Hunter Power Project Response to Submissions

Noise Impact Assessment - Revised

Rev 1

30 July 2021

Snowy Hydro Limited

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Executive Summary

Background

Snowy Hydro Limited (Snowy Hydro) ('the Proponent') proposes to develop a gas fired power station near Kurri Kurri, NSW ('the Proposal'). The Proponent is seeking approval from the NSW Minister for Planning and Public Spaces under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Proposal.

The Proposal involves the construction and operation of an open cycle gas turbine power station. The power station would have a capacity of up to approximately 750 megawatts (MW), operating primarily on natural gas, with operation on diesel as required if there were a constraint or unavailability in the natural gas system and there was a need to supply electricity to the National Electricity Market (NEM).

The Proposal would operate as a "peak load" generation facility supplying electricity at short notice when there is a requirement in the National Electricity Market. The major supporting infrastructure that is part of the Proposal would be a 132 kV electrical switchyard located within the Proposal Site. The Proposal would connect into existing 132 kV electricity transmission infrastructure located adjacent to the Proposal Site. A new gas lateral pipeline and gas receiving station will also be required and this would be developed by a third party and be subject to a separate environmental assessment and planning approval. Other ancillary elements of the Proposal include:

- Storage tanks and other water management infrastructure
- Fire water storage and firefighting equipment such as hydrants and pumps
- Maintenance laydown areas
- Diesel fuel storage tank(s) and truck unloading facilities
- Stormwater basin
- Site access roads and car parking
- Office/administration, amenities, workshop/storage areas.

Key features of the existing environment

The Proposal Site is immediately surrounded by vacant industrial land to the south and east which will eventually be developed into separate industrial lots and form the nearest noise receivers to the Proposal. The immediate north and west of the Site is bushland and does not contain sensitive receivers. Approximately 1 km to the west of the Proposal Site is the suburb of Sawyers Gully, consisting of a number of rural residential and farmland land usage. Some 500 m to 1 km to the southeast of the Proposal Site is the suburb of Loxford, which is primarily rural residential in character while also containing a small number of light industrial, educational, and commercial receivers. The nearest sensitive receiver is a residence in Loxford approximately 1.2 km from the Proposal Site. Approximately 3 km northeast of the Proposal Site is the southern extent of Gillieston Heights, containing mostly farmland and isolated rural residential receivers.

Background noise monitoring was performed within each of the noise catchment areas (NCA) to determine the background noise conditions of each area, and in turn establish the noise criterion for the receivers in each area. Five noise catchment areas were established, representing Sawyers Gully east and west of Sawyers Gully Road, Eastern Loxford, Western Loxford and Gillieston Heights. Vibration receivers in the vicinity of the Proposal Site were identified, however all were far outside the typical range of vibration impact and therefore it was concluded that vibration from the Proposal is unlikely to be an issue.

Technical Inputs

Noise emissions have been predicted to occur during the construction and operation of the Proposal, as well as from Proposal traffic.

The construction noise levels have been determined by developing an equipment inventory for each general phase of construction works and applying an appropriate noise level for each piece of equipment from Jacobs' and other noise databases. The individual noise levels were then combined to form an overall sound power level for each phase of construction (detailed in Table 5.1). Likewise, any equipment that was predicted to be a source of vibration emissions was compared against vibration setback distances to determine the potential extent of vibration impacts resulting from the construction of the Proposal.

Operational noise impacts were determined based on sound power levels with noise attenuation measures in place, which were modelled to assess operational noise levels at receiving locations. Attenuation packages required by gas turbine suppliers in order to achieve operational noise levels that meet the regulatory criteria have also been identified. No vibration producing equipment is planned to be used during the operation of the Proposal.

Assessment of impacts

Noise impacts during the construction and operation phases were assessed using the SoundPLAN 8.0 acoustic modelling software. Noise levels at receivers were compared to criterion developed, using guidance from the Interim Construction Noise Guideline (ICNG) (DECCW, 2009) and Noise Policy for Industry (NPI) (NSW EPA, 2017). The contribution made to local traffic noise levels by the Proposal's construction and operational traffic were determined using the Roads and Maritime Services (RMS) Noise Estimator tool.

During the Proposal's construction, noise levels were predicted to be predominately below the noise management levels (NMLs). Construction phases 1, 3 and 8 have been predicted to produce noise levels above the NMLs by up to 1 – 6 dB(A) at residential receivers in NCA 2 and NCA 3. There are no known vibration receivers within the vibration setback distances of the Proposal Site. The estimated traffic noise levels during both the construction and operation stages were above the TfNSW Road Noise Policy's (RNP) 60 dB(A) day and 55 dB(A) night traffic noise criteria, which is primarily as a result of the existing traffic on the road. Construction traffic was determined to increase the overall traffic noise by 0.2 dB(A), hence not exceeding the RNP's 2 dB(A) road noise traffic increase criterion. Mitigation measures from the Interim *Construction Noise Guideline* have been advised to address the predicted noise impacts during construction.

Noise modelling of operational noise using the Proposal design with identified attenuation, demonstrated compliance with the *Noise Policy for Industry 2017* (NPI) project noise trigger levels at each of the nearest receivers within the five Noise Catchment Areas, as well as at the industrial lots nearest to the Proposal Site. Low frequency emissions were also accounted for with a 2 dB correction to operational noise levels as per guidance from the NPI. No exceedances were predicted as a result of this correction.

As with construction traffic, the operational traffic increased the overall traffic noise level by less than 0.1 dB(A) which is well below the 2 dB(A) traffic noise increase criterion.

A number of potential cumulative noise impacts related to the Proposal have been identified and considered in this assessment due to ongoing or new projects. The construction and operation of the gas receival station, which will be located within the Proposal Site but assessed under a separate environmental assessment, has been assessed to have a negligible impact on overall Proposal noise levels. Additionally, works taking place as part of the ongoing Hydro Aluminium smelter demolition and remediation may have cumulative impacts with the construction of the Proposal, leading to an increase in construction noise levels of up to 6 dB(A) depending on the location of the receiver. However, these impacts would be transient, and are unlikely to occur simultaneously. The potential cumulative impacts associated with the upcoming ReGrowth Kurri Kurri rezoning project have also been assessed and have been deemed unlikely to occur simultaneously.

In order to mitigate operational noise impacts, achieve the noise levels modelled in this assessment and comply with the relevant noise criterion, there will be a requirement for the equipment suppliers to provide attenuation for certain components of the power station, in order to match or exceed the attenuation used in this assessment. The attenuation measures to be adopted will be confirmed during detailed design and are expected to include:

- Slow fan speeds for cooling systems
- Improved sound enclosures
- Improved stack design
- Sound attenuation walls.

Following the commissioning of the Proposal, noise verification monitoring should be performed to confirm that operational noise levels are in line with those predicted in this assessment, with a focus on noise enhancing effects, in order to ensure that the adopted mitigation and management measures are preforming to the required noise levels to meet the noise criterion.

1. Introduction

1.1 Proposal background

Snowy Hydro Limited (Snowy Hydro) ('the Proponent') proposes to develop an open cycle gas fired power station near Kurri Kurri, NSW ('the Proposal'). The Proponent is seeking approval from the NSW Minister for Planning and Public Spaces under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Proposal.

The Proposal involves the construction and operation of a power station and electrical switchyard, together with other associated supporting infrastructure. The power station would have a capacity of up to approximately 750 megawatts (MW) which would be generated via two heavy duty gas turbines. Although primarily a gas fired power station, the facility would also be capable of operating on diesel as required if there were a constraint or unavailability in the natural gas system and there was a need to supply electricity to the National Electricity Market.

1.2 Secretary's Environmental Assessment Requirements (SEARs)

An Environmental Impact Statement (EIS) for the Proposal has been prepared under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This Noise Impact Assessment has been prepared to support the EIS. The purpose of this report is to address the relevant sections of the Secretary's Environmental Assessment Requirements (SEARs) issued on 5 February 2021 (SSI 12590060). The report preparation has also taken cognisance of any applicable agency comments. Table 1.1 outlines the SEARs relevant to this assessment.

Table 1.1: SEARs relevant to this assessment

Secretary's requirement
Noise and vibration – including assessment of the likely construction noise impacts of the Proposal under the *Interim Construction Noise Guideline* (DECCW, 2009)
Noise and vibration – including an assessment of the likely operational noise impacts of the Proposal under the *NSW Noise Policy for Industry* (EPA, 2017)
Noise and vibration – including an assessment of the likely road noise impacts of the Proposal under the *NSW Road Noise Policy* (EPA, 2011)
Noise and vibration – including an assessment of the likely vibration amenity and structural impacts of the Proposal under *Assessing Vibration: A Technical Guideline* (DEC, 2006) and *German Standard DIN 4150-3 Structural Vibration – effects of vibration on structures*

1.3 Proposal location

The Proposal Site is located approximately three kilometres (km) north of Kurri Kurri in New South Wales, in the small suburb or Loxford, and approximately 30 km north-west of Newcastle CBD (refer to Figure 1.1). The total area of the Proposal Site comprises approximately 6.81 hectares (ha) allocated to the power station, with an additional 3.73 ha of buffer land to the south, approximately 1.3 ha allocated for the electrical switchyard to the north and some additional land for a stormwater basin and an Asset Protection Zone around some parts of the Proposal Site boundary.

The Proposal Site is entirely located within the site of the former Kurri Kurri aluminium smelter site, which is owned by Hydro Aluminium Kurri Kurri Pty Ltd (Hydro Aluminium). The Proposal Site is immediately surrounded by land proposed to be zoned for industrial use to the east and south, while natural vegetation is located to the north and west and is currently zoned as Rural Landscape (RU2). Past the proposed industrial land and RU2 vegetation, the predominate land use is a combination of sparsely distributed receivers as well as a number of new residential developments, especially to the east of the site.

The Hunter Expressway runs northeast-southwest directly through the rural land to the south of the Proposal Site, providing the main access route to the Proposal Site.

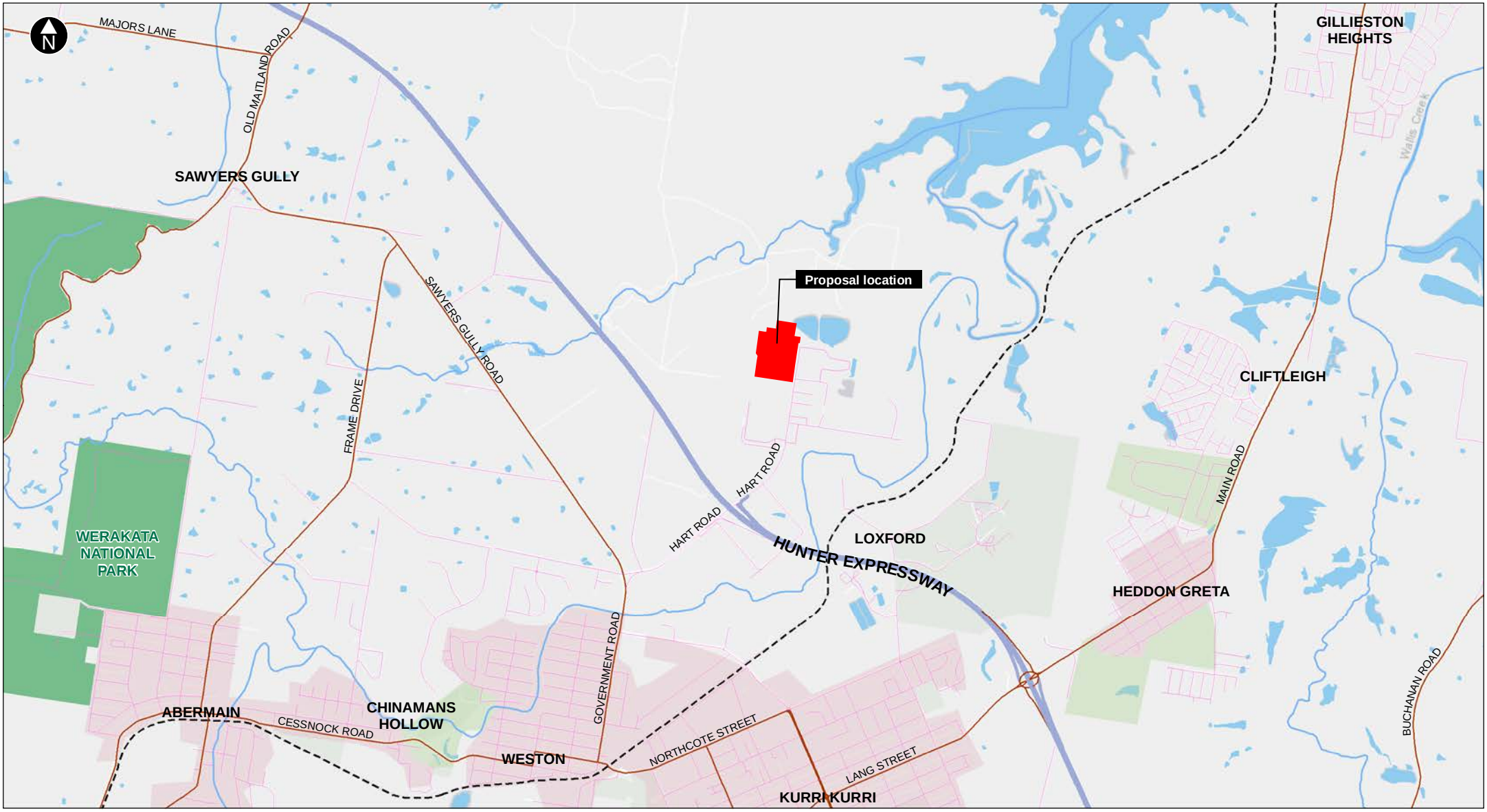

Figure 1-1 Project Location

1.4 Report structure

The report structure is as follows:

- Section 2: Proposal Description – describes the Proposal setting, details and potential noise and vibration-related risks.
- Section 3: Existing Environment – outlines key features of the existing environment including surrounding receivers and background noise levels.
- Section 4: Policy Setting and Criteria - establishes suitable assessment criteria.
- Section 5: Noise and Vibration Model Inputs – details the inputs used to calculate the noise and vibration impacts resultant from the Proposal.
- Section 6: Assessment of Impacts – estimates noise and vibration-related emissions during the construction and operation of the Proposal and predicts the potential for noise and vibration-related impacts at the identified surrounding receivers.
- Section 7: Mitigation and Management – evaluates the significance of these predictions and recommends mitigation and management measures.

2. Proposal description

2.1 Proposal overview

The Proposal involves the construction and operation of an open cycle gas fired power station comprising two heavy duty gas turbine generators. The power station would have a capacity of up to approximately 750 megawatts (MW).

The Proposal would operate as a “peak load” generation facility supplying electricity at short notice when there is a requirement in the National Electricity Market. The major supporting infrastructure that is part of the Proposal will be a 132 kV electrical switchyard located in the northern portion of the Proposal Site. The Proposal will connect into existing 132 kV electricity transmission infrastructure also located adjacent to the Proposal Site. A new gas lateral pipeline and gas receival station will also be required, and this would be developed by a third party, subject to a separate environmental assessment and planning approval. Other ancillary elements of the Proposal include:

- Storage tanks and other water management infrastructure
- Fire water storage and firefighting equipment such as hydrants and pumps
- Maintenance laydown areas
- Diesel fuel storage tanks and truck unloading facilities
- Stormwater basin
- Site access roads and car parking
- Office/administration, amenities, workshop/storage areas.

The Proposal is seeking approval for a capacity factor of up to 10 per cent on natural gas and up to two per cent on diesel (providing a combined capacity factor of 12 per cent) in any given year. However, it is expected that likely operations would result in a capacity factor of two per cent in any given year.

Construction activities are anticipated to commence early 2022 and the Proposal is intended to be fully operational by the end of 2023. The Proposal Site Layout is detailed in Figure 2.1.

2.2 Primary noise and vibration related risks

Noise and vibration-related impacts can arise when levels from industry or construction activities result in unacceptable levels at surrounding sensitive receivers. Noise has the potential to be generated during both the construction and operational phase of the Proposal, with vibration-generating plant and equipment also intended to be used during construction. The key construction and operational activities with the potential to generate noise and vibration during the Proposal include:

- Construction of the gas turbine units, switchyard and balance of plant
- Traffic related to the Proposal on roads around the Proposal Site
- Operation of the Proposal.

