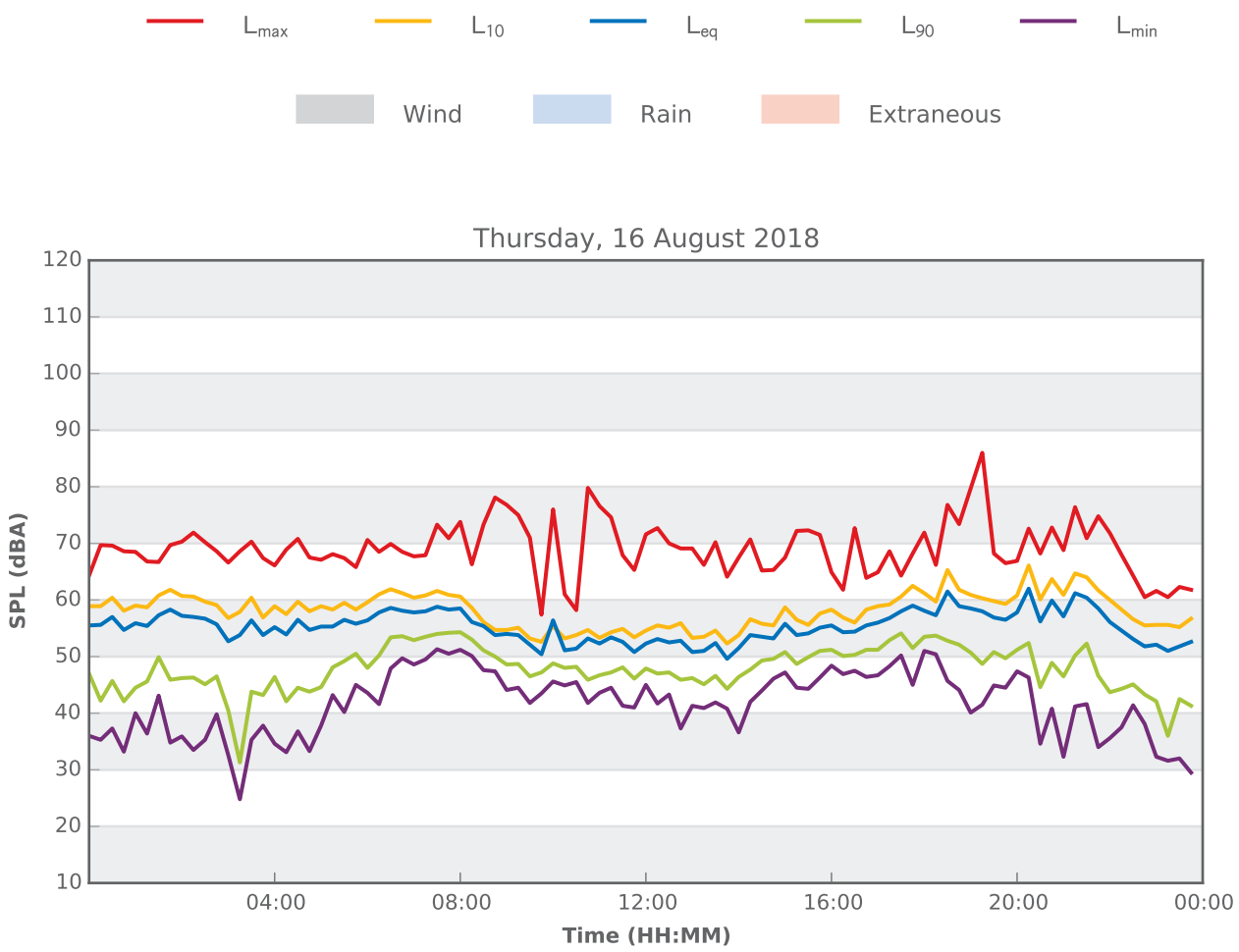


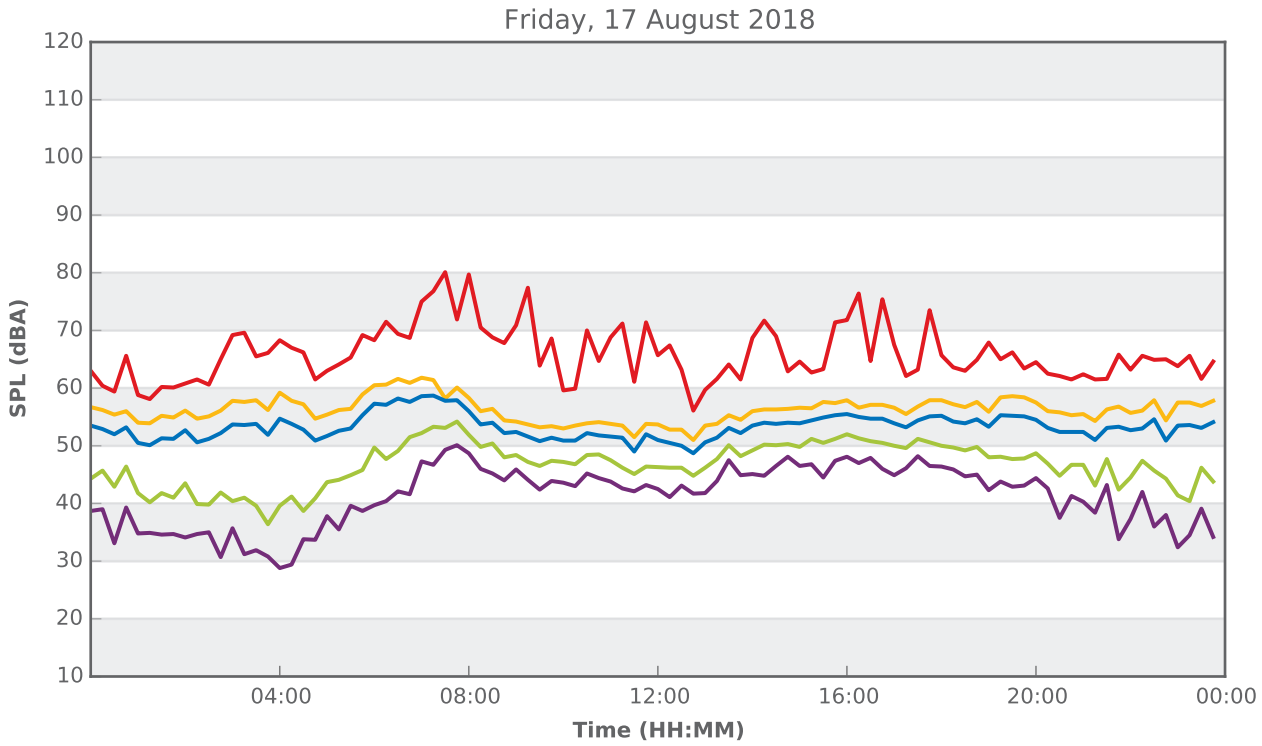
132 Rodeo Drive, Kundabung



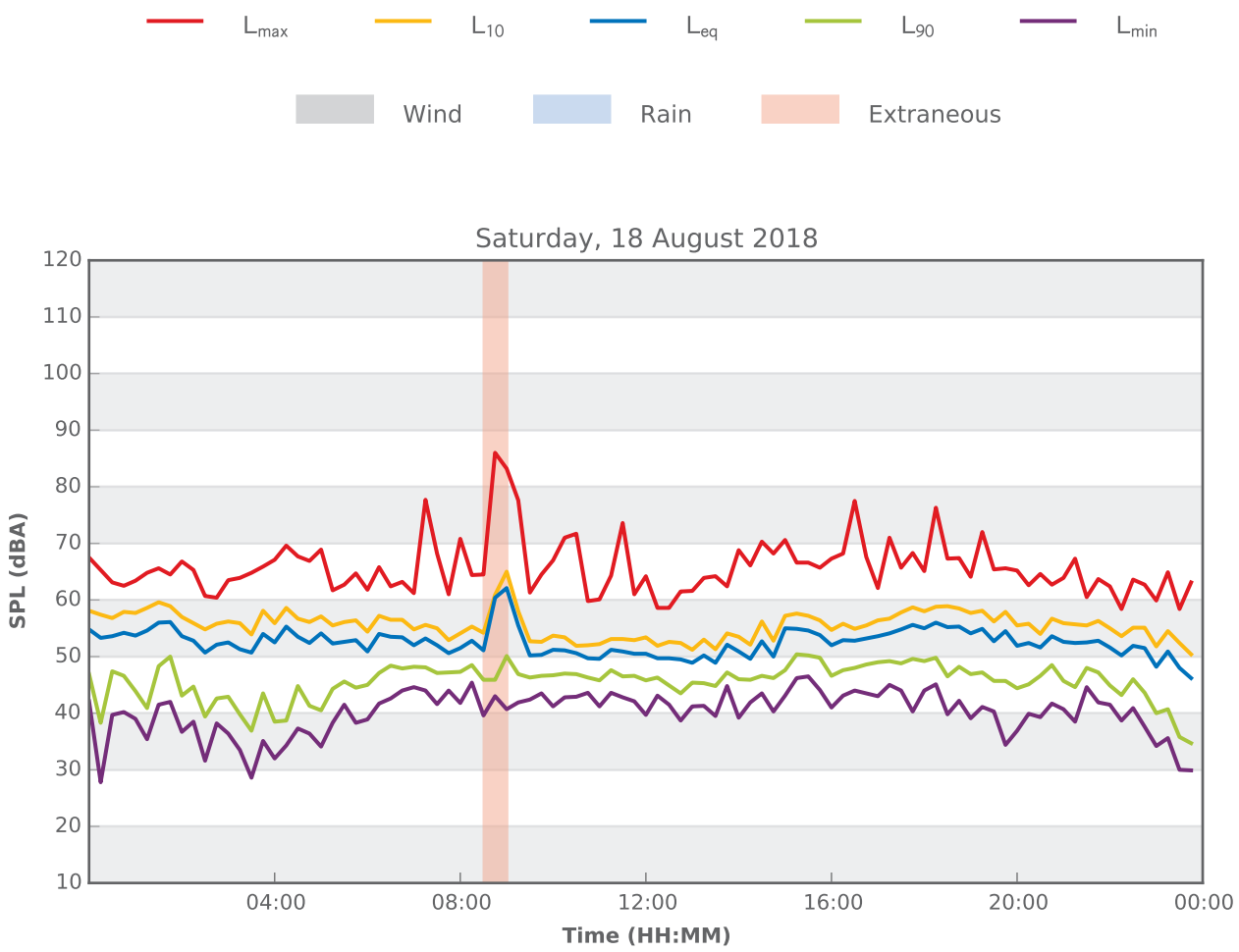


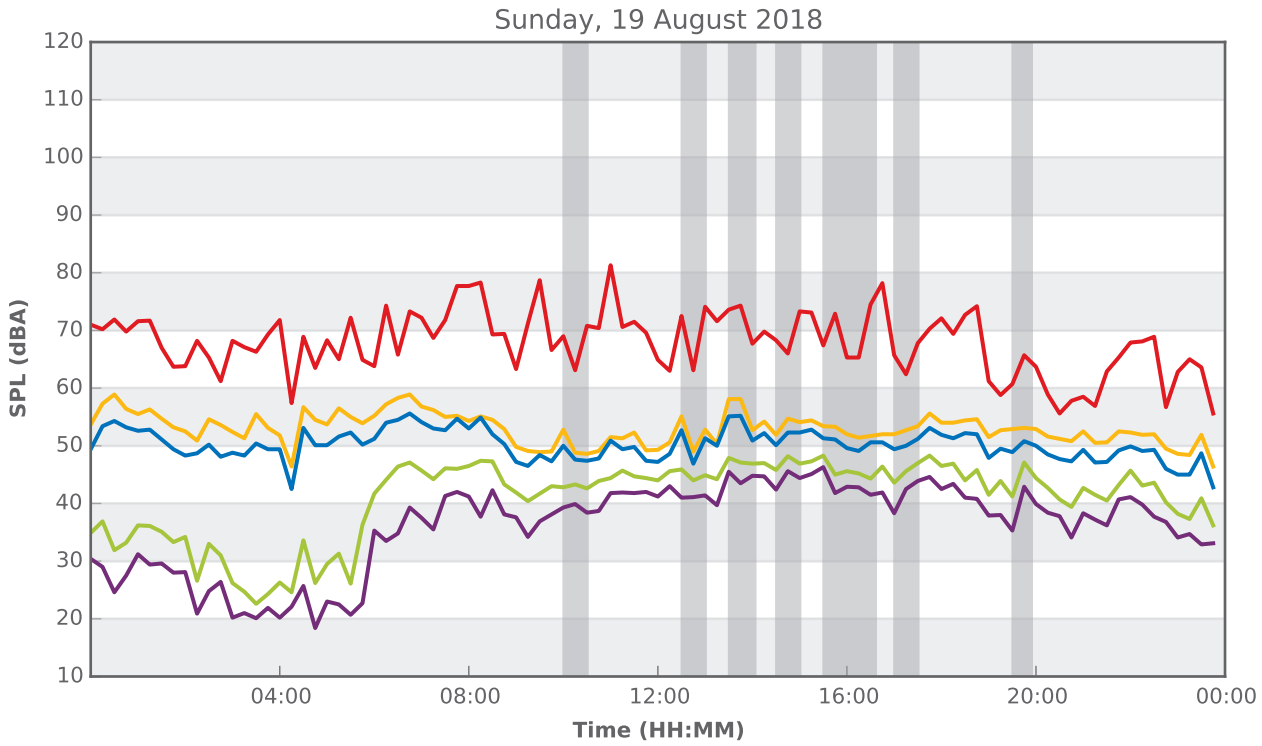
132 Rodeo Drive, Kundabung



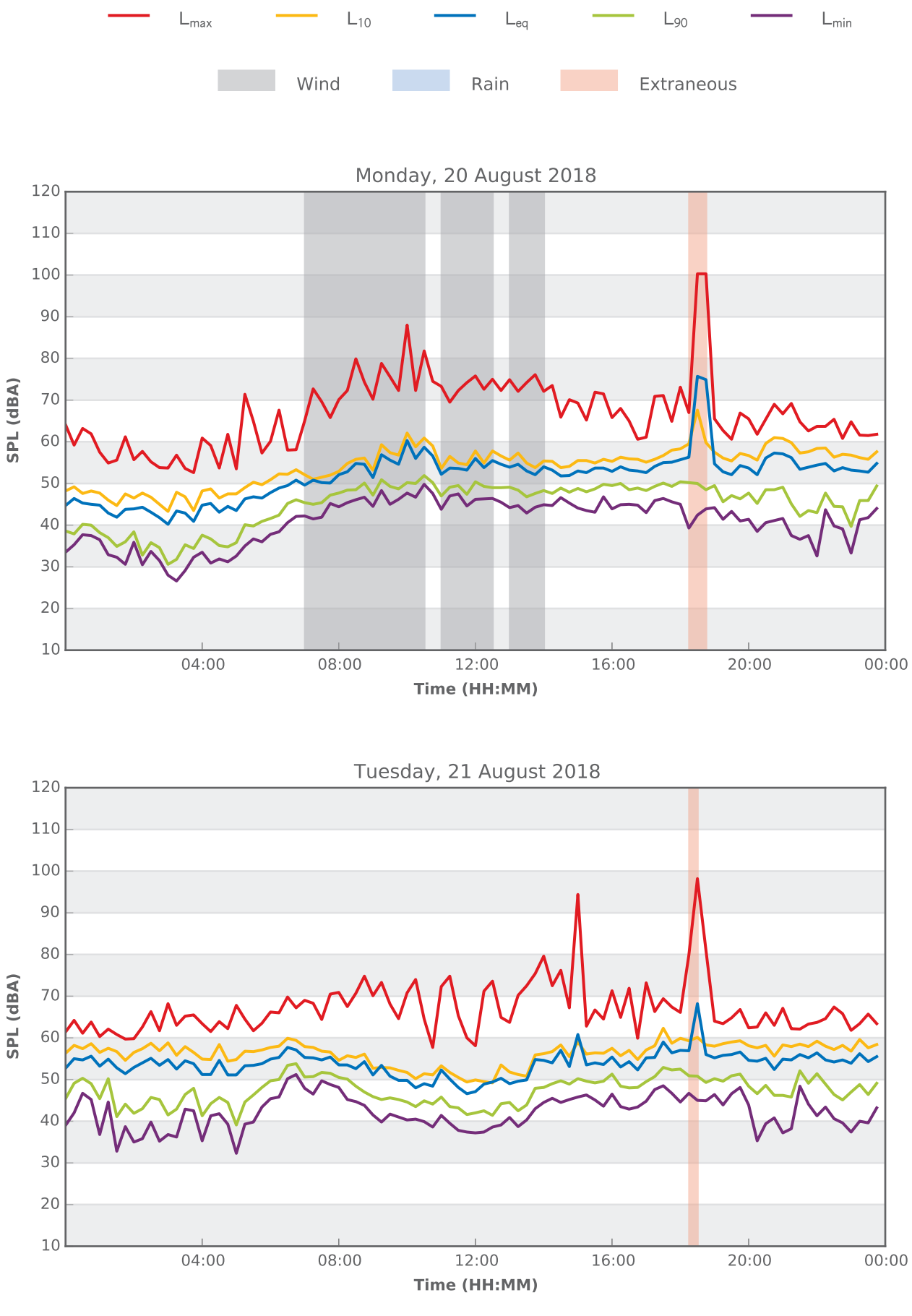


132 Rodeo Drive, Kundabung

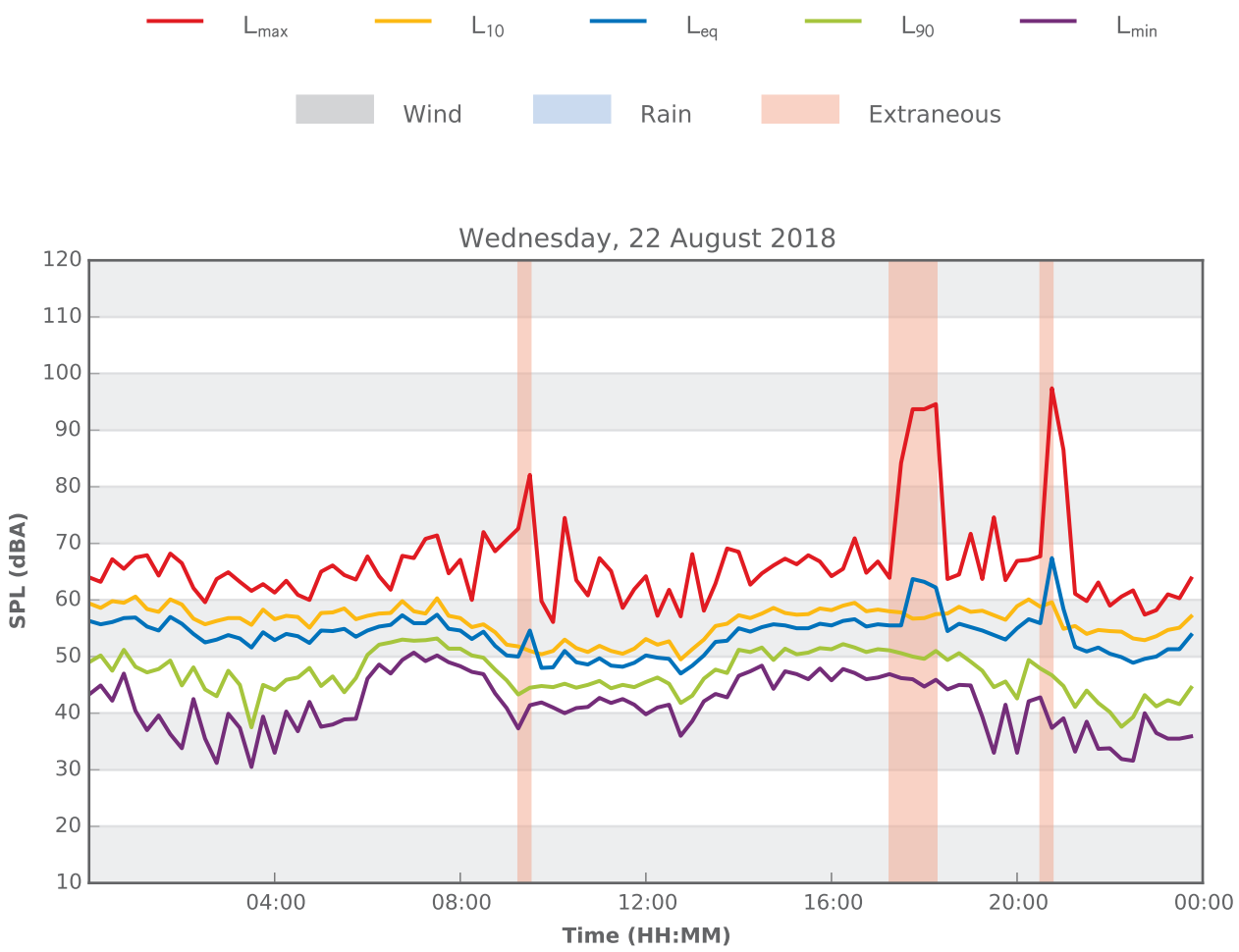


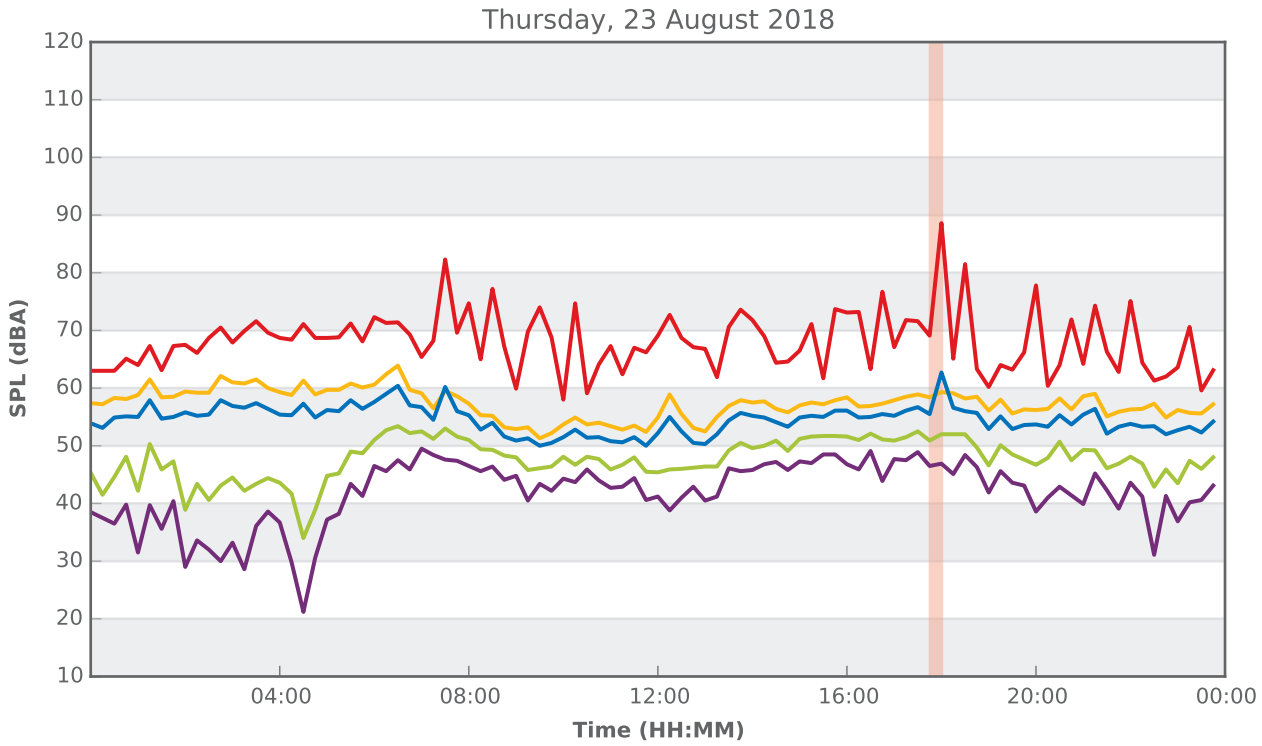


132 Rodeo Drive, Kundabung

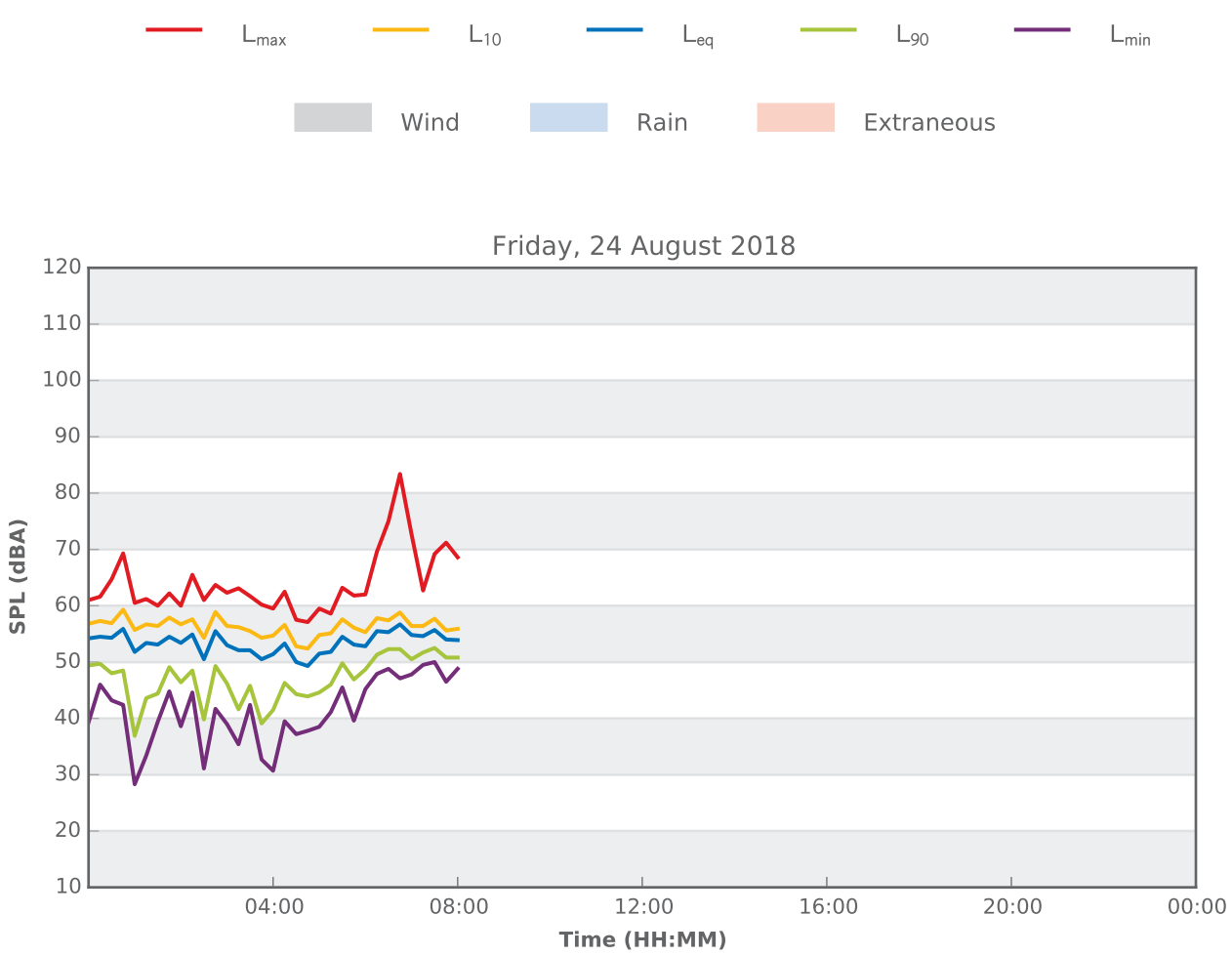


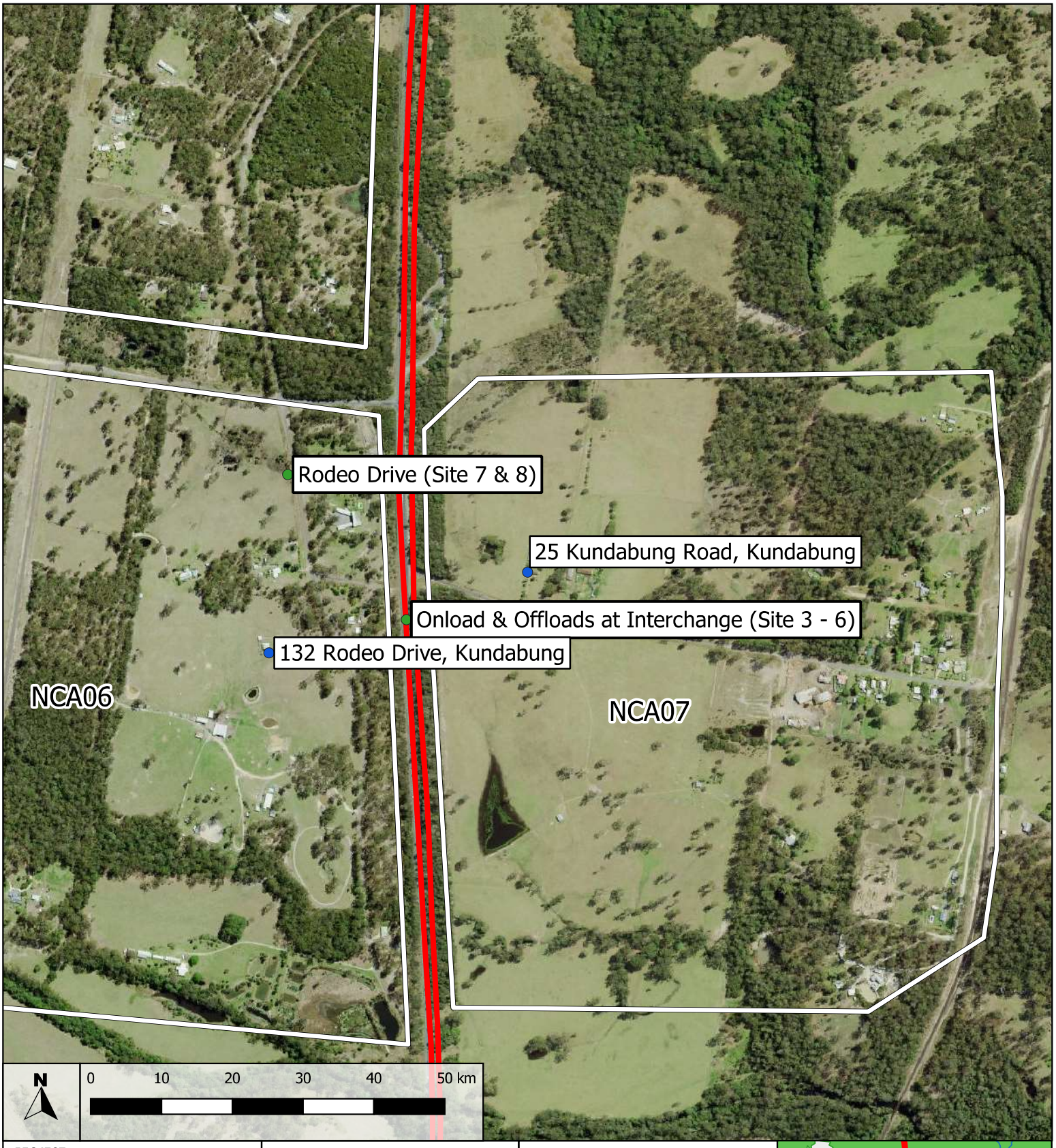
132 Rodeo Drive, Kundabung





132 Rodeo Drive, Kundabung





PROJECT:

Kundabung to Kempsey

TITLE:

Noise Monitoring Locations

Post - Opening Compliance

PROJECT No.: 12063-ES

REVISION: A

PREPARED: PT

APPROVED: BJM

EXPORTED: 16/10/2018

SHEET SIZE: A4

Appendix D

Drawing 5 of 10

WILKINSON MURRAY

ADDRESS:

25 Kundabung Road, Kundabung

START DATE:

14/08/2018

STOP DATE:

23/08/2018

Overall Noise - LAeq, Period

LAeq, 15 Hour

57

LAeq, 9 Hour

58.4

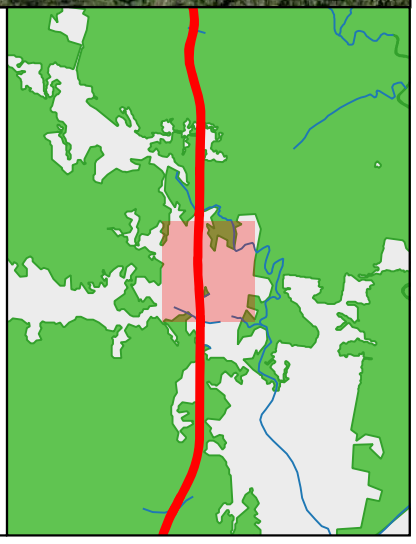
Estimated Traffic Noise - LAeq, Period

LAeq, 15 Hour

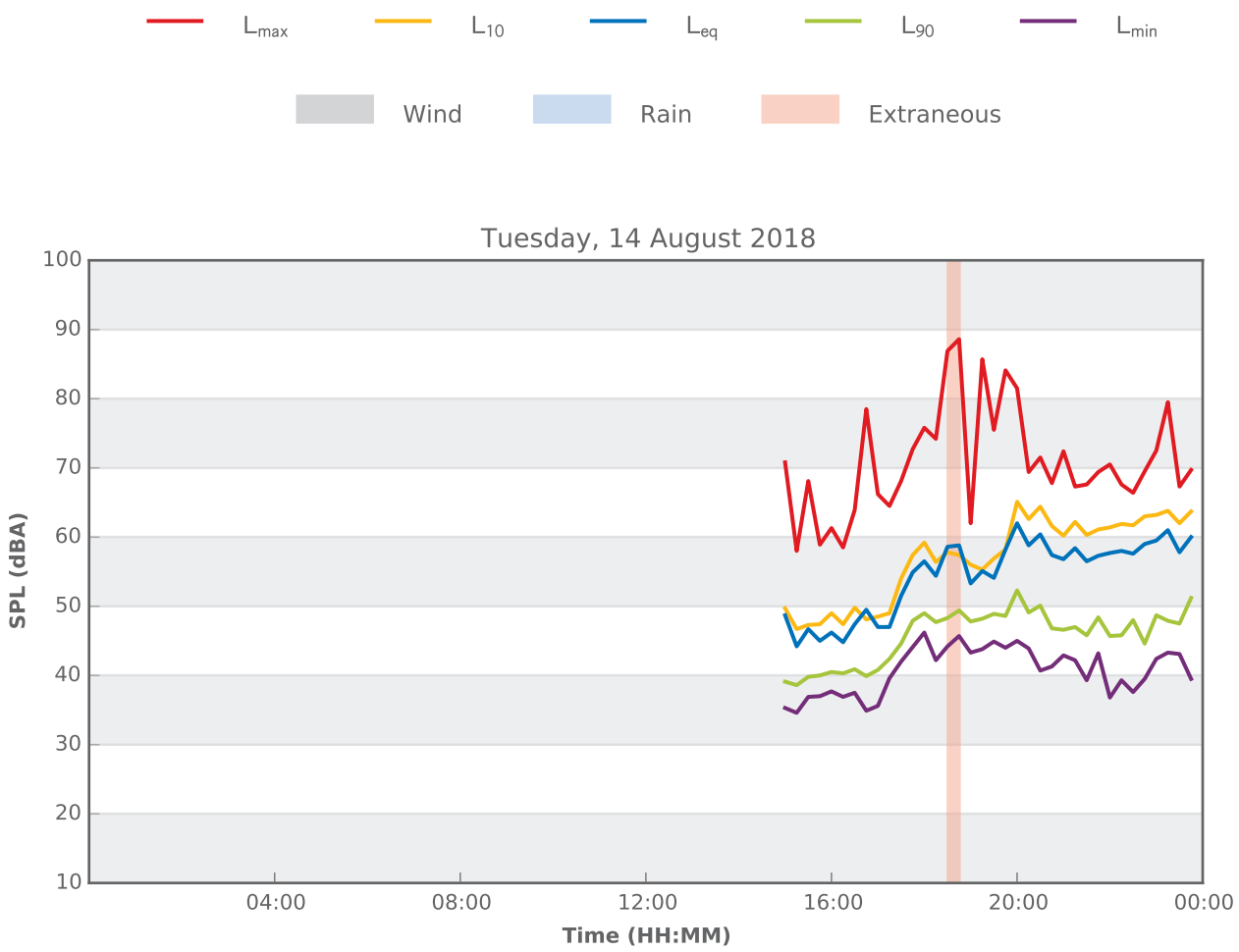
56.7

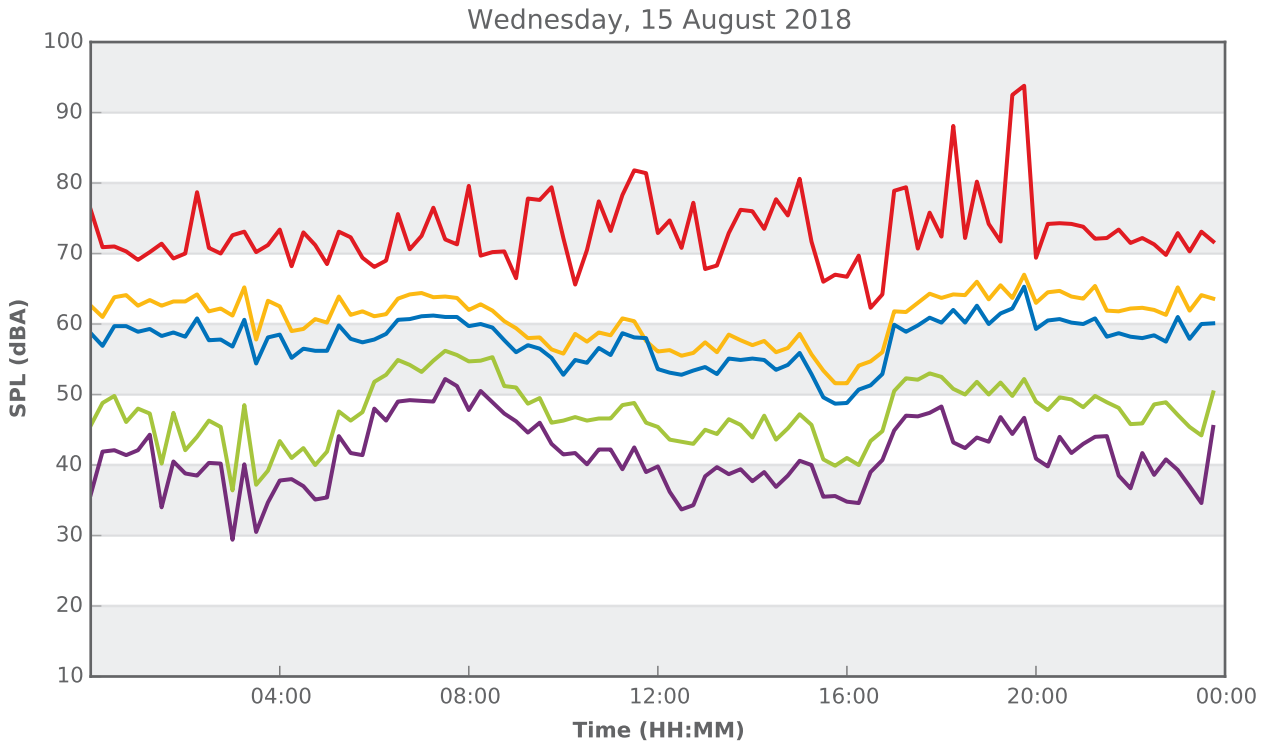
LAeq, 9 Hour

58.3

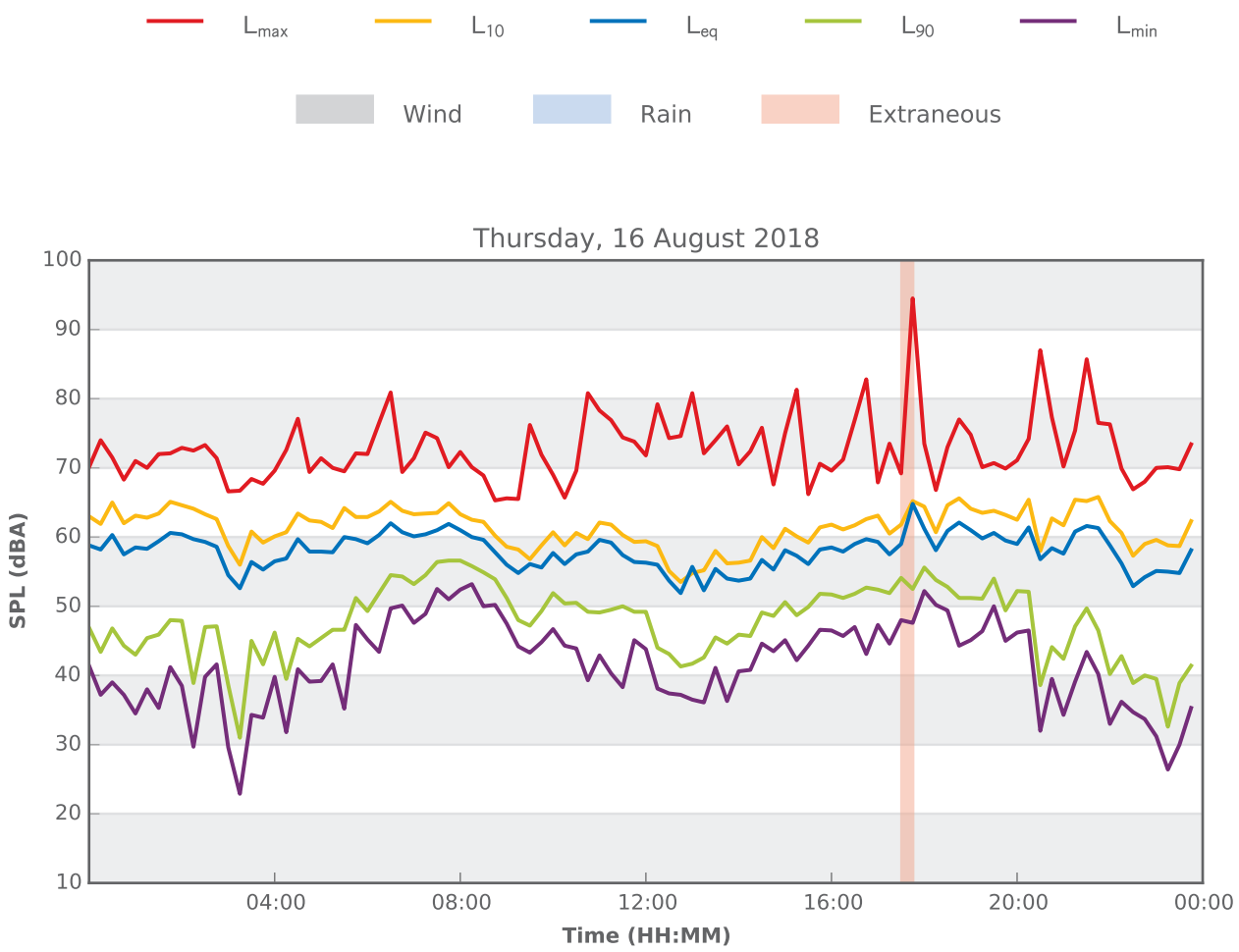


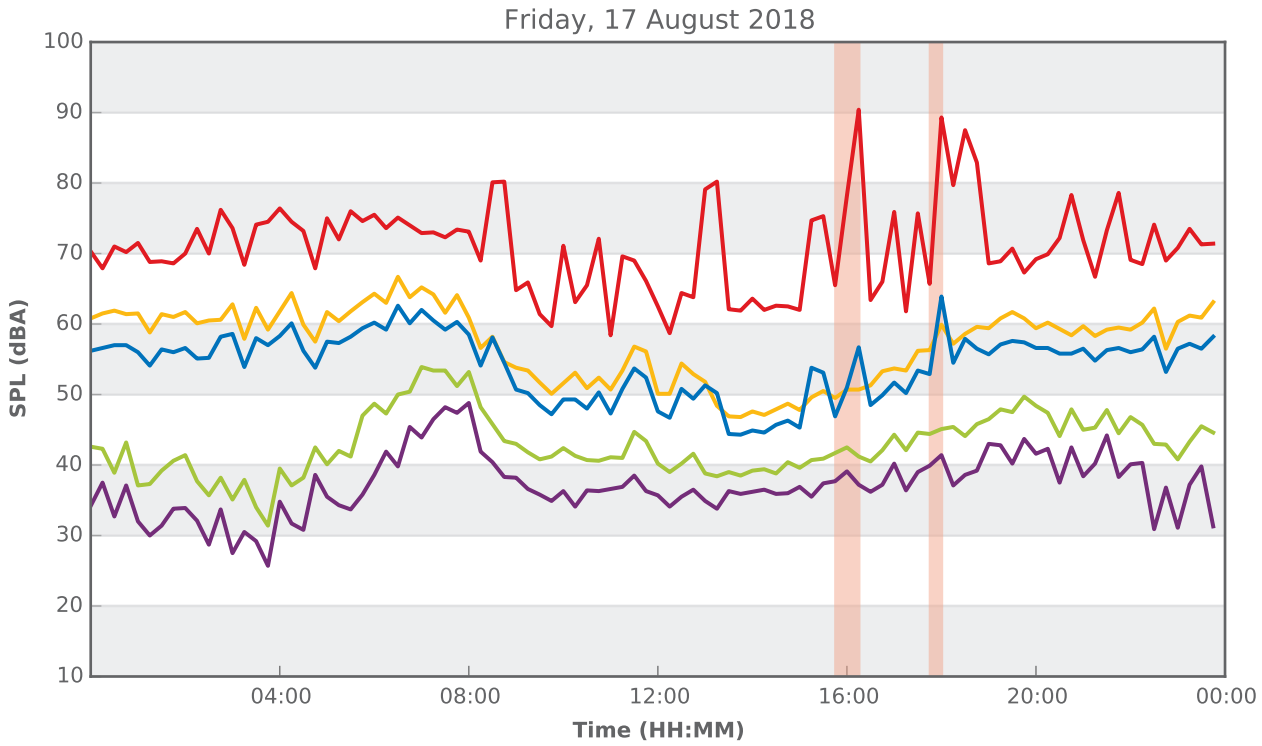
25 Kundabung Road, Kundabung



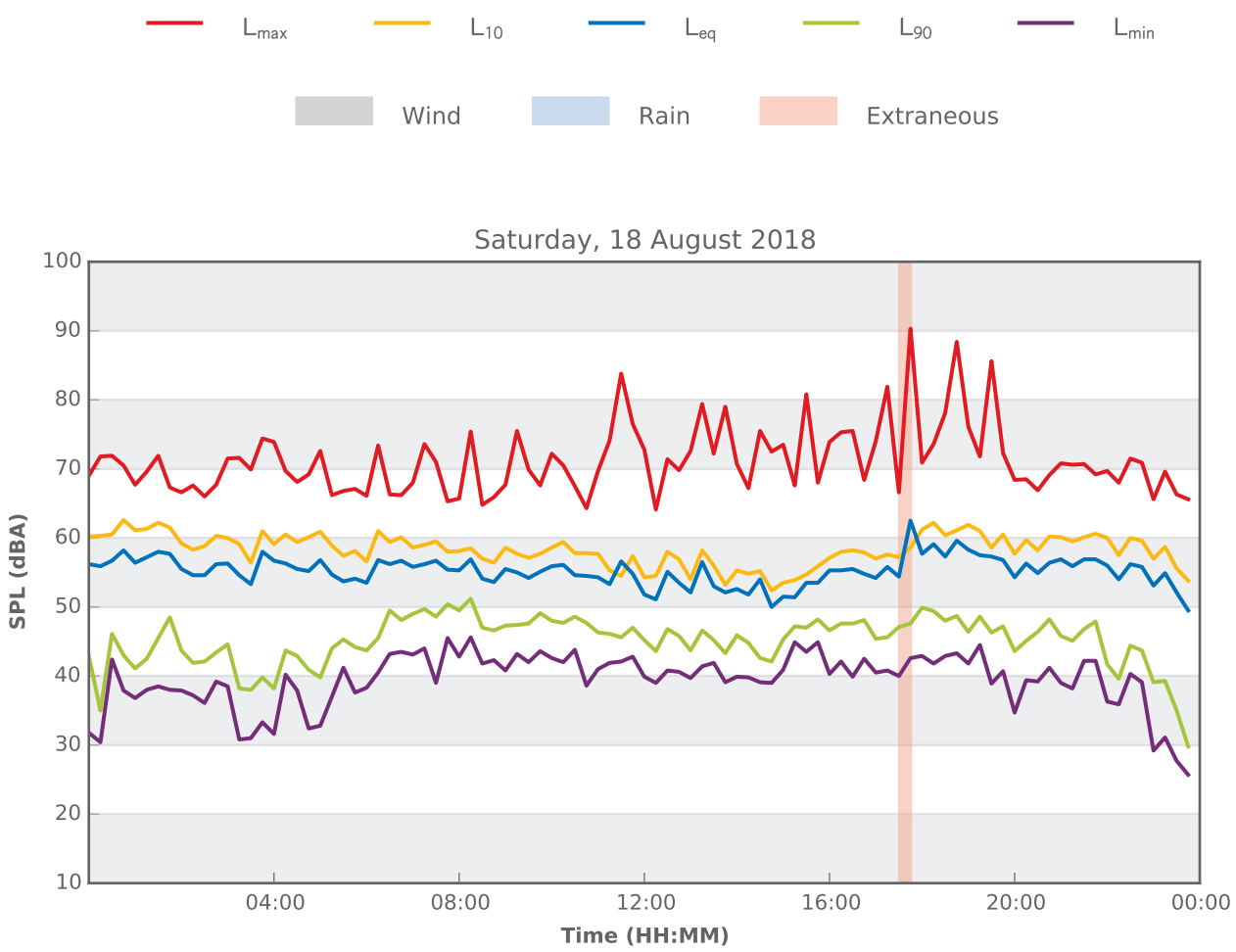


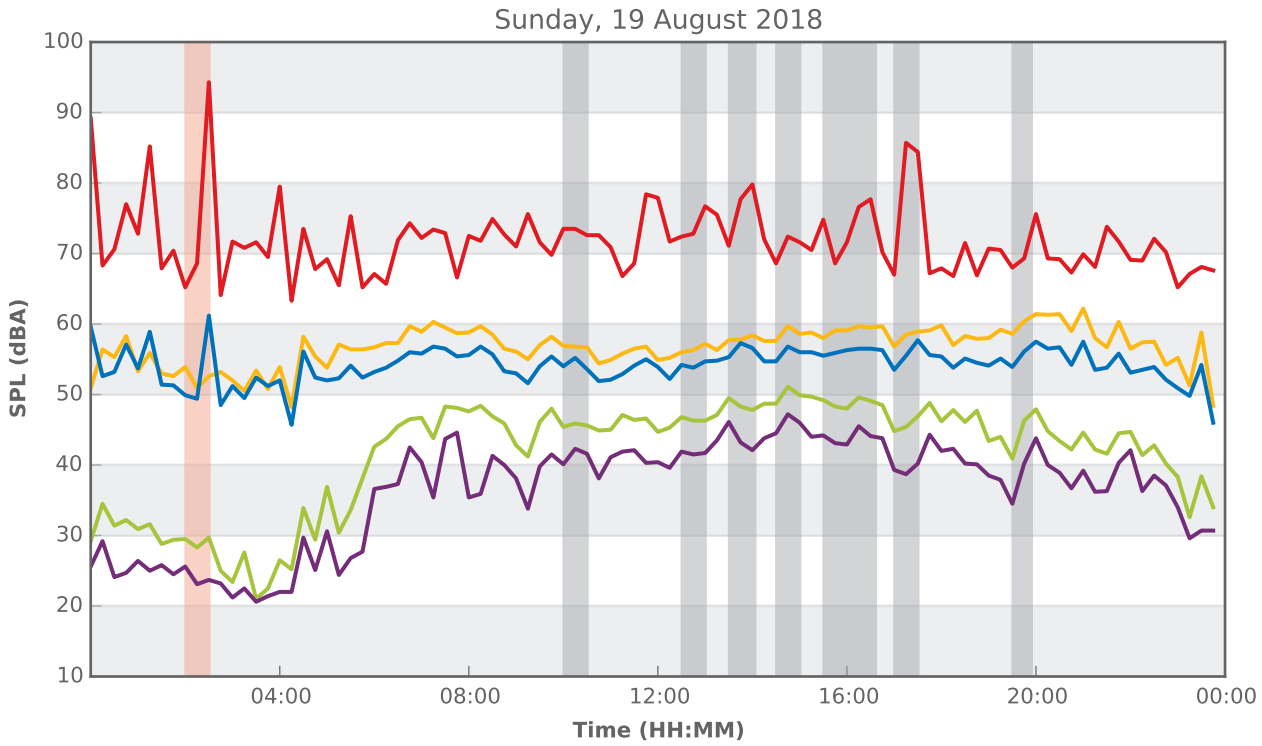
25 Kundabung Road, Kundabung



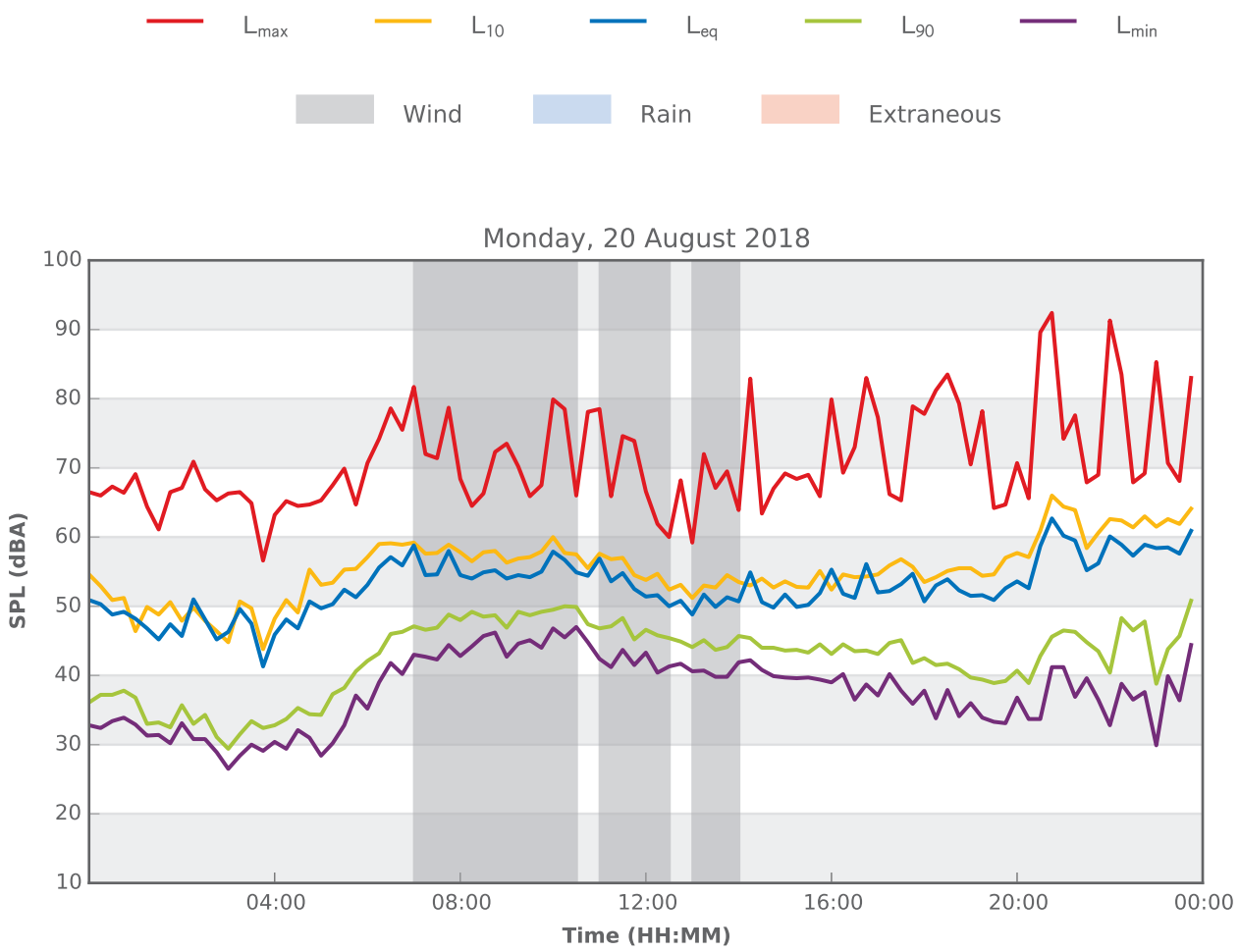


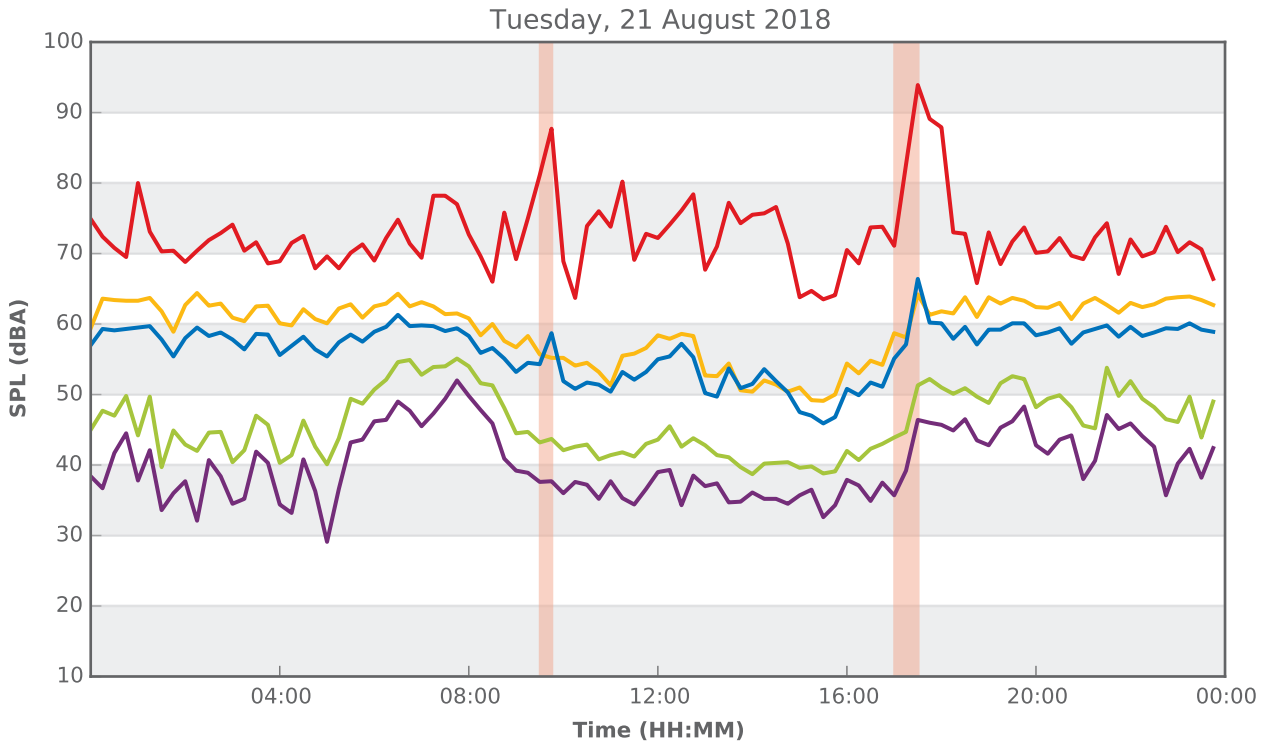
25 Kundabung Road, Kundabung



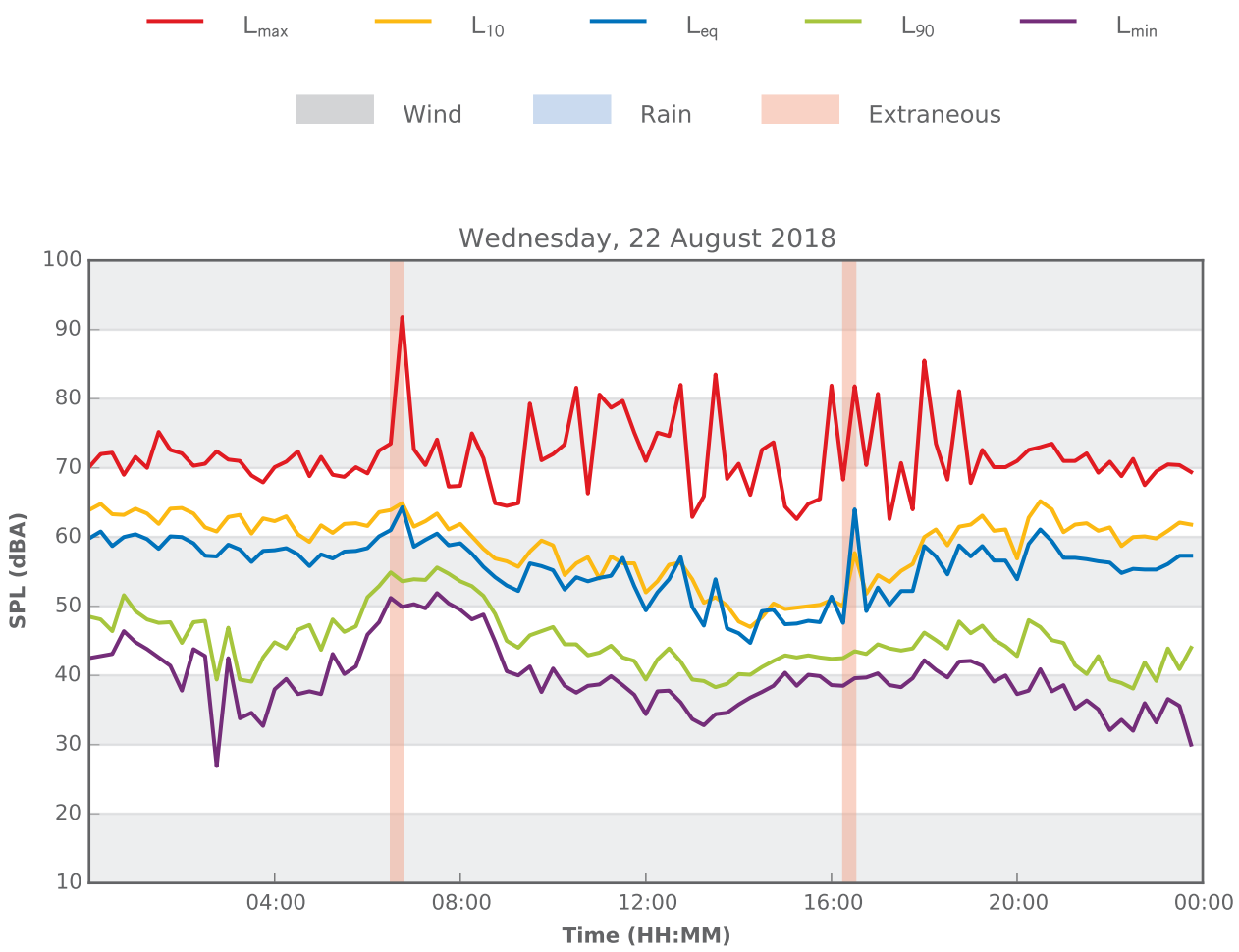


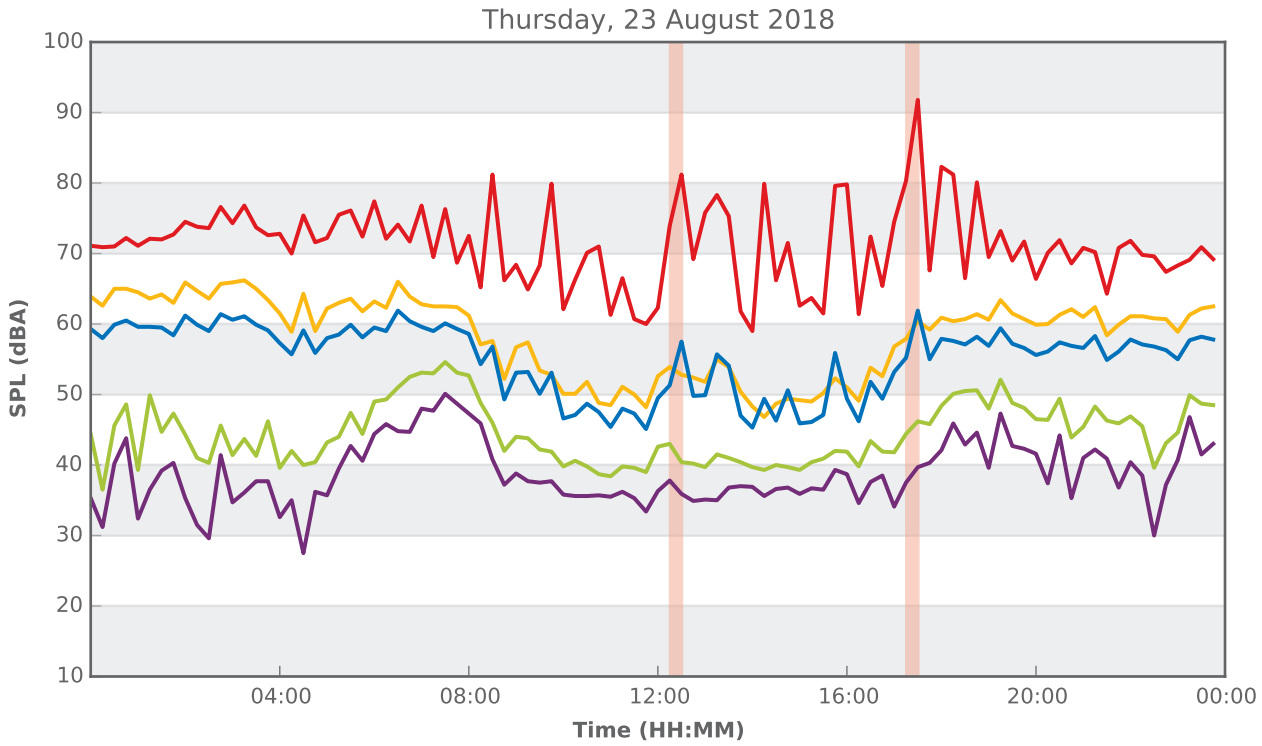
25 Kundabung Road, Kundabung



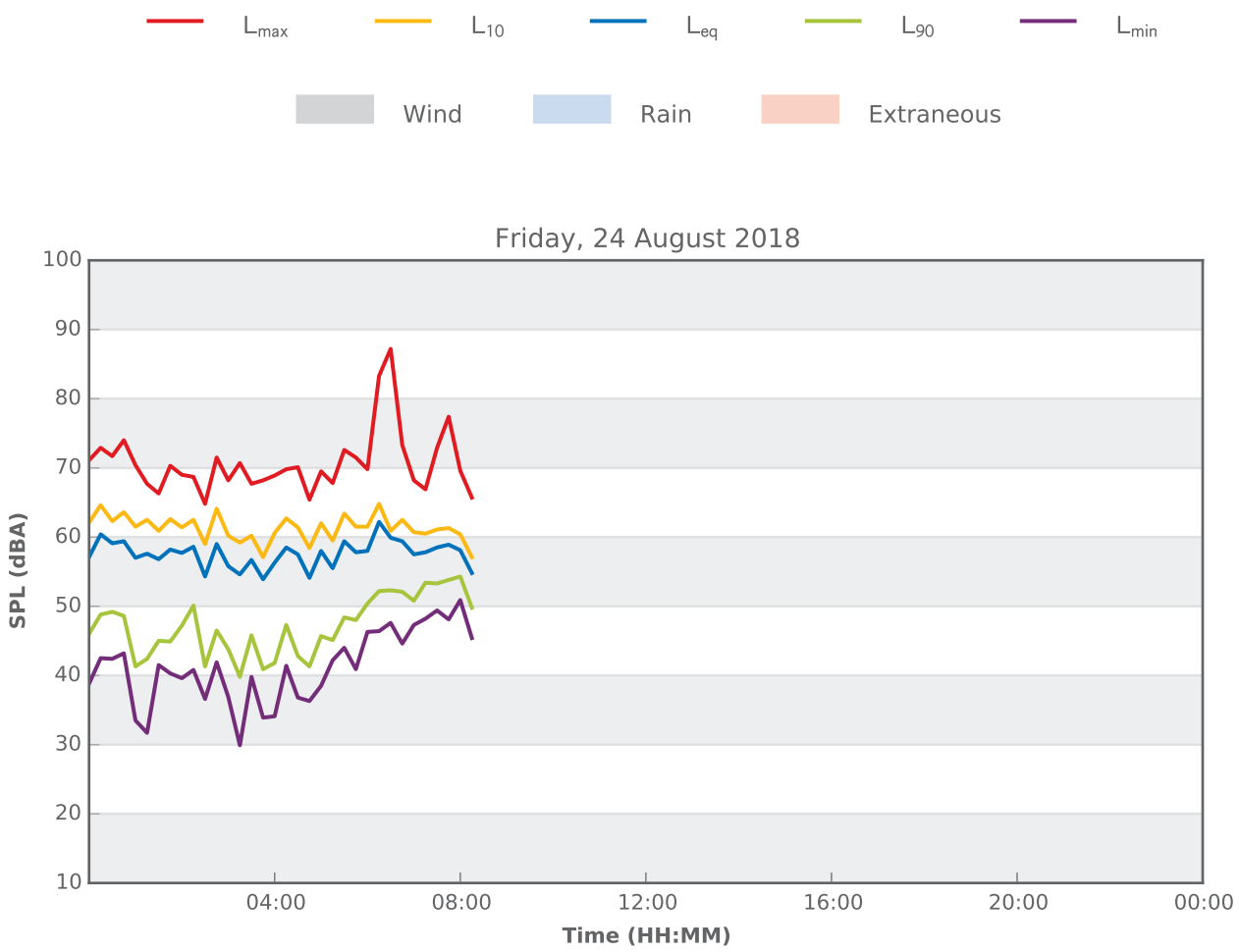


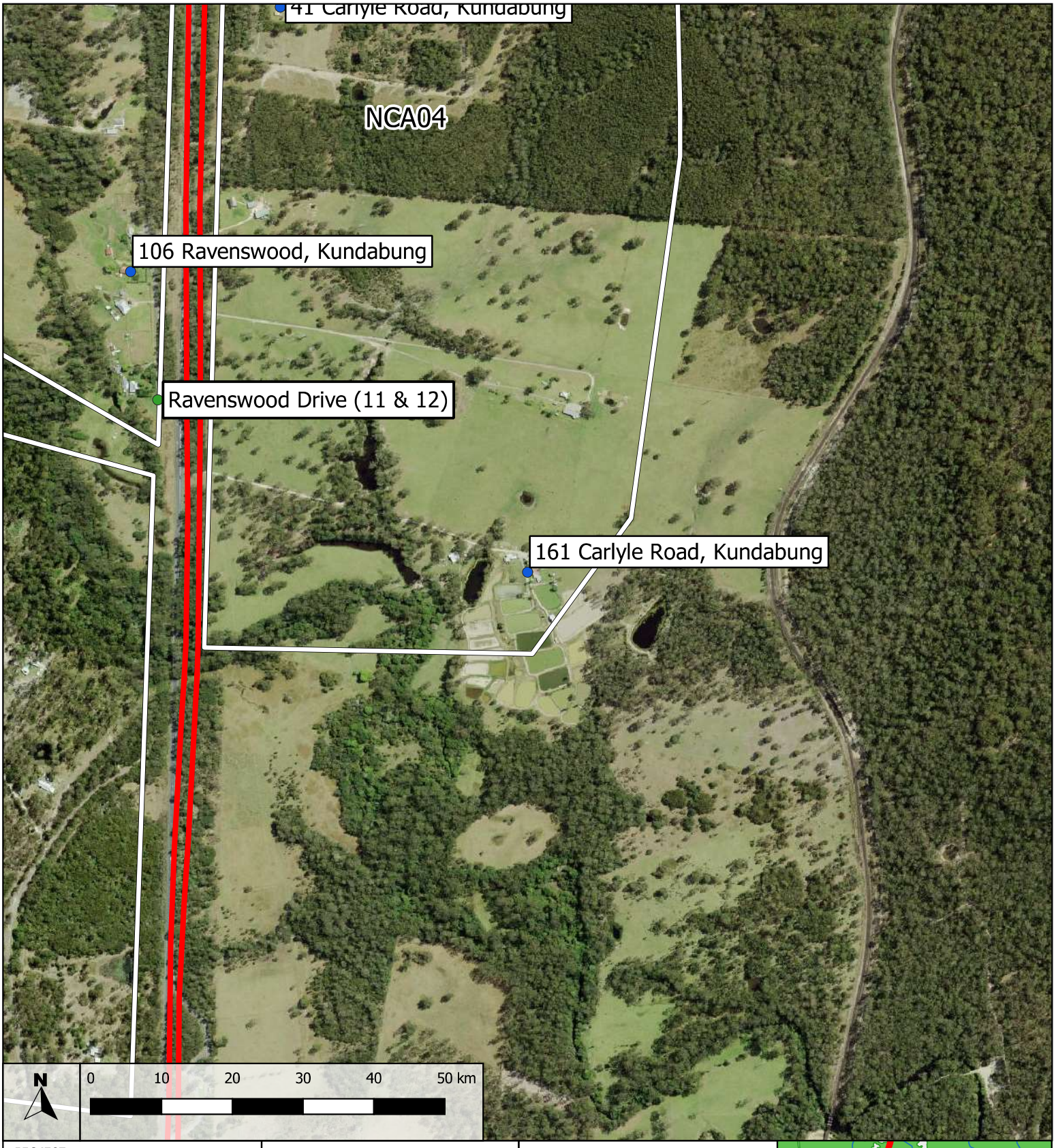
25 Kundabung Road, Kundabung





25 Kundabung Road, Kundabung





PROJECT:

Kundabung to Kempsey

TITLE:

Noise Monitoring Locations

Post - Opening Compliance

PROJECT No.: 12063-ES

REVISION: A

PREPARED: PT

APPROVED: BJM

EXPORTED: 16/10/2018

SHEET SIZE: A4

Appendix D

Drawing 6 of 10

WILKINSON MURRAY

ADDRESS:

161 Carlyle Road, Kundabung

START DATE:

14/08/2018

STOP DATE:

23/08/2018

Overall Noise - LAeq, Period

LAeq, 15 Hour

57

LAeq, 9 Hour

58.9

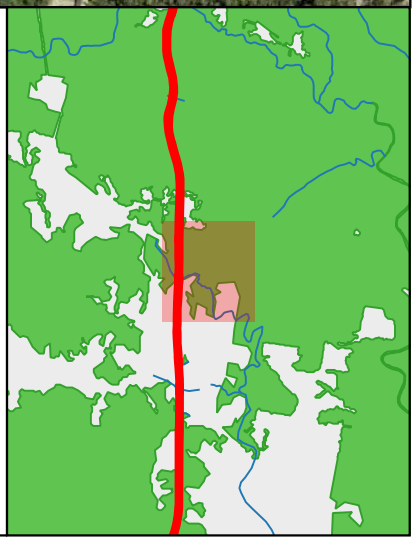
Estimated Traffic Noise - LAeq, Period

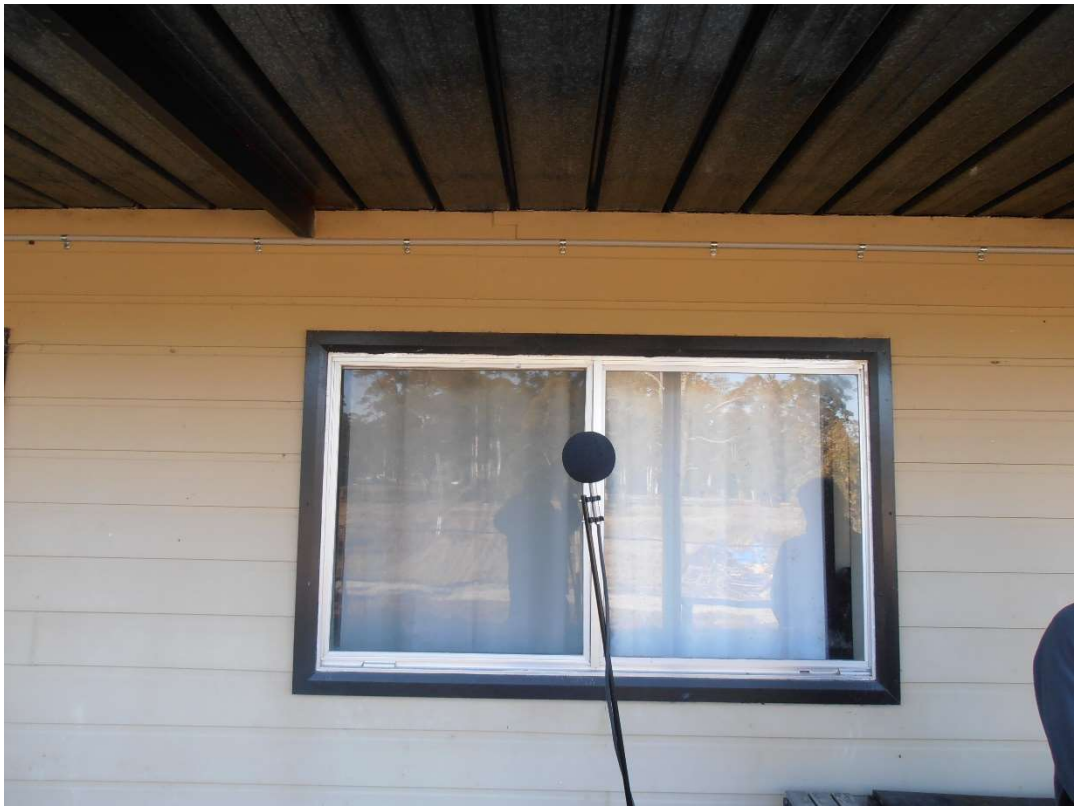
LAeq, 15 Hour

55.4

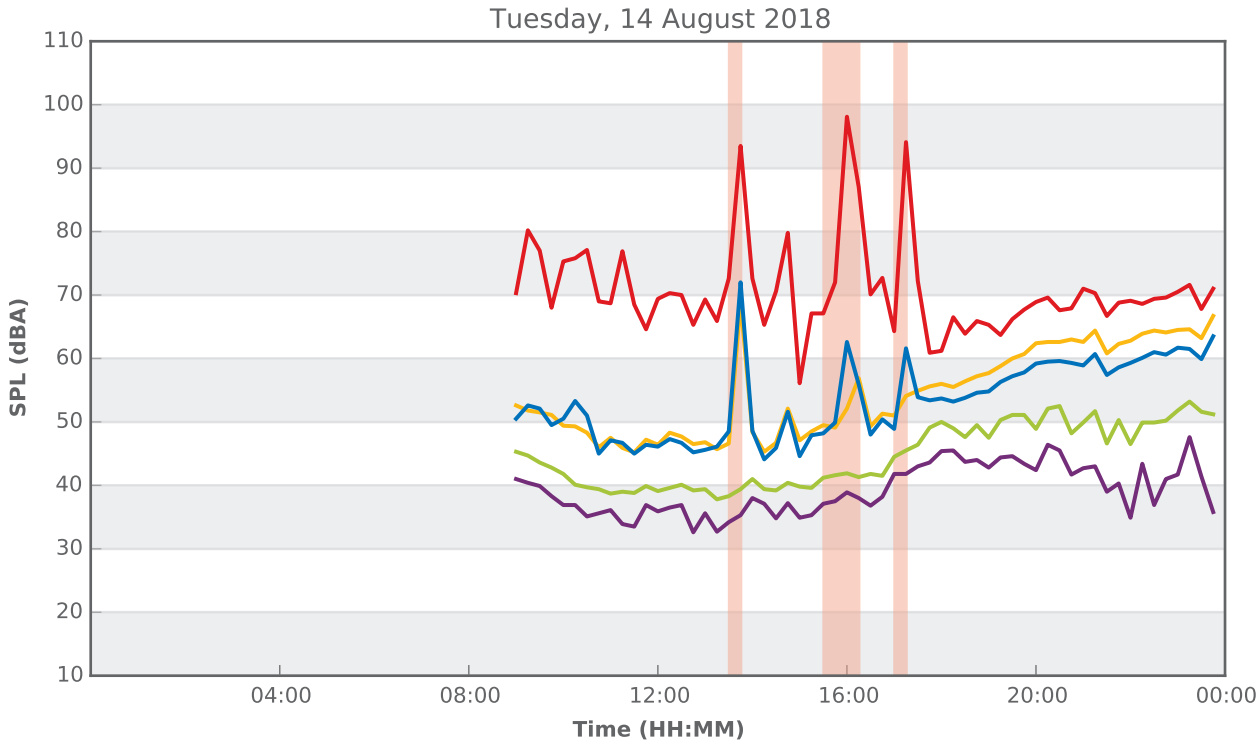
LAeq, 9 Hour

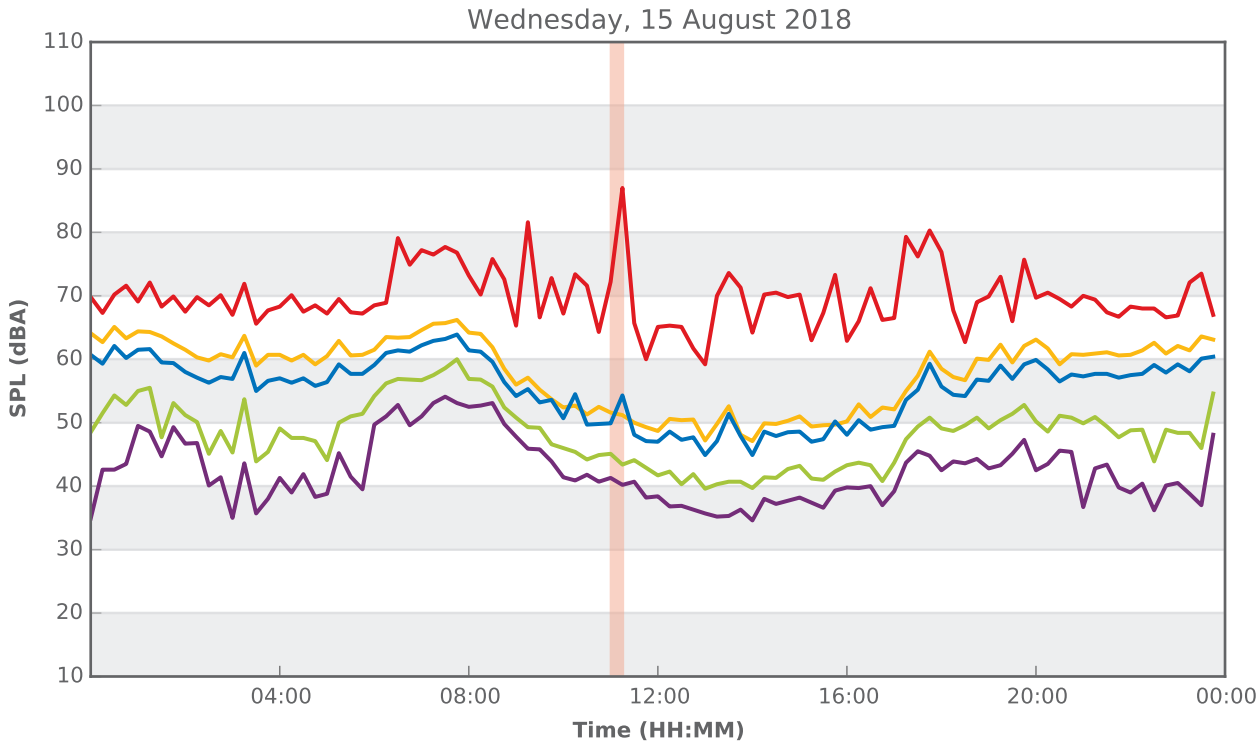
58.9



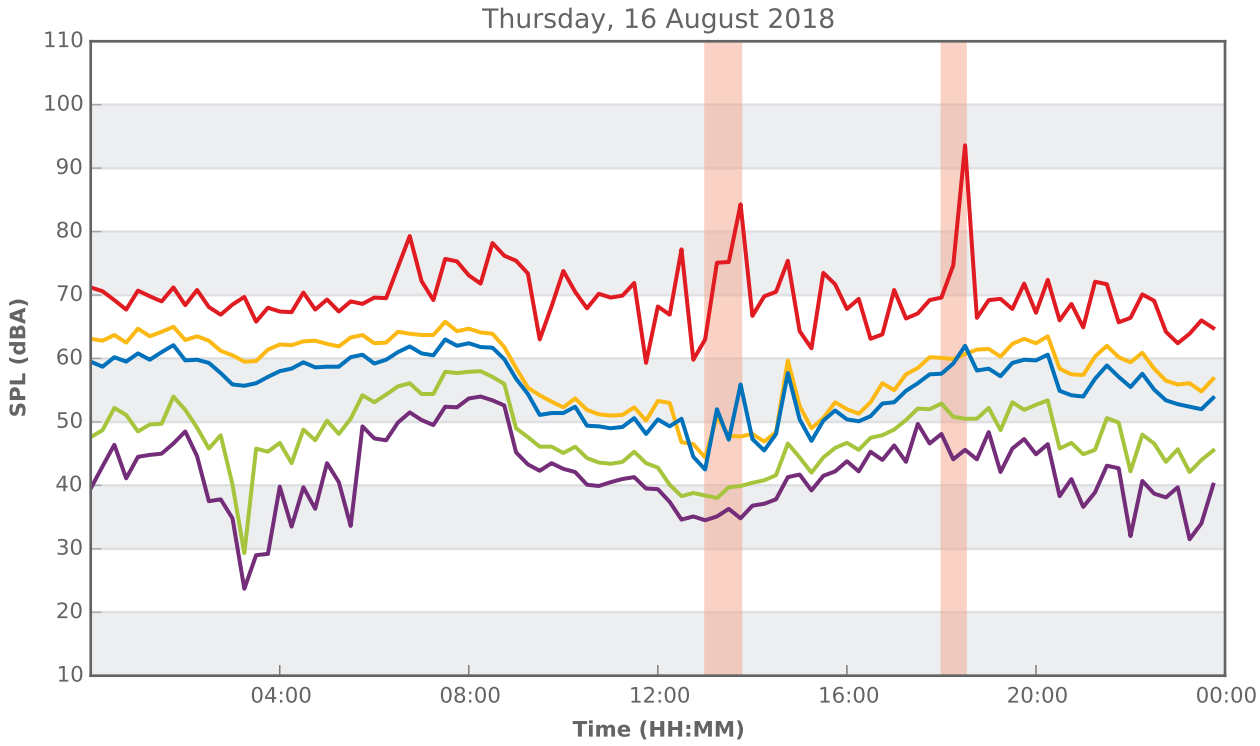


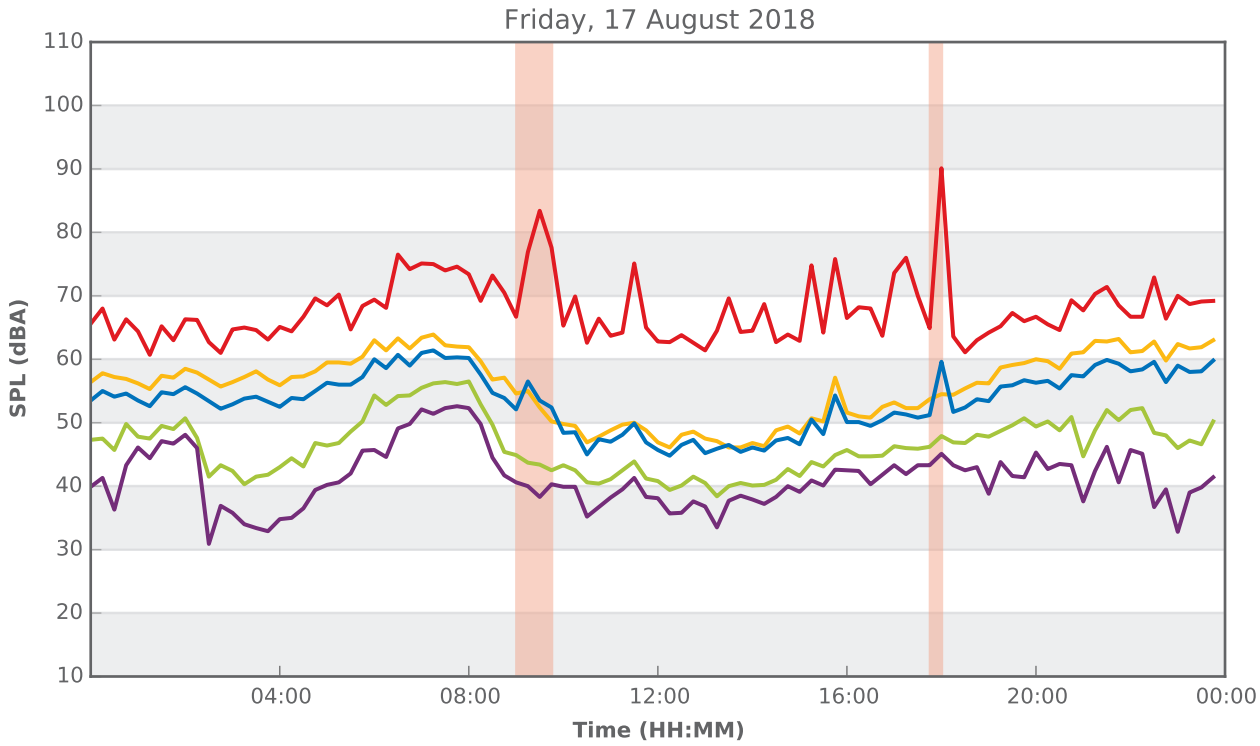
161 Carlyle Road, Kundabung



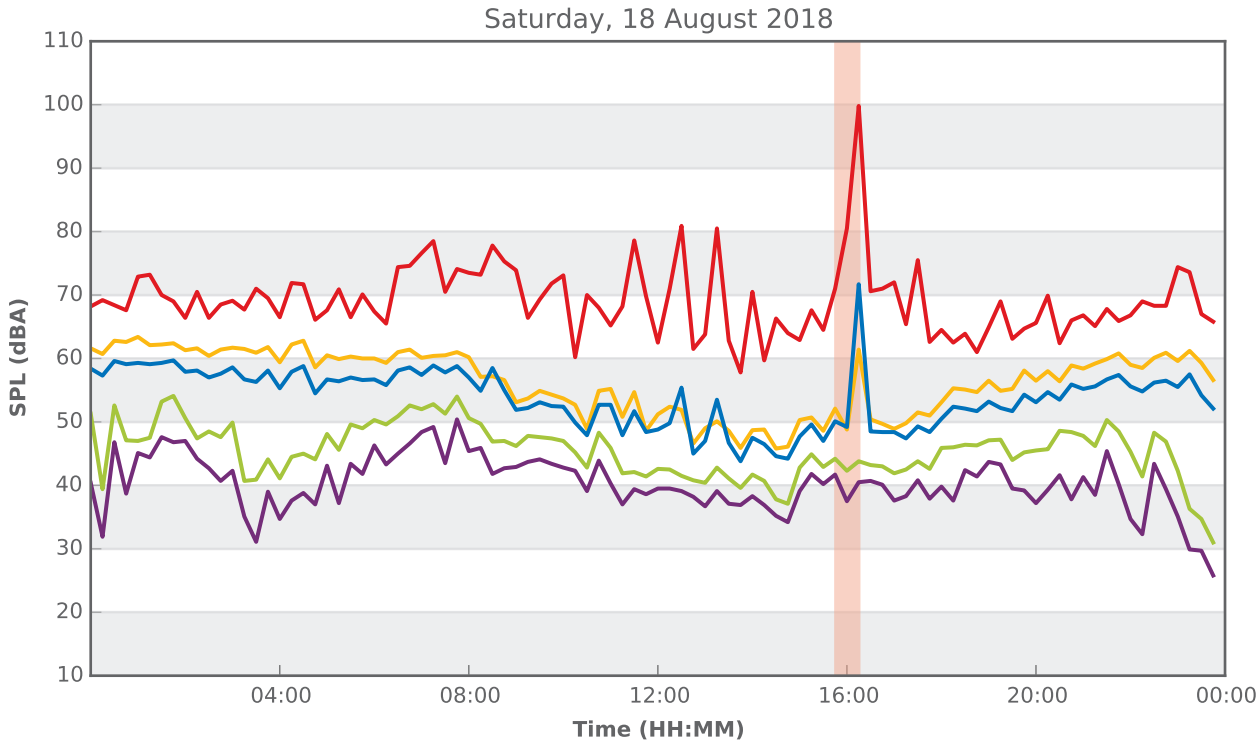


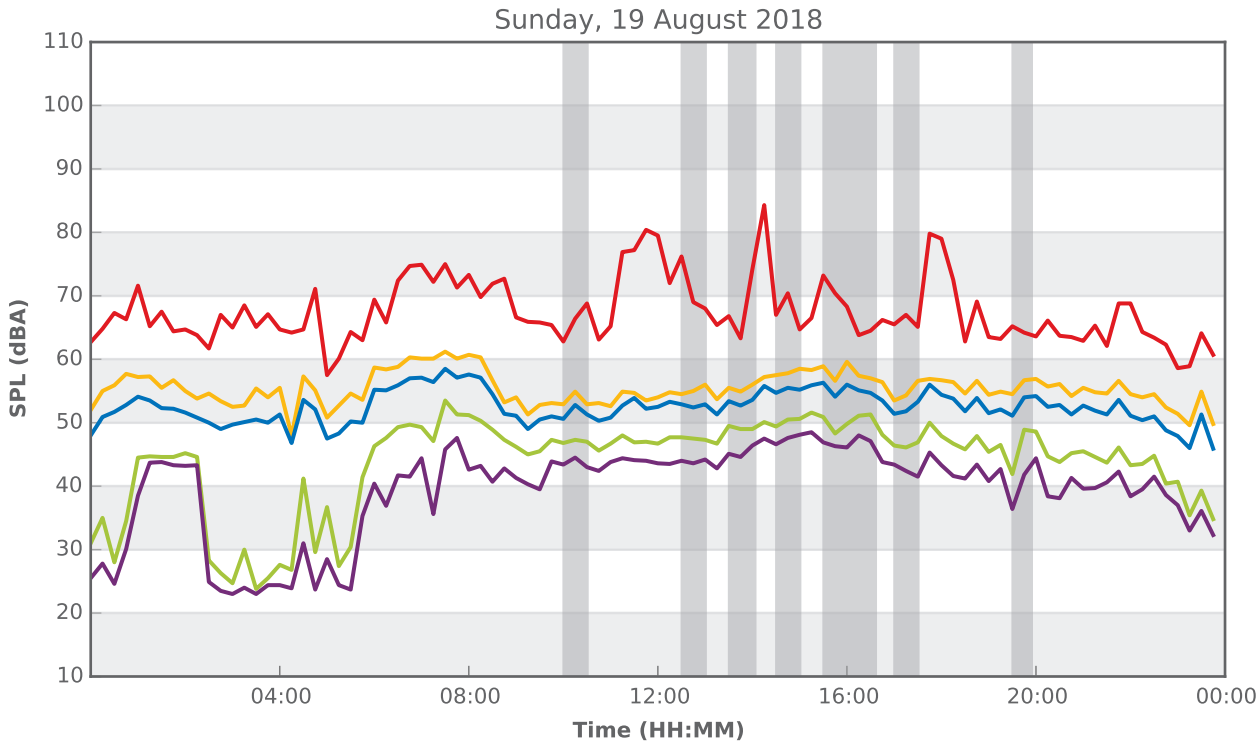
161 Carlyle Road, Kundabung



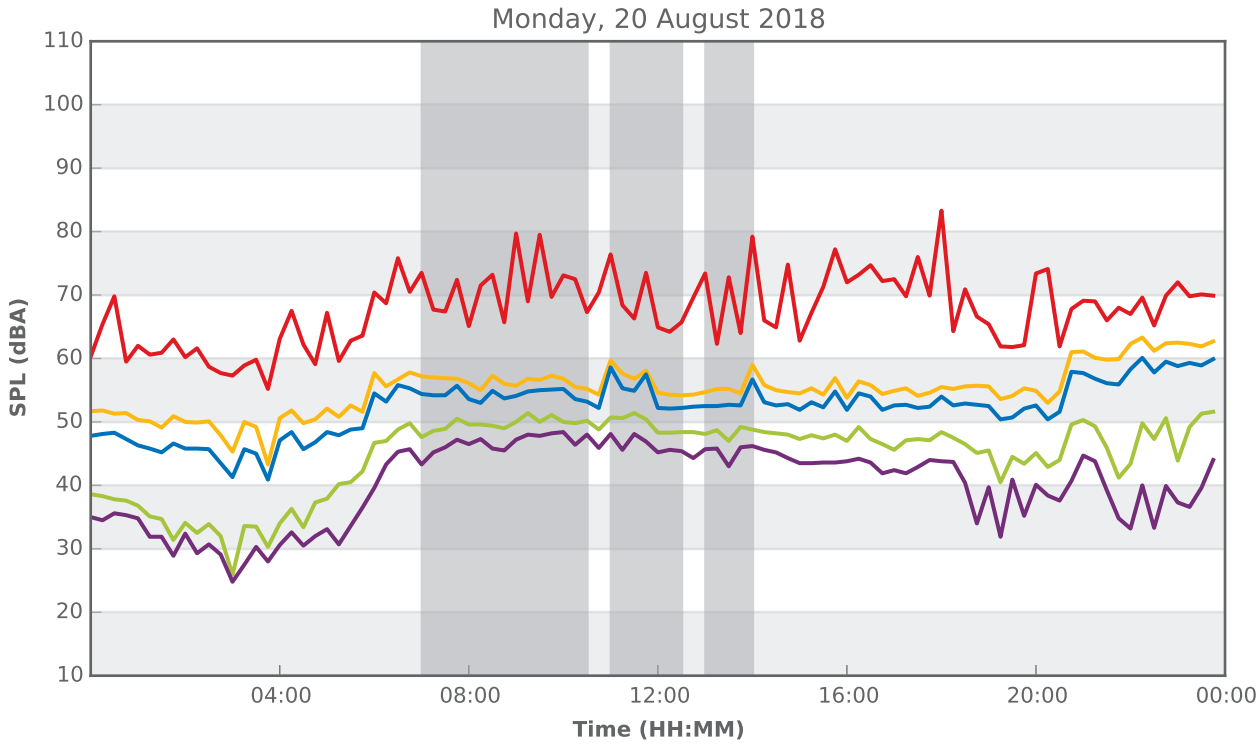


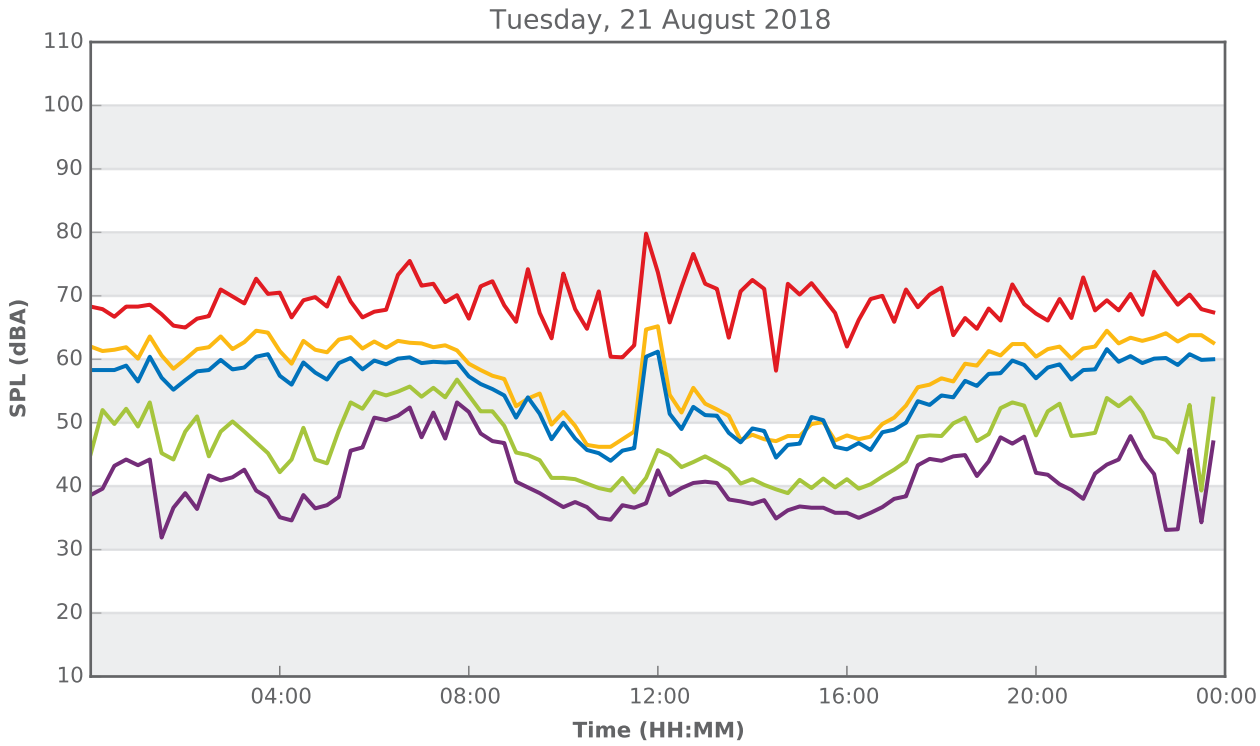
161 Carlyle Road, Kundabung



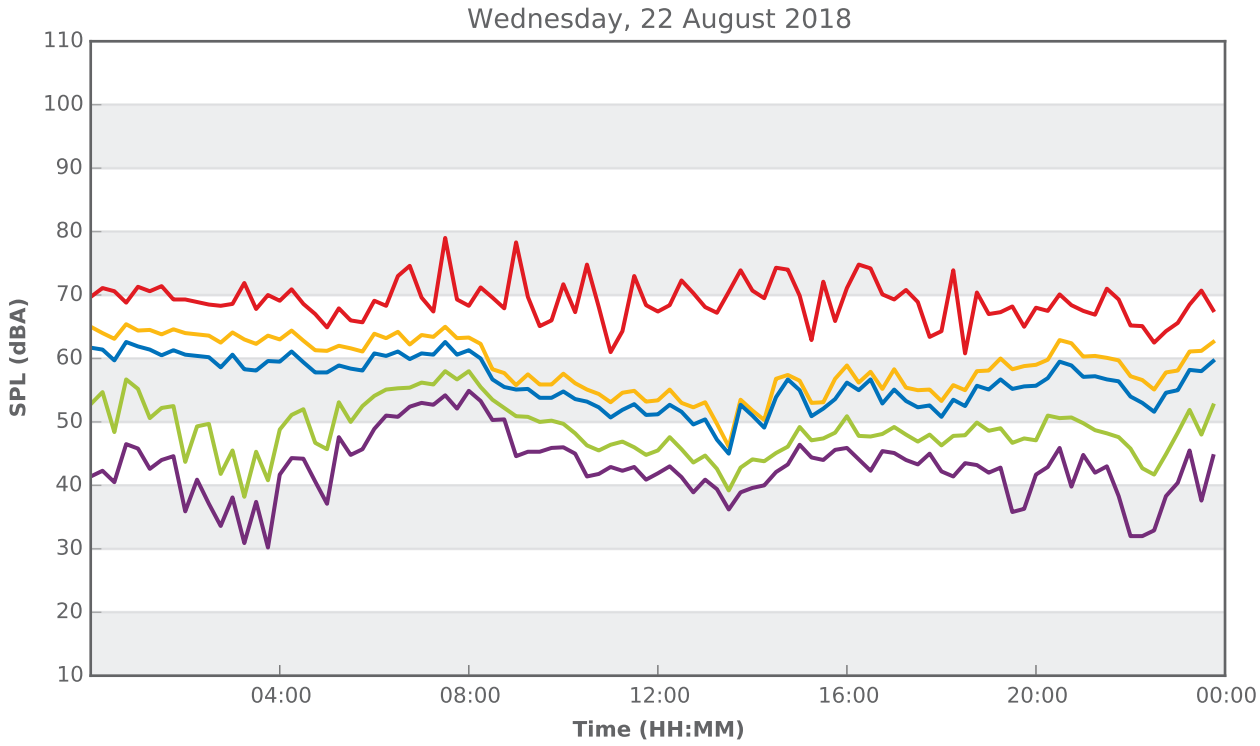


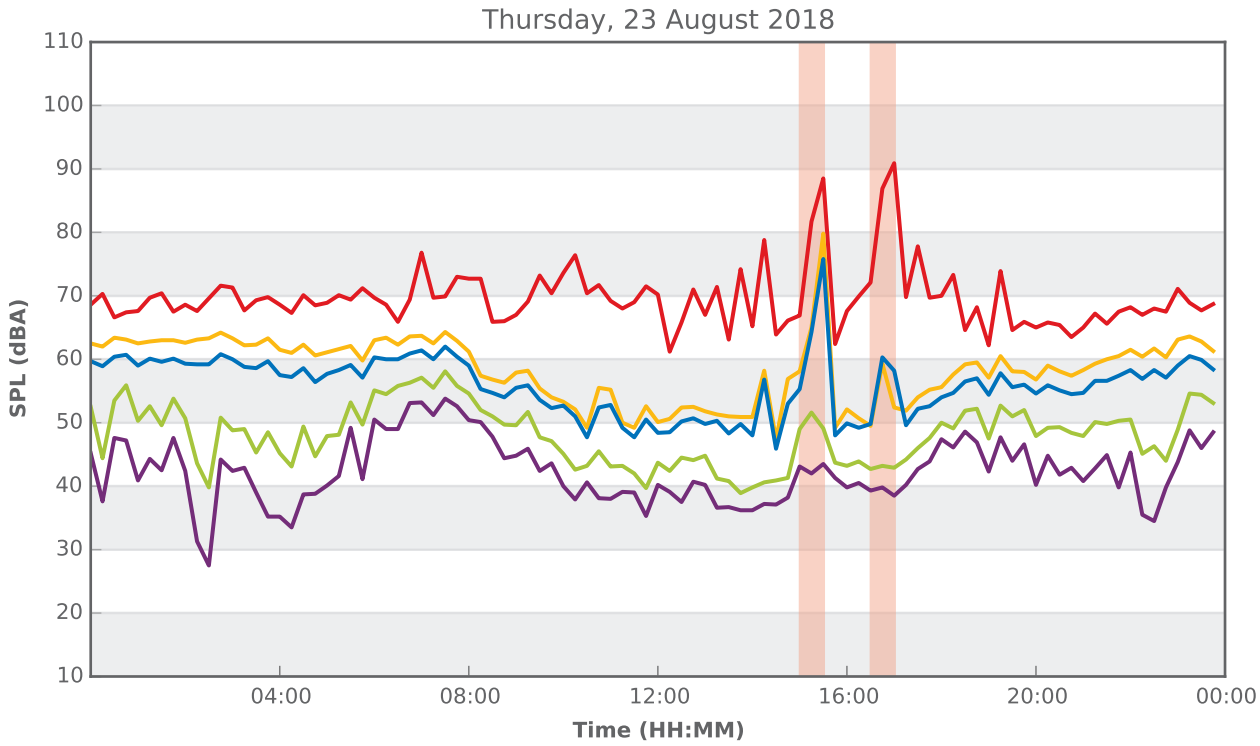
161 Carlyle Road, Kundabung



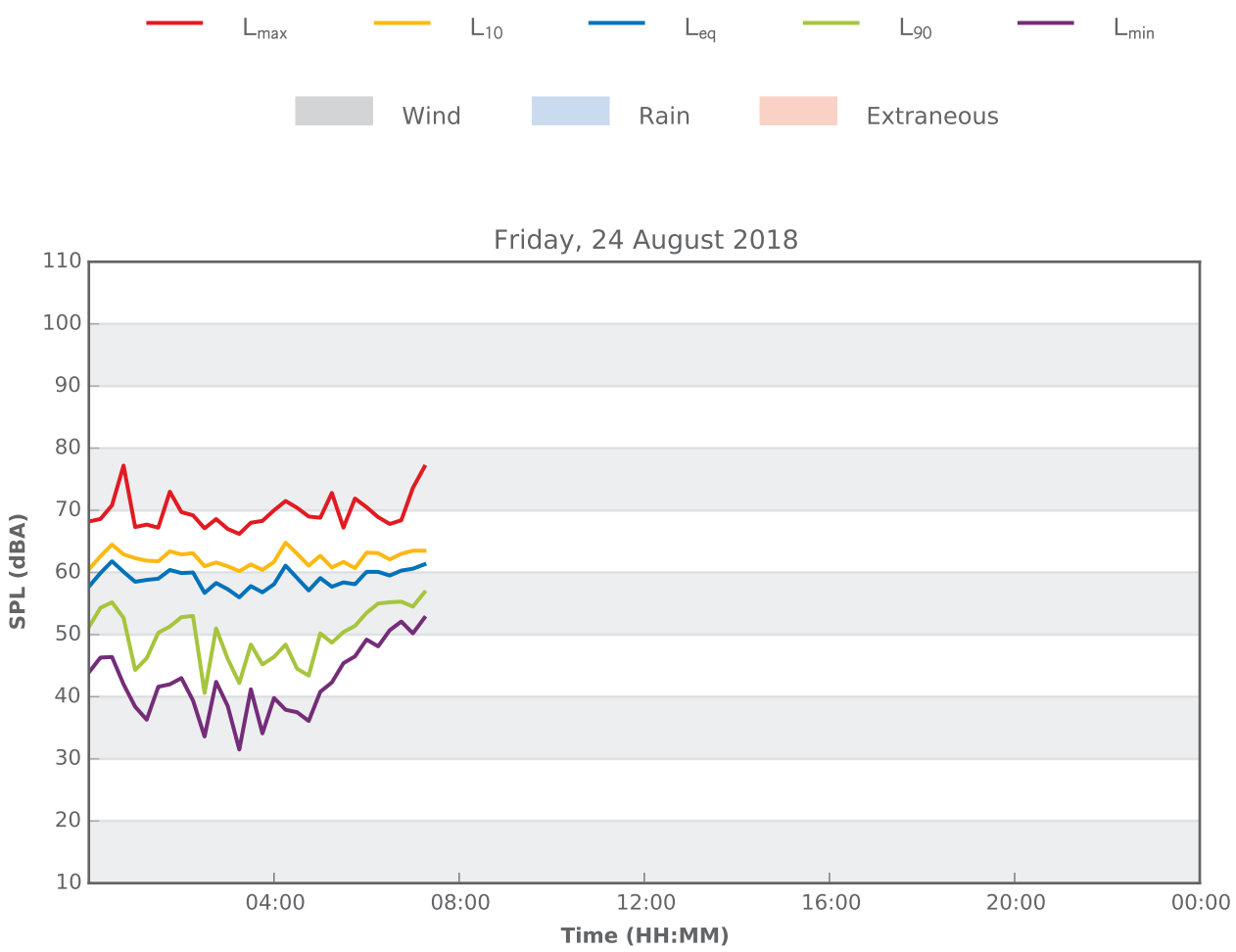


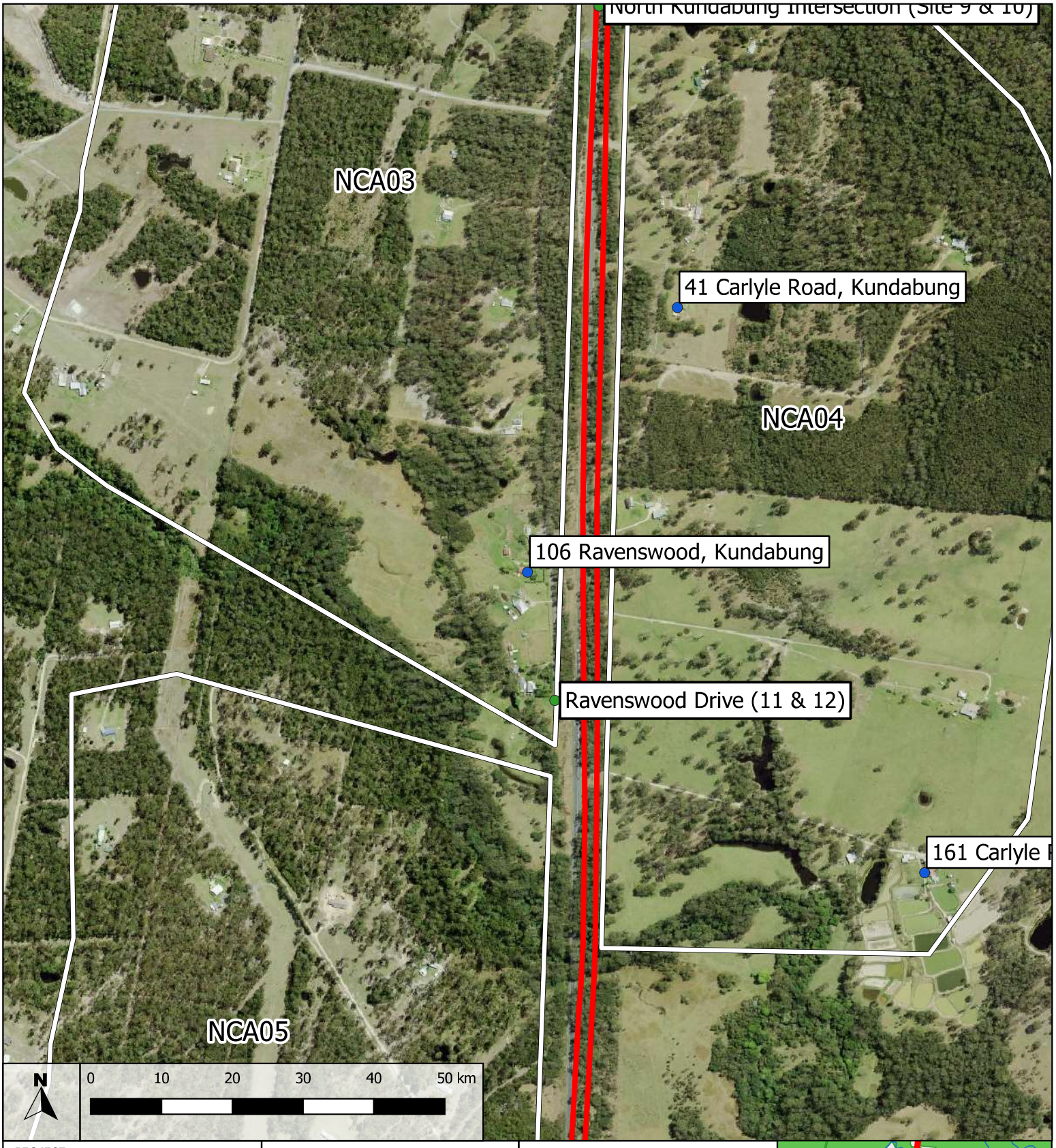
161 Carlyle Road, Kundabung





161 Carlyle Road, Kundabung





PROJECT:

Kundabung to Kempsey

TITLE: Noise Monitoring Locations

Post - Opening Compliance

PROJECT No.: 12063-ES

REVISION: A

PREPARED: PT

APPROVED: BJM

EXPORTED: 16/10/2018

SHEET SIZE: A4

Appendix D

Drawing 7 of 10

WILKINSON MURRAY

ADDRESS:

106 Ravenswood, Kundabung

START DATE:

13/08/2018

STOP DATE:

23/08/2018

Overall Noise - LAeq, Period

LAeq, 15 Hour

53.1

LAeq, 9 Hour

49.9

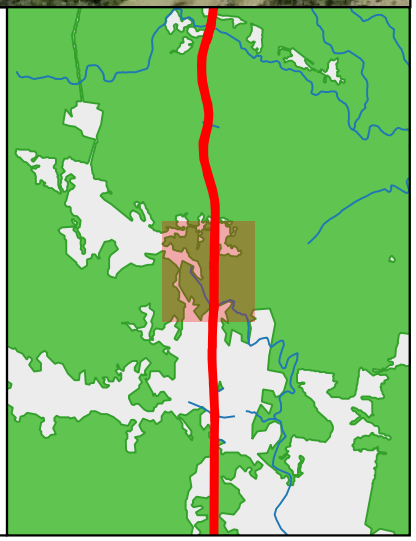
Estimated Traffic Noise - LAeq, Period

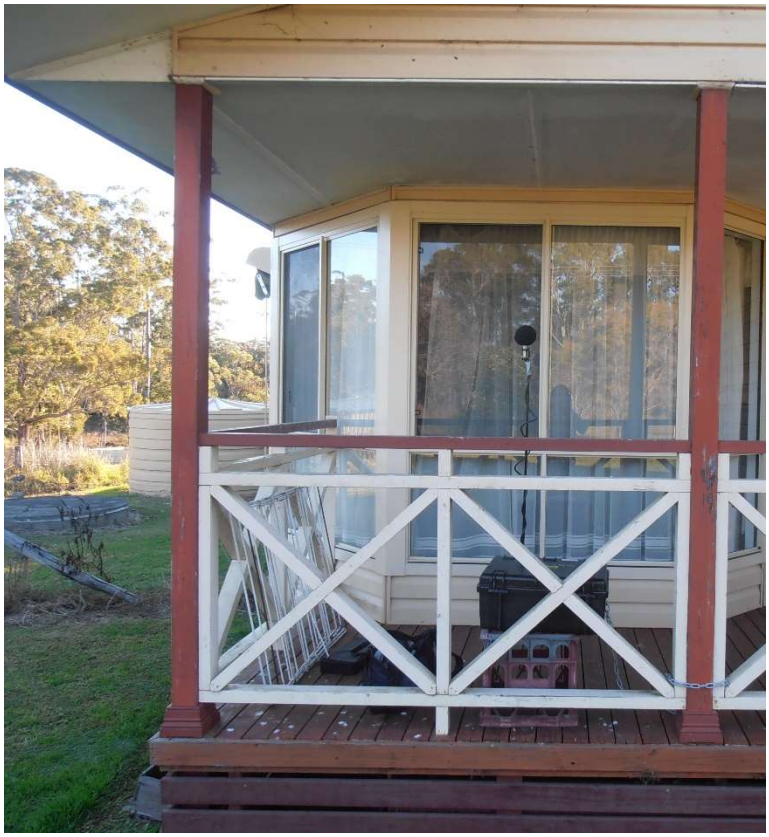
LAeq, 15 Hour

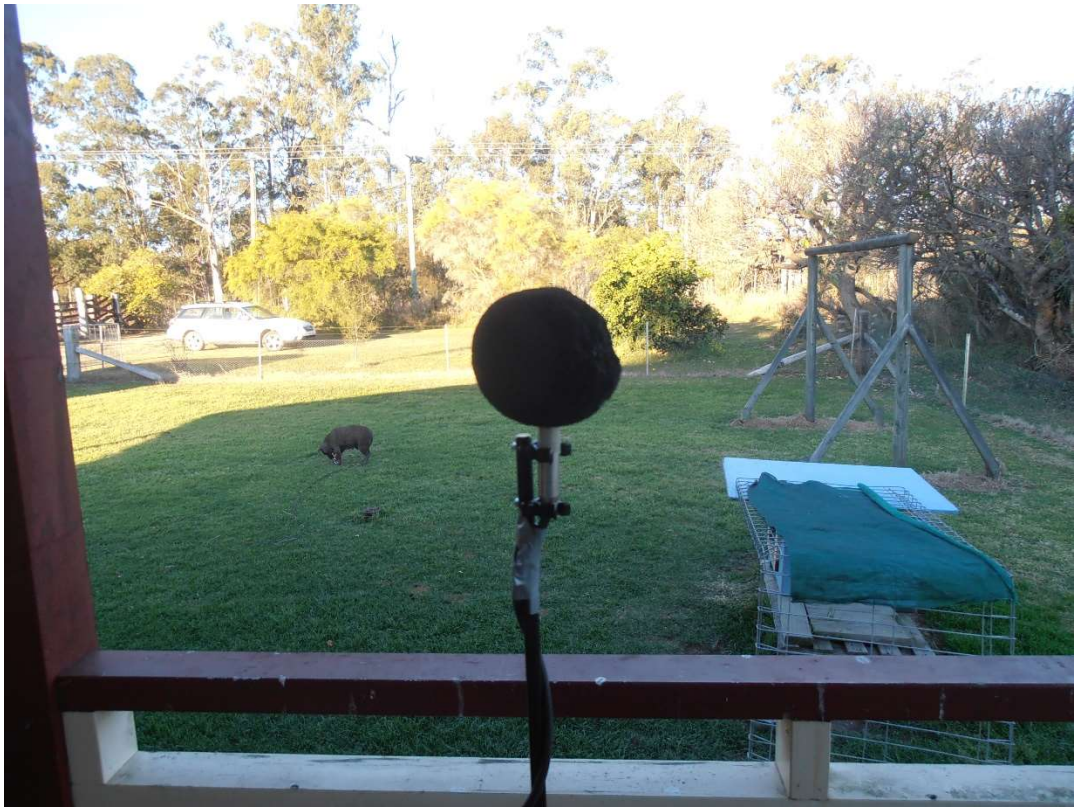
52.8

LAeq, 9 Hour

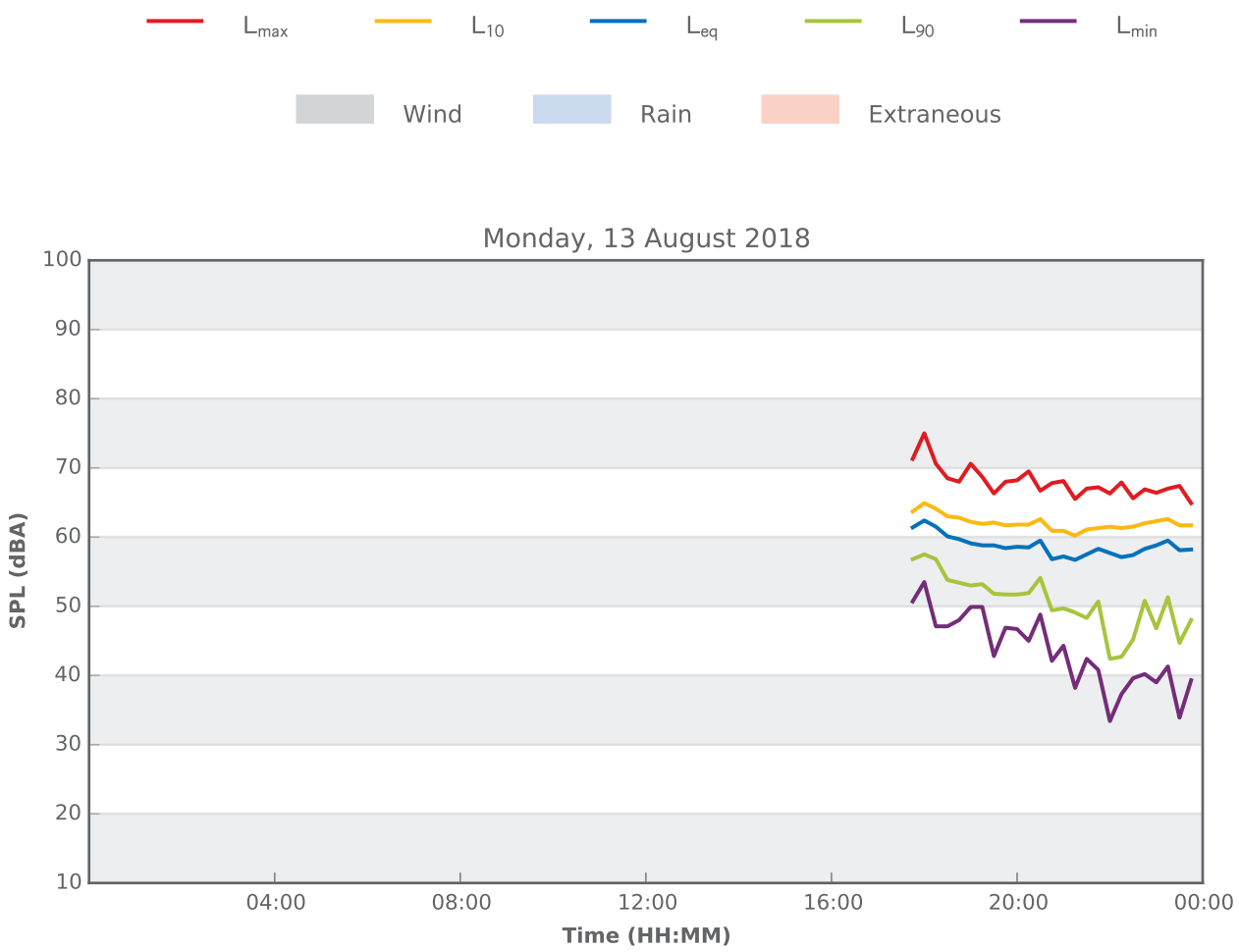
51.9

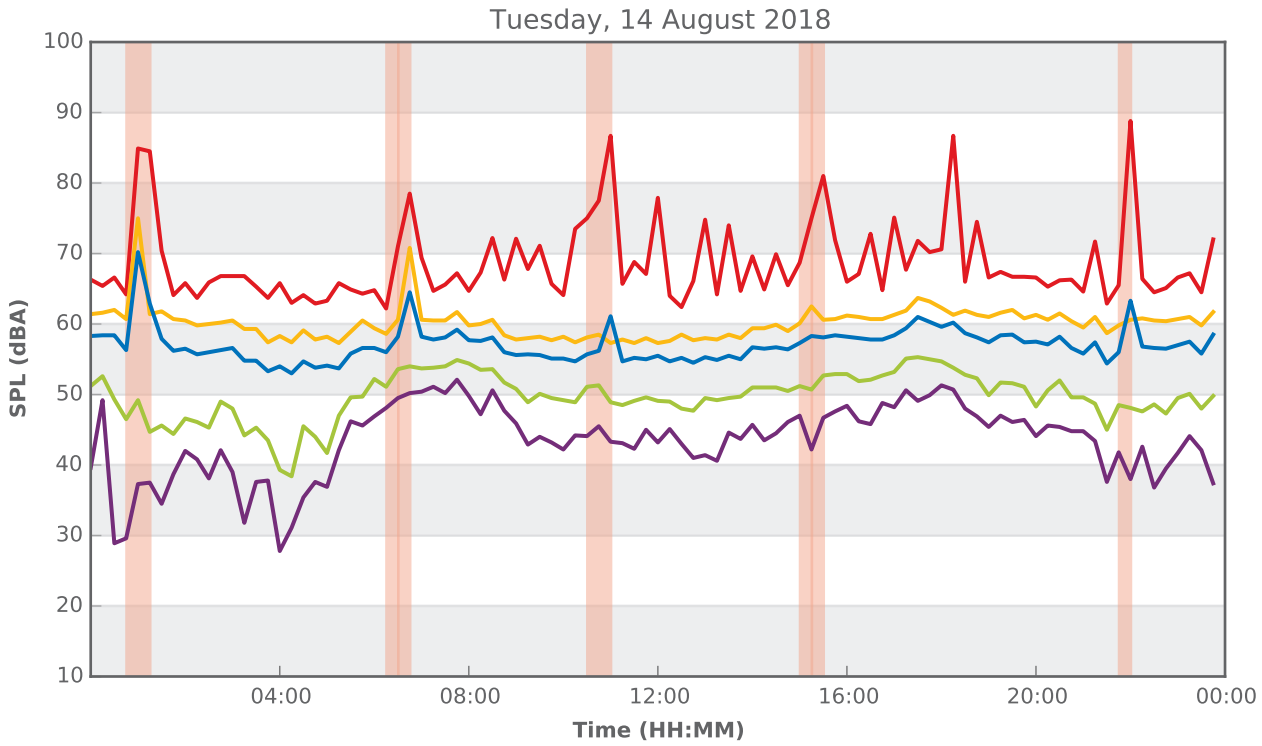




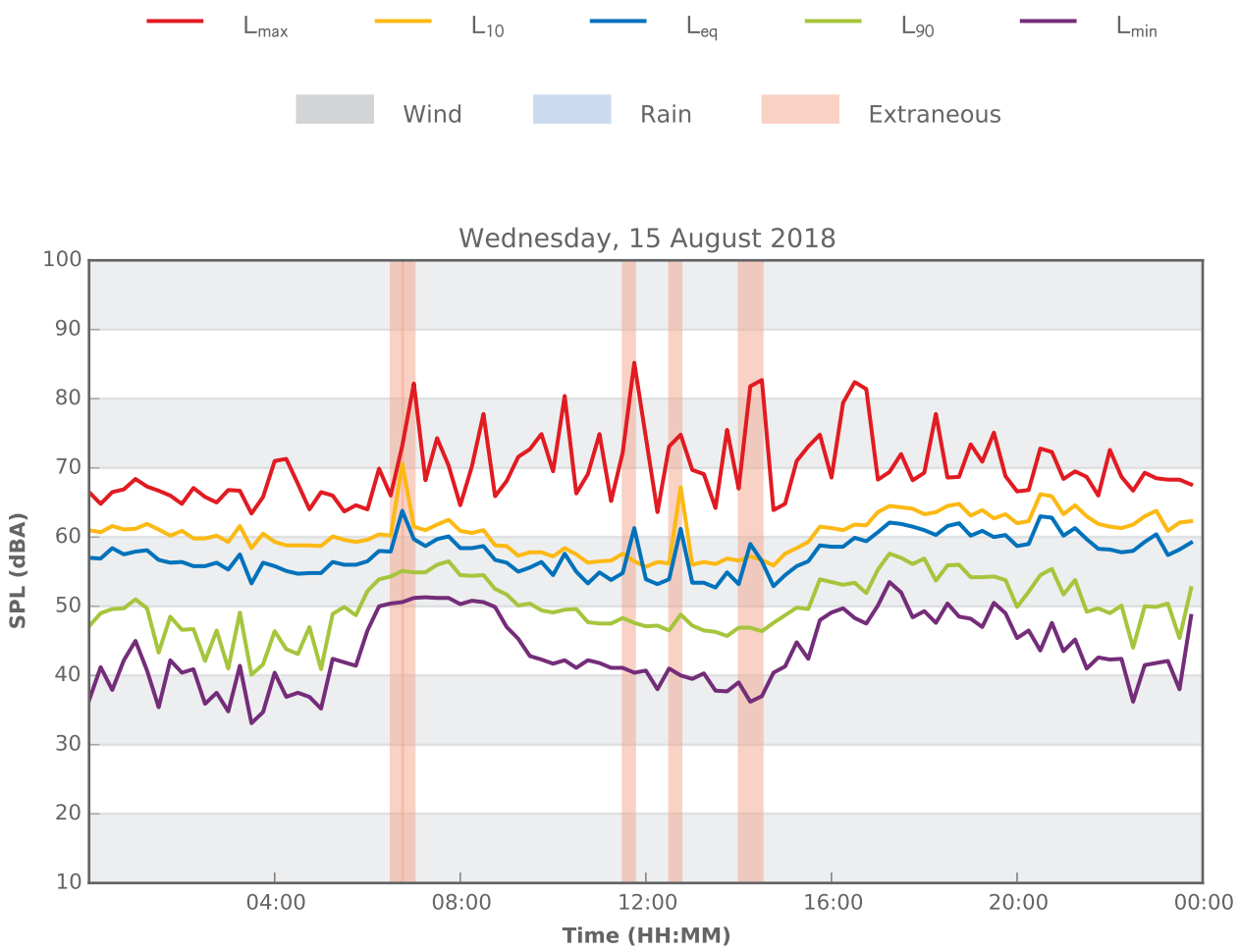


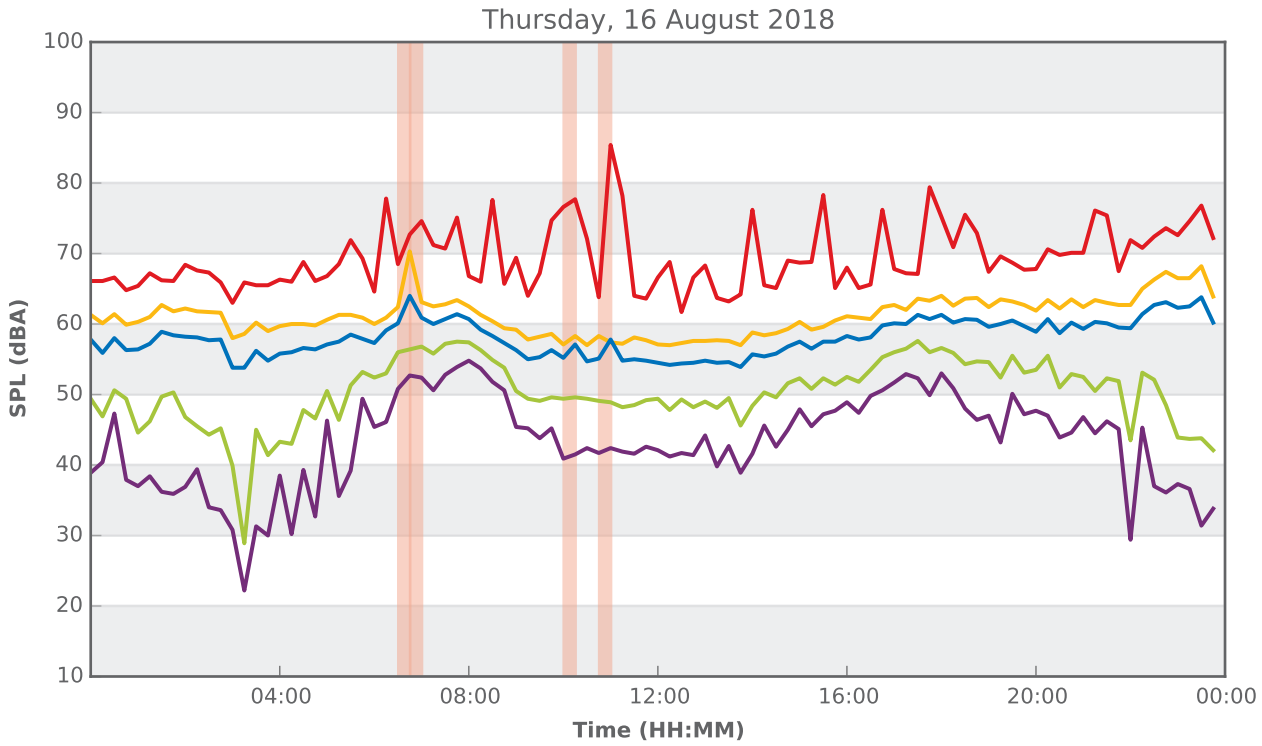
106 Ravenswood Road, Kundabung



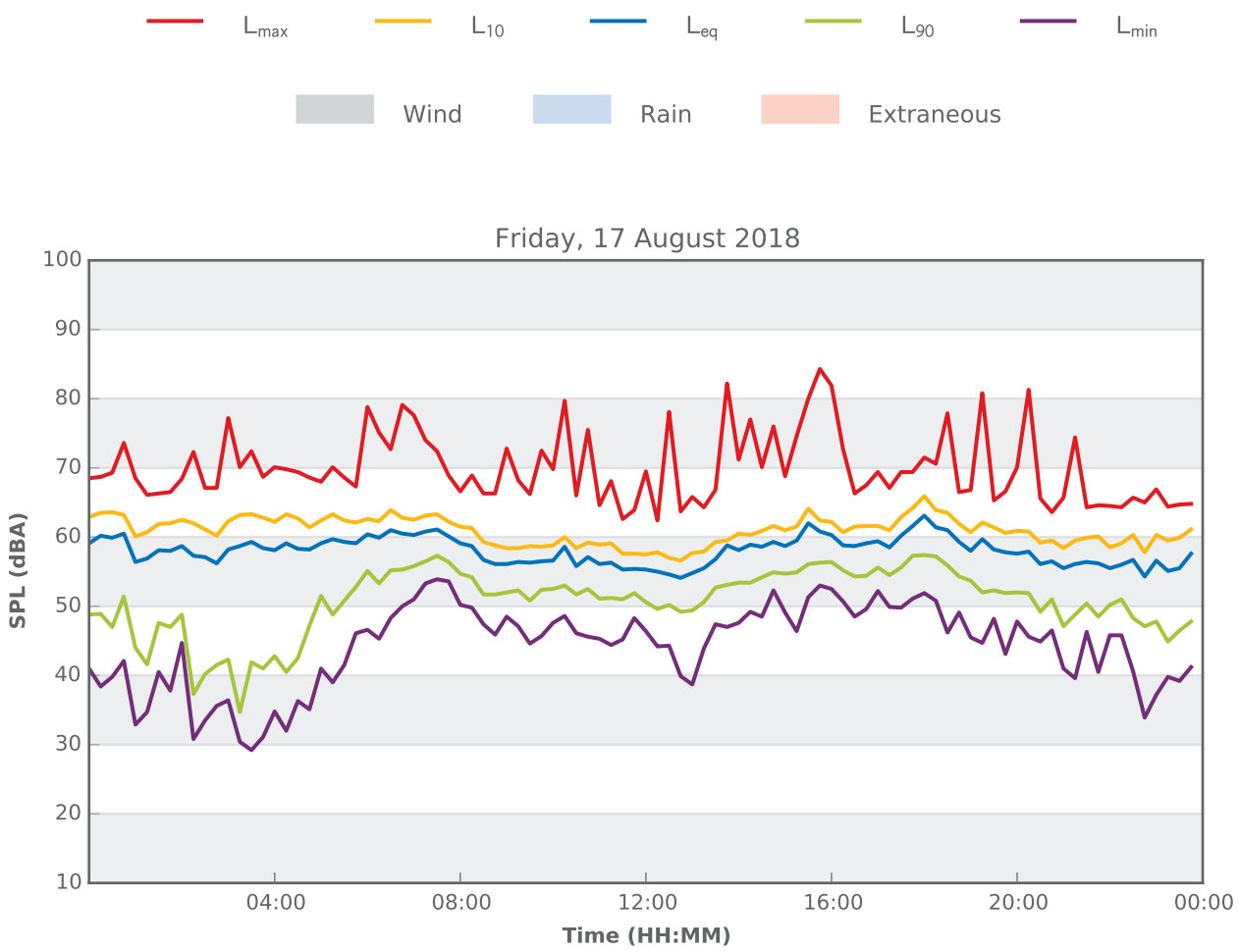


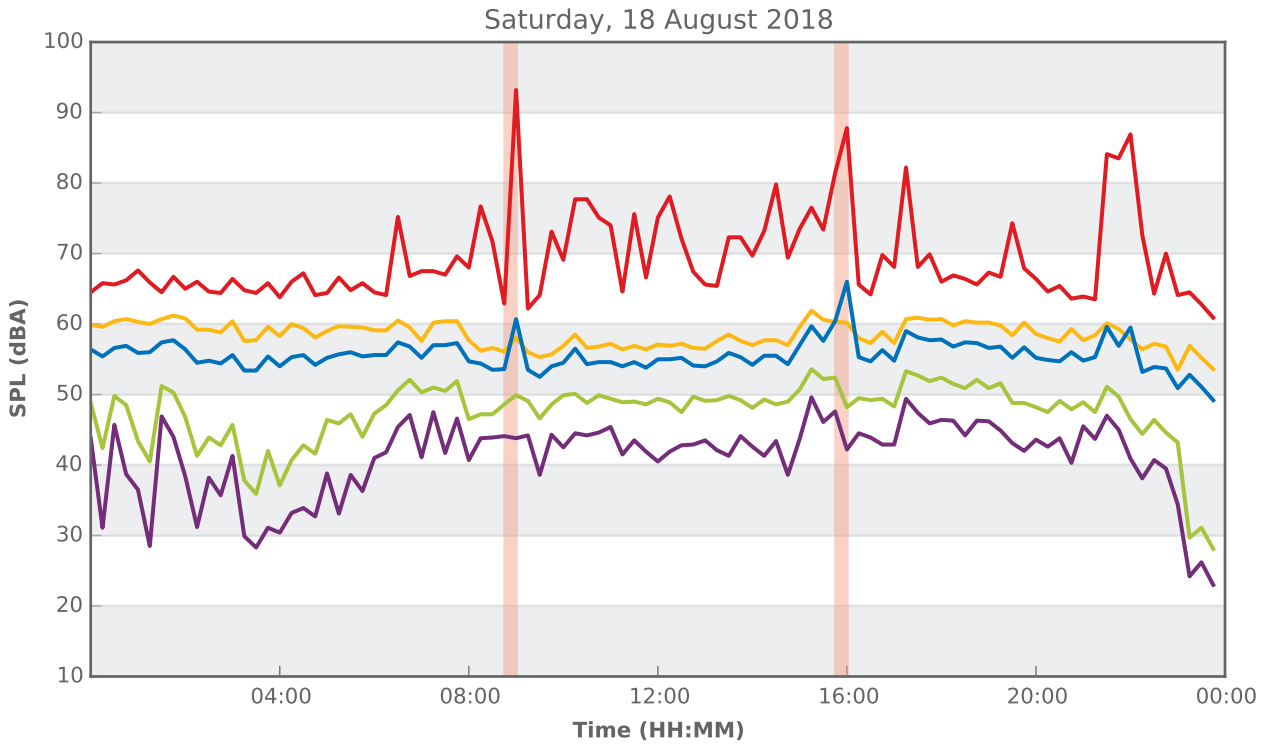
106 Ravenswood Road, Kundabung



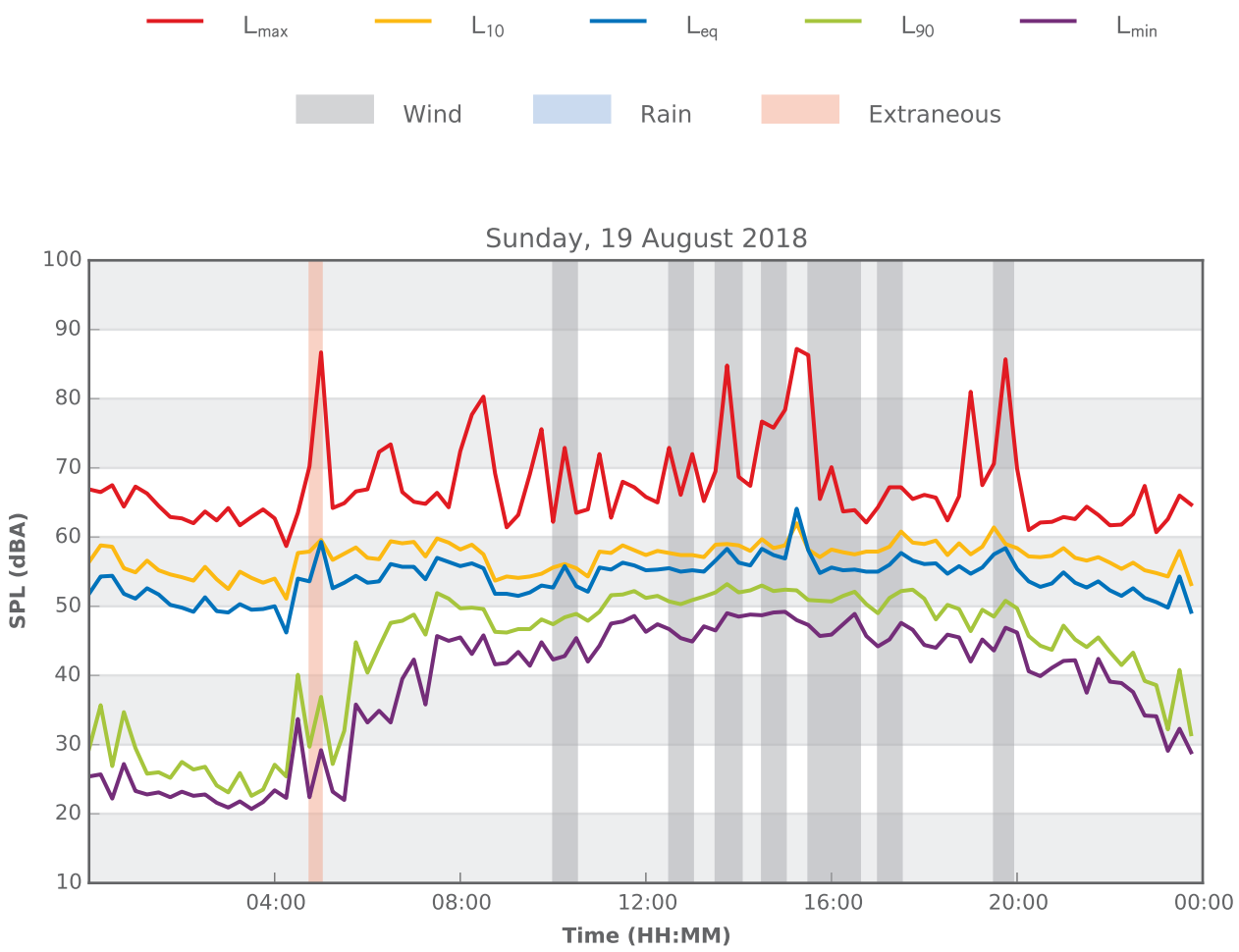


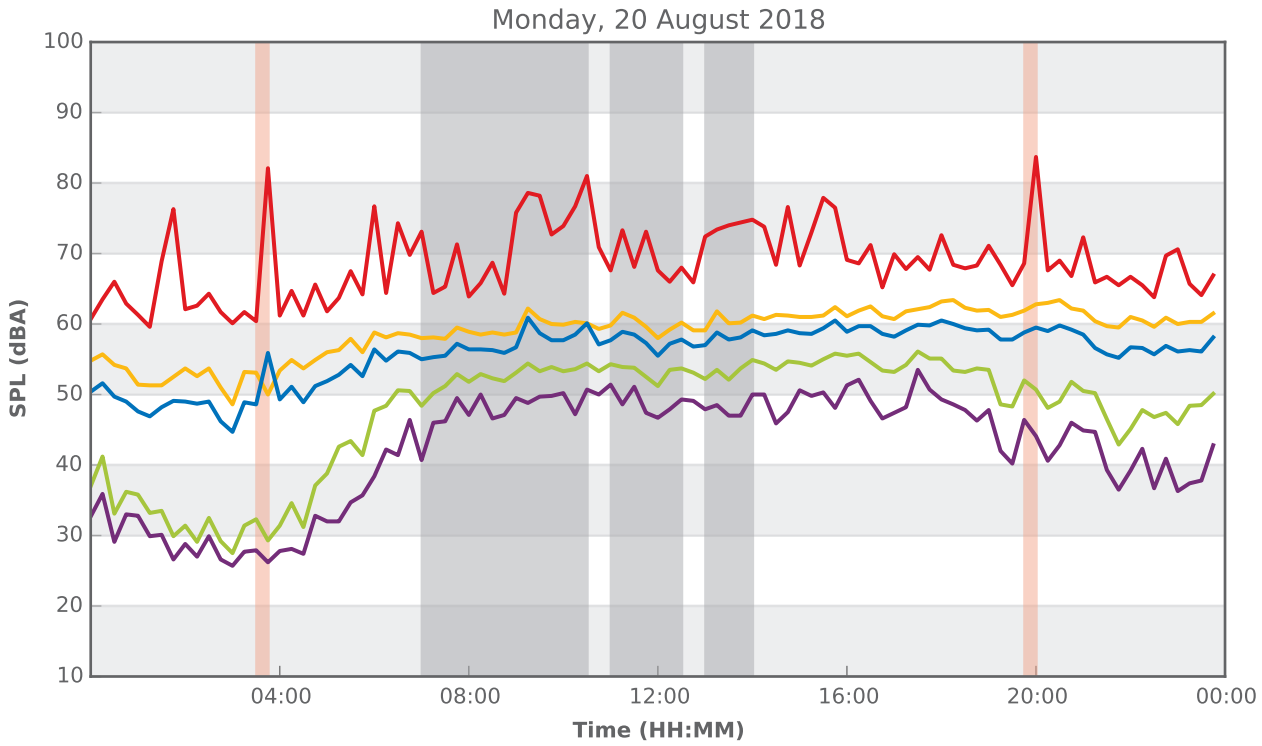