In addition to the above activities, noise impacts from additional traffic generated during the construction and operational phases of the Proposal have also been considered in this assessment.

Proposal site
Existing electrical transmission easement

Motorway
Main roads
Roads
Railway
Waterbodies

1 Proposed Switchyard Area
2 Proposed Plant Area
3 Proposed Buffer Area

0 250 500 m

1:12,000 at A4
Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

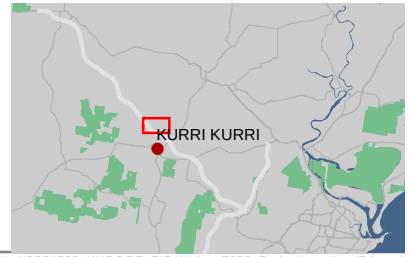

Figure 2-1 Project Overview

snowy hydro renewable energy Jacobs

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3. Existing environment

3.1 Surrounding land use

The Proposal Site is located entirely within a former industrial area, on land formerly occupied by the Kurri Kurri aluminium smelter which closed permanently in 2014 and is still undergoing demolition and remediation works. The Proposal Site and surrounds are currently zoned RU2 Rural Landscape under the *Cessnock Local Environmental Plan 2011*. However, the Proposal Site and vicinity is currently the subject of a rezoning application.

The rezoning, subdivision and industrial development of the Hydro Aluminium Kurri Kurri Pty Ltd land is a major planning proposal by Regrowth Kurri Kurri to rezone approximately 329 ha of land at and around the former Kurri Kurri aluminium smelter from Rural Landscape (RU2) to residential and public recreation, business, heavy and general industrial, infrastructure and environmental conservation (B1, B5, IN1, IN3, R2, RE1 and SP2 (in part)), to reduce the minimum lot size from 40 ha to 450 m^2 (in part) and to identify the site as an urban release area. Under this plan, the Proposal Site would be designated Heavy Industrial. On 1 December 2020 the NSW Department of Planning, Industry and Environment issued a Gateway Determination enabling Cessnock City Council to place the Hydro Kurri Kurri Planning Proposal on public exhibition for a minimum of 28 days and submissions closed on 1 February 2021.

Land use surrounding the Proposal Site is described as follows:

- To the west is Sawyers Gully, a suburb predominately comprised of farmland and sparsely distributed receivers. The suburb is adjacent to the Hunter Expressway, with a number of receivers in close proximity to the carriageway.
- To the southeast of the Proposal Site is Loxford
  - The western extent of Loxford, directly south of the Proposal Site comprises of sparsely distributed residential receivers with some industry, notably a pipe and manifold manufacturing facility. The NCA is adjacent to both the Hunter Expressway and the Kurri Kurri Wastewater Treatment Works. Under the proposed rezoning, the northern and eastern sections of the NCA will be rezoned to General Industry while the southern section would be rezoned to Low Density Residential.
  - The eastern side of Loxford (to the southeast of the Proposal Site), comprises of sparsely distributed residential receivers with the nearby Kurri Kurri TAFE. Under the proposed zoning, the residential areas of this section of Loxford would be rezoned as Low Density Residential.
- Further east of Loxford is the township of Cliftleigh, which is predominately features residential and commercial properties. The township also features a number of new and proposed residential developments.
- Northeast of the Proposal Site the area of Gillieston North comprises isolated farmhouses and pasture
- Approximately 2 km south of the Proposal Site is an existing industrial area, and slightly further south is the township of Kurri Kurri which is predominately residential and commercial.

The surrounding land uses, and noise sensitive receivers are detailed in Figure 3.1.

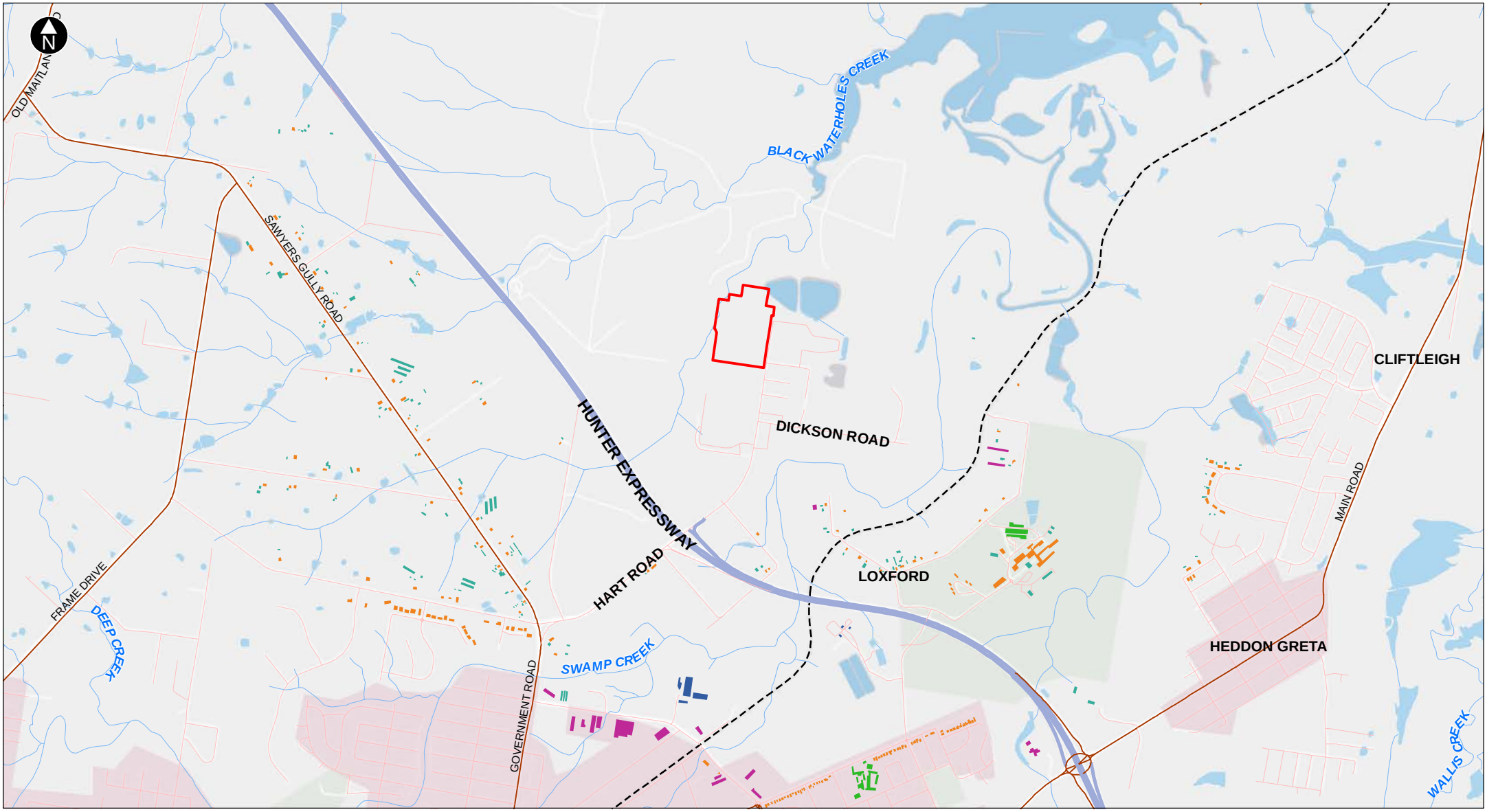

Figure 3-1 Noise Sensitive Receivers around the Project

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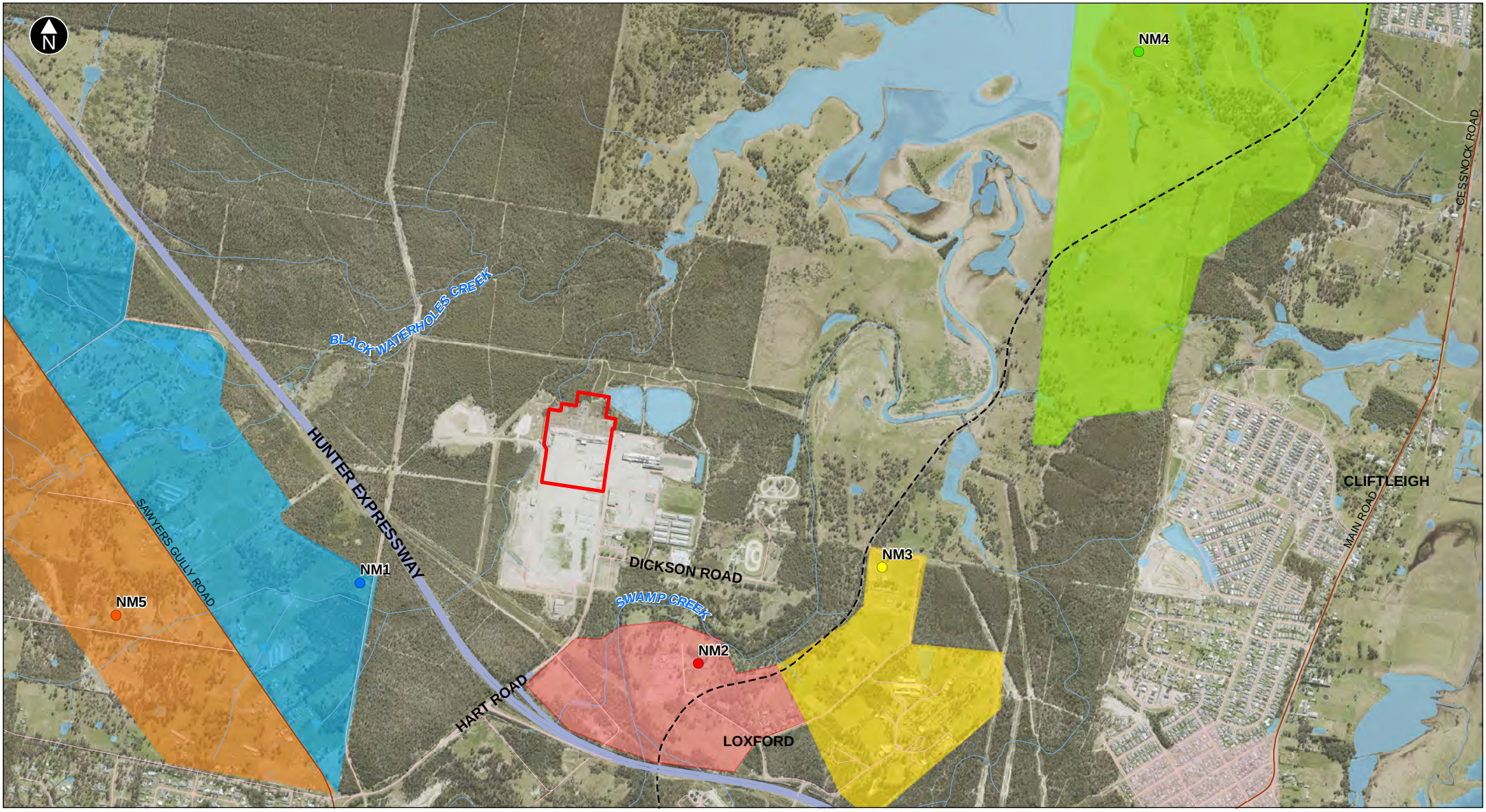
3.2 Noise catchment areas

Based upon the land use of the areas surrounding the Proposal Site, five Noise Catchment Areas (NCAs) have been established to assess potential noise impacts. In addition to the land use, other factors such as the predominate noise sources were also used to determine the NCAs. Table 3.1 below details each NCA, and the extent of the NCAs are displayed in Figure 3.2.

Table 3.1: Noise catchment area summary

Noise Catchment Area	Location	Approximate Distance of Nearest Sensitive Receiver from Centrepoint of Power Island	Predominate Land Uses	Predominate Background Noise Feature
NCA 1	Sawyers Gully (east of Sawyers Gully Road)	1,240 m	Rural Residential	Hunter Expressway, Environmental Noise
NCA 2	Western Loxford	1,150 m	Rural Residential, Light Industry	Hunter Expressway, Environmental Noise, Industrial Noise
NCA 3	Eastern Loxford	1,610 m	Rural Residential, Educational	Environmental Noise, Local Road Noise
NCA 4	Gillieston North	3,210 m	Farmland	Agricultural Noise, Environmental Noise
NCA 5	Sawyers Gully (west of Sawyers Gully Road)	1,955 m	Rural Residential	Environmental Noise, Local Road Noise



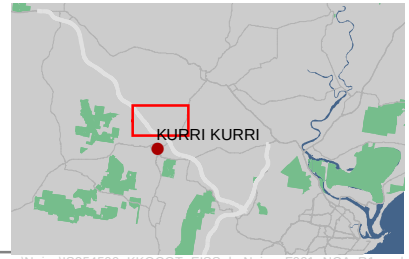
Proposal site
Motorway
Main roads
Roads
Railway

Noise Monitoring Locations
NM1
NM2
NM3
NM4
NM5

Noise Catchment Areas
NCA 1
NCA 2
NCA 3
NCA 4
NCA 5

0 0.5 1 km

1:25,000 at A4
GDA2020 MGA Zone 56



Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 3-2 Noise Catchment Areas

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3.3 Background Noise

3.3.1 Background Noise Levels

Revised background noise monitoring was performed during a period of 14 days between the 29 June and 13 July 2021. This monitoring was performed in response to commentary from the Environmental Protection Authority regarding background noise monitoring performed in December 2020 and January 2021 (detailed in Section 3.3.3). A monitoring location was selected to represent each of the NCAs. Monitoring was undertaken during the winter period in order to limit insect and other environmental noise to the greatest extent possible. A summary of the monitored background noise levels is provided in Table 3.2. Graphs of the monitored noise levels are detailed in Appendix C. It was noted that the evening period was louder than the day period at most noise monitoring locations, as a result of the noise controlling nature of traffic along the Hunter Expressway at NCA 1 and to a lesser extent NCA 2, as well as a result of frogs and other wildlife becoming more active (pertaining especially to NCAs 3, 4 and 5). In those cases, the criterion derived from these noise levels were adjusted to prevent the more sensitive time period from having a less noise sensitive criterion.

Table 3.2: Background noise levels

Monitor ID	NCA	Monitoring Location	Monitoring Duration	Measurement	Measured Noise Level – dB(A)		
					Day (7:00 am to 6:00 pm)	Evening (6:00 pm to 10:00 pm)	Night (10:00 pm to 7:00 am)
NM1	NCA 1	103 Bishops Bridge Rd, Sawyers Gully	29 June 2021 – 13 July 2021	L_{Aeq} (equivalent noise level)	55	57	53
				RBL (Background L_{A90})	45	45	36
NM2	NCA 2	10 Dawes Ave, Loxford	29 June 2021 – 13 July 2021	L_{Aeq} (equivalent noise level)	48	47	46
				RBL (Background L_{A90})	40	43	38
NM3	NCA 3	20 Bowditch Ave, Loxford	29 June 2021 – 13 July 2021	L_{Aeq} (equivalent noise level)	47	44	44
				RBL (Background L_{A90})	38	39	37
NM4	NCA 4	464 Cessnock Rd, Gillieston Heights	29 June 2021 – 13 July 2021	L_{Aeq} (equivalent noise level)	43*	38*	38*
				RBL (Background L_{A90})	29*	33*	30*
NM5	NCA 5	60 Metcalfe Lane, Sawyers Gully	29 June 2021 – 13 July 2021	L_{Aeq} (equivalent noise level)	45	46	42

Monitor ID	NCA	Monitoring Location	Monitoring Duration	Measurement	Measured Noise Level – dB(A)		
					Day (7:00 am to 6:00 pm)	Evening (6:00 pm to 10:00 pm)	Night (10:00 pm to 7:00 am)
				RBL (Background L_{A90})	37	41	35

** - Seven days of valid data was not obtained during monitoring and hence was not used to determine noise limits. Refer to the paragraph below.*

It is noted that at NM4 the noise logger was operational for three days (29 June to 1 July) before being damaged by an animal, preventing the device from operating for the remaining monitoring period. A second round of monitoring took place wherein the noise logger suffered a technical malfunction, allowing it to only collect a further three days of data (6 July to 8 July). Following the filtering of time periods of poor weather, approximately three and a half days of valid noise data remained in total. Due to there being less than the seven days recommended in the "Noise Policy for Industry" (NPI) (NSW EPA, 2017) and also due to the indicative RBLs based on the collected noise data, the 'minimum assumed RBLs' as presented in Table 2.1 of the NPI were adopted at NCA 4 for the assessment.

3.3.2 Background Noise Sources

To gain an understanding of the key sources contributing to background noise levels, handheld attended noise monitoring was undertaken during the monitoring period. The key noise sources observed are detailed in Table 3.3. A study of potential noise generating events, such as those from the Loxford Park Speedway and the Kurri Kurri TAFE found that no events that could generate significant noise took place. It was also noted that the COVID-19 outbreak in June-July 2021 may have resulted in changes to traffic levels and human activity, such as workers adopting working from home arrangements and traffic from Sydney not travelling along the Hunter Expressway due to travel restrictions. These influences may have had a quieting impact on background noise levels by reducing these noise sources.

During monitoring, it was noted that most noise sources were intermittent in nature, especially in regard to sources at NCA 3, NCA 4 and NCA 5. At NCA 1 and NCA 2, traffic along the Hunter Expressway was continuous and was audible throughout the measurement period. Additionally, traffic along the Hunter Expressway was the predominate noise source at NCA 1 and was a major contributing source at NCA 2. Traffic noise from the expressway was also audible and continuous at NCA 3, however it was not a major source of noise in comparison to more localised intermittent sources such as wind, birds and local traffic. The primary noise sources at NCA 4 were from local agriculture and animals, notably cows and dogs. Noise sources at NCA 5 were primarily from local traffic, in addition to animal sources (primarily horses and birds).

Table 3.3 Noise sources detected during attended monitoring

Monitoring Location	NCA 1	NCA 2	NCA 3	NCA 4	NCA 5
Time and Date	13 July 2021 10:50am	13 July 2021 12:41pm	13 July 2021 1:15pm	13 July 2021 11:45am	13 July 2021 10:21am
Recorded $L_{Aeq,15min}$ Noise Level	56 dB(A)	51 dB(A)	48 dB(A)	49 dB(A)	49 dB(A)
Recorded $L_{A90,15min}$ Noise Level	50 dB(A)	49 dB(A)	47 dB(A)	47 dB(A)	47 dB(A)

Monitoring Location	NCA 1	NCA 2	NCA 3	NCA 4	NCA 5
Day Noise Sources, L_{eq}	• Trucks passing on Expressway – 55 to 60 dB(A) • Traffic on Expressway – 53 dB(A) • Dogs barking – 62 dB(A) • Bird calls – 50 dB(A)	• Traffic on Expressway – 45 to 50 dB(A) • Passing car – 55 dB(A) • Bird calls – 50 dB(A) • Light plane overhead – 65 dB(A)	• Traffic on Expressway – 40 dB(A) • Birds – 56 dB(A)	• Cows 'mooing' – 50 dB(A) • Bird calls – 48 to 56 dB(A) • Dogs barking – 55 dB(A) • Trees rustling – 48 dB(A) • Light plane overhead – 65 dB(A)	• Traffic on Sawyers Gully Road – 47 dB(A) • Bird calls – 51 to 55 dB(A) • Horses – 50 dB(A) • Passing 4WD – 60 dB(A)

To identify other noise sources not detected during the short-term attended monitoring, an analysis of the unattended monitoring was performed. Based on this analysis, a number of additional sources were identified, as detailed below.

During the evening and night periods, traffic noise was still a continuous and major contributing noise source at NCA 1 and NCA 2, though traffic noise dropped off in the early hours of the morning. Frogs were also noted as a near continuous noise source at each NCA over the monitoring period and was a notable noise source during the night at NCA 3, NCA 4 and NCA 5.

Table 3.4 Noise sources identified through Firefly analysis

Time of Day	NCA 1	NCA 2	NCA 3	NCA 4	NCA 5
Day Noise Sources, L_{eq}	• No additional sources to those found during attended monitoring	• Mechanical sawing – 40 to 45 dB(A) • Reversing truck 'beepers' – 40 dB(A) • Clanging metal – 50 dB(A) • Grinding – 40 to 45 dB(A)	• Dirt Bike / Quad Bikes in adjacent property and road – 55 to 70 dB(A)	• No additional sources to those found during attended monitoring	• No additional sources to those found during attended monitoring
Evening Noise Sources, L_{eq}	• Frogs – 40 dB(A) • Plane overhead – 60 dB(A)	• Frogs – 40 dB(A) • Traffic on Expressway – 45 to 50 dB(A)	• Frogs – 40 dB(A) • Trees rustling – 40 dB(A) • Dirt Bike / Quad Bikes in adjacent	• Frogs – 35 dB(A) • Cows – 40 to 50 dB(A) (near continuous)	• Frogs – 45 dB(A) • Traffic on Sawyers Gully Road – 47 dB(A)

Time of Day	NCA 1	NCA 2	NCA 3	NCA 4	NCA 5
	• Traffic on Expressway – 55 dB(A) • Truck passing on Expressway – 65 dB(A)	• Clanging metal – 50 dB(A) • Plane passing overhead – 50 dB(A)	property and road – 55 to 70 dB(A) • Traffic on expressway – 45 dB(A) • Dogs in distance – 43 dB(A) • Horses in distance – 41 dB(A)	• Trees rustling – 30 dB(A) • Dogs barking – 55 dB(A)	• Bird calls – 50 dB(A) • Machinery – 55 dB(A) • Passing 4WD – 60 dB(A)
Night Noise Sources, L_{eq}	• Frogs – 40 dB(A) • Traffic on Expressway – 50 dB(A) • Truck passing on Expressway – 60 dB(A) • Single car passing on expressway – 47 dB(A) • Distant traffic (i.e. no traffic passing by) – 40 dB(A)	• Frogs – 40 dB(A) • Traffic on Expressway – 40 to 45 dB(A) • Truck passing on Expressway – 55 dB(A) • Tress rustling – below background	• Frogs – 40 dB(A) • Trees rustling – 40 dB(A) • Truck passing on expressway – 48 dB(A) • Traffic on expressway – 35 to 45 dB(A)	• Dogs barking – 55 dB(A) • Cows – 40 to 50 dB(A) (sporadic) • Trees rustling – 30 dB(A) • Frogs – 35 dB(A)	• Frogs – 40 dB(A) • Trees rustling – 35 dB(A) • Distant traffic – 35 to 40 dB(A) • Passing car – 50 dB(A)

3.3.3 Previous Monitoring Data

Initial background noise monitoring was performed during a period between December 2020 and January 2021. Monitoring locations were selected at each of the NCAs barring NCA 5, which was introduced in the revised noise assessment.

It is also noted that while monitoring was undertaken over two weeks, the overall data collected at each location (with the exception of NM3) amounted to eight days of data, which after filtering for rain and wind resulted in the minimum of 7 days of required data. At NM3, the noise logger was operational for three days (Mon 30 Nov to Wed 2 Dec) before being vandalised, preventing the device from operating for the remaining monitoring period. A second round of monitoring took place wherein the noise logger suffered a technical malfunction, allowing it to only collect two days of data (Fri 15 Jan to Sat 16 Jan). Following the filtering of time periods of poor weather, approximately four and a half days of valid noise data remained in total.

It was noted that monitored noise levels were notably higher during this round of monitoring compared to the revised monitoring data. This would potentially be the result of the contribution of cicadas and crickets, seasonal differences such as additional human activity and traffic during the summer months and the lack of influence from COVID-19 restrictions. The previously monitored background is summarised in Table 3.5. Due to the lack of valid data gathered during this round of monitoring, in addition to potential influence on background data by

summer insects, this round of background noise data was disregarded for the purposes of establishing noise criteria.

Table 3.5 Previously monitored background data

Monitor ID	NCA	Monitoring Location	Monitoring Duration	Measurement	Measured Noise Level – dB(A)		
					Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)
NM1	NCA 1	103 Bishops Bridge Rd, Sawyers Gully	15 Jan – 23 Jan 2021	L_{Aeq} (equivalent noise level)	56	58	53
				RBL (Background L_{A90})	47	48	44
NM2	NCA 2	10 Dawes Ave, Loxford	30 Nov – 14 Dec 2020	L_{Aeq} (equivalent noise level)	62	57	55
				RBL (Background L_{A90})	55	50	48
NM3	NCA 3	8 Bowditch Ave, Loxford	30 Nov – 14 Dec 2020, 15 Jan – 23 Jan 2021	L_{Aeq} (equivalent noise level)	58	55	52
				RBL (Background L_{A90})	52	44	46
NM4	NCA 4	464 Cessnock Rd, Gillieston Heights	30 Nov – 14 Dec 2020	L_{Aeq} (equivalent noise level)	56	51	51
				RBL (Background L_{A90})	48	48	45

3.4 Meteorological conditions

A study of Bureau of Meteorology data recorded at the Maitland Airport Automatic Weather Station (Station Number 061428) during the monitoring period found that winds predominately travelled from the west north-west, with wind speeds predominately ranging from 1.5 to 4.5 m/s and calms 21.7% of the time. It was also found that temperature inversions took place on more than 30% of nights (defined as 6pm to 7am) during monitoring.

For noise modelling, 'standard' and 'noise-enhancing' meteorological conditions consistent with the NPI were considered for the assessment. The specific meteorological conditions applied are detailed in Table 3.6.

Table 3.6: Meteorological parameters used in the assessment

Atmospheric Condition	Definition	Air Temperature (degrees centigrade)	Humidity (%)	Wind Velocity (m/s)	Barometric Pressure (millibars)	Atmosphere Stability Class
Standard	Stability categories A-D with wind speed up to 0.5 m/s at 10 m AGL	20	70	0	1013.3	D
Noise Enhancing Day	Stability categories A-D with light wind (up to 3 m/s at 10 m AGL)	20	70	3	1013.3	D
Noise Enhancing Night	Stability categories A-D with light wind (up to 3 m/s at 10 m AGL) and/or stability category F with winds up to 2 m/s at 10 m AGL	20	70	2	1013.3	F

3.5 Vibration sensitive receivers

Certain receivers and structures, such as medical centres, precision industry and heritage structures are typically more susceptible to vibration and are subject to more stringent criteria. The nearest medical centres to the Proposal Site, My Medical Services Kurri Kurri and Weston Medical Centre, are located 3.4 km south and 3.3 km southwest of the Proposal Site respectively. A single heritage structure has been identified in the vicinity of the Proposal, the South Maitland Railway System, located approximately 1.3 km from the Proposal Site. No precision industry was identified within a 4 km radius of the Proposal Site. At these distances, no vibration impacts from the Proposal Site are predicted.

4. Policy setting and criteria

4.1 Construction noise

4.1.1 Noise management levels

The "Interim Construction Noise Guideline" (ICNG) (Department of Environment and Climate Change [DECC], 2009) provides guidance for assessing noise from construction activities in NSW. It establishes noise management levels (NMLs) for recommended standard construction hours and for outside of the recommended standard hours. Construction is considered to have the potential to cause a noise impact if the predicted noise exceeds the applicable noise management level. Table 4.1 lists ICNG guidance for establishing construction NMLs at residential receivers.

Table 4.1: ICNG guidance for establishing construction NMLs at residential receivers

Time of day	Management level $L_{Aeq(15min)}$	How to apply
Recommended standard hours (SH): Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	Noise affected: Rating Background Level (RBL) + 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected: 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours (OoH) – All other times including public holidays	Noise affected: RBL + 5 dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see Section 7.2.2 of the ICNG.

Considering the adopted RBLs presented in Table 3.2, the NMLs for the identified surrounding residential receivers are presented in Table 4.2.

Table 4.2: Construction noise management levels (residential receivers)

NCA	NML $L_{eq\ 15\ min}$ dB(A)			
	Day (during standard hours) 7:00 am – 6:00 pm Weekdays, 8:00 am – 1:00 pm Saturdays	Day (outside standard hours) 7:00 am – 6:00 pm Outside of Standard Hours	Evening 6:00pm-10:00pm	Night 10:00pm-7:00am
NCA 1	55	50	50	41
NCA 2	50	45	45*	43
NCA 3	48	43	43*	42
NCA 4	45**	40**	35**	35**
NCA 5	47	42	42*	40

** Criteria reduced so Evening criteria is not higher than Day OoH criteria.*

*** Criteria derived from the NPI's minimum assumed RBLs (Table 2.1 of NPI).*

The ICNG also provides construction NMLs for non-residential land uses. These are presented in Table 4.3.

Table 4.3: ICNG NMLs for non-residential receivers

Non-residential receiver type	Noise management level, $L_{Aeq(15min)}$ (applies when properties are being used)
Commercial	External Noise Level – 70 dB(A)
Industrial	External Noise Level – 75 dB(A)
Educational facilities	Internal Noise Level – 45 dB(A)
Hospital / Medical	Internal Noise Level – 45 dB(A)
Place of Worship	Internal Noise Level – 45 dB(A)
Passive Recreation	External Noise Level – 60 dB(A)
Active Recreation	External Noise Level – 65 dB(A)

It should be noted that the NSW EPA is developing a new construction noise guideline, the *Construction Noise Guideline*, which is currently in-draft. When released, the *Construction Noise Guideline* will replace the ICNG.

4.1.2 Construction traffic noise impacts

Road traffic noise impacts due to the construction (and operation) of the Proposal were assessed against the following guidance from the application notes of the EPA's "NSW Road Noise Policy" (RNP) (2011):

> *'…for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.'*

In reference to the day or night assessment criterion above, the assessment refers to the following criterion provided in the RNP.

Table 4.4 Relevant road noise policy assessment criteria

Road Category	Type of project/land use	Assessment Criteria – dB(A)	
		Day (7am – 10pm)	Night (10pm – 7am)
Freeway/ arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq, (15\ hour)}$ 60 dB(A)	$L_{Aeq, (9\ hour)}$ 55 dB(A)

4.1.3 Sleep disturbance

For premises where night construction (and operations) occur, the potential for noise levels to lead to sleep disturbance should be considered. Section 4.3 of the ICNG discusses the method for assessing and managing sleep disturbance. This guidance references further information in the *NSW Road Noise Policy* (RNP) (NSW EPA, 2013) that discusses criteria for the assessment of sleep disturbance.

Where noise levels from a construction (or industrial) source at a residential receptor at night exceeds the following, a maximum noise level event assessment should be undertaken:

- $L_{Aeq,15min}$ 40 dB(A) or the RBL + 5 dB(A), whichever is greater, and/or
- L_{AFMax} 52 dB(A) or the RBL +15 dB(A), whichever is greater.

Based on this guidance, Table 4.5 and Table 4.6 present the sleep disturbance screening criterion for the noise catchment areas surrounding the Proposal.

Table 4.5: $L_{Aeq,15min}$ Sleep disturbance criterion

Noise Catchment Area	Night RBL (L_{A90} dB(A))	RBL + 5 dB(A)	Indicative $L_{Aeq,15min}$ Sleep disturbance criterion	Selected $L_{Aeq,15min}$ Sleep disturbance criterion
NCA 1	36	41	40	41
NCA 2	38	43		43
NCA 3	37	42		42
NCA 4	30	35		40
NCA 5	35	40		40

Table 4.6: L_{AFMax} Sleep disturbance criterion

Noise Catchment Area	Night RBL (L_{A90} dB(A))	RBL + 15 dB(A)	Indicative L_{AFMax} Sleep disturbance criterion	Selected L_{AFMax} Sleep disturbance criterion
NCA 1	36	51	52	52
NCA 2	38	53		53
NCA 3	37	52		52
NCA 4	30	45		52
NCA 5	35	50		52

4.1.4 'Annoying' noise characteristics

Equipment that has the potential to produce a tonal noise, an impulsive noise or any other type of noise defined by the ICNG as 'particularly annoying', the noise level for that particular equipment will receive a + 5 dB(A) penalty.

As per guidance from the NPI, the penalty for intermittent noise (i.e. the hammers, packers, and compactors) would only be applied during night periods. The penalty for tonal noise (i.e. road saws and grinders) will apply for all periods.

4.2 Operational noise

4.2.1 Overview

Operational noise criteria for the Proposal were determined in accordance with the NSW EPA's NPI which seeks to regulate noise impact from 'industrial activity' pertaining to noise from fixed industry and mechanical plant rather than from road, rail, or construction sources. To achieve this, the NPI applies two separate noise criteria:

- Limiting the intrusiveness of the Proposal's noise against the prevailing background noise, and
- Achieving suitable acoustic amenity for the surrounding land uses from industry.

The more stringent of these is used to define the operational noise criteria for a Proposal.