106 Ravenswood Road, Kundabung



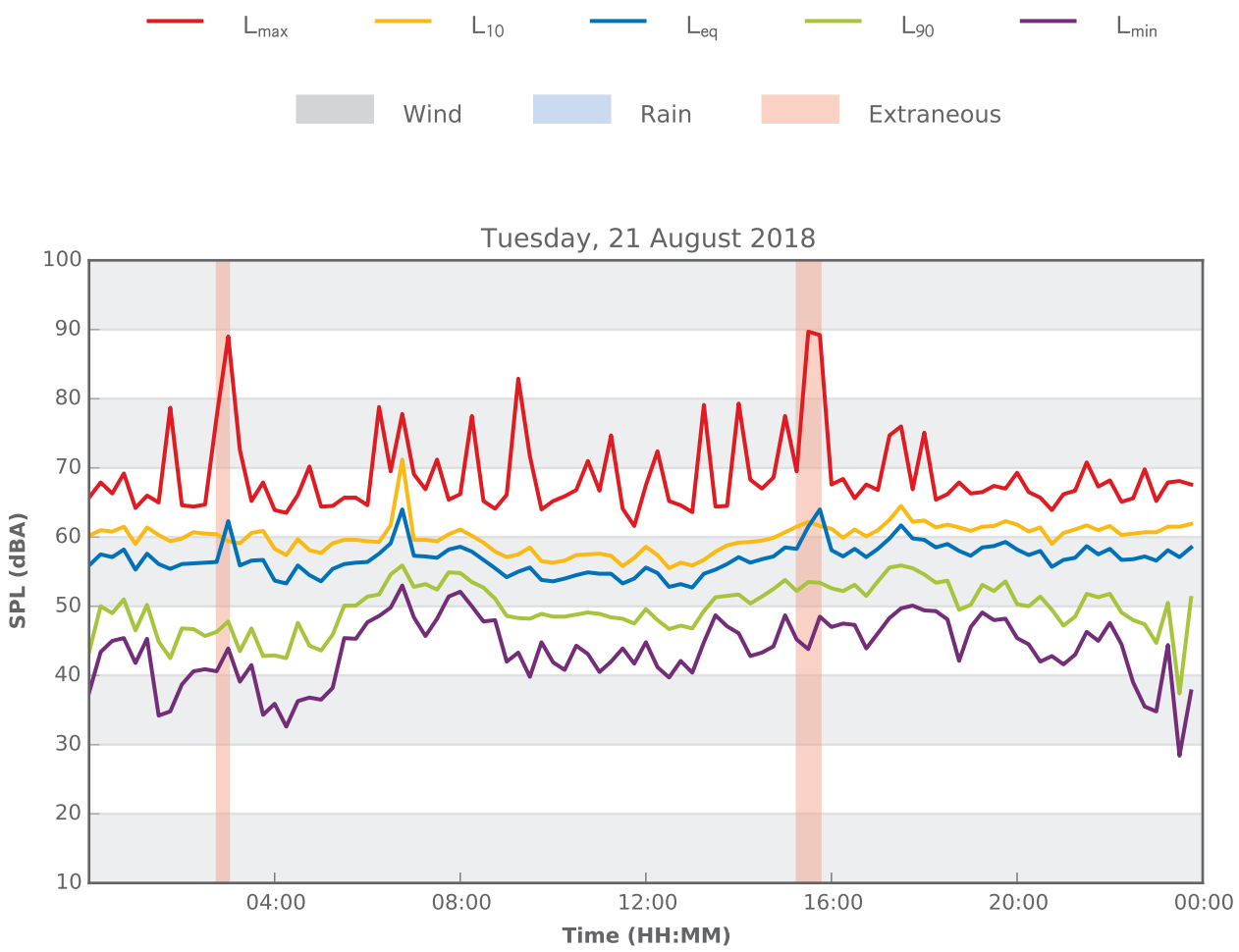


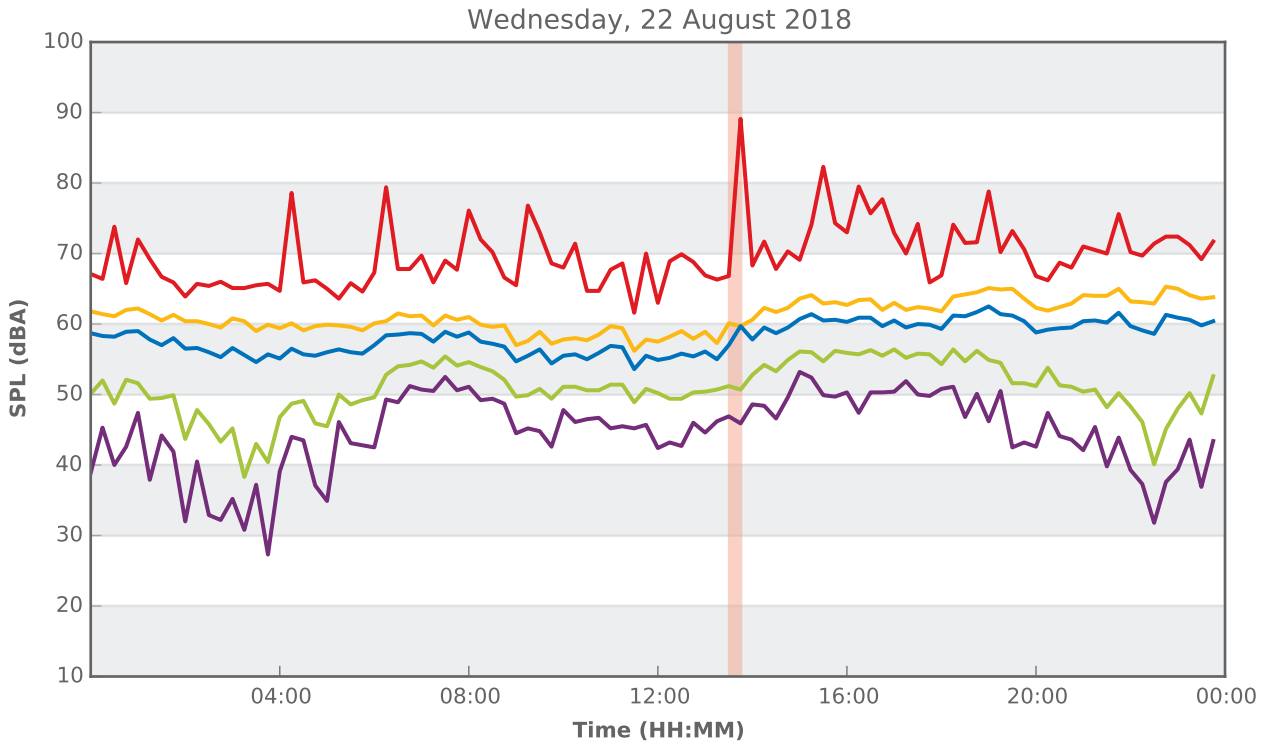
106 Ravenswood Road, Kundabung



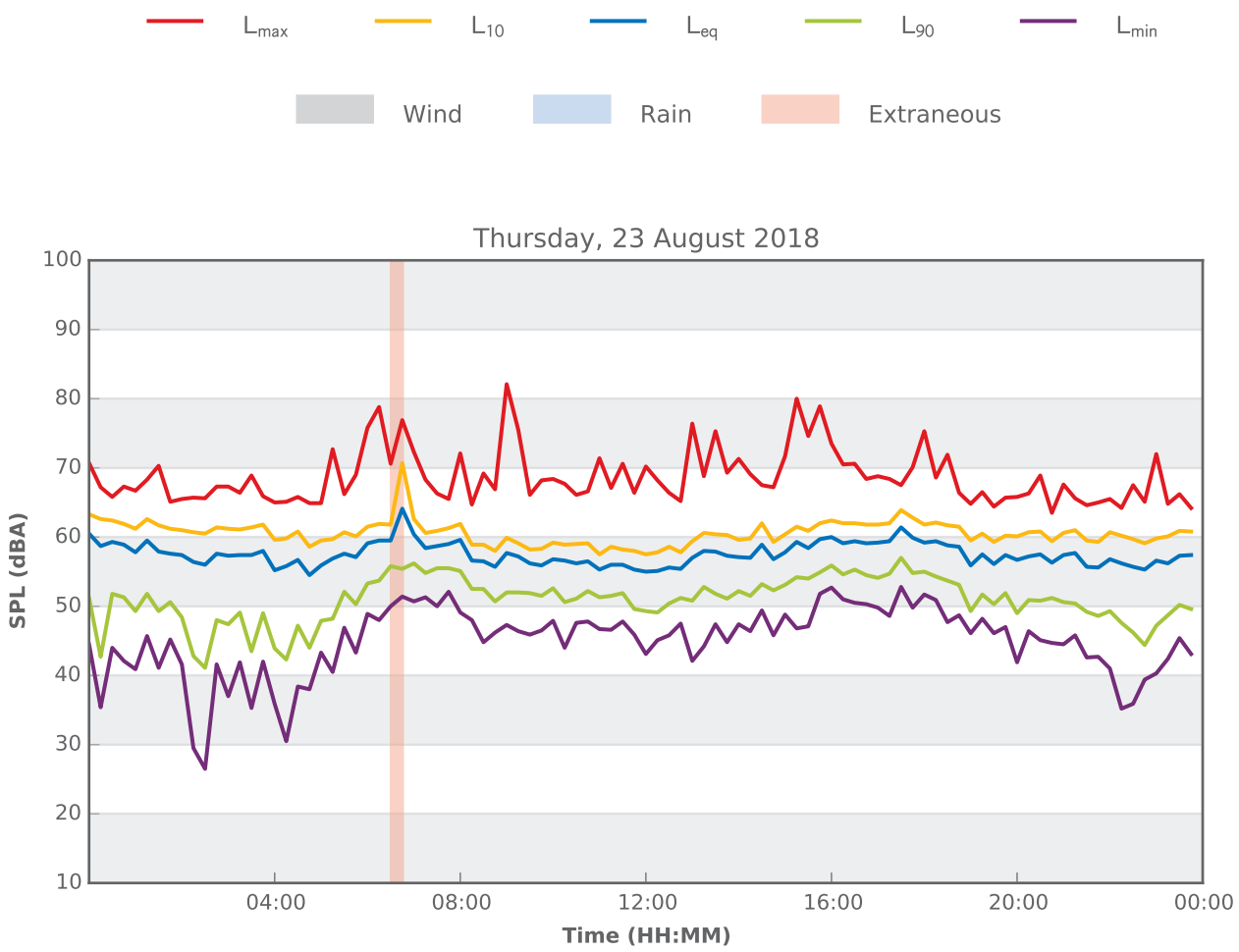


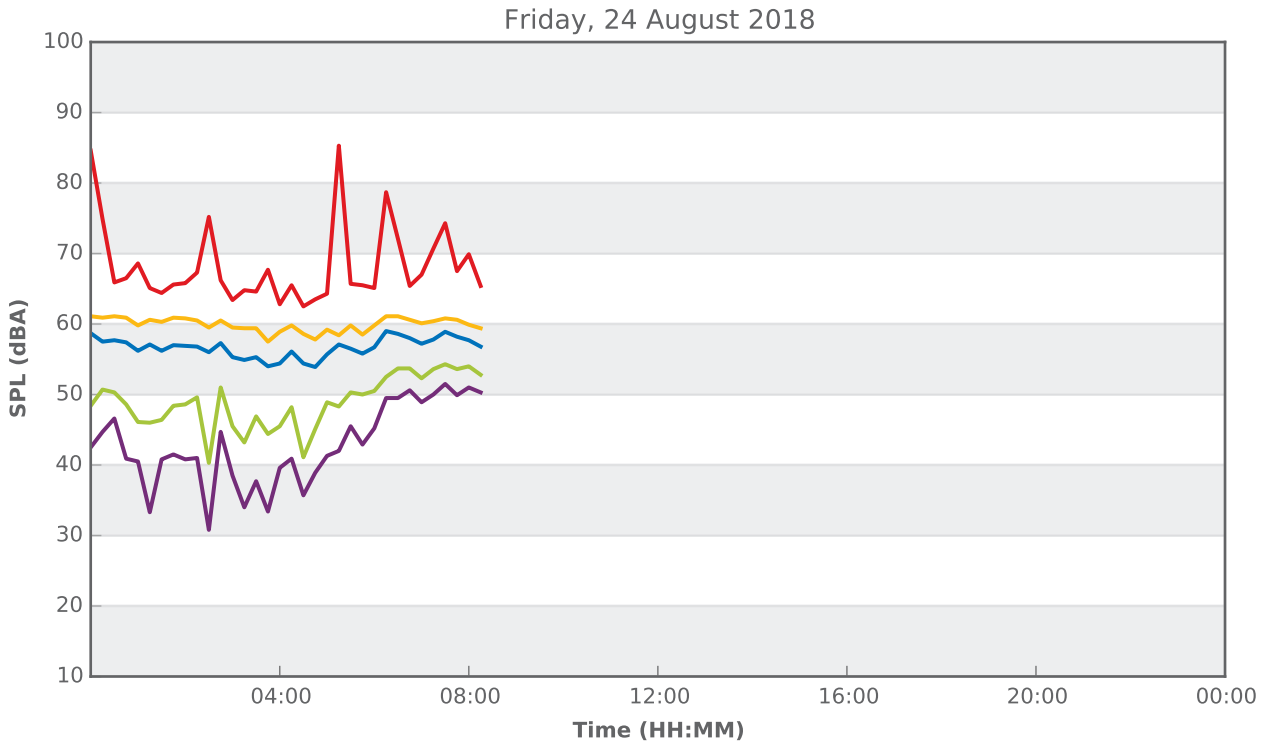
106 Ravenswood Road, Kundabung

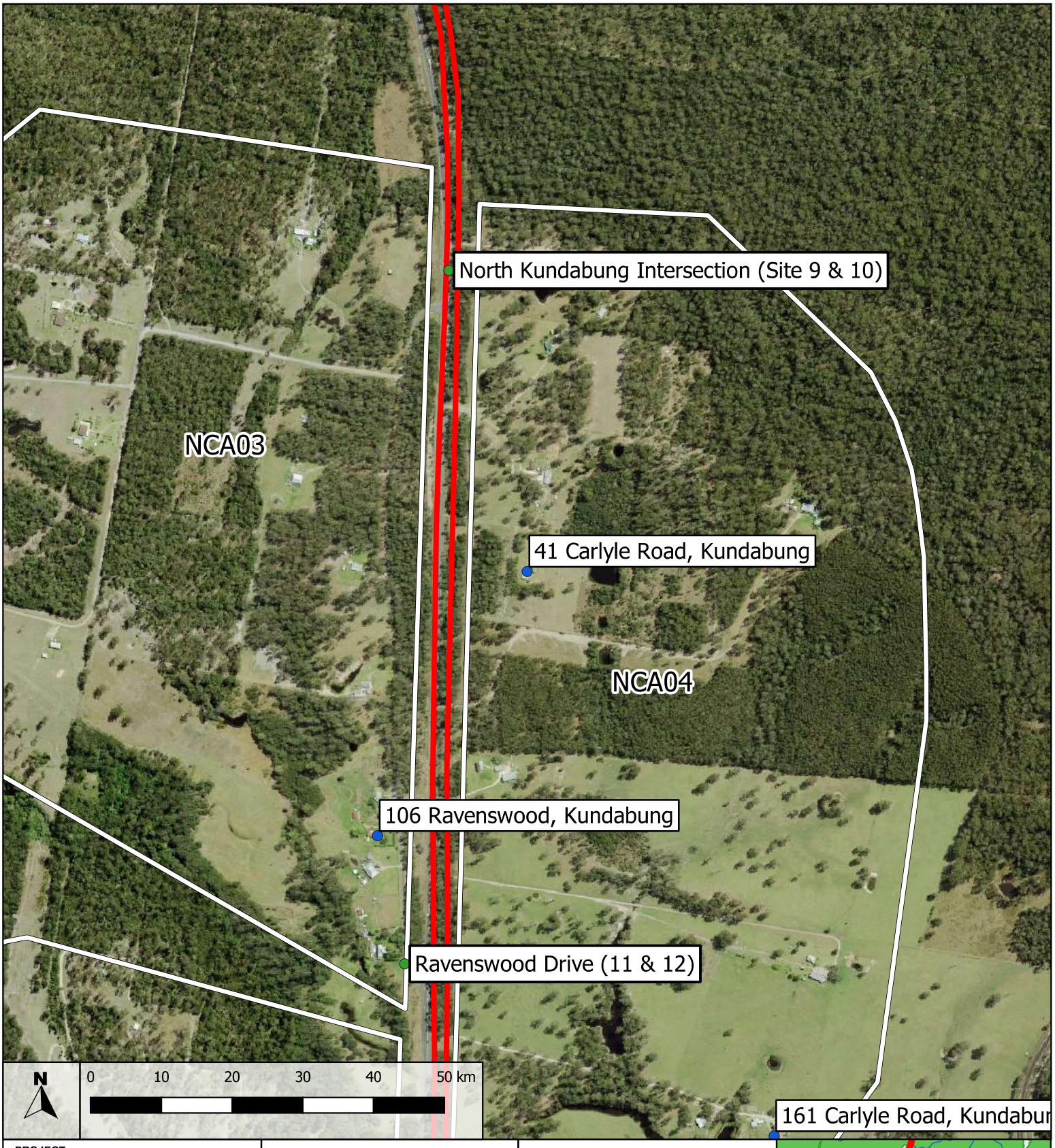




106 Ravenswood Road, Kundabung







PROJECT:

Kundabung to Kempsey

TITLE:

Noise Monitoring Locations

Post - Opening Compliance

PROJECT No.: 12063-ES

REVISION: A

PREPARED: PT

APPROVED: BJM

EXPORTED: 16/10/2018

SHEET SIZE: A4

Appendix D

Drawing 8 of 10

WILKINSON MURRAY

ADDRESS:

41 Carlyle Road, Kundabung

START DATE:

14/08/2018

STOP DATE:

23/08/2018

Overall Noise - LAeq, Period

LAeq, 15 Hour

60.3

LAeq, 9 Hour

60.6

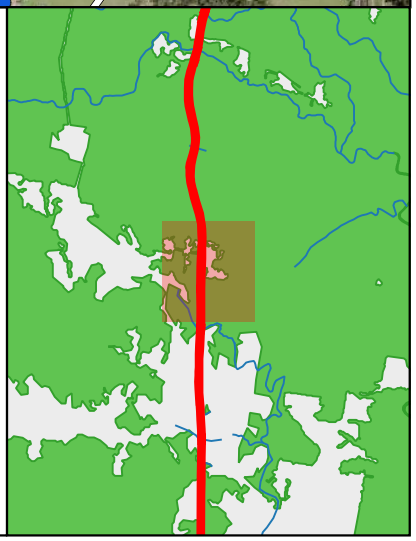
Estimated Traffic Noise - LAeq, Period

LAeq, 15 Hour

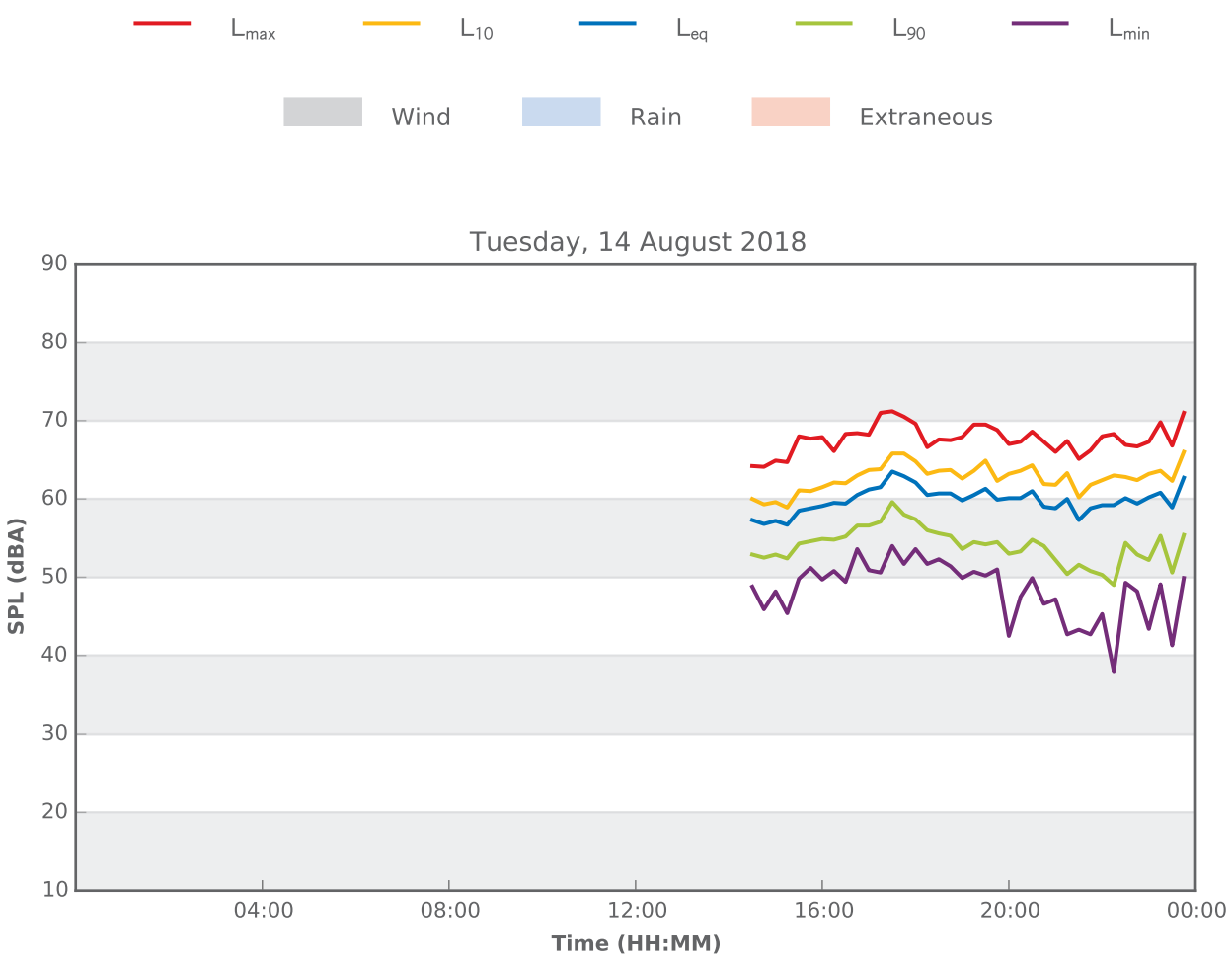
60.3

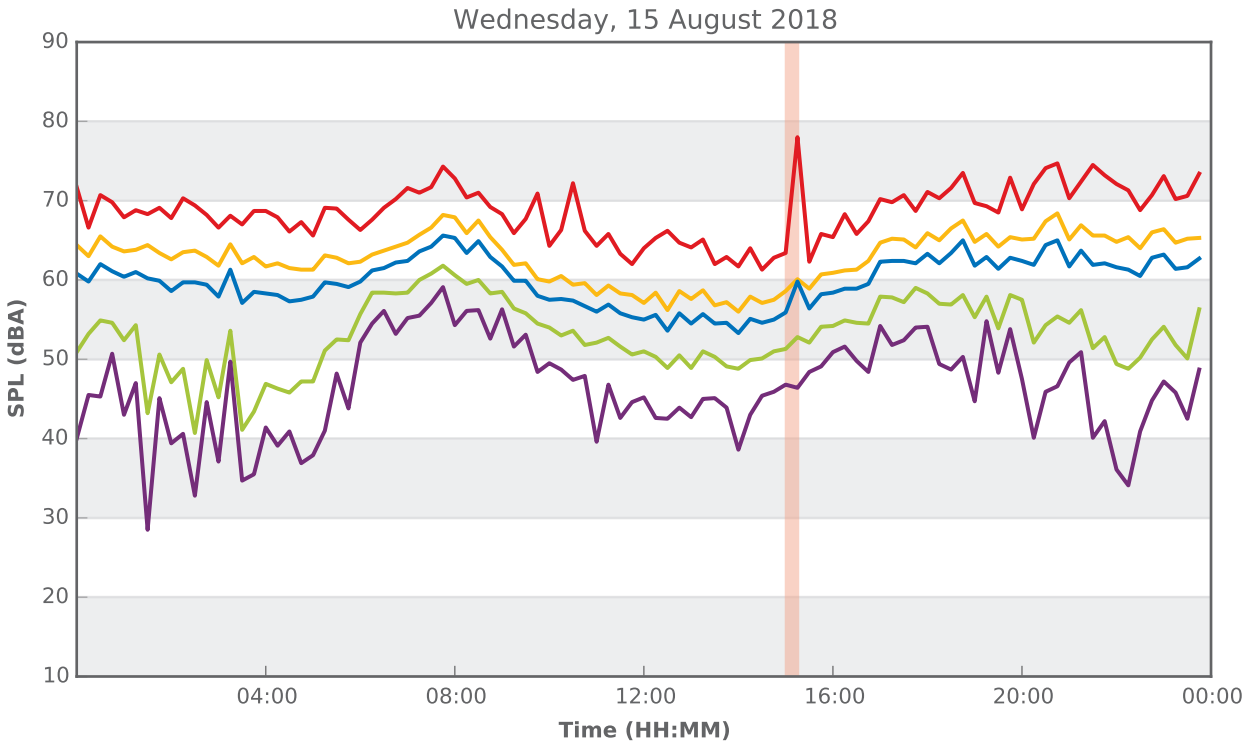
LAeq, 9 Hour

60.6

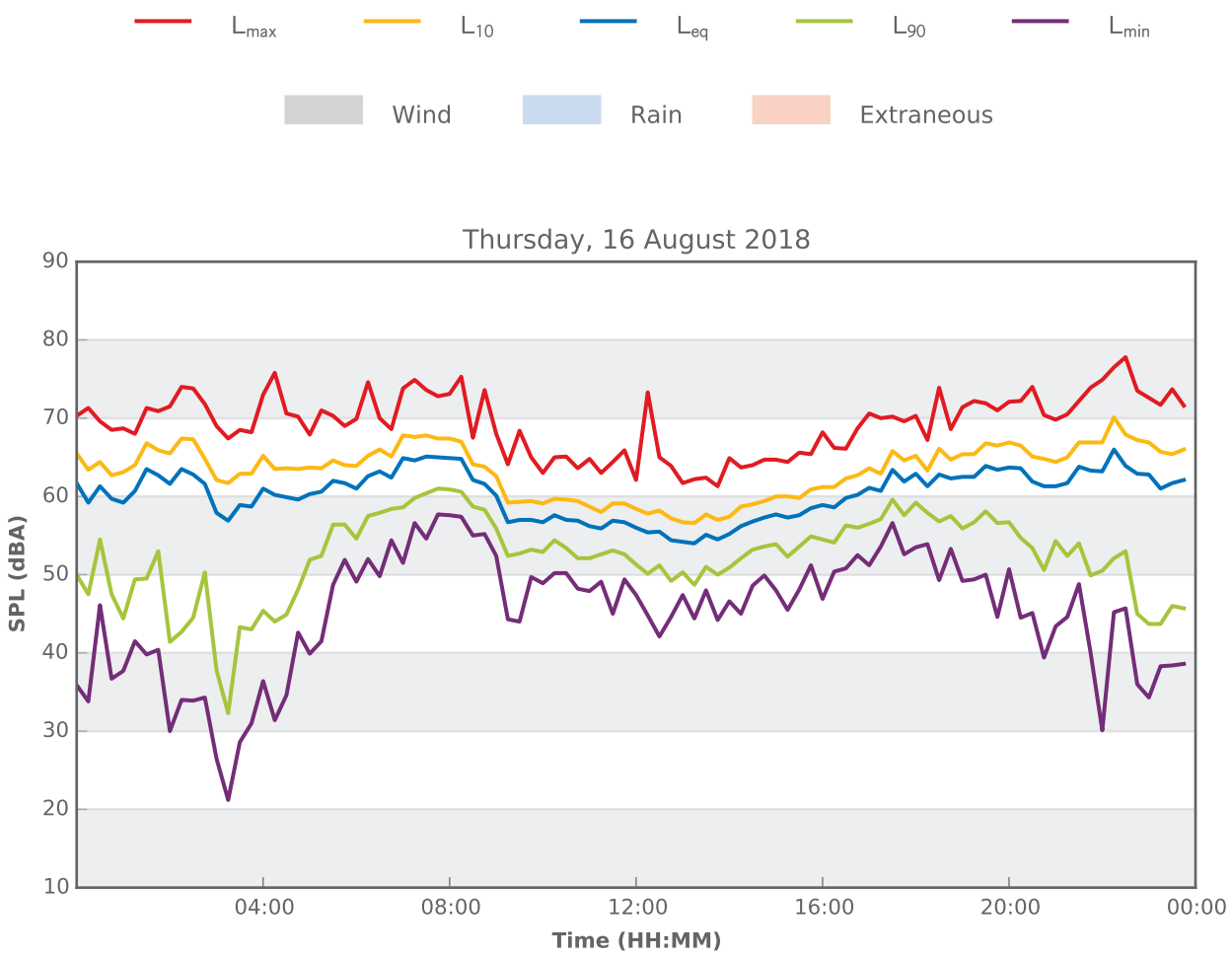


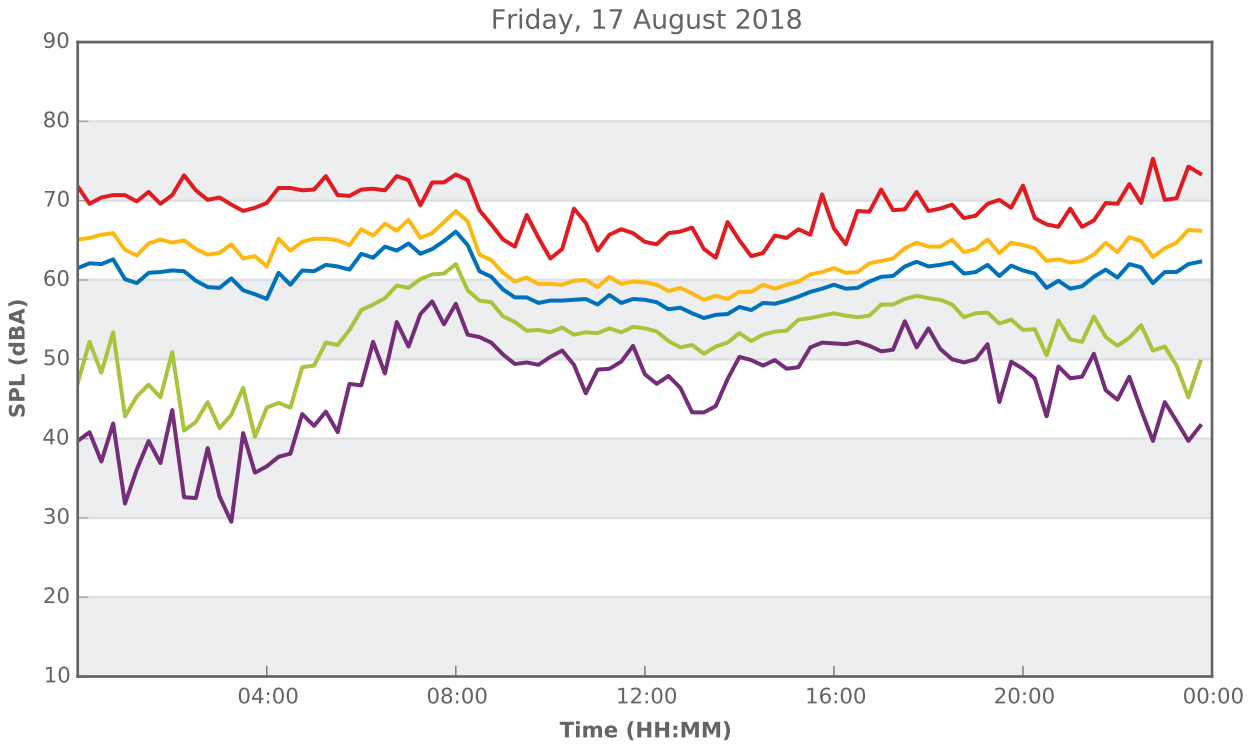
41 Carlyle Road, Kundabung



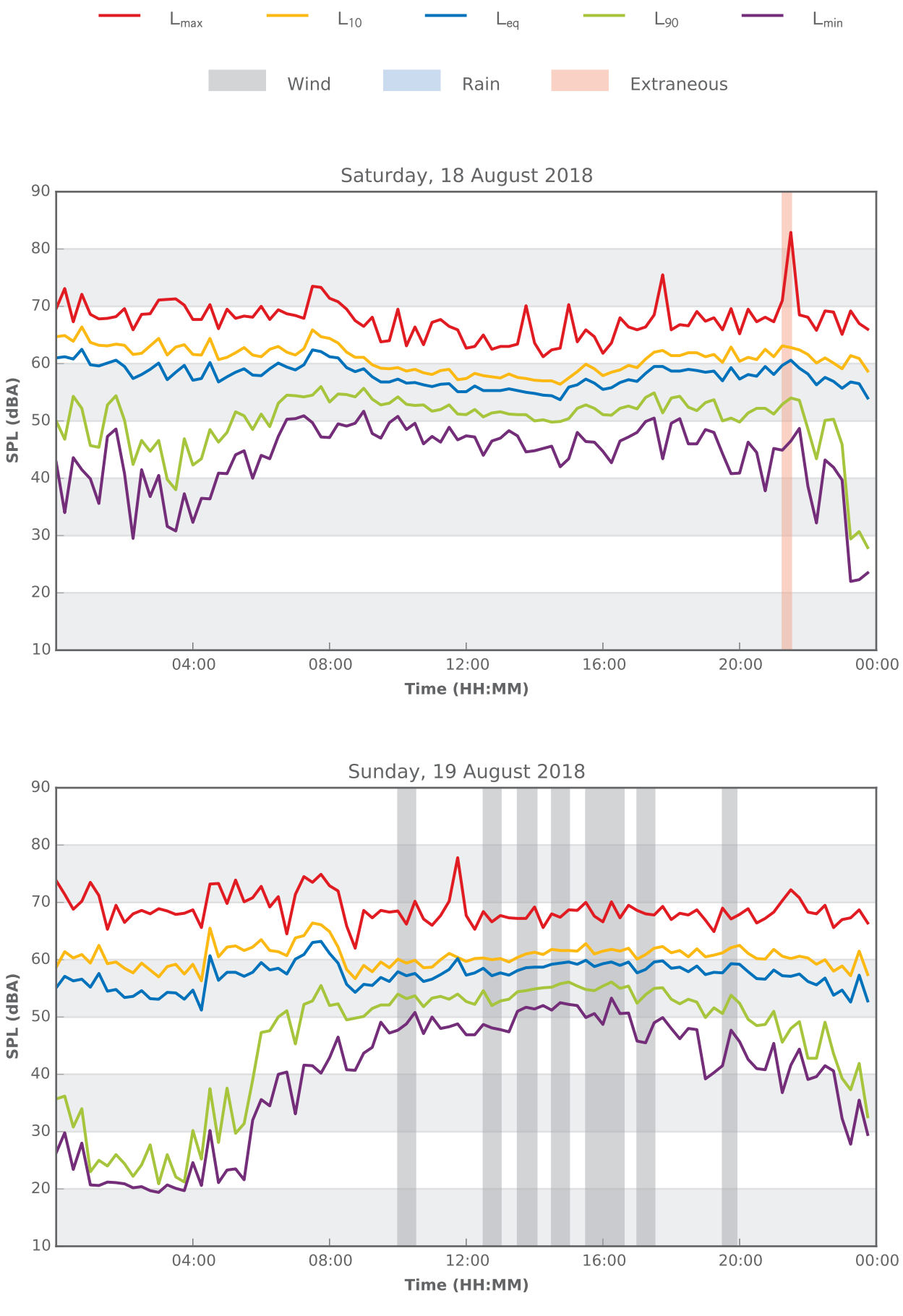


41 Carlyle Road, Kundabung

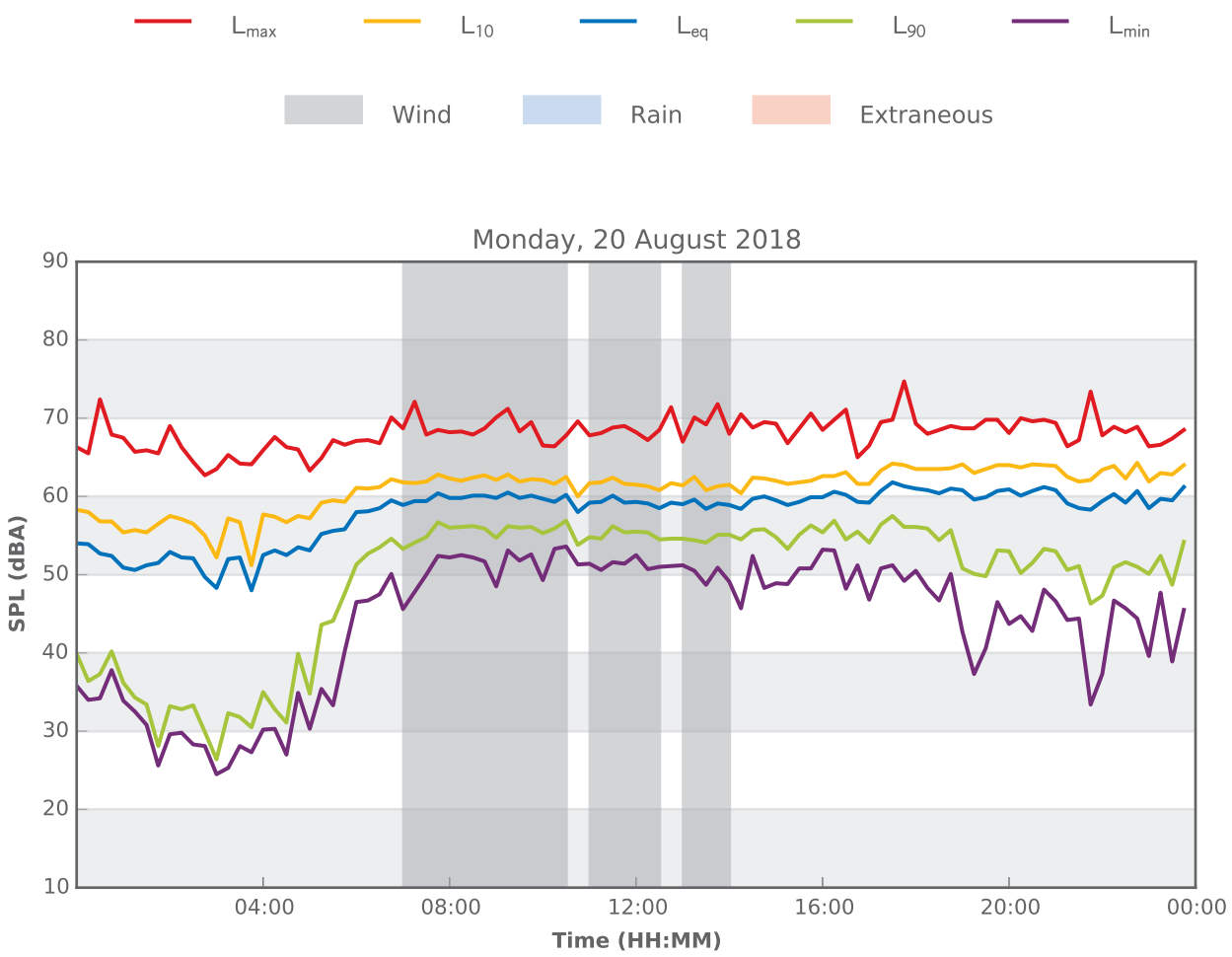


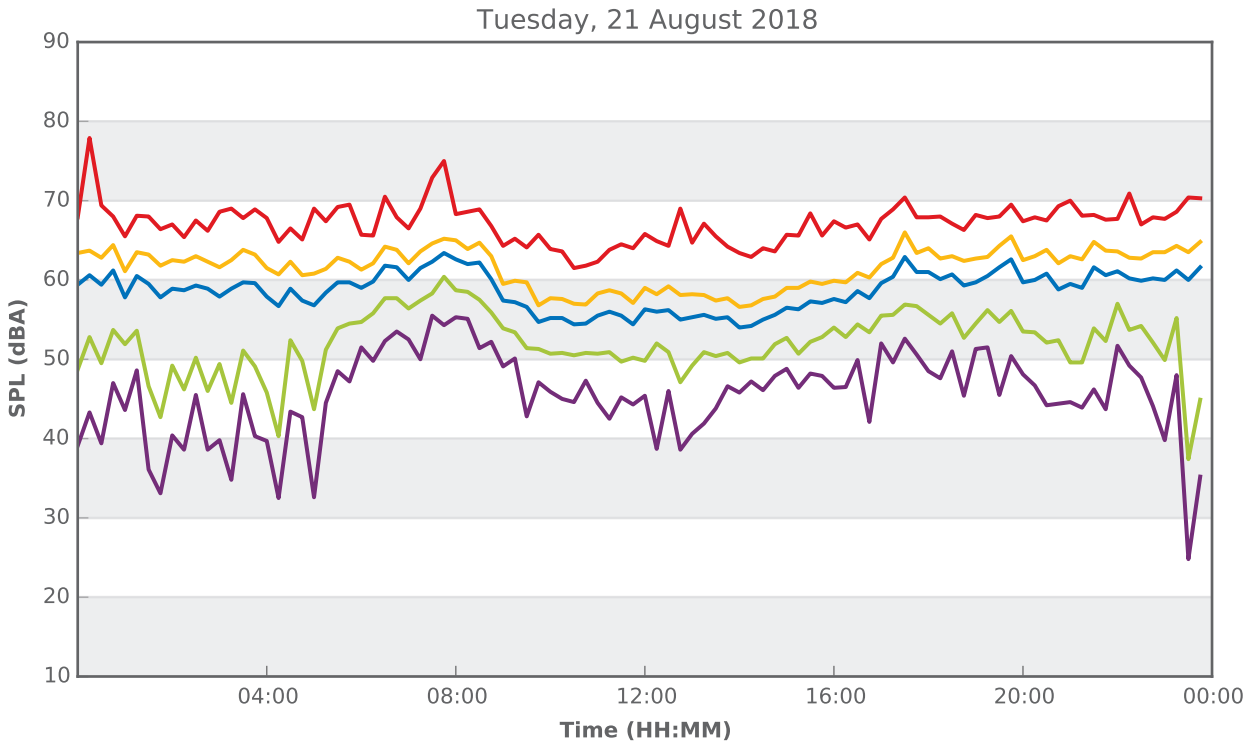


41 Carlyle Road, Kundabung

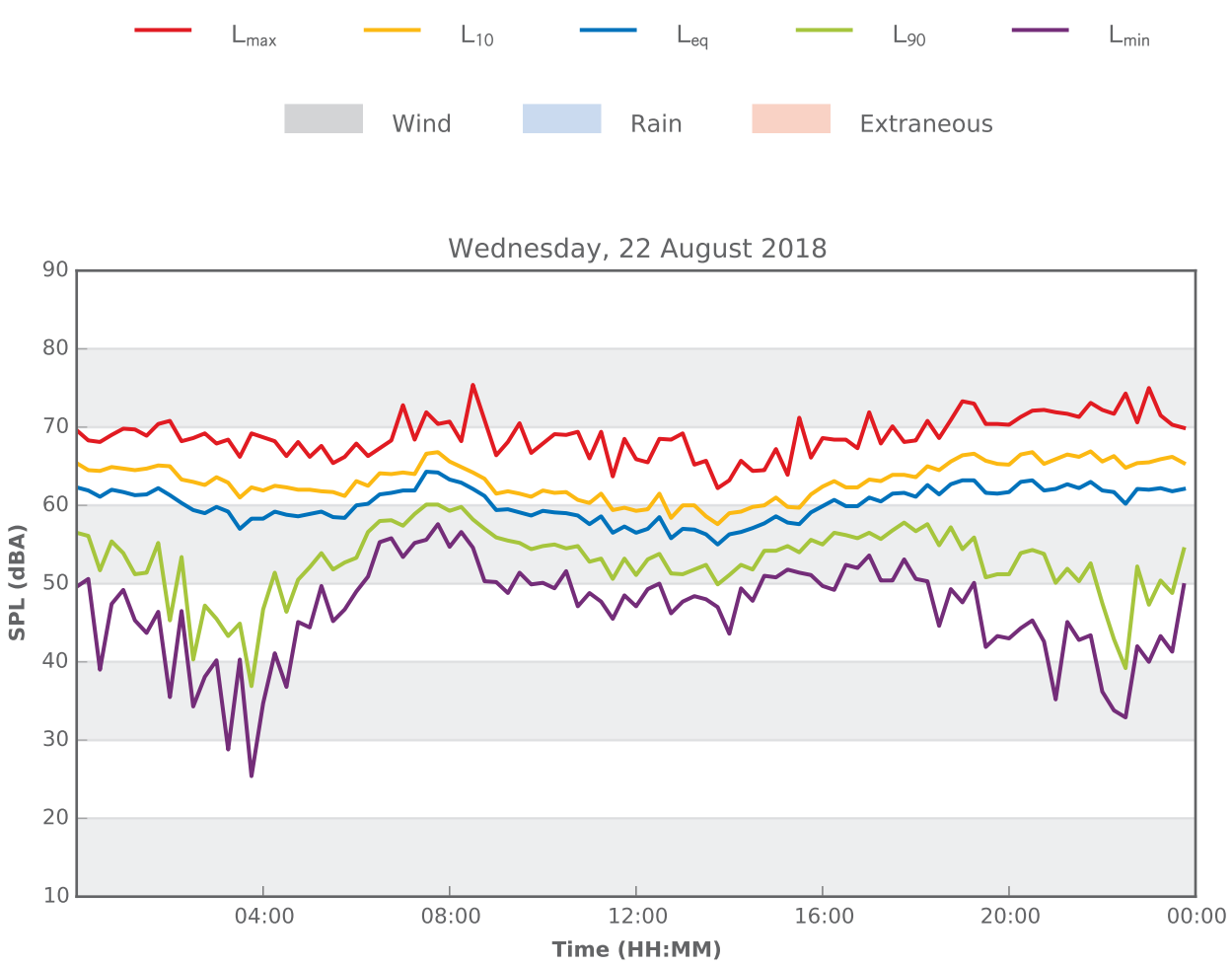


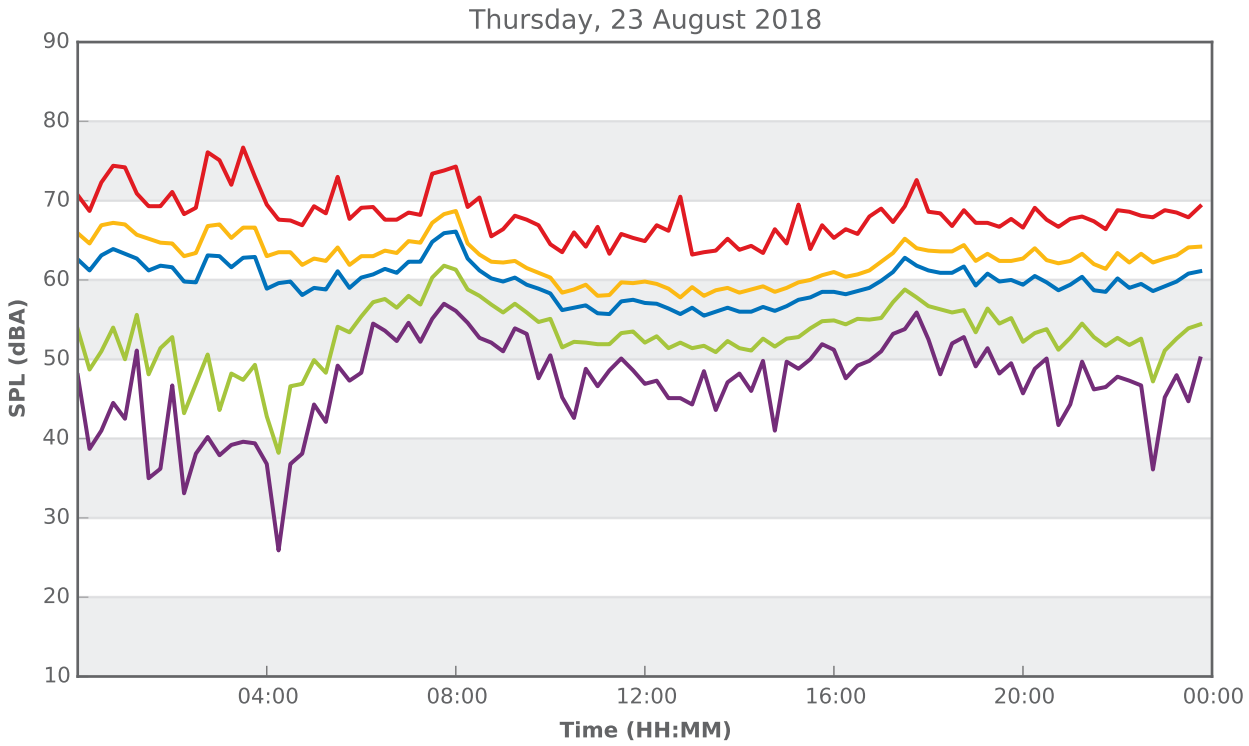
41 Carlyle Road, Kundabung



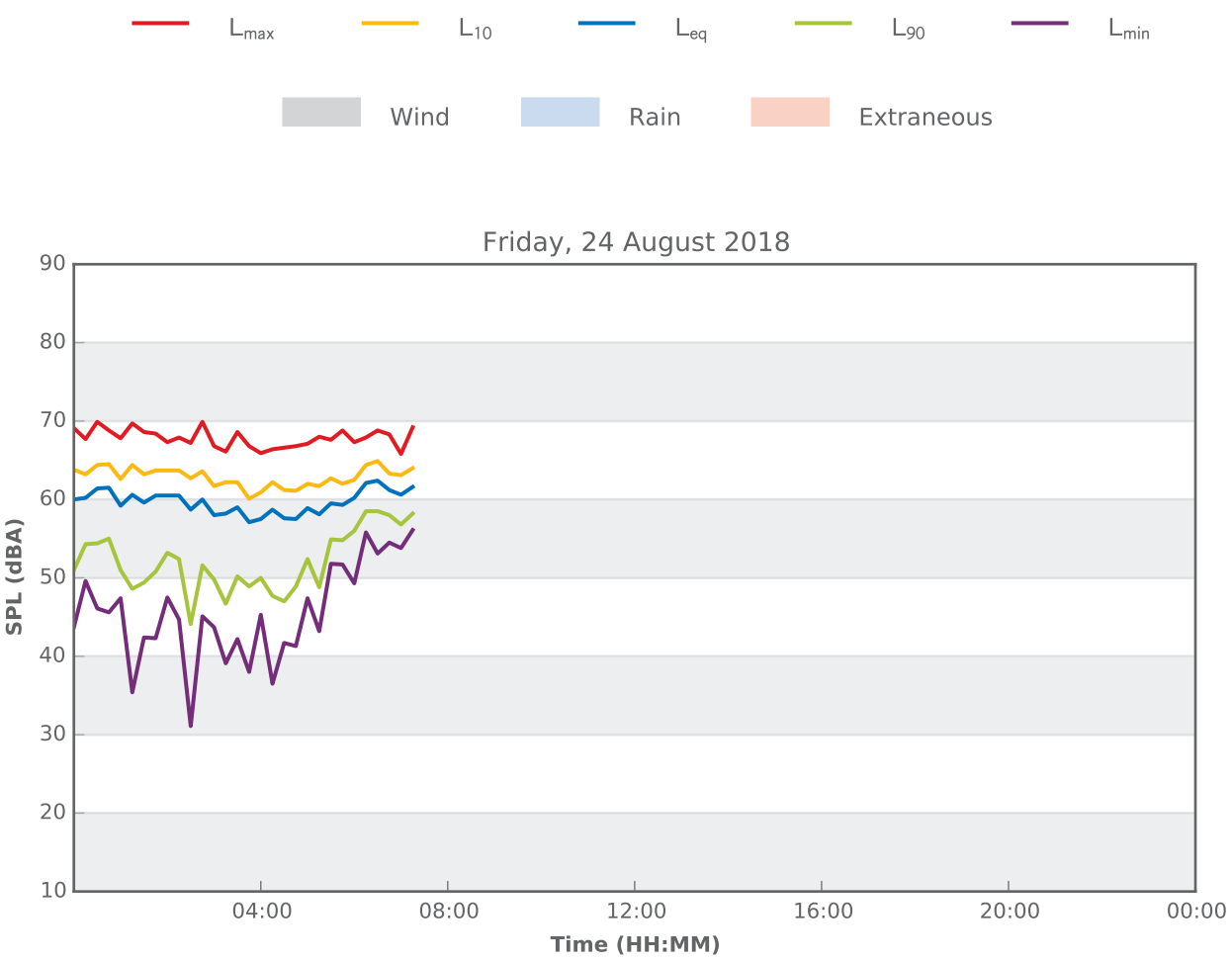


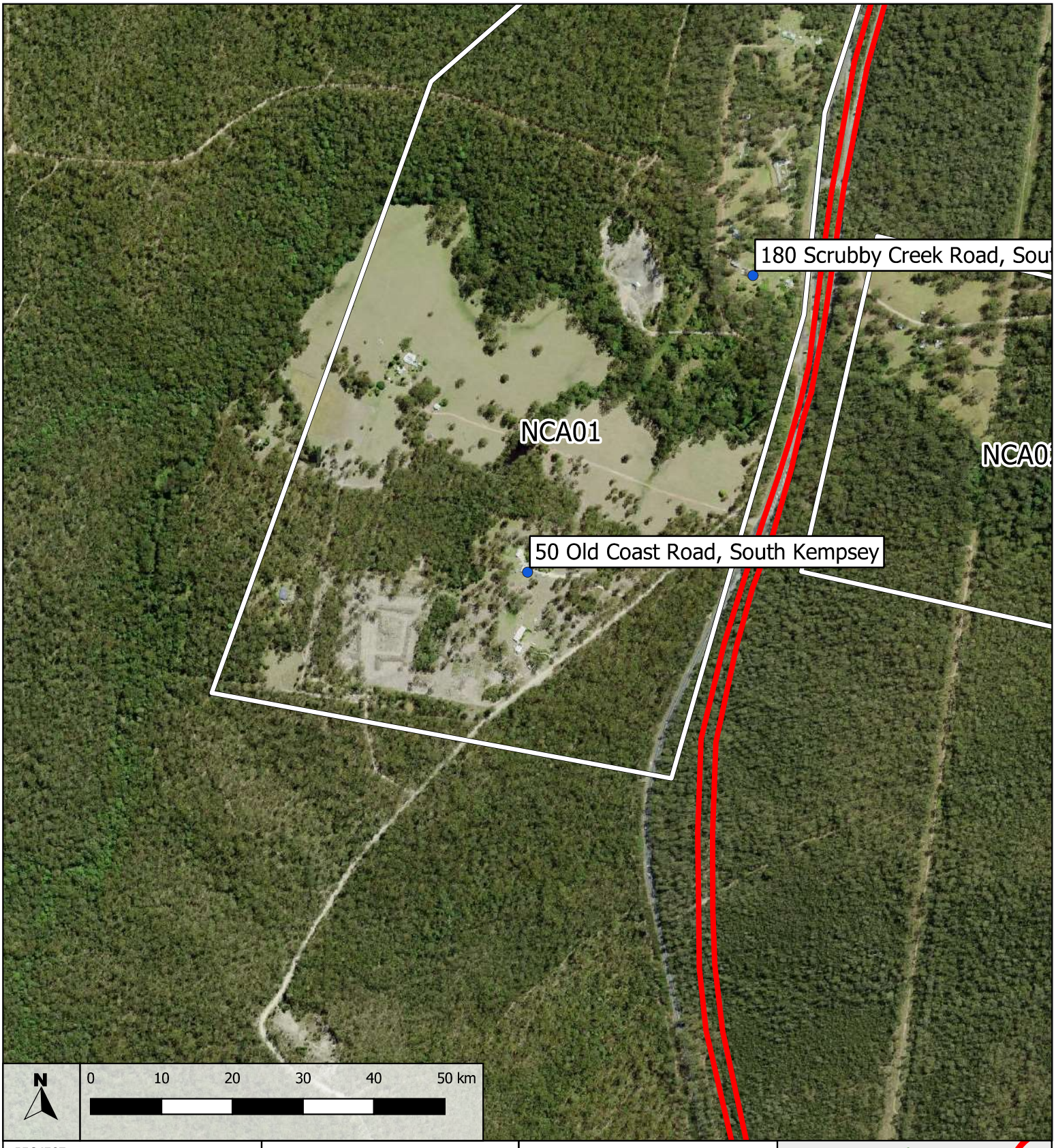
41 Carlyle Road, Kundabung





41 Carlyle Road, Kundabung





PROJECT:

Kundabung to Kempsey

TITLE:

Noise Monitoring Locations

Post - Opening Compliance

PROJECT No.: 12063-ES

REVISION: A

PREPARED: PT

APPROVED: BJM

EXPORTED: 16/10/2018

SHEET SIZE: A4

Appendix D

Drawing 9 of 10

WILKINSON MURRAY

ADDRESS:

50 Old Coast Road, South Kempsey

START DATE:

13/08/2018

STOP DATE:

23/08/2018

Overall Noise - LAeq, Period

LAeq, 15 Hour

48.4

LAeq, 9 Hour

57.7

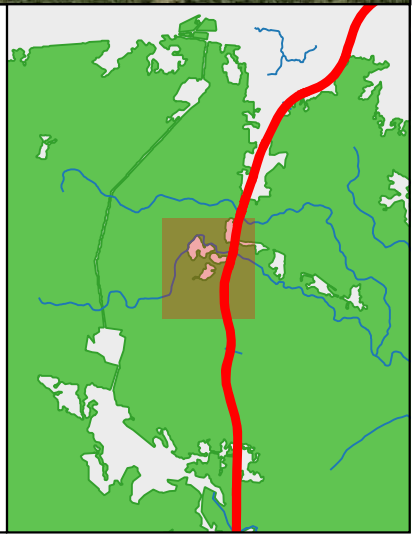
Estimated Traffic Noise - LAeq, Period

LAeq, 15 Hour

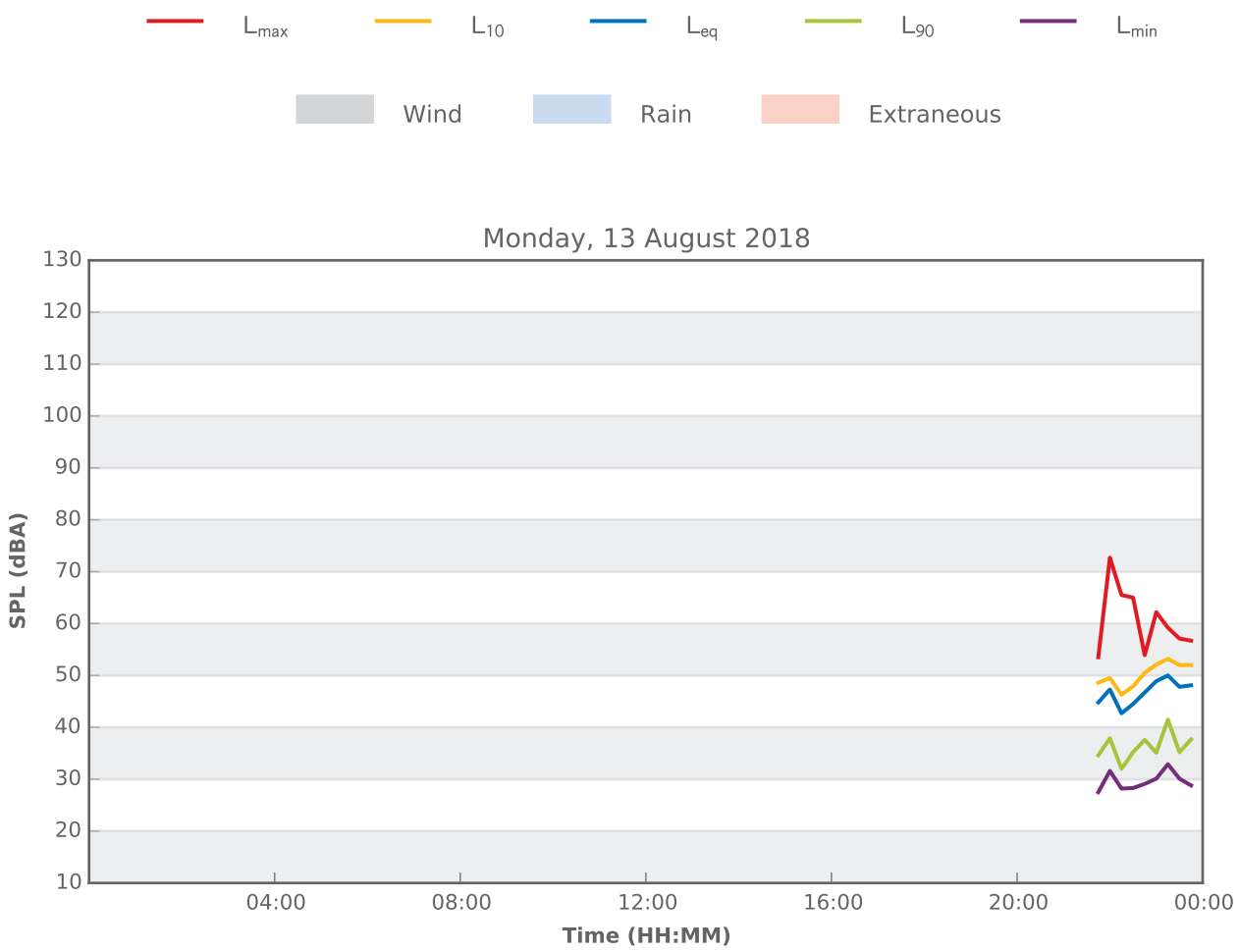
48.4

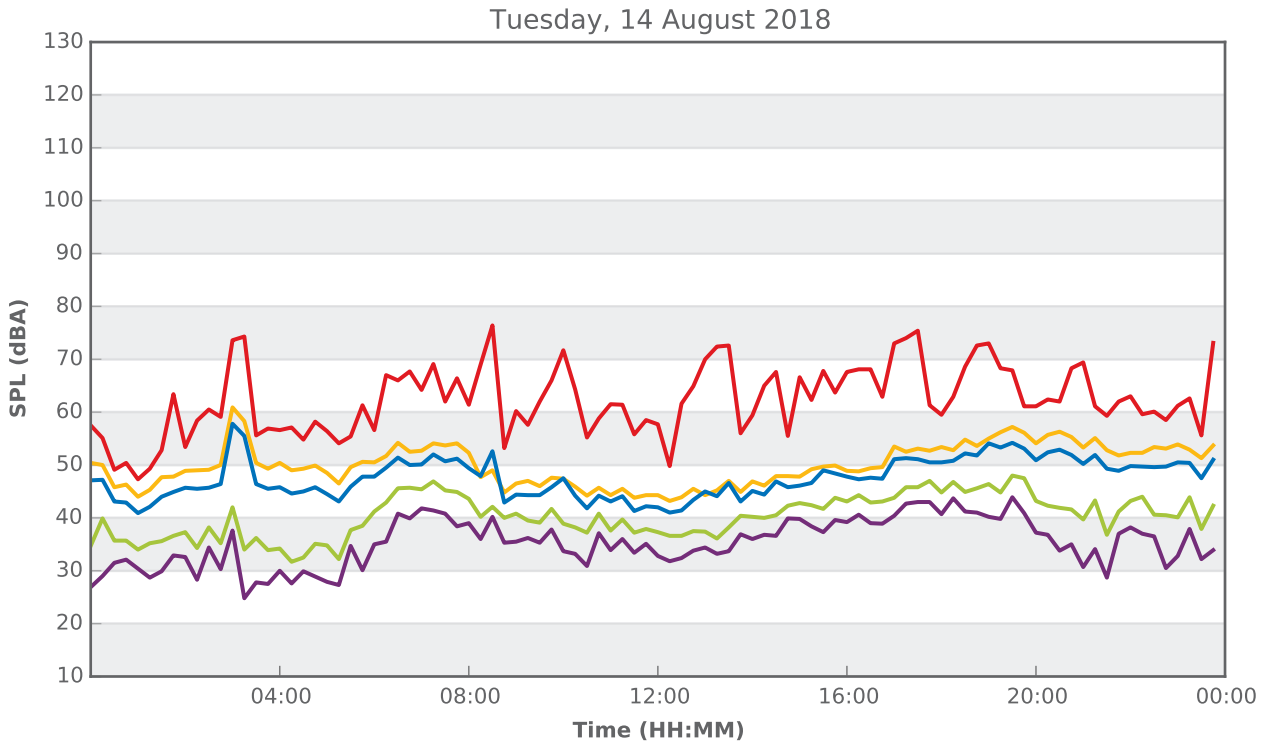
LAeq, 9 Hour

49.6

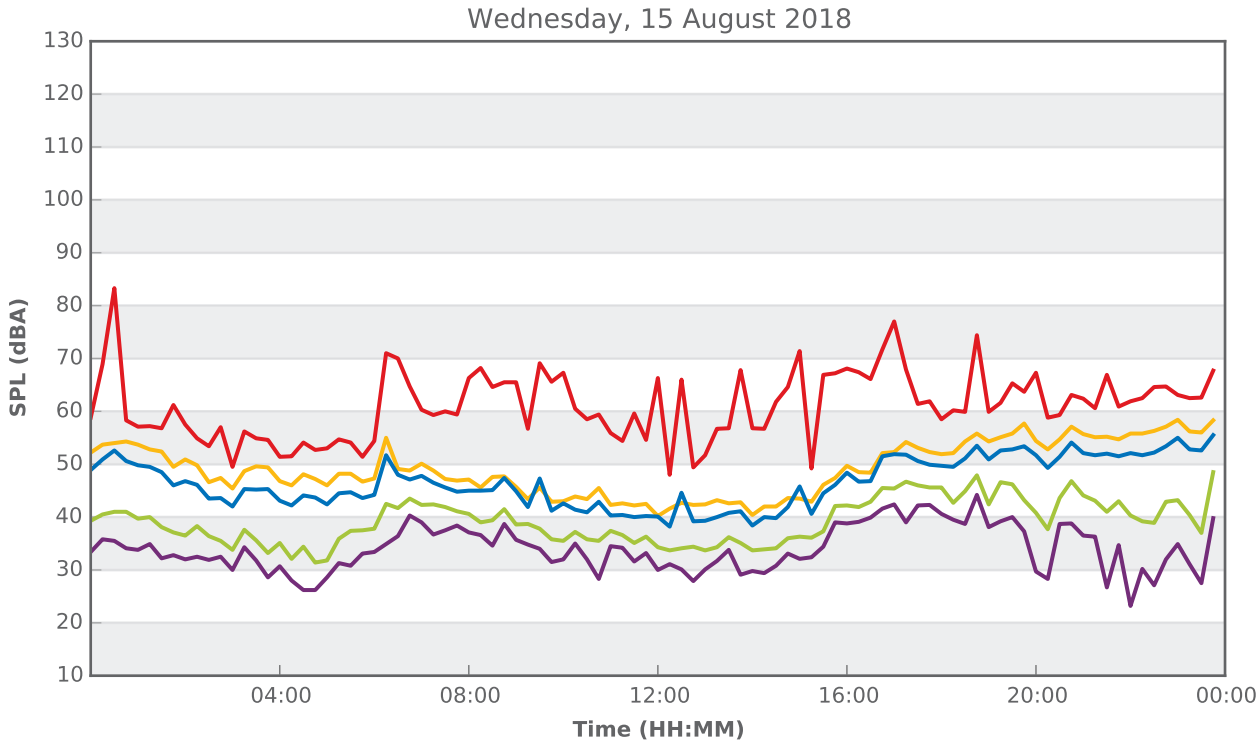


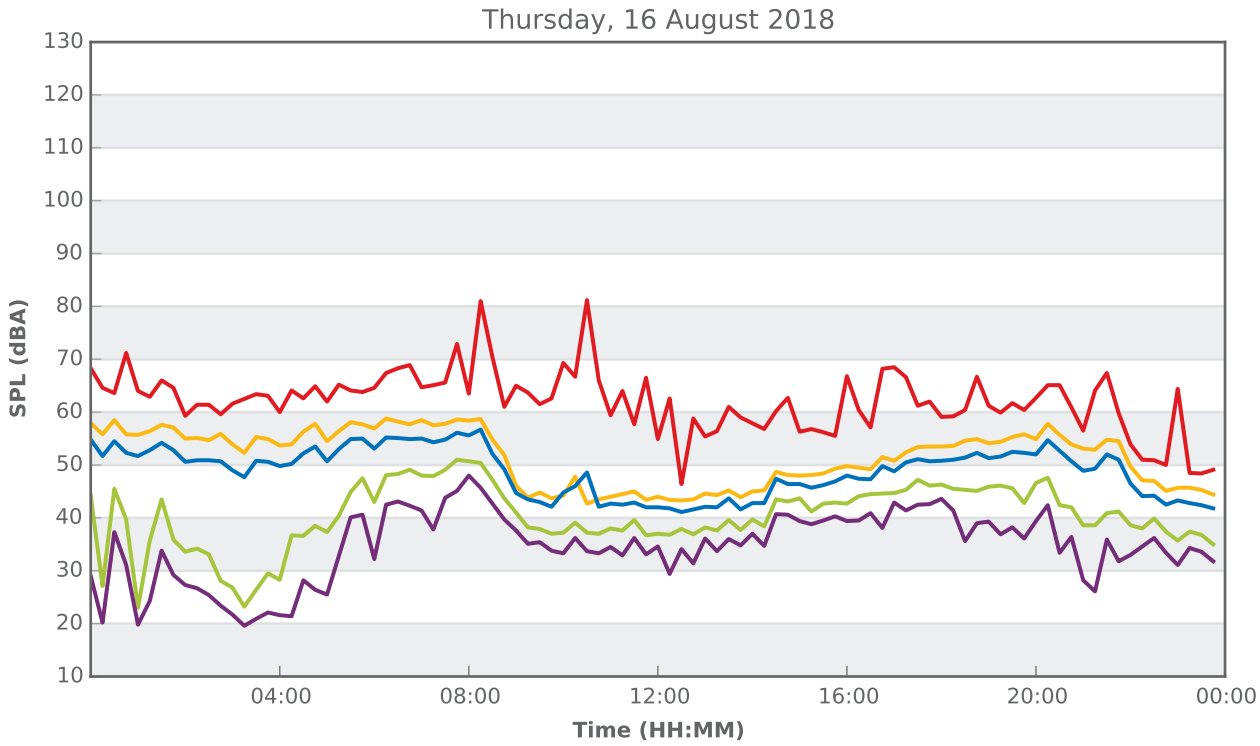
50 Old Coast Road, Kundabung



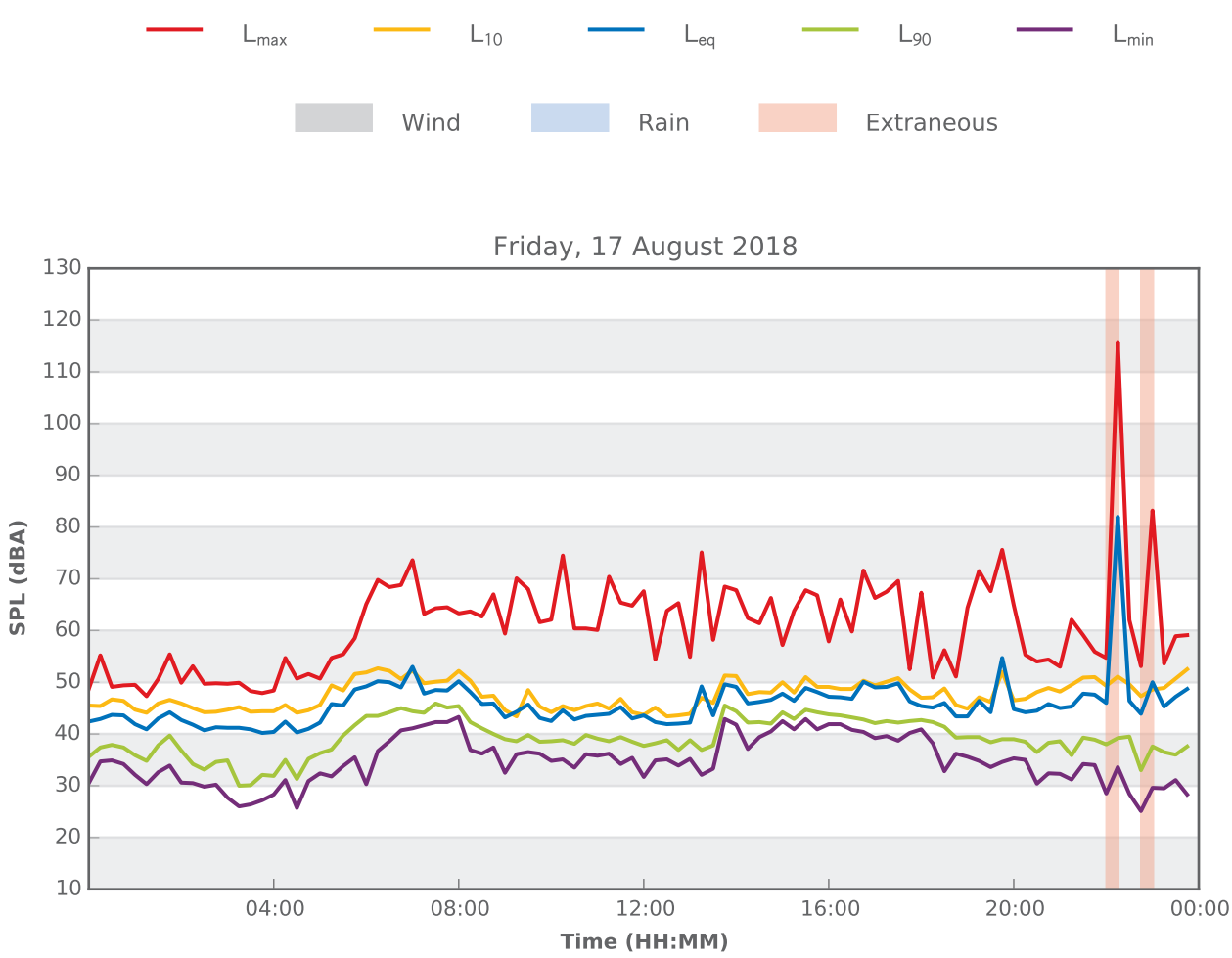


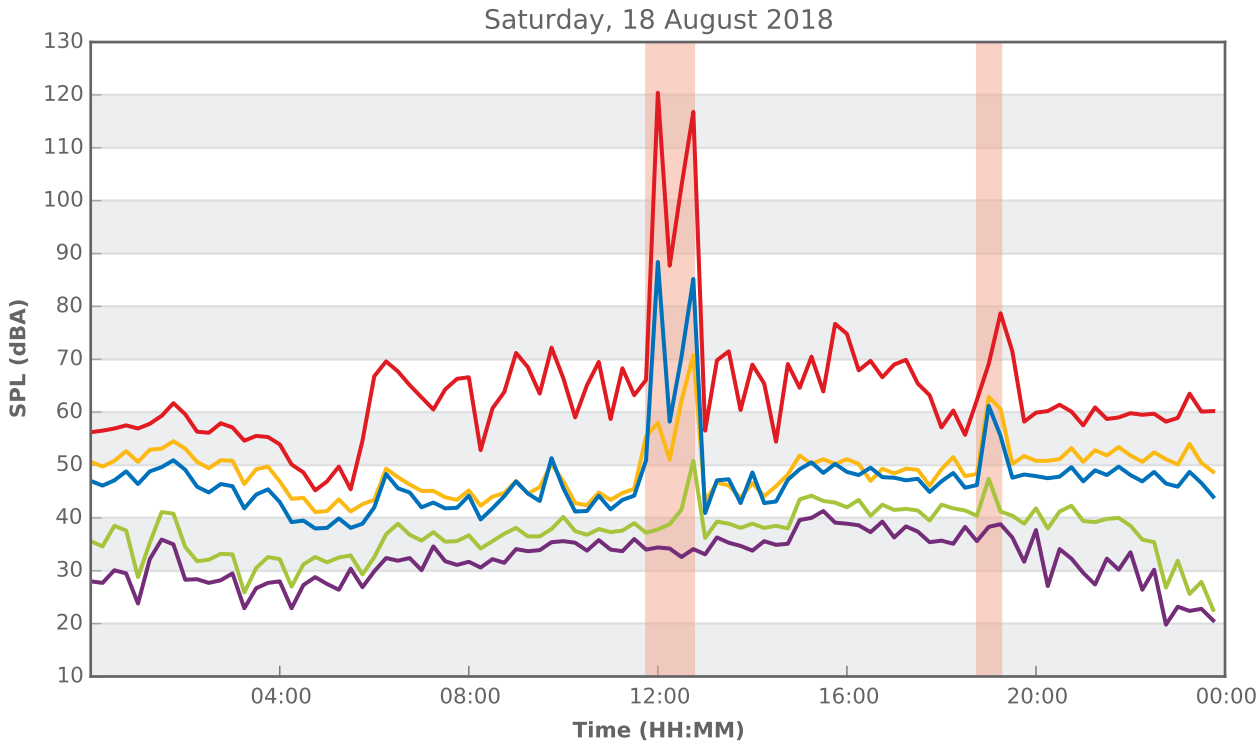
50 Old Coast Road, Kundabung



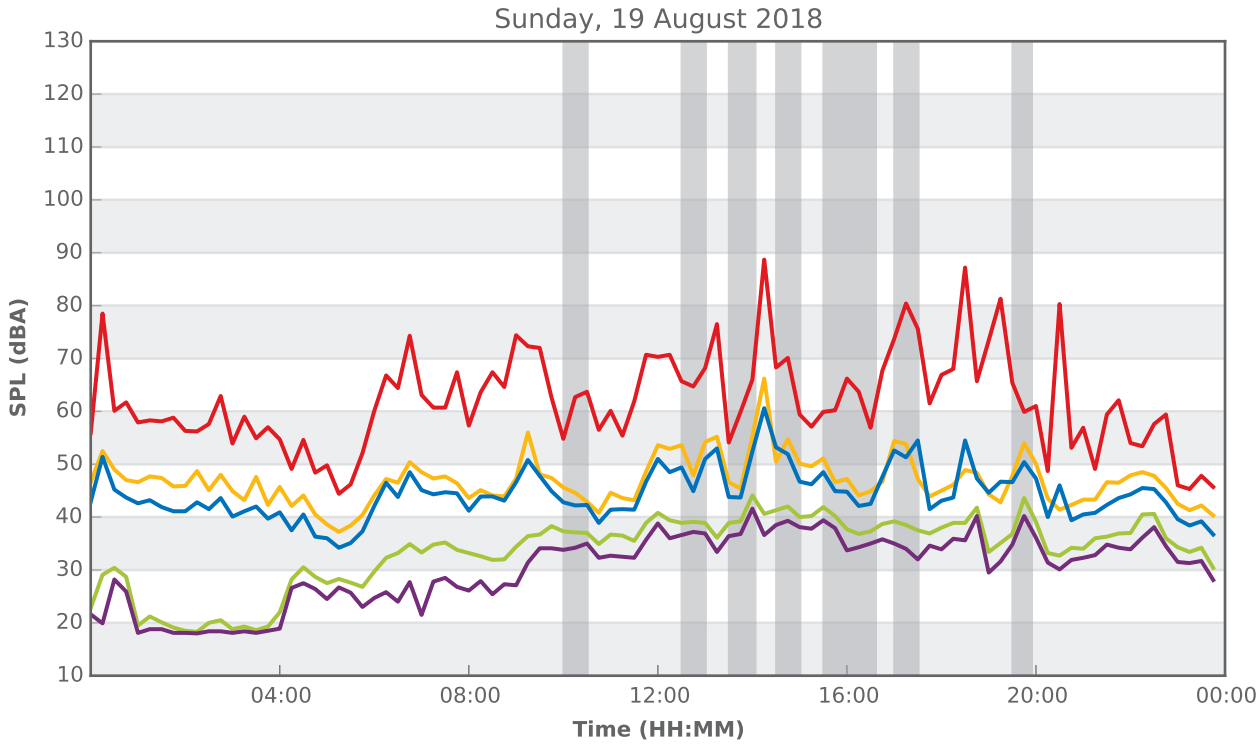


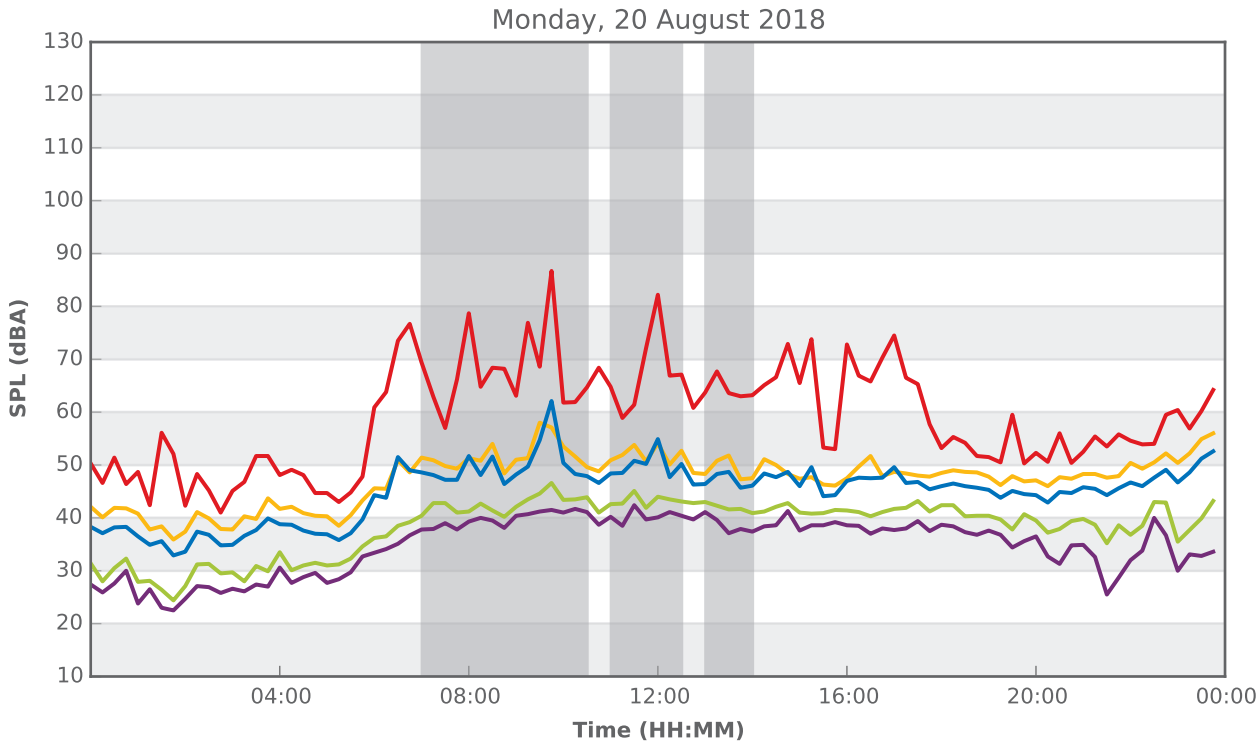
50 Old Coast Road, Kundabung



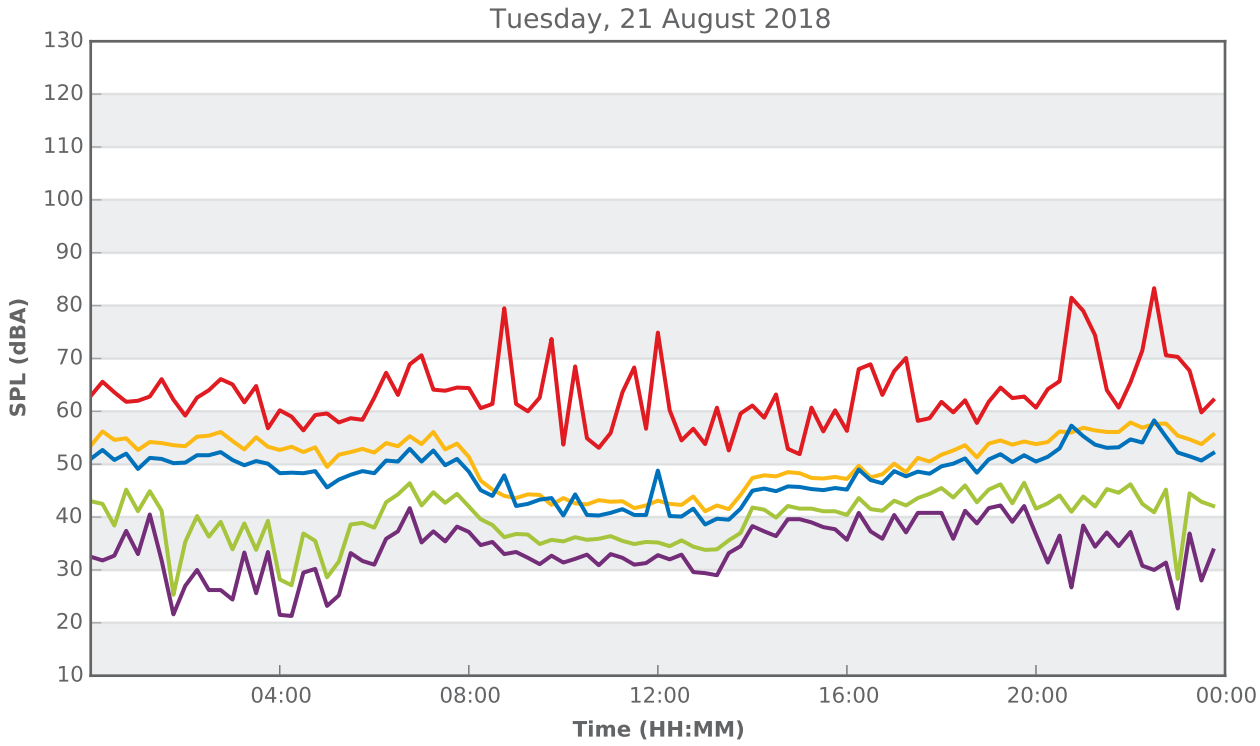


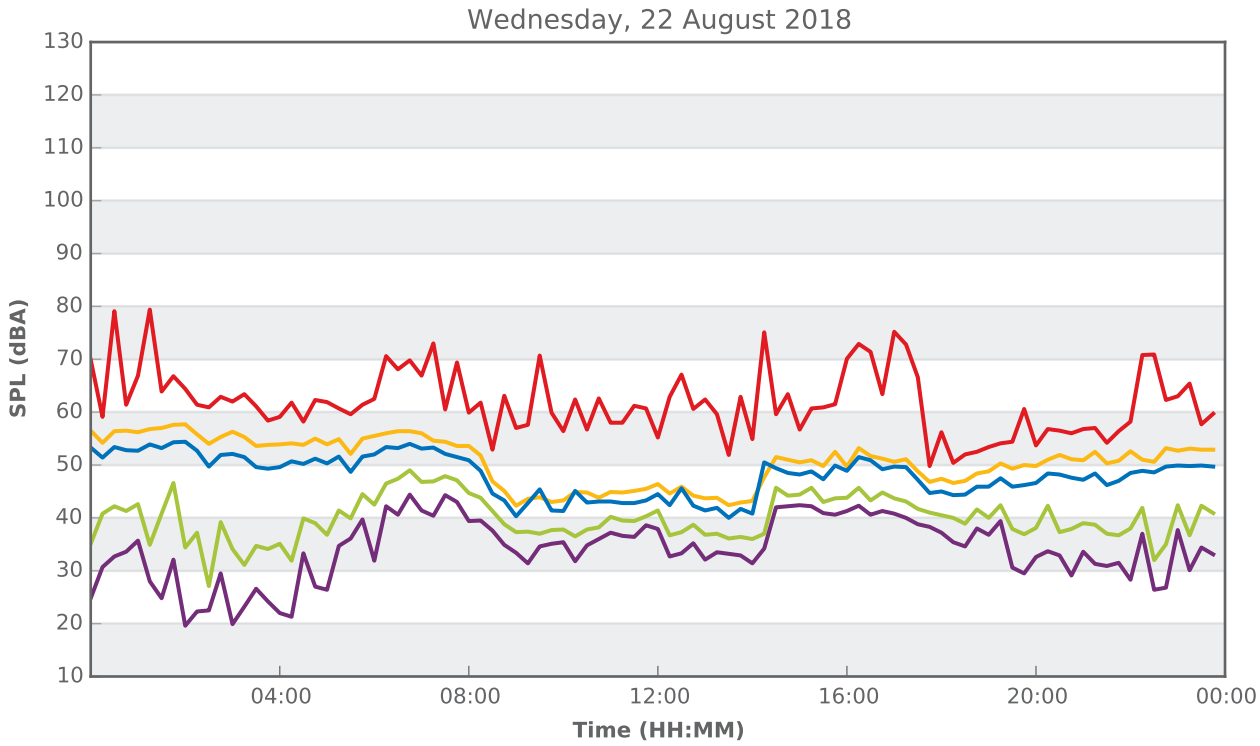
50 Old Coast Road, Kundabung



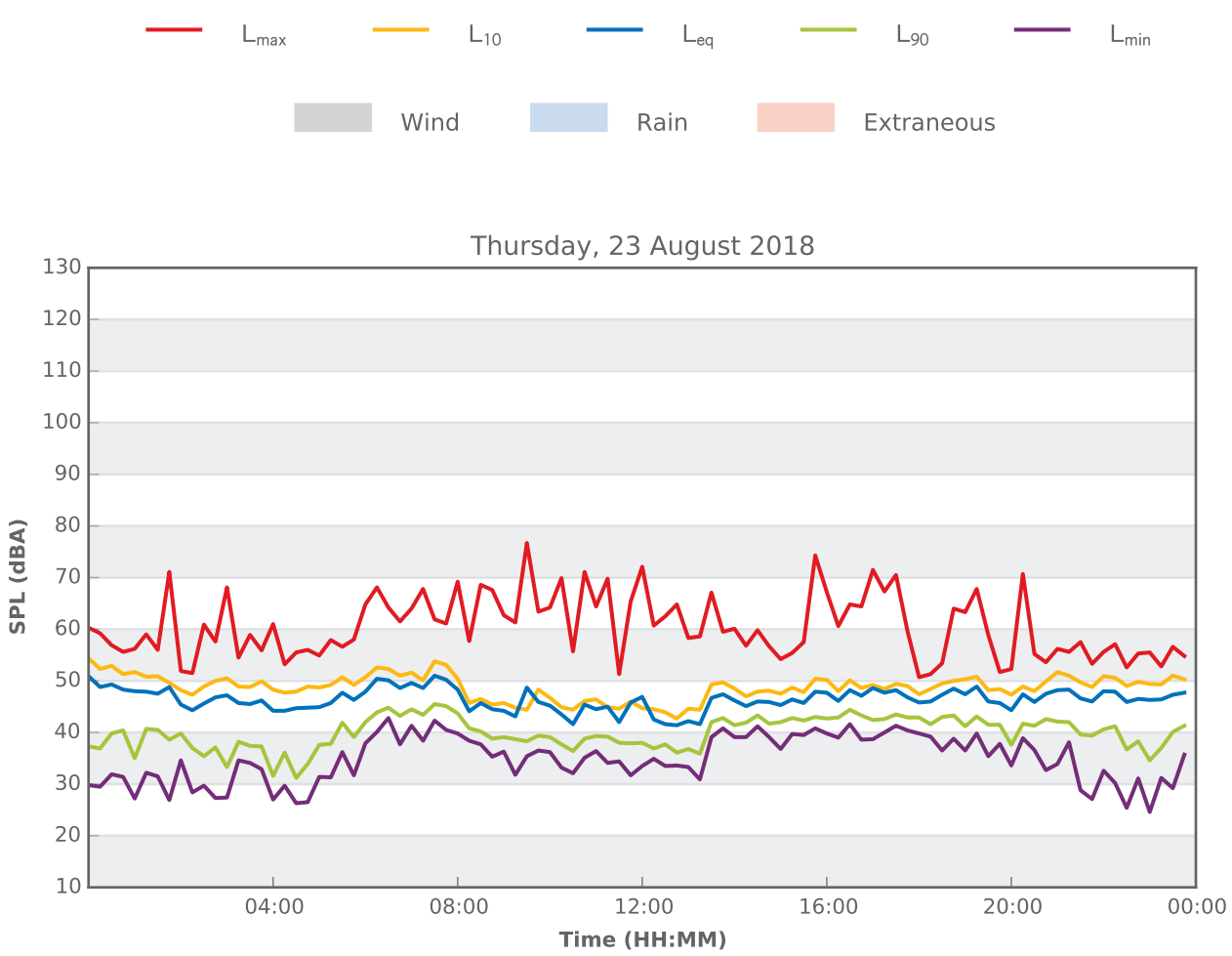


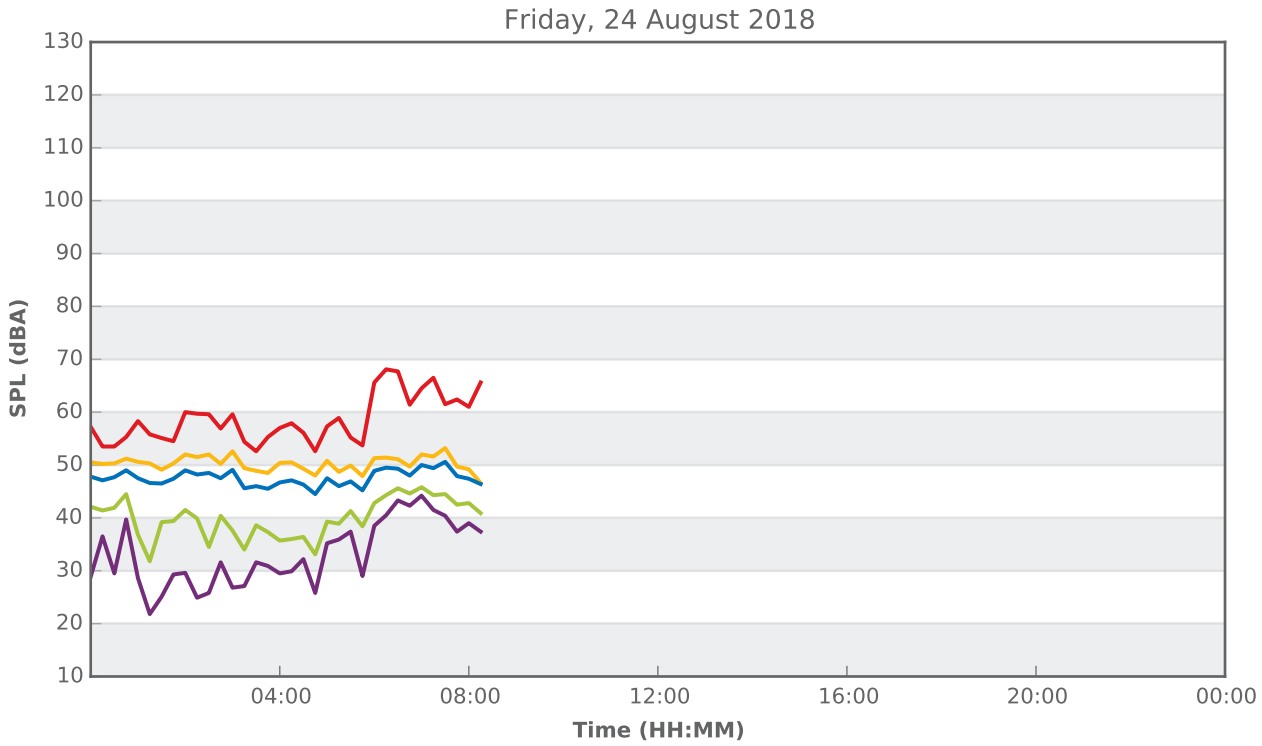
50 Old Coast Road, Kundabung

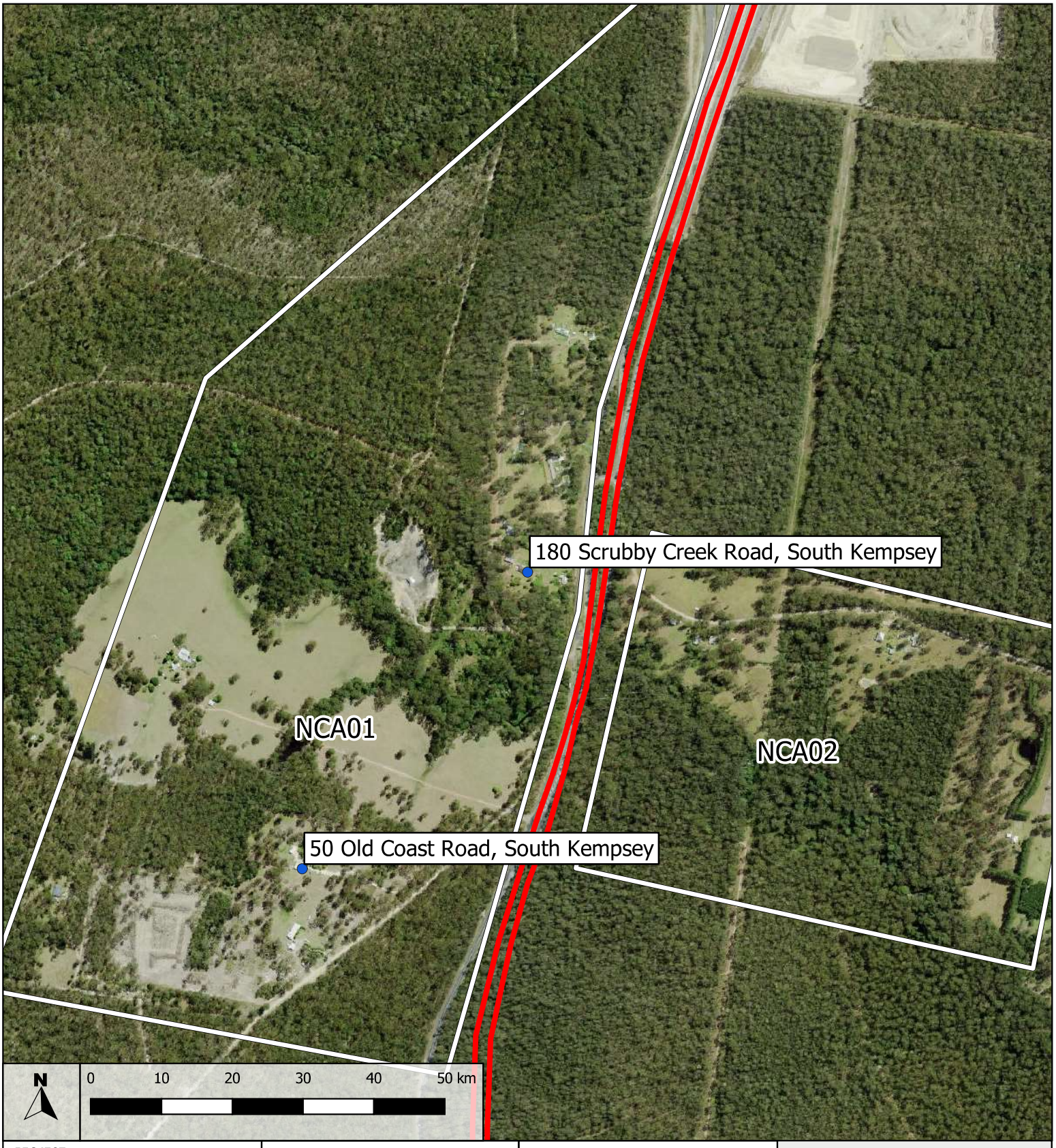




50 Old Coast Road, Kundabung







PROJECT:

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Noise Monitoring Locations

Post - Opening Compliance

PROJECT No.: 12063-ES

REVISION: A

PREPARED: PT

APPROVED: BJM

EXPORTED: 16/10/2018

SHEET SIZE: A4

Appendix D

Drawing 10 of 10

WILKINSON MURRAY

ADDRESS:

180 Scrubby Creek Road, South Kempsey

START DATE:

13/08/2018

STOP DATE:

23/08/2018

Overall Noise - LAeq, Period

LAeq, 15 Hour

56.3

LAeq, 9 Hour

56

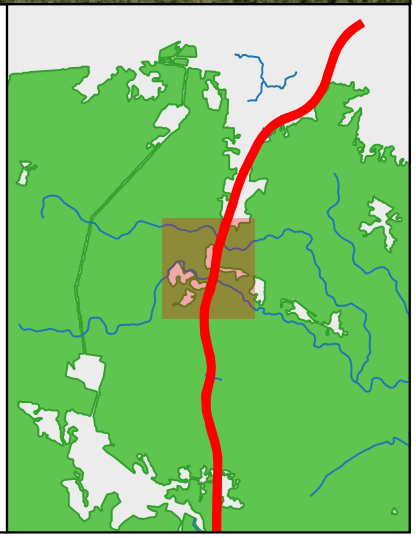
Estimated Traffic Noise - LAeq, Period

LAeq, 15 Hour

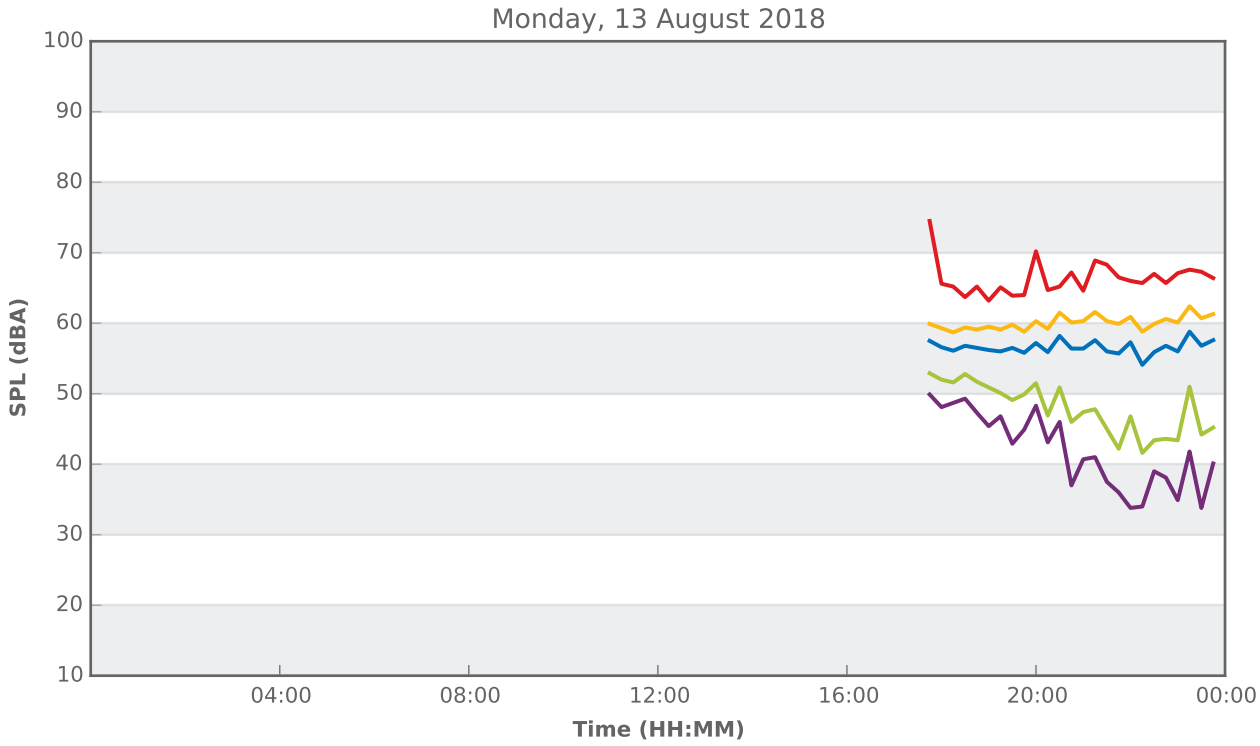
56

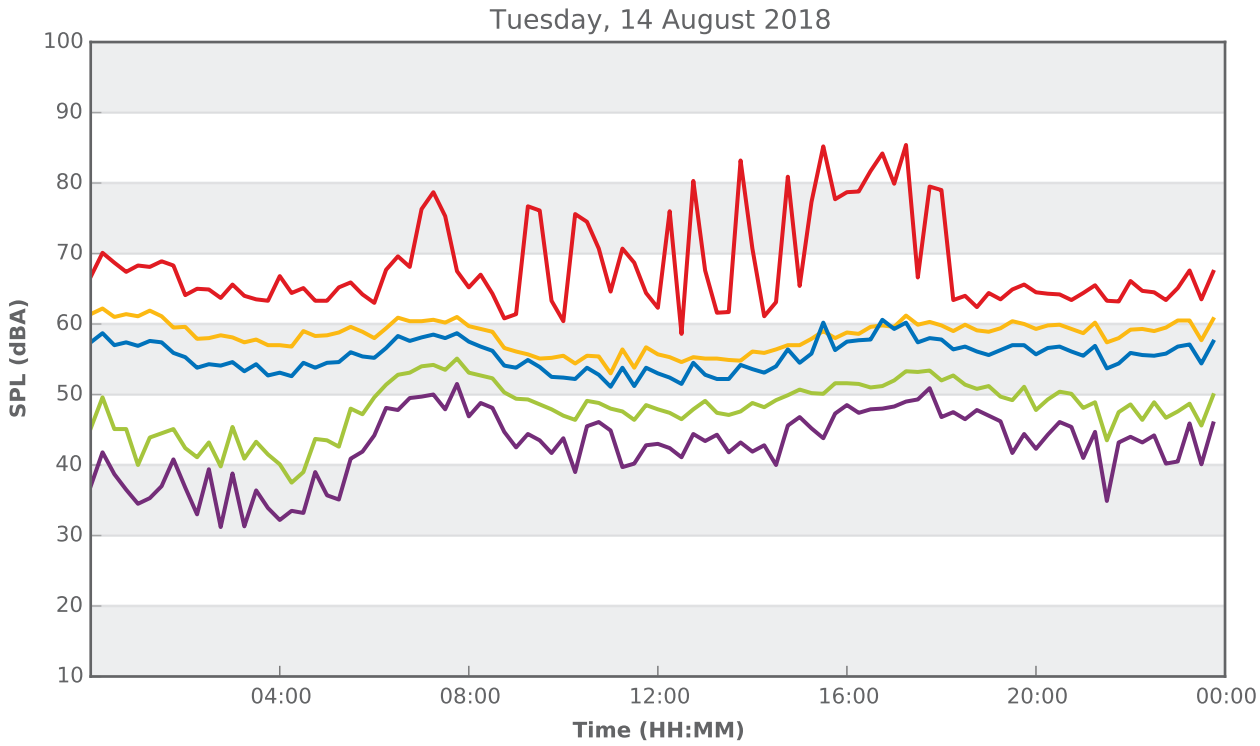
LAeq, 9 Hour

56

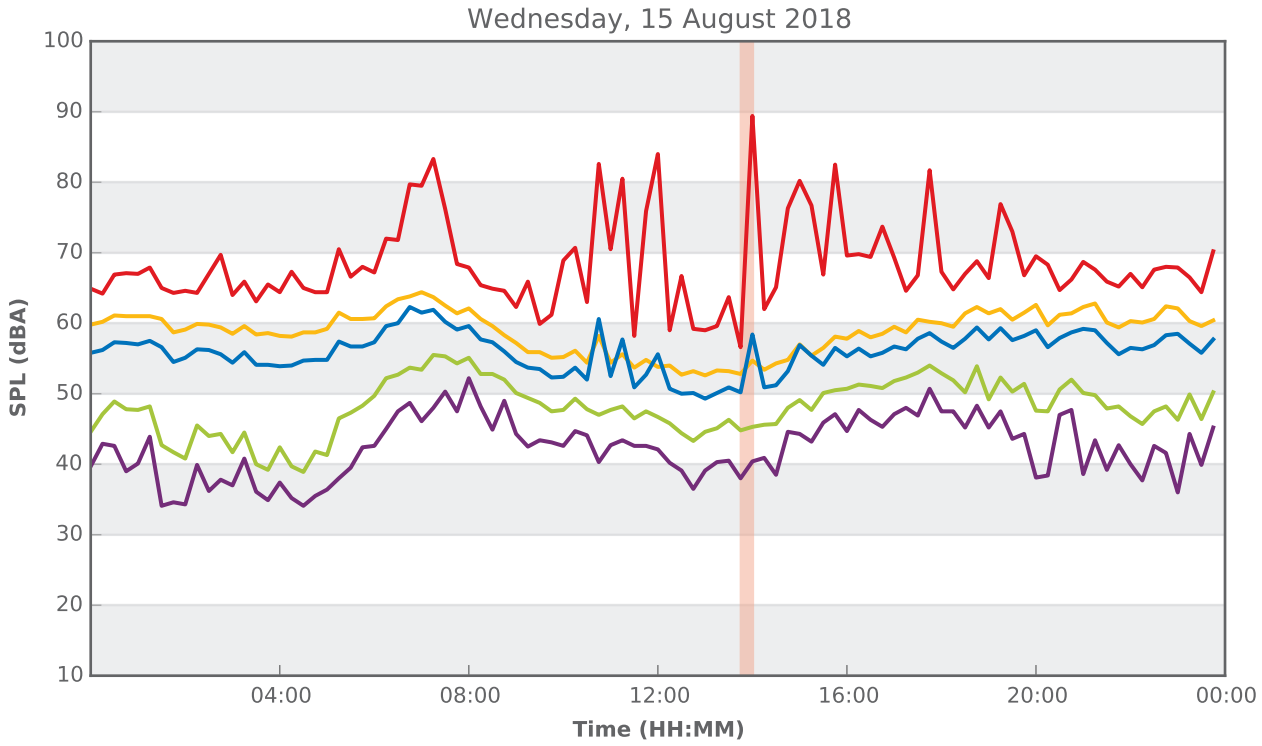


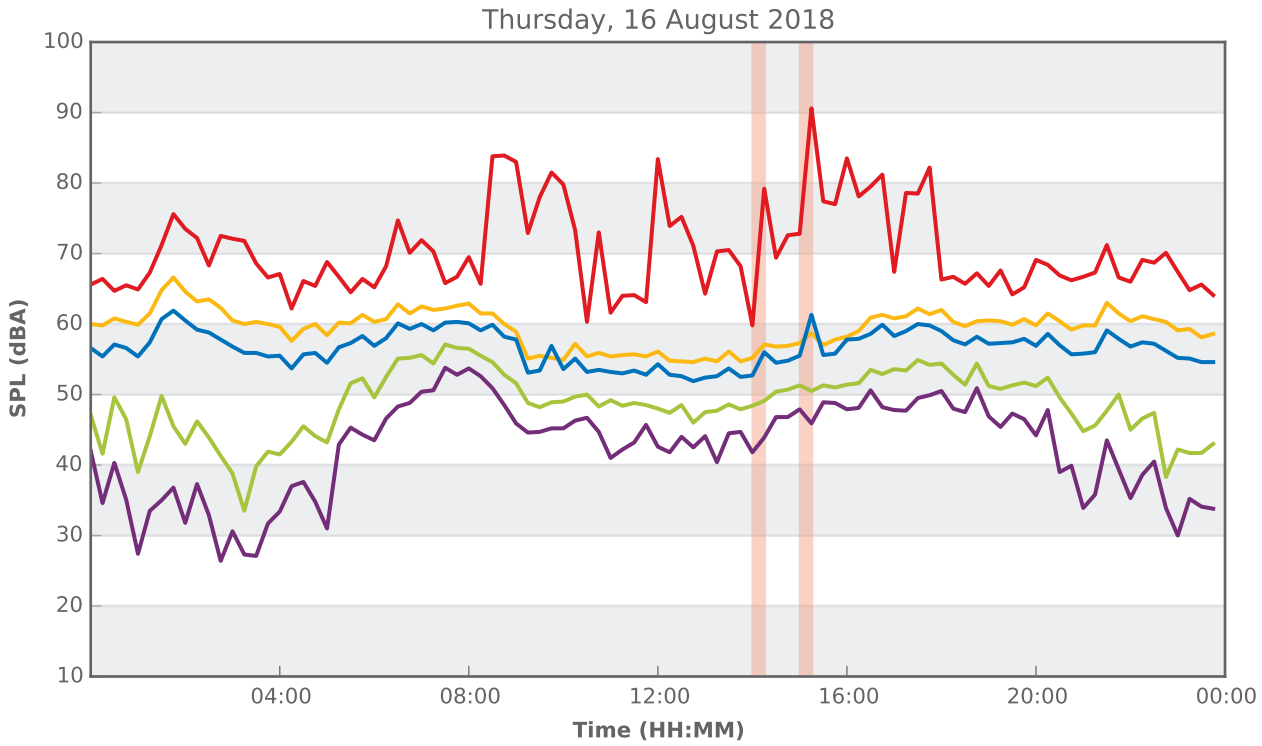
180 Scrubby Creek Road, South Kempsey



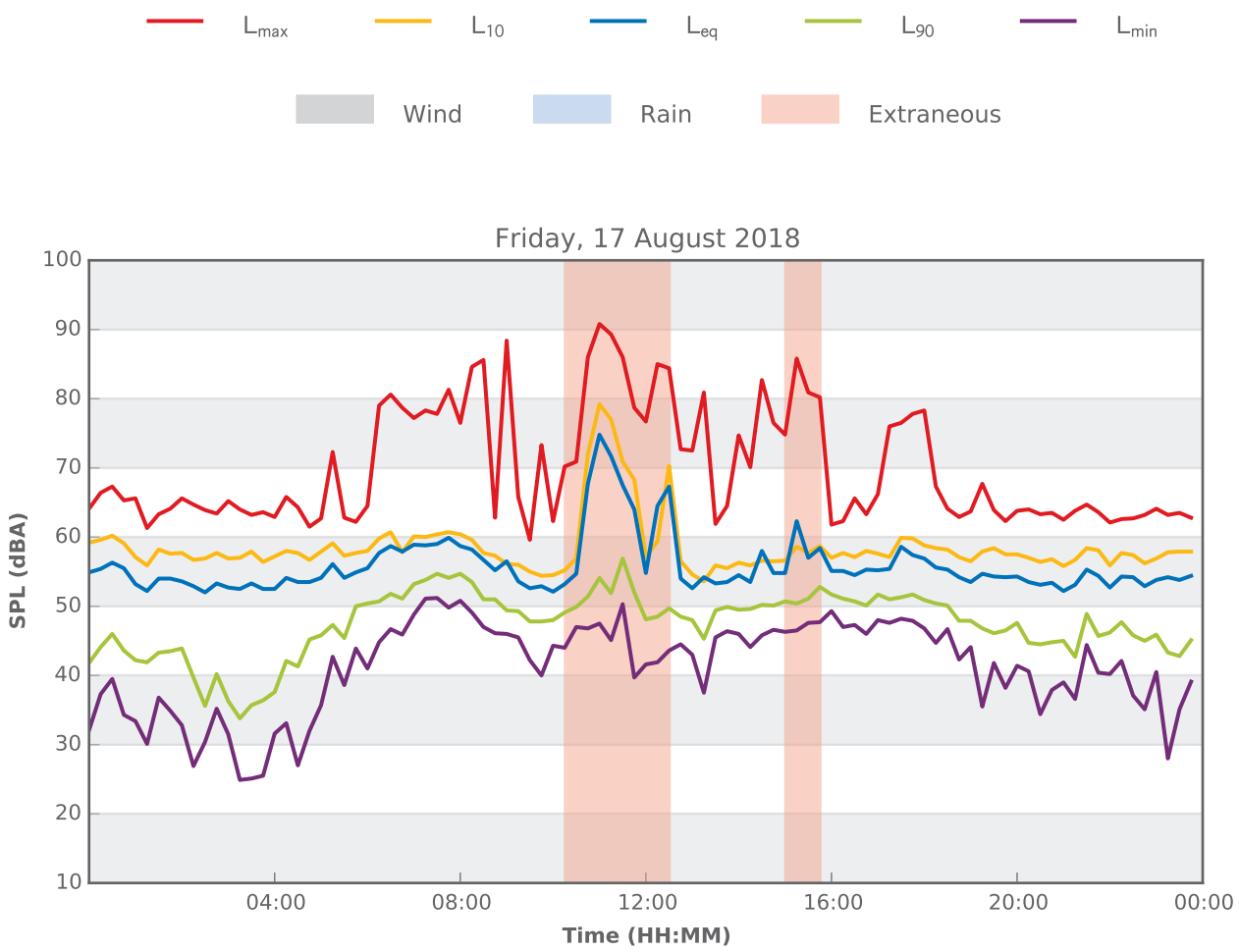


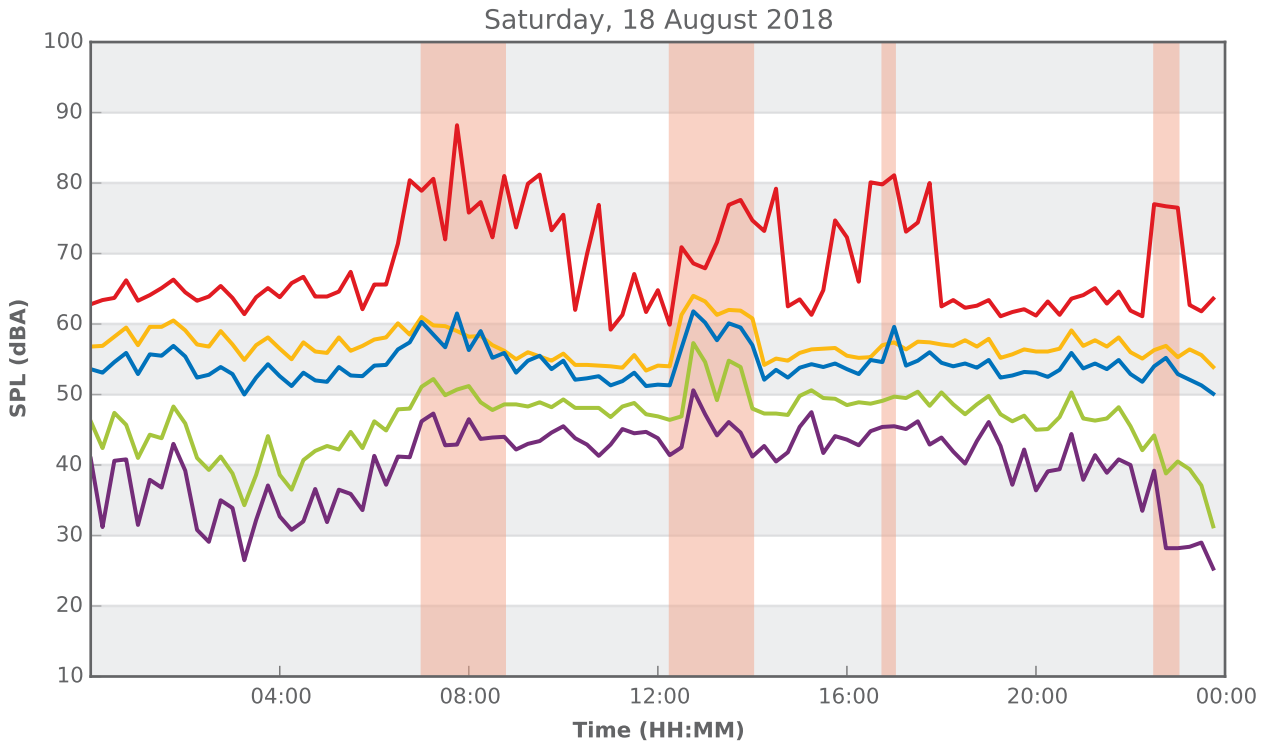
180 Scrubby Creek Road, South Kempsey



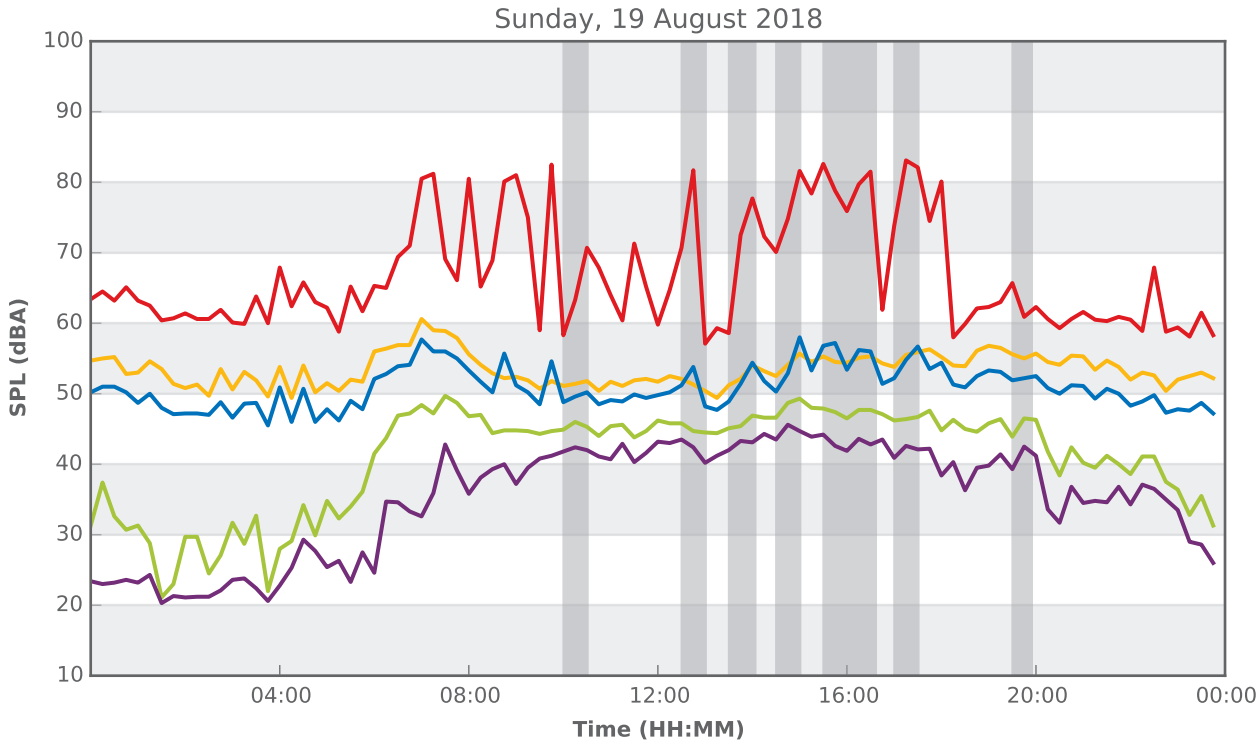


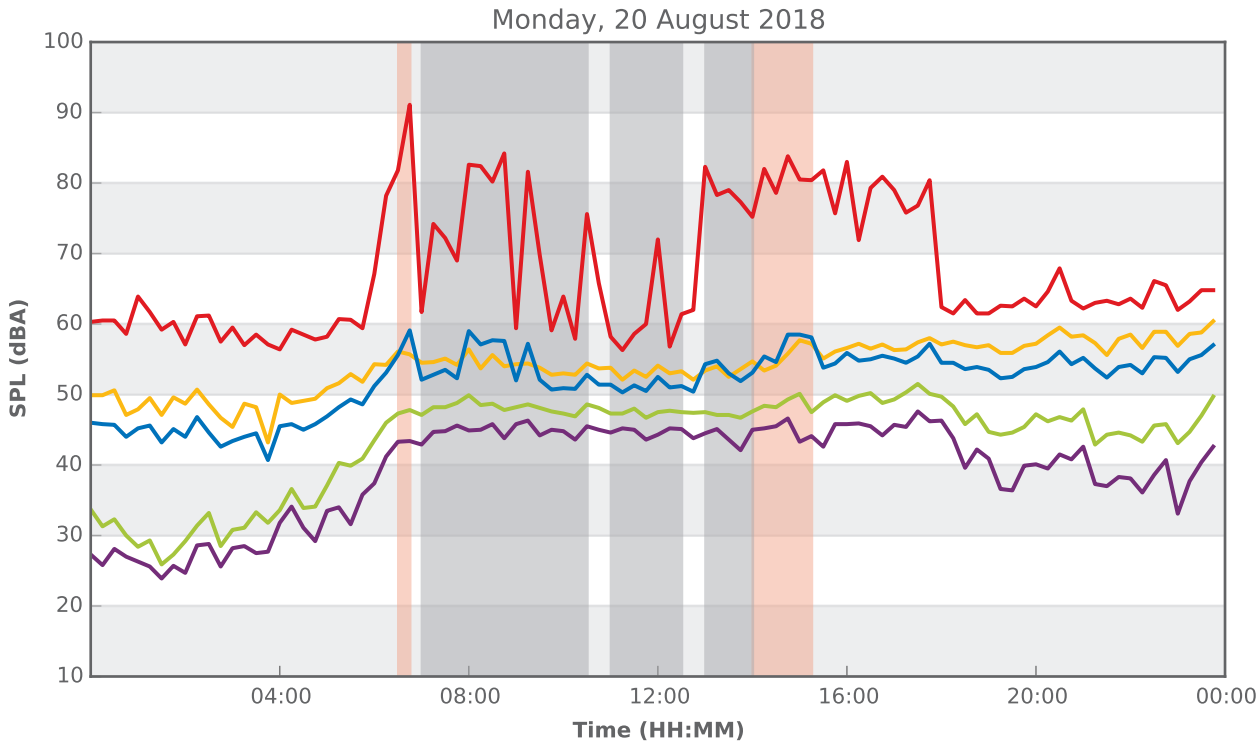
180 Scrubby Creek Road, South Kempsey



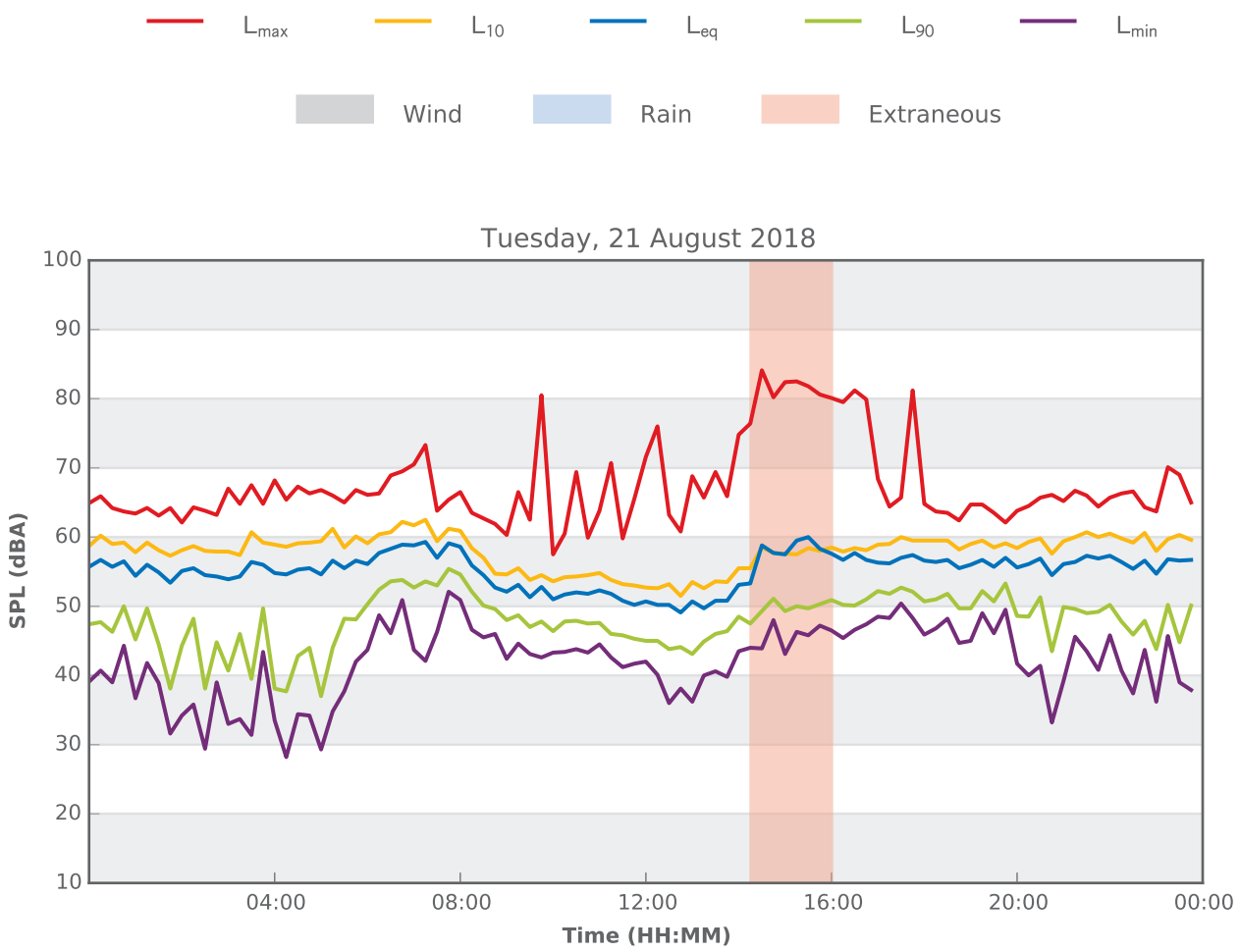


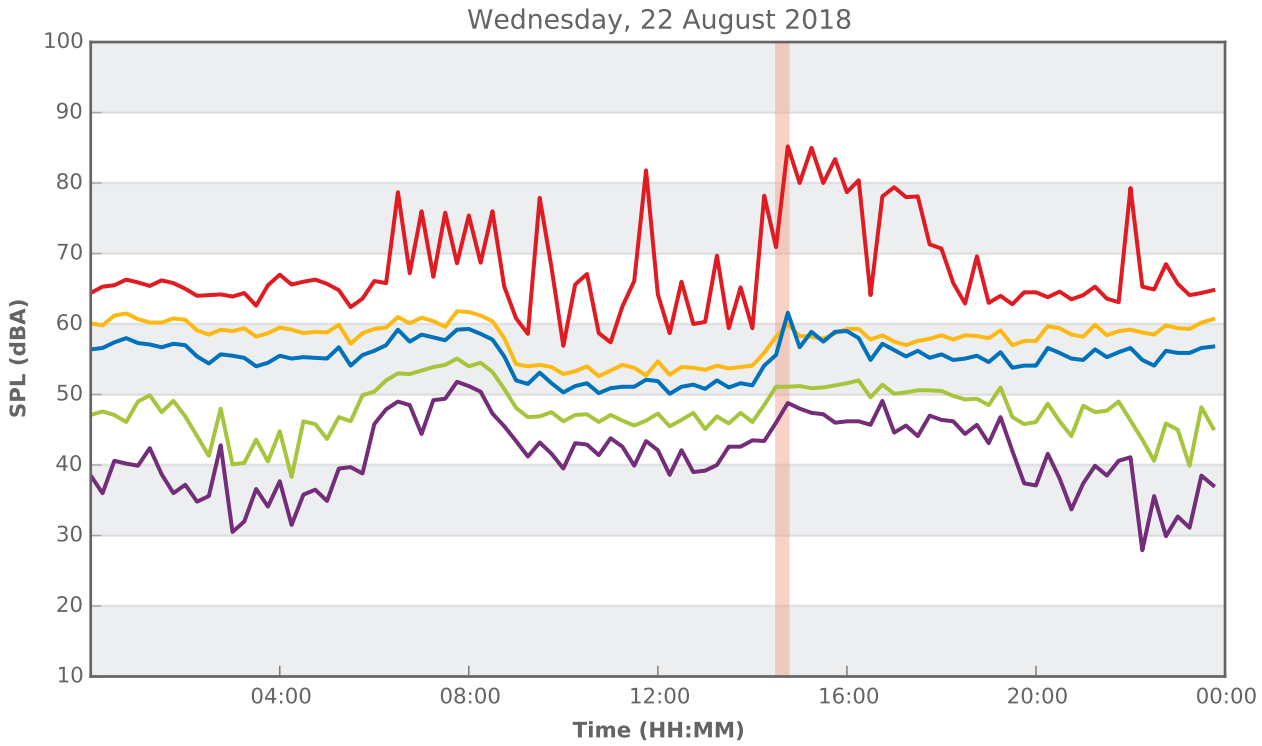
180 Scrubby Creek Road, South Kempsey



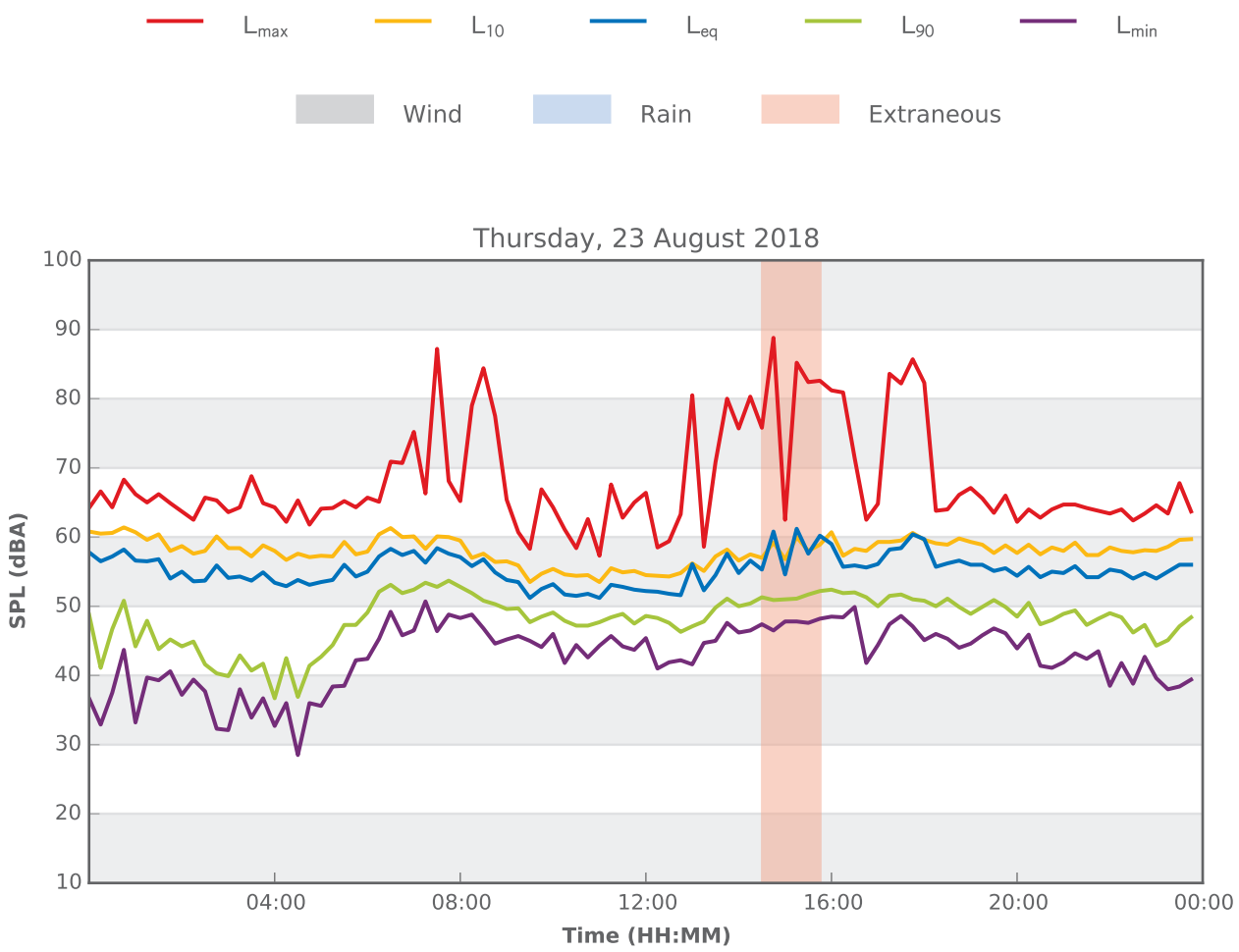


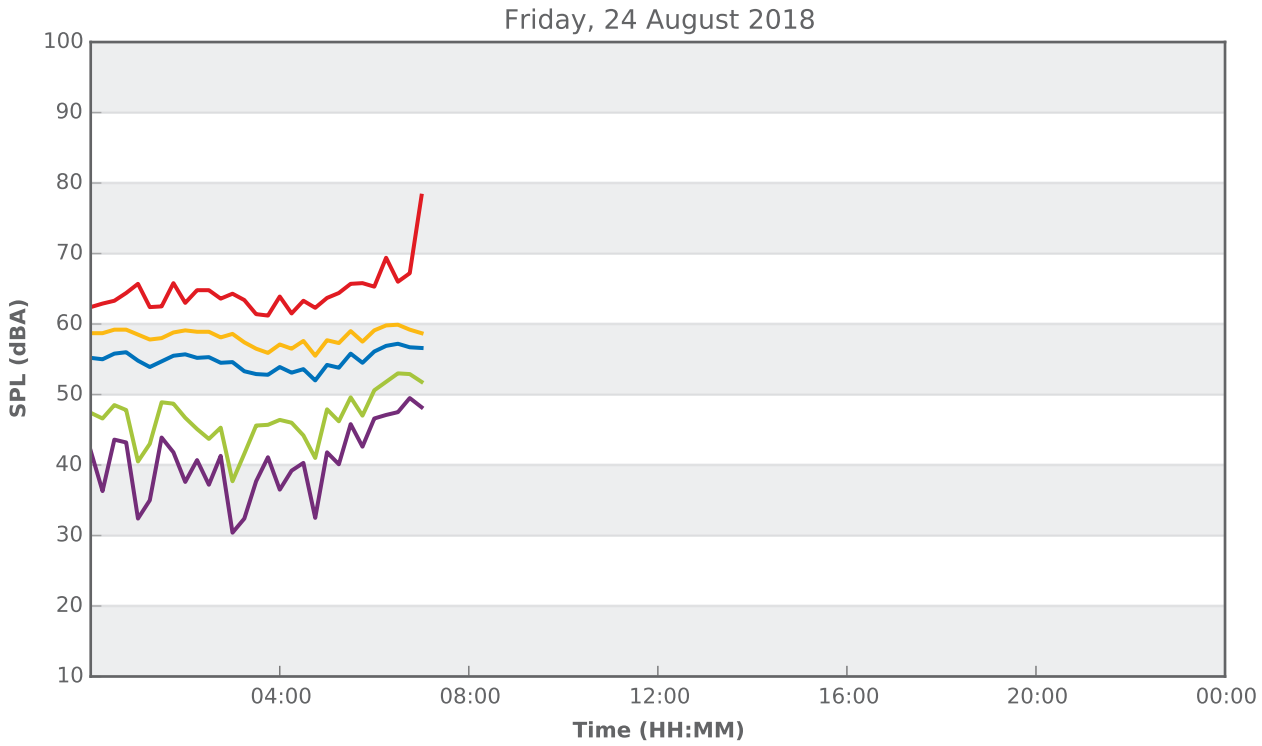
180 Scrubby Creek Road, South Kempsey





180 Scrubby Creek Road, South Kempsey



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