4.2.2 Intrusiveness noise levels

A noise source will be deemed to be non-intrusive if the monitored $L_{Aeq\ (period)}$ noise level of the development does not exceed the RBL by more than 5 dB(A). Table 4.7 presents the noise intrusiveness criteria for the noise catchment areas, based on their RBLs (see Table 3.2). Intrusiveness noise levels are not used directly as regulatory criterion. They are used in combination with the amenity noise level to assess the potential impact of noise, assess reasonable and feasible mitigation options and subsequently determine achievable noise requirements.

Table 4.7: NPI intrusiveness noise levels

Receiver Group	Time of Day	L_{90} (RBL) dB(A)	Allowance	Noise intrusiveness criteria dB(A)
NCA 1	Day (7:00 am to 6:00 pm)	45	+5 dB(A)	50
	Evening (6:00 pm to 10:00 pm)	45		50
	Night (10:00 pm to 7:00 am)	36		41
NCA 2	Day (7:00 am to 6:00 pm)	40		45
	Evening (6:00 pm to 10:00 pm)	43		45*
	Night (10:00 pm to 7:00 am)	38		43
NCA 3	Day (7:00 am to 6:00 pm)	38		43
	Evening (6:00 pm to 10:00 pm)	39		43*
	Night (10:00 pm to 7:00 am)	37		42
NCA 4	Day (7:00 am to 6:00 pm)	35**		40**
	Evening (6:00 pm to 10:00 pm)	30**		35**
	Night (10:00 pm to 7:00 am)	30**		35**
NCA 5	Day (7:00 am to 6:00 pm)	37		42

Receiver Group	Time of Day	L_{90} (RBL) dB(A)	Allowance	Noise intrusiveness criteria dB(A)
	Evening (6:00 pm to 10:00 pm)	41		42*
	Night (10:00 pm to 7:00 am)	35		40

** Level reduced to prevent noise level being higher than in the preceding period.*

*** Background levels and criteria derived from the NPI's minimum assumed RBLs (Table 2.1 of NPI).*

4.2.3 Amenity noise levels

As per the NPI (2017), the recommended amenity noise levels represent the objective for total industrial noise at a receiver location, whereas the Proposal amenity noise level represents the objective for noise from a single industrial development at a receiver location. Proposal amenity noise levels ensure that industrial noise levels remain within the recommended amenity noise levels for an area.

Amenity noise levels are not used directly as regulatory criterion. They are used in combination with the Proposal intrusiveness noise level to assess the potential impact of noise, assess reasonable and feasible mitigation options, and subsequently determine achievable noise requirements.

Table 4.8 presents the recommended amenity noise levels as per the NPI, and the Proposal amenity noise level (recommended amenity noise level minus 5 dB, plus 3 dB to convert from a period level to a 15-minute noise level). Table 4.8 also presents the amenity noise levels for non-residential land usage.

Table 4.8: NPI amenity noise criteria, residential receivers

Receiver	Time of Day	Recommended amenity L_{Aeq} Noise Level dB(A)	Proposal amenity $L_{eq\ 15\text{-}minute}$ Noise Level dB(A)
Residential receivers (Rural)	Day (7 am to 6 pm)	50	48
	Evening (6 pm to 10 pm)	45	43
	Night (10 pm to 7 am)	40	38
Residential receivers (Suburban)	Day (7 am to 6 pm)	55	53
	Evening (6 pm to 10 pm)	45	43
	Night (10 pm to 7 am)	40	38
Residential receivers (Urban)	Day (7 am to 6 pm)	60	58
	Evening (6 pm to 10 pm)	50	48
	Night (10 pm to 7 am)	45	43
Commercial	When in use	65	63
Industrial	When in use	70	68
Educational / Childcare	Noisiest 1-hour period when in use	35 (internal), 45 (external)	33 (internal), 43 (external)
Hospital / Medical	Noisiest 1-hour period	35 (internal), 50 (external)	33 (internal), 48 (external)
Place of Worship	When in use	40 (internal), 50 (external)	38 (internal), 48 (external)
Passive Recreation	When in use	50	48
Active Recreation	When in use	55	53

As detailed in Table 4.8, amenity noise levels for residential receivers are defined based on three amenity noise areas: urban, suburban, and rural. The most appropriate amenity noise area needs to be selected for each NCA. The selected amenity noise area for each NCA and the justification for each selection have been detailed in Table 4.9.

It was noted that the land use surrounding the project were primarily rural in nature, however at NCA 1 and NCA 2, noise sources such as major through traffic from the Hunter Expressway and local industry influence background noise in these locations. Additionally, RBLs in some cases were higher than those typical of rural receivers in the NPI's guidance regarding the selection of the appropriate amenity area. As such from a noise perspective, these locations are somewhat atypical of a rural residential location, in spite of the current land use zoning.

Table 4.9 Determination of amenity noise areas

Noise Catchment Area	Applicable Noise Amenity Area	Reasoning (In reference to Table 2.3 of the Noise Policy for Industry)
NCA 1	Urban	• RBLs match the 'Typical existing background noise levels' for an Urban Receiver as per Table 2.3 of the NPI • The acoustical environment predominately features heavy and continuous through-traffic during peak periods (due to the proximity of the Hunter Expressway) • Future zoning as per the ReGrowth Kurri Kurri Rezoning, subdivision, and industrial development places the NCA closer to industrial and business zones, more in line with an urban setting
NCA 2	Urban	• Evening and night RBLs match the 'Typical existing background noise levels' for an Urban Receiver as per Table 2.3 of the NPI • Existing industry located in or near the NCA, including a piping and manifolds manufacturer to the north of the NCA and wastewater treatment plant to the south of the NCA • Acoustical environment influenced by through-traffic on the Hunter Expressway • Future zoning as per the ReGrowth Kurri Kurri Rezoning, subdivision, and industrial development places the NCA within a short proximity to a number of industrial zones, in addition to residential zoning, more in line with an urban setting
NCA 3	Suburban	• Evening and night RBLs match the 'Typical existing background noise levels' for a Suburban Receiver as per Table 2.3 of the NPI • Acoustical environment predominately features human activity (including vehicles) and environmental noise • Future zoning as per the ReGrowth Kurri Kurri Rezoning, subdivision, and industrial development rezones the NCA to a low-density residential zone, more in line with a suburban setting
NCA 4	Rural	• Evening and night RBLs match the 'Typical existing background noise levels' for a Rural Receiver as per Table 2.3 of the NPI

Noise Catchment Area	Applicable Noise Amenity Area	Reasoning (In reference to Table 2.3 of the Noise Policy for Industry)
		• Acoustical environment predominately features agricultural and environmental noise • Land is currently zoned as Rural Landscape under the Maitland Local Environmental Plan 2011
NCA 5	Suburban	• Evening and night RBLs match the 'Typical existing background noise levels' for a Suburban Receiver as per Table 2.3 of the NPI • Acoustical environment predominately features local traffic along Metcalfe Lane and Sawyers Gully Road and environmental noise

The NPI additionally notes that under circumstances where noise from heavy traffic may be high enough to effectively render industrial noise sources inaudible, the Project Amenity Noise Level may be derived from the following process:

$$\text{High Traffic Project Amenity Noise Level} = L_{Aeq,period(traffic)} \text{ minus } 15 \text{ dB(A)}$$

This method for determining the Project Amenity Noise Level can only be applied if all of the following apply:

- Traffic noise is the dominant noise source at the site
- the existing traffic noise level (determined using the procedure outlined in A2, Fact Sheet A, that is, measuring traffic instead of industrial noise) is 10 dB or more above the recommended amenity noise level for the area
- it is highly unlikely traffic noise levels will decrease in the future.

It was determined that while points one and three above are applicable for NCA 1, the second point may not be applicable for all receivers in the NCA. The day, evening and night $L_{Aeq,15min}$ levels measured at NCA 1 (which were dominated by traffic noise), measured 55 dB(A), 57 dB(A) and 53 dB(A), respectively. These levels are below or less than 10 dB(A) above the urban recommended amenity noise levels.

Even taking into consideration the more stringent, rural recommended amenity noise levels, the measured traffic noise levels are 5 dB(A), 12 dB(A) and 13 dB(A) above day, evening and night amenity noise levels. As such, for receivers further west of the Expressway in NCA 1, the traffic noise levels may be less than 10 dB(A) above the recommended amenity noise levels during all time periods.

Hence, while traffic noise is the dominant noise source at NCA 1, the application of the High Traffic Project Amenity Noise Level is not applicable at this NCA and usage of an amenity noise area was adopted to determine the Project Amenity Noise Level for NCA 1.

4.2.4 Proposal operational noise criteria

The NPI recommends that the more stringent values between intrusiveness and amenity noise level criteria be applied for an operational noise assessment. Considering the intrusive and amenity criteria outlined in Section 4.2.2 and Section 4.2.3, Table 4.10 presents the operational noise criteria adopted for the various NCAs related to the Proposal and this assessment.

Table 4.10: Proposal operational noise criteria

Receiver type	Time of day	Recommended L_{Aeq} Noise Level dB(A)
NCA 1	Day (7:00 am to 6:00 pm)	50
	Evening (6:00 pm to 10:00 pm)	48
	Night (10:00 pm to 7:00 am)	41
NCA 2	Day (7:00 am to 6:00 pm)	45
	Evening (6:00 pm to 10:00 pm)	45
	Night (10:00 pm to 7:00 am)	43
NCA 3	Day (7:00 am to 6:00 pm)	43
	Evening (6:00 pm to 10:00 pm)	43
	Night (10:00 pm to 7:00 am)	38
NCA 4	Day (7:00 am to 6:00 pm)	40
	Evening (6:00 pm to 10:00 pm)	35
	Night (10:00 pm to 7:00 am)	35
NCA 5	Day (7:00 am to 6:00 pm)	42
	Evening (6:00 pm to 10:00 pm)	42
	Night (10:00 pm to 7:00 am)	38

4.2.5 Sleep disturbance

The NPI (2017) also derives its guidance for the sleep disturbance screening criteria from the RNP (NSW EPA, 2011), and as such the criteria adopted for the construction phase (refer to Table 4.5) is also applicable for the operations phase.

4.2.6 'Annoying' noise characteristics

'Annoying' noise characteristics associated with the operation of industrial facilities are addressed in Fact Sheet C of the NPI. Where an 'annoying' noise characteristic is identified, a positive correction will be applied to the noise levels to account for it. For this assessment, the two most likely 'annoying' noise characteristics are tonality and low frequency noise.

Where a tonal noise is predicted to be generated from a noise source, a one-third octave analysis should be performed using the methodology detailed in *ISO 1996-2:2007 Annex D: Objective Method for Assessing the Audibility of Tones in Noise*. Where the level of one-third octave band exceeds the level of the adjacent bands on both sides by:

- 5 dB or more if the centre frequency of the band containing the tone is in the range 500–10,000 Hz;
- 8 dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz; or
- 15 dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz.

Then a correction of 5 dB should be applied to the noise source.

Low Frequency Noise is accounted for using a two-step assessment of the A-weighted and C-weighted noise levels. A correction for low frequency noise will be applied where:

1) The C-weighted noise contribution is 15 dB greater than the A-weighted noise source contribution at a noise receiver, AND

2) Any of the third octave noise levels presented in Table C2 of Fact Sheet C are exceeded at the noise receiver.

Where the exceedance of the third octave noise levels is less than or equal to 5 dB, a correction of 2 dB is applied during the evening and night periods, and where the exceedance of the third octave noise levels is greater than 5 dB, a correction of 5 dB is applied during the evening and night periods.

4.3 Vibration

4.3.1 Overview

Vibration arising from construction activities can result in impacts on human comfort or the damage of physical structures such as dwellings. These two outcomes have different criterion, with the effects of vibration on human comfort having a lower threshold.

4.3.2 Human comfort

With respect to human comfort, vibration arising from construction activities must comply with criteria presented in "Assessing Vibration: a technical guideline", (DECC, February 2006) and *British Standard 6472-1: 2008 Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting* [BS 6472-1: 2008]. DECC, 2006 identifies three different forms of vibration associated with construction activities:

- Continuous: uninterrupted vibration occurring over a defined period
- Impulsive: short-term (typically less than two seconds) bursts of vibration which occurs up to three times over an assessment period
- Intermittent: interrupted periods of continuous or repeated impulsive vibration, or continuous vibration that varies significantly in magnitude.

Continuous vibration may result from steady road traffic or steady use of construction equipment (i.e. generator). Impulsive vibration may arise during the loading or unloading of heavy equipment or materials or infrequent use of hammering equipment. Intermittent vibration may arise from the varied use of construction equipment (i.e. a dump truck moving around a site, idling while being loaded with materials, and then dumping the materials) or repeated high-noise activities such as hammering, piling or cutting.

Preferred and maximum values of human exposure for continuous and impulsive vibrations are listed in Table 4.11 (DECC, 2006), for relevant receivers to this Proposal. As per DECC, daytime is between 7:00 am and 10:00 pm, and night is between 10:00 pm and 7:00 am.

Table 4.11: Preferred and maximum weighted Root Mean Square (RMS) values for continuous and impulsive vibration acceleration (m/s^2) 1-80 Hz

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis[2]	x and y axis[2]	z-axis	x and y axis
Continuous vibration					
Residences	Day	0.010	0.0071	0.020	0.014
	Night	0.007	0.005	0.014	0.010
Impulsive vibration					
Residences	Day	0.30	0.21	0.60	0.42

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis[2]	x and y axis[2]	z-axis	x and y axis
	Night	0.10	0.071	0.20	0.14

[1] Daytime is 7:00 am to 10:00 pm. Night-time is 10:00 pm to 7:00 am

[2] z-axis refers to vertical vibration, while the x and y axes refer to horizontal vibration.

Intermittent vibration is assessed differently using vibration dose values (VDV). Preferred and maximum VDVs for different types of receivers have been reproduced in Table 4.12 for relative receivers in this assessment.

Table 4.12: Preferred and maximum VDVs for intermittent vibration ($m/s^{-1.75}$), (DECC, 2006)

Location	Day time (7:00 am to 10:00 pm)		Night-time (10:00 pm to 7:00 am)	
	Preferred VDV	Maximum VDV	Preferred VDV	Maximum VDV
Residences	0.20	0.40	0.13	0.26

4.3.3 Buildings and structures

Section J4.4.3 of *Australian Standard AS2187.2 – 2006 Explosives – Storage and use Part 2: Use of explosives* provides frequency-dependent guide levels for cosmetic damage to structures arising from vibration. These levels are adopted from *British Standard BS7385: 1990 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from groundborne vibration* [BS7385-2:1993] and are presented in Table 4.13.

Table 4.13: Transient vibration guideline values for cosmetic damage

Type of building	Peak particle velocity (ppv) mm/s		
	4 to 15 Hz	15 to 40 Hz	40 Hz and above
Reinforced or framed structures industrial and heavy commercial buildings	50		
Un-reinforced or light-framed structures residential or light commercial type buildings	15 to 20	20 to 50	50

Guidance for more sensitive structures is presented in the German standard, *DIN 4150-3 Vibrations in buildings – Part 3: Effects on structures* (DIN 4150-3: 2016). Vibration velocities not exceeding 3 mm/s at 1 to 10 Hz are recommended in this standard.

4.3.4 Construction noise and vibration guideline

Section 7 of the Construction Noise and Vibration Guideline (CNVG), (Roads and Maritime Services, 2016) provides guidance for safe working distances to achieve human comfort (*Assessing Vibration: a technical guideline*, (DECC, 2006) and cosmetic building damage (BS7385-2:1993) criteria for a range of different plant and equipment. These safe working distances are relevant for some plant and equipment that may be used during construction of the Proposal, and so this guidance (presented below in Table 4.14) was considered.

Table 4.14: Recommended safe setback distances

Plant	Rating / description	Safe working distance (metres)	
		Cosmetic damage (Ref: BS7385-2: 1993)	Human response (Ref: DECC, 2006)
Vibratory Roller	<50 kN (typically 1-2 tonne) <100 kN (typically 2-4 tonne) <200 kN (typically 4-6 tonne) <300 kN (typically 7-13 tonne) >300 kN (typically 13-18 tonne) >300 kN (> 18 tonne)	5 m 6 m 12 m 15 m 20 m 25 m	15 m to 20 m 20 m 40 m 100 m 100 m 100 m
Small hydraulic hammer	300 kg – 5 to 12 tonne excavator	2 m	7 m
Medium hydraulic hammer	900 kg – 12 to 18 tonne excavator	7 m	23 m
Large hydraulic hammer	1600 kg – 18 to 34 tonne excavator	22 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	20 m
Pile boring	≤800 mm	2 m (nominal)	4 m
Jackhammer	Handheld	1 m (nominal)	2 m

5. Technical inputs

5.1 Construction noise emissions

5.1.1 Construction staging and plant

Sound power levels were estimated for certain main phases of construction for the Proposal. Sound power levels for each construction phase were determined by developing an inventory of noise producing equipment and the estimated numbers of equipment based on the works taking place, and estimating the sound power levels of each piece of equipment using sound power levels presented in national and international standards and guidelines, as well as from a Jacobs measurement database.

The indicative construction phases for the Proposal works are presented in Table 5.1.

Table 5.1: Construction phase sound power levels

Phase	Works	Location	Equipment	Number of Equipment	Individual Equipment SWL	Phase SWL
1	Site earthworks	Whole Site	Excavator 5-20t	1	99	117
			Dozer	1	116	
			Grader	1	108	
			Delivery Truck	1	100	
			Generator	1	101	
			Roller	1	104	
			Water Cart	1	95	
			Cars	1	95	
2	Pile foundations	Power Islands	Franna	1	99	117
			Piling Rig (Driven)*	1	116	
			Hand Tools	1	94	
			Concrete Truck	1	109	
			Delivery Truck	1	100	
			Generator	1	101	
			Cars	1	95	
3	Underground services	From power islands to gas receiving station, demineralised water plant, fuel oil storage tanks, stormwater basin and control building	Excavator 5-20t	1	99	119
			Concrete Saw**	1	118	
			Roller	1	104	
			Vacuum Truck	1	109	
			Hand Tools	1	94	
			Delivery Truck	1	100	
			Generator	1	101	
			Cars	1	95	

Phase	Works	Location	Equipment	Number of Equipment	Individual Equipment SWL	Phase SWL
4	Balance of plant (BoP)	Closed Cycle heat exchangers, Demineralised Water Tanks, Potable Water Tanks, Fuel Oil Storage Tanks, Buildings	Franna	1	99	111
			Excavator 5-20t	1	99	
			Hand Tools	1	94	
			Concrete Truck	1	109	
			Delivery Truck	1	100	
			Generator	1	101	
			Cars	1	95	
5	Switchyard – Electrical	Switchyard	Power Hand Tools	1	96	106
			Welder	1	97	
			Generator	1	101	
			Franna	1	99	
			Delivery Truck	1	100	
			Cars	1	95	
6	Primary installation of gas turbine and generator	Power Islands	Power Hand Tools	1	96	106
			Welder	1	97	
			Generator	1	101	
			Franna	1	99	
			Delivery Truck	1	100	
			Cars	1	95	
7	HV electrical installation	GT Transformers	Power Hand Tools	1	96	108
			Excavator 5-20t	1	99	
			Generator	1	101	
			Roller	1	104	
			Delivery Truck	1	100	
			Cars	1	95	
8	Site Surfacing	Whole Site	Paving Machine	1	104	119
			Concrete Truck	1	109	
			Roller	1	104	
			Excavator 5-20t	1	99	
			Generator	1	101	
			Grader	1	108	
			Concrete Saw**	1	118	
			Delivery Truck	1	100	
			Cars	1	95	

* - Receives a 5 dB(A) penalty for intermittent noise when works take place during night periods. As the works will not take place at night, no penalty was applied.

** - Receives a 5 dB(A) penalty for tonal noise. The time correction applied to the saw and grinder (typically 5 minutes out of a 15-minute period) and the penalty have both been taken into account when calculating the equipment noise level.

5.1.2 Vibration-generating plant and equipment

From the plant and equipment expected to be used during the construction phase of the Proposal, the following pieces of equipment were identified as vibration-generating:

- Vibratory roller
- Piling rig.

These pieces of equipment were considered as the potential sources of vibration during the construction of the Proposal and were considered in the vibration impact assessment.

5.1.3 Construction timing

For this assessment, it has been assumed that construction works will take place during standard construction hours, with the potential for some out of hours day works (i.e. Saturdays 1:00 pm – 6:00 pm) occurring.

5.1.4 Construction traffic

The Proposal would result in additional traffic movements to the Proposal Site, which would result in additional vehicle-related noise emissions being generated.

During construction, the predicted peak additional traffic flows were estimated as follows (Note: one vehicle entering then leaving the site is counted as two vehicle movements, one in and one out):

- Up to 400 additional light vehicle movements per day, with morning and afternoon peaks (200 inbound trips during the morning peak hour and 200 outbound trips during the afternoon peak hour)
- Approximately 120 additional heavy vehicle movements (60 inbound trips and 60 outbound trips)
- Approximately two additional oversize overmass heavy vehicle movements during the night (one inbound trip and one outbound trip).

5.2 Operational noise emissions

5.2.1 Operational plant and equipment

The operational noise was largely divided into two sources, emanating from the power islands (i.e. the gas turbines, generator, stack along with the other supporting equipment), and the balance of plant (i.e. diesel unloading station, water pumps and the demineralization plant). Table 5.2 details the estimated noise levels of the main power island components based on a representative 'typical' offering from the major equipment suppliers, in addition to noise reductions that would be achieved by attenuation to be included in the Proposal. The table also displays the attenuated component levels, which were used in the noise modelling and impact assessment.

The attenuation was modelled as being applied equally across the dB(A), dB(C) and unweighted dB, and the levels of attenuation required have been developed to sit well below what is considered feasibly possible to be provided from a supplier. Table 5.3 displays the indicative noise levels from the balance of plant.

It is noted that while the switchyard to the north of the power station is part of the Proposal Site, the switchyard noise levels have been considered to be negligible as the associated generator step-up transformers would be located within the power island footprints. As such, the noise levels from the power islands would mask any noise generated from the electrical switchyard itself.

The power island noise levels for the Proposal have been derived from 1/3 octave noise data provided to Jacobs by potential equipment suppliers. Due to confidentiality reasons, this 1/3 octave data has not been shown. Instead, 1/3 octave data predicted at each residential receiver has been displayed in Table 5.4 to demonstrate

the incorporation of 1/3 octave data in modelling. These frequencies will also be used to determine the requirement for penalties regarding annoying noise characteristics.

Table 5.2: Power island sound power levels

Noise Source	Unattenuated SWL			Attenuation Applied (dB)	Attenuated SWL		
	dB	dB(A)	dB(C)		dB	dB(A)	dB(C)
Exhaust Stack/Opening	135	109	132	12	123	97	120
Exhaust Diffuser	125	112	122	14	111	98	108
Gas Turbine Housing	122	104	123	6	116	98	117
Gas Turbine Air Inlet	117	107	116	12	105	95	104
Gas Turbine Generator Enclosure	121	102	119	5	116	97	114
Generator Step-up Transformers*	116	104	115	5	111	99	110
Generator Fin Fan Cooler	116	100	112	3	113	97	109
Hydraulic Skid	99	96	99	Nil	99	96	99
Liquid Fuel Module	100	96	99	Nil	100	96	99
Fuel Gas Systems	99	96	98	Nil	99	96	98

** Transformers were indicated as a candidate for the tonality noise level correction as per Fact Sheet C of the NPI. However, suppliers have indicated that the transformers will be attenuated for tonal noise, hence the attenuated transformers were predicted to not pose a tonal noise risk and the tonality correction was not applied.*

Table 5.3: Balance of plant sound power levels

Noise Source	Overall SWL		
	dB	dB(A)	dB(C)
Water Tank Pumps	95	93	95
Liquid Fuel (diesel) Pump Station	88	85	88
Demineralization Plant	88	85	88

Table 5.4 Predicted 1/3 octave sound pressure levels at nearest receivers

Nearest Receiver	Predicted Unweighted Sound Pressure Level (dB) Frequency																									
	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1k Hz	1.25k Hz	1.6k Hz	2k Hz	2.5k Hz	3.15k Hz	4k Hz	5k Hz
NCA1	55	48	42	56	51	46	53	49	45	45	41	39	36	34	32	34	32	31	29	28	27	21	21	21	11	11	11
NCA2	57	50	44	57	52	47	55	51	47	48	45	42	40	38	36	37	35	34	29	29	28	24	24	24	15	15	16
NCA3	52	46	39	53	48	43	50	46	42	43	40	37	35	33	31	33	31	30	25	24	23	18	18	18	4	4	5
NCA4	43	36	30	43	38	33	41	36	33	34	31	28	25	23	20	22	20	19	11	10	10	-	-	-	-	-	-
NCA5	49	42	36	50	45	40	47	43	39	39	36	33	31	28	26	28	27	25	21	20	20	12	11	11	-	-	-

5.2.2 Operational traffic

The operation of the Proposal would require traffic movements to deliver personnel, fuel and equipment to the Proposal Site. As with during construction, this would result in additional vehicle-related noise emissions generated from the Proposal Site.

During operation, two events would result in higher traffic flows than normal conditions. These are:

- Diesel Fuel Replacement Events (infrequent event which could occur up to approximately seven days a year depending on the amount of diesel fuel that needs to be replaced):
  - Up to 12 heavy vehicle movements per day (6 inbound trips and 6 outbound trips)
- Gas Turbine Major Overhaul Events (occurring for approximately six days a week for a six-week period, once every 10 years):
  - Up to 80 light vehicle movements per day (40 inbound trips and 40 outbound trips)
  - Up to 10 heavy vehicle movements per day (5 inbound trips and 5 outbound trips).

5.3 Model setup

Noise from the operation of the Proposal was modelled using the SoundPLAN 8.0 acoustic modelling software. Within the noise modelling software, the CONCAWE noise propagation calculation was applied for dB(A) noise calculations. The CONCAWE calculation was selected due to its reliability in assessing industrial noise impacts. CONCAWE considers noise propagation and attenuation by:

- Geometrical spreading
- Atmospheric absorption
- Ground effects
- Meteorological conditions conducive of the propagation of noise
- Barriers
- Topography and distance between the source and receptor.

A number of inputs were used to create the model. These are detailed in Table 5.5.

Table 5.5: Noise model input details

Model Input	Details
Topography	Terrain data were derived from NSW Land Property Information (LPI) 10 m resolution bare earth Digital Elevation Model (DEM). The DEM was produced from a standard LiDAR survey conducted by LPI.
Buildings	Footprints for receptor and other buildings in the area surrounding works was determined from aerial photography. Heights and floor numbers were ascertained from Google Street view, or otherwise, assuming a building height of 3 m per floor plus 2 m for the roof.
Ground Absorption	Heavily Forested Area: 1.00 Rural Area/Grassland: 0.75 Urban Area: 0.50 Water: 0.00
Noise Sources	Construction and Operational SWLs were set as outlined in Section 5.1.1 and Section 5.2.1, respectively.

Model Input	Details
Meteorology	Meteorological conditions were set out as outlined in Section 3.3.2

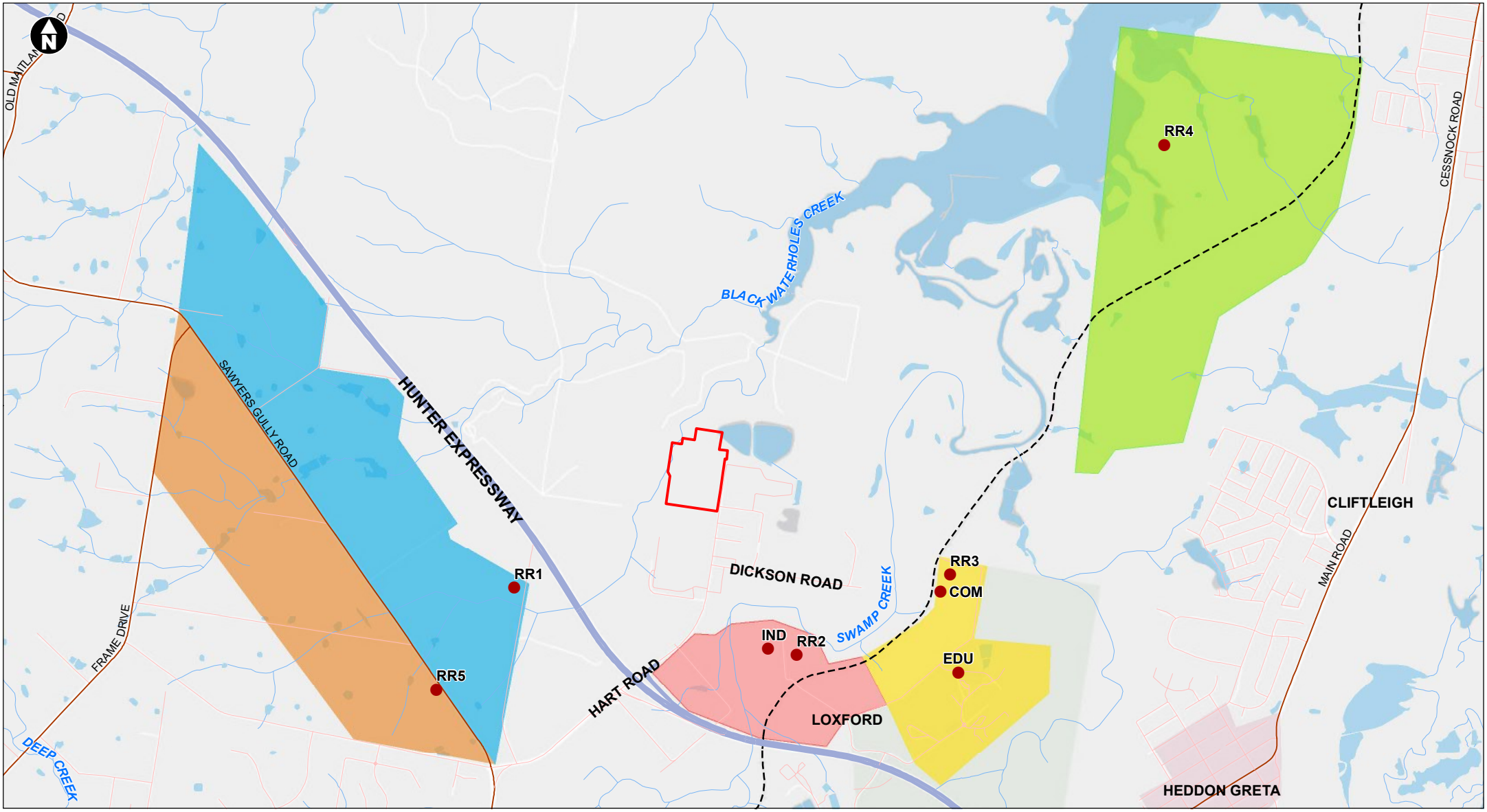
5.4 Noise measurement locations

In order to understand the noise impact at each noise catchment area surrounding the Proposal, eight receivers were selected as locations where modelled construction and operation noise levels were measured at. These include the residential receivers nearest to the Proposal in each NCA, as well as any identified non-residential land use in the NCAs. These receivers are listed in Table 5.6, and are displayed in Figure 5.1.

Table 5.6: Measurement locations for noise modelling

Receiver	Noise Catchment Area	Land Use	Address	Approximate Distance of Nearest Sensitive Receiver from Centrepoint of Power Island
NCA 1 Representative Residential Receiver	NCA 1	Residential	103 Bishops Bridge Rd, Sawyers Gully	1,240 m
NCA 2 Representative Residential Receiver	NCA 2	Residential	10 Dawes Avenue, Loxford	1,150 m
NCA 3 Representative Residential Receiver	NCA 3	Residential	20 Bowditch Avenue, Loxford	1,610 m
NCA 4 Representative Residential Receiver	NCA 4	Residential	464 Cessnock Rd, Gillieston Heights	3,210 m
NCA 5 Representative Residential Receiver	NCA 5	Residential	59 Sawyers Gully Road, Sawyers Gully	1,955 m
NCA 2 Industrial Receiver	NCA 2	Industrial	6 Dawes Avenue, Loxford	1,130 m
NCA 3 Educational Receiver	NCA 3	Educational	TAFE Kurri Kurri, McLeod Road, Loxford	1,995 m
NCA 3 Commercial Receiver	NCA 3	Commercial	18 Bowditch Avenue, Loxford	1,595 m

Additionally, noise levels were also measured across the Proposal boundary where a proposed industrial lot is predicted to be adjacent. The highest levels measured along the boundary were considered when assessing noise impacts.

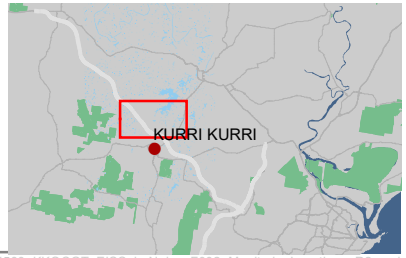


Proposal site
Motorway
Main roads
Roads
Railway
Waterbodies
Representative Receiver Locations

Noise Catchment Areas
NCA 1
NCA 2
NCA 3
NCA 4
NCA 5

0 1 2 km

1:30,000 at A4
Coordinate System: GDA2020 MGA Zone 56



Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 5-1 Representative Receivers

snowy hydro renewable energy Jacobs

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6. Assessment of impacts

6.1 Construction noise

Estimated noise levels at the nearest receivers were predicted from the anticipated noise levels generated during each construction phase of the Proposal. Table 6.1 presents the predicted noise impact at each representative residential receiver during each construction phase, while Table 6.2 presents the predicted noise impact at each non-residential receiver during each construction phase.

The assessment assumed all plant and equipment for each activity was operated concurrently while positioned at the location closest to each individual receiver. This was considered to be a conservative approach and while this may provide for the determination of conservative noise levels, actual construction noise levels should be lower than predicted in this assessment.

As Table 6.1 shows, during phase 1, noise levels were predicted to be above the standard hours NML of the NCA 2's nearest receiver by 1 dB(A), as well as the out of hours day NMLs at NCA 2's and NCA 3's nearest receivers by up to 6 dB(A) and 2 dB(A), respectively. Construction noise levels were also predicted to be above the NMLs at NCA 2's nearest receiver during phases 3 and 8. Noise levels up to 6 dB(A) above NMLs fall well within the range of impacts that could be addressed through reasonable and feasible mitigation measures. These have been provided in Section 7.1.1.

The construction phases which were predicted to result in the highest noise levels at the nearest sensitive receiver are the initial site earthworks and surfacing works (i.e. Phases 1 and 8). These works would result in noise levels of 51 dB(A) and 49 dB(A) at the nearest residential receiver, respectively.

As listed in Table 6.2, noise levels were not predicted to be above NMLs at any non-residential receivers in each of the NCAs.

Noise contour maps for each of the assessed construction phases are displayed in Appendix A.

Table 6.1: Noise impacts from construction works at residential receivers

Construction Phase	NCA 1			NCA 2			NCA 3			NCA 4			NCA 5		
	Highest Predicted Noise Level at NCA 1 Representative Residential Receiver (dB(A))	Noise Level Below NML?		Highest Predicted Noise Level at NCA 2 Representative Residential Receiver (dB(A))	Noise Level Below NML?		Highest Predicted Noise Level at NCA 3 Representative Residential Receiver (dB(A))	Noise Level Below NML?		Highest Predicted Noise Level at NCA 4 Representative Residential Receiver (dB(A))	Noise Level Below NML?		Highest Predicted Noise Level at NCA 5 Representative Residential Receiver (dB(A))	Noise Level Below NML?	
		Standard Hours – 55 dB(A)	Out of Hours, Day – 50 dB(A)		Standard Hours – 50 dB(A)	Out of Hours, Day – 45 dB(A)		Standard Hours – 48 dB(A)	Out of Hours, Day – 43 dB(A)		Standard Hours – 45 dB(A)	Out of Hours, Day – 40 dB(A)		Standard Hours – 47 dB(A)	Out of Hours, Day – 42 dB(A)
1	47	Yes	Yes	51	No, by 1 dB(A)	No, by 6 dB(A)	45	Yes	No, by 2 dB(A)	32	Yes	Yes	41	Yes	Yes
2	42	Yes	Yes	45	Yes	Yes	40	Yes	Yes	<30	Yes	Yes	36	Yes	Yes
3	45	Yes	Yes	48	Yes	No, by 3 dB(A)	43	Yes	Yes	31	Yes	Yes	39	Yes	Yes
4	36	Yes	Yes	40	Yes	Yes	35	Yes	Yes	<30	Yes	Yes	30	Yes	Yes
5	30	Yes	Yes	34	Yes	Yes	30	Yes	Yes	<30	Yes	Yes	<30	Yes	Yes
6	31	Yes	Yes	35	Yes	Yes	<30	Yes	Yes	<30	Yes	Yes	<30	Yes	Yes
7	33	Yes	Yes	36	Yes	Yes	31	Yes	Yes	<30	Yes	Yes	<30	Yes	Yes
8	45	Yes	Yes	49	Yes	No, by 4 dB(A)	43	Yes	Yes	30	Yes	Yes	39	Yes	Yes

Table 6.2: Noise impacts from construction works at non-residential receivers

Phase	NCA 2*		NCA 3*			
	Highest Predicted Noise Level at NCA 2 Industrial Receiver (dB(A))	Noise Level Below NML? Industrial – 75 dB(A)	Highest Predicted Noise Level at NCA 3 Commercial Receiver (dB(A))	Noise Level Below NML? Commercial – 70 dB(A)	Highest Predicted Noise Level at NCA 3 Educational Receiver (dB(A))	Noise Level Below NML? Educational – 55 dB(A)
1	51	Yes	45	Yes	42	Yes
2	45	Yes	40	Yes	38	Yes
3	48	Yes	43	Yes	40	Yes
4	40	Yes	35	Yes	32	Yes
5	34	Yes	30	Yes	27	Yes
6	34	Yes	29	Yes	26	Yes
7	36	Yes	31	Yes	29	Yes
8	49	Yes	43	Yes	40	Yes

* There were no non-residential receivers identified in NCA 1, NCA 4 and NCA 5

6.2 Noise resulting from construction traffic

Existing traffic volumes on the Hunter Expressway were obtained from the nearest Transport for NSW (TfNSW) permanent count stations (ID HEX1 & HEX2) located 3.5 km north of the Expressway exit to the Proposal Site. Table 6.3 presents the average daily traffic count from the traffic ID stations in 2020.

Table 6.3: Average daily vehicle movements TfNSW permanent count stations HEX1 & HEX2

Vehicle type	Day		Night	
	Northbound	Southbound	Northbound	Southbound
Light	7052	8370	2003	862
Heavy	1378	1791	535	280

As a result of the existing traffic levels, noise levels of 62.8 dB(A) during the day and 61.2 dB(A) during the night were predicted, above the 60 dB(A) $L_{Aeq,15hr}$ day traffic noise criteria and 55 dB(A) $L_{Aeq,9hr}$ night traffic noise criteria at the nearest sensitive receiver (75 m away from the road alignment).

During construction of the Proposal, the estimated peak vehicle movements per day at the peak of construction is expected to be 400 light vehicle movements, along with 120 heavy vehicle movements during standard hours daily, along with two oversize over mass movements during the night (one inbound trip and one outbound trip).

Considering the estimate of construction vehicle movements per day, using the Construction Noise Estimator, it was determined that noise from the existing road traffic plus the additional construction noise traffic would be 63 dB(A) during the day and 61.2 dB(A) during the night. While these levels are above the day and night traffic noise criteria, the additional construction noise traffic associated with the Proposal would only contribute 0.2 dB(A) to the overall traffic noise level during the day and would contribute less than 0.1 dB(A) to the traffic noise level during the night. Therefore, the 2 dB(A) traffic noise increase criterion would not be exceeded, and it was concluded that the noise generated from the additional traffic during construction of the Proposal would not present a noise impact issue.

6.3 Sleep disturbance – construction

Construction is not predicted to take place during the night, and as such construction activities associated with the Proposal would not result in sleep disturbance impacts.

6.4 Operational noise

The noise impacts resulting from the operation of the Proposal on residential receivers are detailed in Table 6.4, while impacts on non-residential receivers are detailed in Table 6.5.

The ‘standard’ and ‘noise-enhancing’ meteorological conditions were adopted for the assessment (refer to Section 3.3.2), and the Proposal has been assumed to potentially operate at any time of day or night.

It has been predicted by the noise model that operational noise levels would be compliant at all receivers at all times. The receiver with the highest noise impact was the nearest sensitive receiver in NCA 2. Under standard conditions noise levels were predicted to be 39 dB(A), while noise levels under noise-enhancing conditions were predicted to be 43 dB(A). Generally, noise-enhancing conditions increase noise levels at receivers by approximately 5 dB(A).

It has been noted that the operational noise emissions were closest to the noise criterion during the night period. However, this is also the least likely time for operations to occur, resulting in the noise impact being minimised to a smaller occurrence and duration compared to the day and evening period.

Noise contours displaying the spatial distribution of noise from the Proposal are displayed in Figure 6.1 and Figure 6.2, as well as Appendix B.

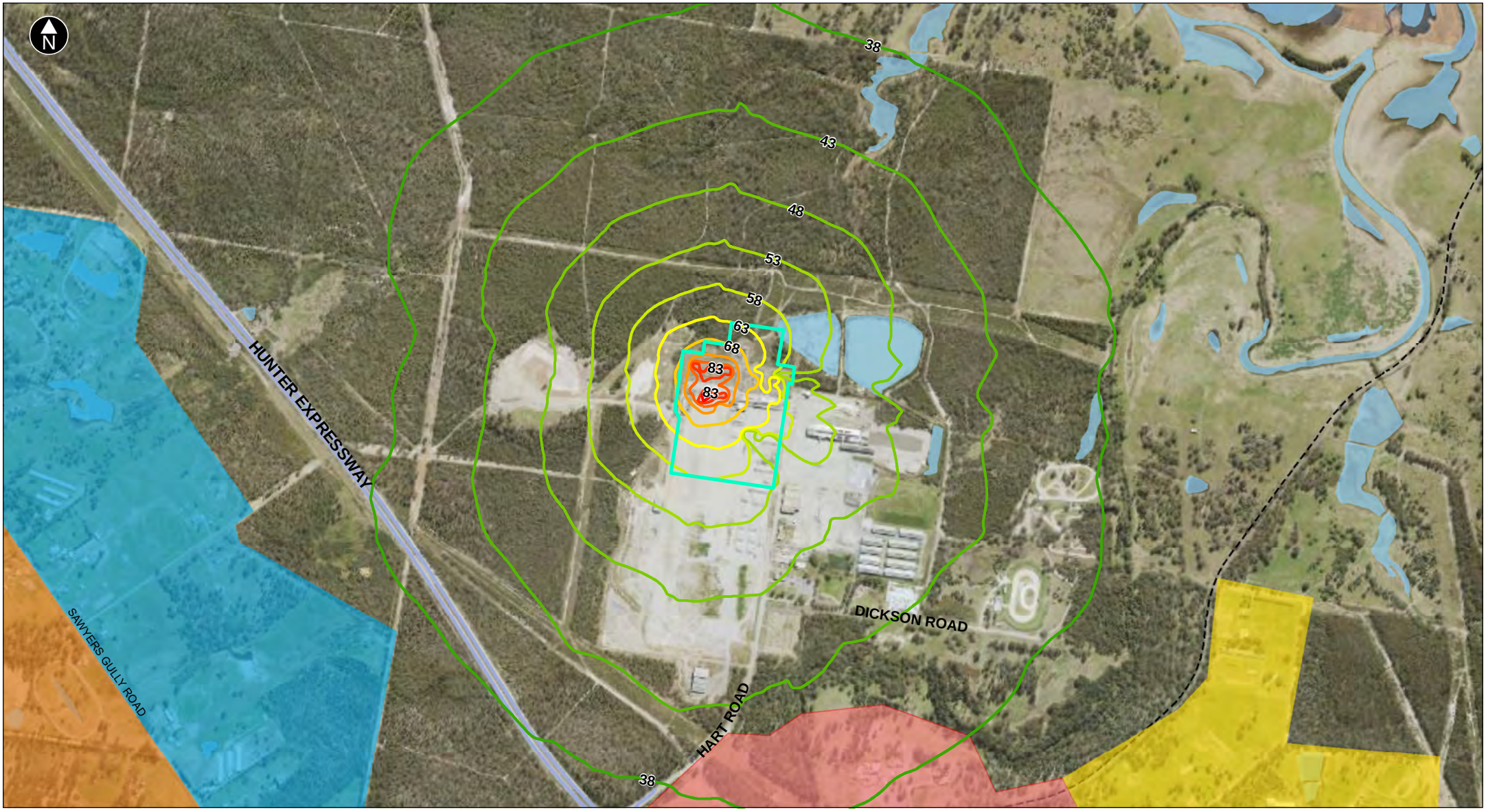
Table 6.4: Operational noise impact at the nearest residential receivers

Noise Level at Nearest Residential Receiver in Noise Catchment Area	Highest Predicted Noise Level at Residential Receiver		Noise Criteria	Compliant with Noise Criteria?	
	Standard Conditions	Noise-Enhancing Conditions		Standard Conditions	Noise-Enhancing Conditions
NCA 1 Representative Residential Receiver	36 dB(A) [1]	41 dB(A) [1]	Day – 50 dB(A)	Yes	Yes
			Evening – 48 dB(A)	Yes	Yes
			Night – 41 dB(A)	Yes	Yes
			Sleep Disturbance – 52 dB(A)	Yes	Yes
NCA 2 Representative Residential Receiver	39 dB(A) [1]	43 dB(A) [1]	Day – 45 dB(A)	Yes	Yes
			Evening – 45 dB(A)	Yes	Yes
			Night – 43 dB(A)	Yes	Yes
			Sleep Disturbance – 53 dB(A)	Yes	Yes
NCA 3 Representative Residential Receiver	32 dB(A)	37 dB(A)	Day – 43 dB(A)	Yes	Yes
			Evening – 43 dB(A)	Yes	Yes
			Night – 38 dB(A)	Yes	Yes
			Sleep Disturbance – 52 dB(A)	Yes	Yes
NCA 4 Representative Residential Receiver	<30 dB(A)	<30 dB(A)	Day – 40 dB(A)	Yes	Yes
			Evening – 35 dB(A)	Yes	Yes
			Night – 35 dB(A)	Yes	Yes
			Sleep Disturbance – 52 dB(A)	Yes	Yes
NCA 5 Representative Residential Receiver	<30 dB(A)	33 dB(A)	Day – 42 dB(A)	Yes	Yes
			Evening – 42 dB(A)	Yes	Yes
			Night – 38 dB(A)	Yes	Yes
			Sleep Disturbance – 52 dB(A)	Yes	Yes

[1] A 2dB positive adjustment for low frequency noise as per the NSW NPI (2017) has been applied to the predicted noise levels. The determination of this adjustment is provided in Section 6.5.1.

Table 6.5: Operational noise impact at the nearest existing non-residential receivers

Non-Residential Receiver	Highest Predicted Noise Level at Non-Residential Receiver		Noise Criteria	Compliant with Noise Criteria?	
	Standard Conditions	Noise-Enhancing Conditions		Standard Conditions	Noise-Enhancing Conditions
NCA 2 Industrial Receiver	39 dB(A)	44 dB(A)	Industrial Criteria – 68 dB(A)	Yes	Yes
NCA 3 Commercial Receiver	34 dB(A)	39 dB(A)	Commercial Criteria – 63 dB(A)	Yes	Yes
NCA 3 Educational Receiver	32 dB(A)	37 dB(A)	Educational Criteria – 43 dB(A)	Yes	Yes



Proposal site
Motorway
Railway
Waterbodies

Noise Catchment Areas
NCA 1
NCA 2
NCA 3
NCA 5

Noise Level dB(A)
38
43
48
53
58
63
68
73
78
83
88

0 0.5 1 km

Representative frequency range: 16 Hz to 8000 Hz
Modelling parameters:
- Calculation at 1.5m above ground
- 20°C temperature and 70% humidity
- Neutral weather conditions (Pasquill Grade D with wind speed of 0 m/s)
- Softground G = 1.0
- Calculation method: Concawe

1:15,000 at A4
GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

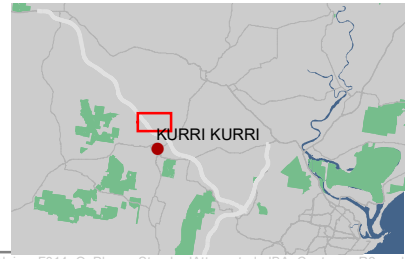


Figure 6-1 Attenuated F-Class OCGT Power Station – Standard Meteorological Conditions – dB(A)

snowy hydro renewable energy Jacobs

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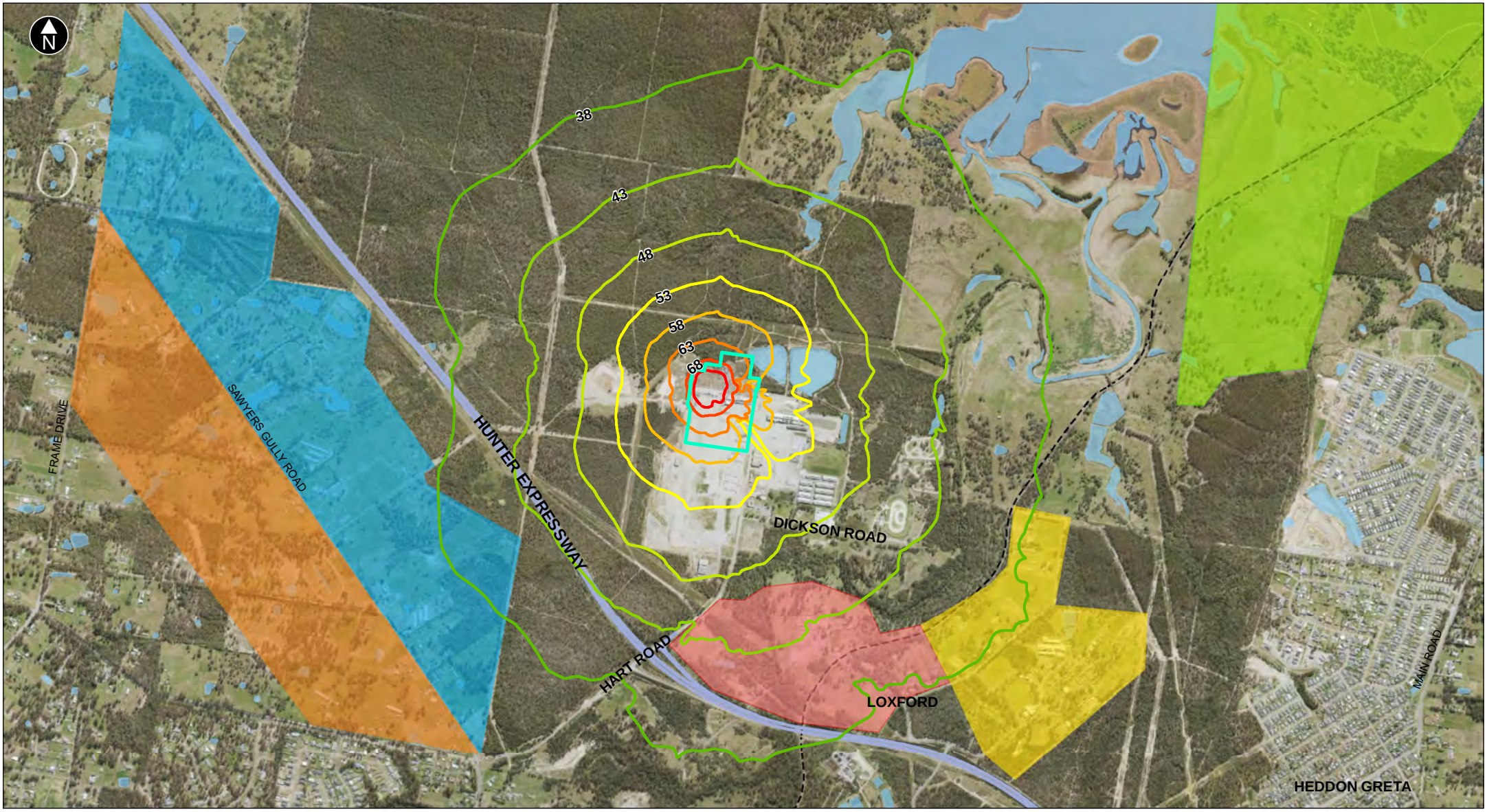

Figure 6-2 Attenuated F-Class OCGT Power Station – Adverse Meteorological Conditions – dB(A)

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Created by : AA | QA by : KI

When the planned industrial lots adjacent to the Proposal Site are occupied, the occupiers of those lots would experience noise from the Proposal. In order to assess the potential impact of industrial noise on adjacent industrial receivers, operational noise levels have been conservatively measured at the sections of the plant boundary interfacing with the proposed lots. It has been predicted that operational noise levels at the site boundary would remain below the operational noise criteria for industrial receivers. The operational noise impact at the Proposal Site boundary is detailed in Table 6.6.

Table 6.6: Operational noise impacts at the proposal boundary

Non-Residential Receiver	Highest Predicted Noise Level at Non-Residential Receiver		Noise Criteria	Compliant with Noise Criteria?	
	Standard Conditions	Noise-Enhancing Conditions		Standard Conditions	Noise-Enhancing Conditions
Site Boundary	61 dB(A)	64 dB(A)	Industrial Criteria – 68 dB(A)	Yes	Yes

6.5 'Annoying' Noise Penalty Assessments

6.5.1 Low frequency noise assessment

As per the Fact Sheet C of the NPI, and as described in the NPI, in order to account for potential low frequency noise impacts, a correction is applied to noise levels based on a two-step criterion. The first step is to analyse the difference between the C-weighted and A-weighted noise levels predicted at the assessed receivers. If the difference between the C-weighted and A-weighted noise levels is greater than 15 dB, the second step of the assessment will take place. This is to determine if a positive adjustment (i.e. a penalty) of two dB or five dB should be applied to the predicted A-weighted noise levels during the evening and night periods. C-weighted noise levels under noise-enhancing conditions were predicted in SoundPlan and were compared to the A-weighted levels under noise-enhancing conditions, to develop the worst-case scenario to assess the noise levels against. The comparison of the difference in C and A weighted noise levels, and whether each exceeds the NPI criterion is detailed below in Table 6.7.

Table 6.7: Predicted operational noise levels (C and A weighted)

Noise Sensitive Receiver	Difference between C and A weighted predicted noise levels $L_{eq,15min}$ dB	
	Worst-Case Conditions	Requires assessment at the octave band level to determine the level of adjustment due to LFN?
NCA 1 Nearest Residential Receiver	57 – 39 > 15	Yes
NCA 2 Nearest Residential Receiver	59 – 41 > 15	Yes
NCA 3 Nearest Residential Receiver	54 – 37 >15	Yes
NCA 4 Nearest Residential Receiver	44 – 28 >15	Yes
NCA 5 Nearest Residential Receiver	51 – 33 >15	Yes
NCA 3 Educational Receiver	51 – 35 >15	Yes

As displayed, the difference between C and A weighted noise levels exceeds the 15 dB criteria at each receiver. As such, the low frequency third octave noise contribution at each receiver was compared to the criterion presented in Table C2 of the NPI. The comparisons of the low frequency contribution of the Proposal to the criterion are detailed in Table 6.8.

Table 6.8: Predicted low frequency contribution

Noise Sensitive Receiver	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz
NPI Table C2 Threshold Levels	89	86	77	69	61	54	50	50	48	48	46	44
NCA 1 Nearest Residential Receiver	55	48	42	56	51	46	53	49	45	45	41	39
NCA 2 Nearest Residential Receiver	57	50	44	57	52	47	55	51	47	48	45	42
NCA 3 Nearest Residential Receiver	52	46	39	53	48	43	50	46	42	43	40	37
NCA 4 Nearest Residential Receiver	43	36	30	43	38	33	41	37	33	34	31	28
NCA 5 Nearest Residential Receiver	49	42	36	50	45	40	47	43	39	39	36	33
NCA 3 Educational Receiver	50	43	37	50	45	40	48	44	40	41	38	35

As displayed, the contribution of the Proposal in the 50Hz (at two of the residential receivers) and 63Hz (at one of the residential receivers) one third octave bands exceeds the Noise Policy criteria for those octave bands by 1 – 5 dB. Due to this, a 2 dB correction has been applied to the noise levels of the Proposal to account for low frequency noise at the respective receivers.

As per the most sensitive noise criterion detailed in Table 6.4, with the correction applied, the night noise level at the nearest residential receiver in NCA 2 will reach but not exceed the night criterion for that receiver. No receiver noise criteria are expected to be exceeded as a result of this correction.

6.5.2 Tonal noise assessment

As per the Fact Sheet C of the NPI, tonality is assessed based on a 1/3 octave band analysis using the *Objective method for assessing the audibility of tones in noise – simplified method* (ISO1996.2-2007 – Annex D). The NPI details that a 5 dB(A) penalty should be applied when the level of one-third octave band exceeds the level of the adjacent bands on both sides by:

- 5 dB or more if the centre frequency of the band containing the tone is in the range 500–10,000 Hz
- 8 dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz
- 15 dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz.

Table 6.9 details the comparison of the 1/3 octave bands predicted at the Representative Residential Receivers to the above assessment criterion. As displayed in the table, no exceedances of the above criterion have been identified, and hence no tonal penalty will need to be applied.

Table 6.9 Tonal noise assessment

Receiver	Measurement	1/3 Octave Band Frequencies (unweighted dB)																							
		20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1k Hz	1.25k Hz	1.6k Hz	2k Hz	2.5k Hz	3.15k Hz	4k Hz	5k Hz
NCA 1 Nearest Residential Receiver	Predicted SPL	42	56	51	46	53	49	45	45	41	39	36	34	32	34	32	31	29	28	27	21	21	21	11	11	11
	Level above Left Neighbour	-	14	-5	-5	7	-4	-4	0	-4	-2	-3	-2	-2	2	-2	-1	-2	-1	-1	-6	0	0	-10	0	0
	Level above Right Neighbour	-	5	5	-7	4	4	0	4	2	3	2	2	-2	2	1	2	1	1	6	0	0	10	0	0	11
	Penalty Triggered?	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
NCA 2 Nearest Residential Receiver	Predicted SPL	44	57	52	47	55	51	47	48	45	42	40	38	36	37	35	34	29	29	28	24	24	24	15	15	16
	Level above Left Neighbour	-	13	-5	-5	8	-4	-4	1	-3	-3	-2	-2	-2	1	-2	-1	-5	0	-1	-4	0	0	-9	0	1
	Level above Right Neighbour	-	5	5	-8	4	4	-1	3	3	2	2	2	-1	2	1	5	0	1	4	0	0	9	0	-1	16
	Penalty Triggered?	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
NCA 3 Nearest Residential Receiver	Predicted SPL	39	53	48	43	50	46	42	43	40	37	35	33	31	33	31	30	25	24	23	18	18	18	4	4	5
	Level above Left Neighbour	-	14	-5	-5	7	-4	-4	1	-3	-3	-2	-2	-2	2	-2	-1	-5	-1	-1	-5	0	0	-14	0	1
	Level above Right Neighbour	-	5	5	-7	4	4	-1	3	3	2	2	2	-2	2	1	5	1	1	5	0	0	14	0	-1	5
	Penalty Triggered?	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
NCA 4 Nearest	Predicted SPL	30	43	38	33	41	36	33	34	31	28	25	23	20	22	20	19	11	10	10	-	-	-	-	-	-
	Level above Left Neighbour	-	13	-5	-5	8	-5	-3	1	-3	-3	-3	-2	-3	2	-2	-1	-8	-1	0	-	-	-	-	-	-

Receiver	Measurement	1/3 Octave Band Frequencies (unweighted dB)																								
		20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1k Hz	1.25k Hz	1.6k Hz	2k Hz	2.5k Hz	3.15k Hz	4k Hz	5k Hz
Residential Receiver	Level above Right Neighbour	-	5	5	-8	5	3	-1	3	3	3	2	3	-2	2	1	8	1	0	10	-	-	-	-	-	-
	Penalty Triggered?	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	-	-	-	-	-	-
NCA 5 Nearest Residential Receiver	Predicted SPL	36	50	45	40	47	43	39	39	36	33	31	28	26	28	27	25	21	20	20	12	11	11	-	-	-
	Level above Left Neighbour	-	14	-5	-5	7	-4	-4	0	-3	-3	-2	-3	-2	2	-1	-2	-4	-1	0	-8	-1	0	-	-	-
	Level above Right Neighbour	-	5	5	-7	4	4	0	3	3	2	3	2	-2	1	2	4	1	0	8	1	0	11	-	-	-
	Penalty Triggered?	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	-	-	-
NCA 3 Educational Receiver	Predicted SPL	37	50	45	40	48	44	40	41	38	35	34	32	30	31	30	29	21	20	20	12	12	12	-	-	-
	Level above Left Neighbour	-	13	-5	-5	8	-4	-4	1	-3	-3	-1	-2	-2	1	-1	-1	-8	-1	0	-8	0	0	-	-	-
	Level above Right Neighbour	-	5	5	-8	4	4	-1	3	3	1	2	2	-1	1	1	8	1	0	8	0	0	12	-	-	-
	Penalty Triggered?	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	-	-	-

6.6 Noise Resulting from Operational Traffic

During operation of the Proposal, two events, the diesel fuel replacement and the Gas Turbine Major Overhaul, would result in higher daily traffic numbers than during normal operation. The traffic movements for each event have been detailed in Section 0. Existing traffic values are detailed in Table 6.3.

As stated in Section 6.6, it was predicted that the existing traffic levels, would result in traffic noise levels of 62.8 dB(A) during the day and 61.2 dB(A) during the night, above the 60 dB(A) $L_{Aeq,15hr}$ day traffic noise criteria and 55 dB(A) $L_{Aeq,9hr}$ night traffic noise criteria at the nearest sensitive receiver (75 m away from the road alignment).

During both events, the existing road traffic plus the additional operational traffic noise at the nearest sensitive receiver would be 62.7 dB(A) during the day and 61.2 dB(A) during the night. While both the day and night traffic noise levels are above the respective criteria, the additional operational traffic noise associated with both events would contribute less than 0.1 dB(A) to the overall daytime traffic noise levels. As such, the 2 dB(A) traffic noise increase criterion would not be exceeded, and it was concluded that the noise generated from the additional traffic during the operation of the Proposal would not lead to any noise impact.

6.7 Vibration

As identified in Section 5.1.2, a vibratory roller and piling rig, which are considered to be a vibration-generating plant, would be used during construction. With the use of a piling rig and vibratory roller, cosmetic damage impacts may occur up to 25 m away from the works, while human response impacts may occur up to 100 m away from the works. As no vibration receivers are located within these distances, no vibration impacts have been predicted. Additionally, as the nearest medical facility is over three km away from the Proposal site, no impacts to medical facilities due to construction vibration have been predicted.

No equipment used during the operation of the Proposal has been predicted to produce vibration impacts.

6.8 Cumulative impacts

6.8.1 Interfaces with adjacent industrial receivers

The current schedule for the construction of the Proposal means that the Proposal will be constructed prior to the occupation of any of the adjacent industrial lots. Hence, impacts at these lots have not been considered during the assessment. However, if the construction of the Proposal is delayed, these lots may be occupied, and hence impacts may occur. As such, the potential noise impacts at the boundary of the Proposal Site has been assessed in the following subsections.

6.8.1.1 Construction noise

During a number of construction phases, the highest predicted noise along the Proposal Site boundary is equal to but not above the Noise Management Level for industrial receivers. Additionally, a number of construction phases nearly reach the NML. Phases one and three reach the NML, while phases four and eight are within 1-2 dB(A) of the NML. As the noise levels at many phases are close to the NML, construction and cumulative noise impacts would need to be carefully managed in line with measures provided in Section 7.1 to prevent the noise criteria from being exceeded. The noise levels in comparison to the criteria during each construction phase are detailed in Table 6.10.

Table 6.10: Construction noise impacts at the Proposal boundary

Phase	Industrial Lot	
	Highest Predicted Noise Level at the Boundary (dB(A))	Compliant with Noise Criteria?
		Industrial – 75 dB(A)
1	75	Yes
2	66	Yes
3	75	Yes
4	74	Yes
5	70	Yes
6	54	Yes
7	57	Yes
8	73	Yes

6.8.1.2 Construction vibration

As mentioned in Section 6.7, with the use of a piling rig and vibratory roller, cosmetic damage impacts may occur up to 25 m away from the works, while human response impacts may occur up to 100 m away from the works. If any adjacent industrial lots were occupied prior to or during construction of the Proposal, some impacts may occur. It is advised that if the adjacent lots are occupied, suggested mitigation measures to reduce vibration impact provided in Section 7.1.2 should be implemented

6.8.2 Gas receival station

The gas receival station is subject to a separate third-party proposal and approval process. However, as construction of the gas receival station is estimated to commence towards the end of the construction phase of the Proposal, based on the current schedule for the Proposal. Therefore, construction of the gas receival station could potentially coincide with both the construction and operation stages of the Proposal.

Based on the current construction scheduling, the gas receival station will most likely be constructed towards the end of the construction of the Proposal and prior to the operation of the Proposal's turbines on gas. Due to this, it is unlikely that timing of the noisiest activities of the gas receival station construction would coincide with the timing of the noisiest construction and operational phases of the Proposal, hence significant cumulative noise impacts are not expected during the construction of the gas receival station.

During its operation, the Proposal and the gas receival station would be in operation simultaneously, leading to a cumulative impact. Modelling has been performed to determine the contribution that the gas receival station would make to overall operational noise levels. The SWLs of the gas receival station are detailed in Table 6.11.

Table 6.11: Gas receival station sound power levels

Noise Source	Sound Power Level, SWL (dB) Octave Band Centre Frequency (Hz)										Overall SWL		
	16	31.5	63	125	250	500	1000	2000	4000	8000	dB	dB(A)	dB(C)
Gas Receival Station	106	106	103	92	85	75	74	72	74	76	110	84	106

Modelling was performed to determine the contribution of the gas receival station to the overall power station noise levels. As displayed in Table 6.12, the model predicted that at all representative receivers, the gas receival station would produce noise levels of less than 20 dB(A). Due to this, the noise contribution of the gas receival station to the overall project noise levels would not impose a cumulative noise impact.

Table 6.12: Gas receival station noise levels

Noise Level at Nearest Residential Receiver in Noise Catchment Area	Highest Predicted Gas Receival Station noise level at Residential Receiver		Highest Predicted Power Station (minus the Gas Receival Station) Noise Level at Residential Receiver		Highest Predicted Overall Power Station Noise Level at Residential Receiver	
	Standard Conditions	Noise-Enhancing Conditions	Standard Conditions	Noise-Enhancing Conditions	Standard Conditions	Noise-Enhancing Conditions
Site Boundary	32 dB(A)	34 dB(A)	61 dB(A)	64 dB(A)	61 dB(A)	64 dB(A)
NCA 1 Representative Residential Receiver	<20 dB(A)	<20 dB(A)	34 dB(A) [1]	39 dB(A) [1]	34 dB(A) [1]	39 dB(A) [1]
NCA 2 Representative Residential Receiver	<20 dB(A)	<20 dB(A)	37 dB(A) [1]	41 dB(A) [1]	37 dB(A)[1]	41 dB(A) [1]
NCA 3 Representative Residential Receiver	<20 dB(A)	<20 dB(A)	32 dB(A)	37 dB(A)	32 dB(A)	37 dB(A)
NCA 4 Representative Residential Receiver	<20 dB(A)	<20 dB(A)	21 dB(A)	26 dB(A)	21 dB(A)	26 dB(A)

Noise Level at Nearest Residential Receiver in Noise Catchment Area	Highest Predicted Gas Receival Station noise level at Residential Receiver		Highest Predicted Power Station (minus the Gas Receival Station) Noise Level at Residential Receiver		Highest Predicted Overall Power Station Noise Level at Residential Receiver	
	Standard Conditions	Noise-Enhancing Conditions	Standard Conditions	Noise-Enhancing Conditions	Standard Conditions	Noise-Enhancing Conditions
NCA 5 Representative Residential Receiver	<20 dB(A)	<20 dB(A)	28 dB(A)	33 dB(A)	28 dB(A)	33 dB(A)

[1] The 2dB positive adjustment for low frequency noise required under the NSW NPI (2017) has not been applied in order to facilitate a more accurate comparison between noise levels.

6.8.3 Demolition and remediation of the Hydro Aluminium smelter

The Proposal Site forms part of the decommissioned Hydro Aluminium Kurri Kurri Pty Ltd aluminium smelter site, which ceased operation in late 2012 and was permanently closed in 2014. Demolition of the former aluminium smelter and remediation of the land is an approved State Significant Development and was the subject of an Environmental Impact Statement that was publicly exhibited in 2016. The extensive works are ongoing but would be completed within the Proposal Site prior to construction of the Proposal. Remediation of the former Kurri Kurri aluminium smelter land outside of (adjacent) the Proposal Site is estimated to be ongoing to late 2023 and therefore concurrent with the construction of the Proposal. Following consultation with Hydro Aluminium regarding future works scheduled to take place, a number of works with the potential to take place concurrently with the with the construction of the proposal have been identified. These works, their timings, equipment and predicted noise levels have been displayed in Table 6.13.

Table 6.13 Demolition and remediation activities planned for the Hydro Aluminium Smelter

Phase	Location	Timing	Equipment	Number of Equipment	Individual Equipment SWL	Phase SWL
Demolition of 7A Bake Furnace and 68C	7A Bake Furnace and 68C	June 2022 to November 2022	45t Excavator w/ hammer*	1	117	123
			45t Excavator w/ shears	1	114	
			45t Excavator w/ grabber	1	114	
			Concrete Saw**	1	118	
			Delivery Truck	2	100	
			Concrete crushing plant	1	115	
			Asphalt Grader	1	114	
Completion of ECC Base Liner	ECC	March 2022 to April 2022	Telehandler	1	99	106
			10t Excavator	1	99	
			Delivery Truck	1	100	
			Generator	1	101	
Loading of Material	Stockpiles	March to September 2022	35t Excavator	1	104	105
			Delivery truck	1	100	

Phase	Location	Timing	Equipment	Number of Equipment	Individual Equipment SWL	Phase SWL
from Stockpiles to Trucks						
Haulage of Material from Stockpiles to ECC	Haul Roads between Stockpiles and ECC	March to September 2022	Delivery truck	2	100	103
Unloading of Material from Trucks to ECC	ECC	March to September 2022	35t Excavator	1	104	105
			Delivery truck	1	100	
Capping of ECC	ECC	November 2022 to May 2023	35t Excavator	1	104	105
			Delivery truck	1	100	

* - Receives a 5 dB(A) penalty for intermittent noise when works take place during night periods. As the works will not take place at night, no penalty was applied.

** - Receives a 5 dB(A) penalty for tonal noise. The time correction applied to the saw and grinder (typically 5 minutes out of a 15-minute period) and the penalty have both been taken into account when calculating the equipment noise level.

In order to assess the potential cumulative impacts resulting from the construction of the Proposal and the Aluminium Smelter, the worst-case cumulative scenario has been assessed. Phase 1 of the proposal's construction, site establishment, has been selected for the cumulative assessment due to a combination of factors:

- The works extend across the whole proposal site
- The works have amongst the highest sound power levels of the construction phases
- The works produce the highest predicted noise levels at the nearest sensitive receivers
- The works would occur alongside the demolition of the bake furnace, the loudest of the Hydro Aluminium activities occurring alongside the construction of the Proposal, in addition to the movement of material from the stockpiles to the storage area.

The predicted cumulative impacts associated with the works undertaken during Phase 1 along with the concurrent Hydro Aluminium Demolition and Remediation activities has been detailed in Table 6.14 for residential receivers, and Table 6.15 for non-residential receivers. As shown in the table, cumulative impacts may result in an increase in construction noise levels at the nearest receivers. Construction noise levels at the nearest receivers at NCA 3 and NCA 4 (the receivers nearest to the demolition works) increase by approximately 6 dB(A), resulting in noise levels above the standard hours NML at NCA 3. The cumulative works also increase construction noise levels at NCA 2's nearest receiver by 3 dB(A), and at NCA 1 and NCA 5 by 1 dB(A) each. Cumulative noise has not been predicted to be above the NMLs of any non-residential receivers. While cumulative construction noise levels may be up to 9 dB(A) above the Noise Management Levels, these noise levels still fall into the range of noise levels that could be addressed through reasonable and feasible mitigation measures, including those detailed in Section 7.1.1. Additionally, cumulative impacts could be further reduced through planning with other proponents to reduce situations arising where multiple noisy works are undertaken concurrently.

Table 6.14 Cumulative construction noise impact on residential receivers

Works	NCA 1			NCA 2			NCA 3			NCA 4			NCA 5		
	Highest Predicted Noise Level at NCA 1 Representative Residential Receiver (dB(A))	Noise Level Below NML?		Highest Predicted Noise Level at NCA 2 Representative Residential Receiver (dB(A))	Noise Level Below NML?		Highest Predicted Noise Level at NCA 3 Representative Residential Receiver (dB(A))	Noise Level Below NML?		Highest Predicted Noise Level at NCA 4 Representative Residential Receiver (dB(A))	Noise Level Below NML?		Highest Predicted Noise Level at NCA 5 Representative Residential Receiver (dB(A))	Noise Level Below NML?	
		Standard Hours – 55 dB(A)	Out of Hours, Day – 50 dB(A)		Standard Hours – 50 dB(A)	Out of Hours, Day – 45 dB(A)		Standard Hours – 48 dB(A)	Out of Hours, Day – 43 dB(A)		Standard Hours – 45 dB(A)	Out of Hours, Day – 40 dB(A)		Standard Hours – 47 dB(A)	Out of Hours, Day – 42 dB(A)
Phase 1	47	Yes	Yes	51	No, by 1 dB(A)	No, by 6 dB(A)	45	Yes	No, by 2 dB(A)	32	Yes	Yes	41	Yes	Yes
Phase 1 with Hydro Aluminium Works	48	Yes	Yes	54	No, by 4 dB(A)	No, by 9 dB(A)	51	No, by 3 dB(A)	No, by 8 dB(A)	37	Yes	Yes	42	Yes	Yes

Table 6.15 Cumulative construction noise impact on non-residential receivers

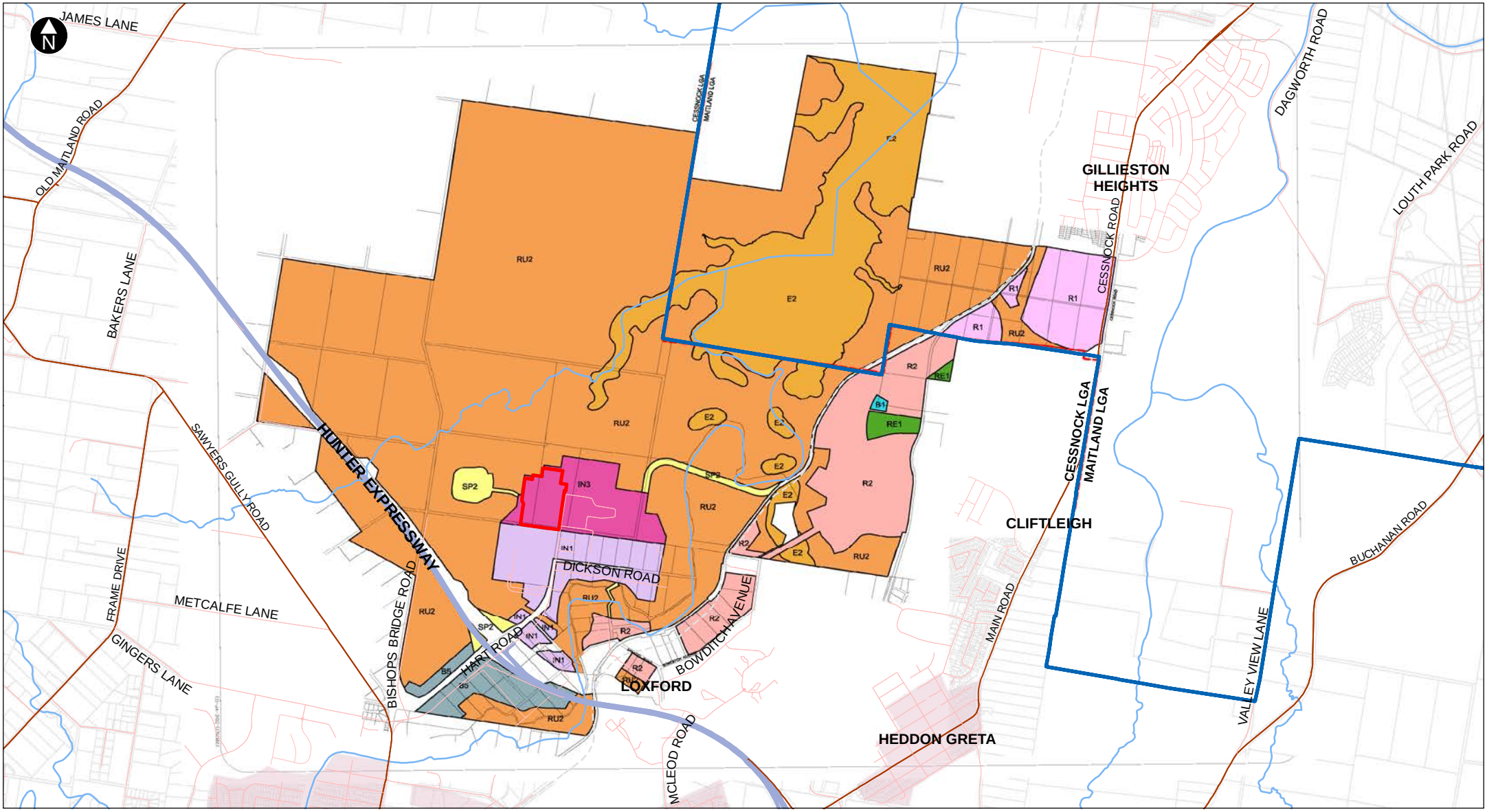
Works	NCA 2[1]		NCA 3*			
	Highest Predicted Noise Level at NCA 2 Industrial Receiver (dB(A))	Noise Level Below NML? Industrial – 75 dB(A)	Highest Predicted Noise Level at NCA 3 Commercial Receiver (dB(A))	Noise Level Below NML? Commercial – 70 dB(A)	Highest Predicted Noise Level at NCA 3 Educational Receiver (dB(A))	Noise Level Below NML? Educational – 55 dB(A)
Phase 1	51	Yes	45	Yes	42	Yes
Phase 1 with Hydro Aluminium Works	54	Yes	51	Yes	47	Yes

6.8.4 ReGrowth Kurri Kurri Rezoning, subdivision and industrial development

The rezoning, subdivision and industrial development of the Hydro Aluminium Kurri Kurri Pty Ltd aluminium smelter land is a major planning proposal by Regrowth Kurri Kurri to rezone approximately 329 ha of land at and around the former aluminium smelter from Rural Landscape (RU2) to residential and public recreation, business, heavy and general industrial, infrastructure and environmental conservation (B1, B5, IN1, IN3, R2, RE1 and SP2 (in part)), to reduce the minimum lot size from 40 ha to 450 m^2 (in part) and to identify the site as an urban release area.

The rezoning proposal is subject to further approval and physical works would be subject to lodgement and approval of separate development applications. Development applications for development of the land following rezoning and subdivision are not expected until 2023, by which time the Proposal is anticipated to be well under construction or even in operation. There are no current development applications, nor any further detail around the type of future development that might occur adjacent to the Proposal Site. Therefore, potential cumulative impacts from the ReGrowth Kurri Kurri rezoning, subdivision and industrial development have not been assessed. It is assumed however, in terms of the applicable land use zoning of the Proposal Site and the likely adjacent future land use context, that the rezoning proposal will be approved.

The rezoning would result in sections of NCA 2 and NCA 3 changing from RU2 – 'Rural Landscape' to R2 – 'Low Density Residential'. As this assessment already considers the residential receivers within these locations, the results of this assessment should not fundamentally change as a result of the rezoning.



Proposal Site
Urban areas
Cadastre
Motorway
Main roads
Roads
Railway
Local Government Area

B1	NEIGHBOURHOOD CENTRE (1.19ha)	R2	LOW DENSITY RESIDENTIAL (137.22ha)
B5	BUSINESS DEVELOPMENT (33.20ha)	RE1	PUBLIC RECREATION (8.54ha)
E2	ENVIRONMENTAL CONSERVATION (268.51ha)	RU2	RURAL LANDSCAPE (1246.75ha)
IN1	GENERAL INDUSTRIAL (65.73ha)	SP2	SPECIAL PURPOSE INFRASTUCTURE (12.77ha)
IN3	HEAVY INDUSTRIAL (53.48ha)		
R1	GENERAL RESIDENTIAL (56.57ha)		

0 1 2 km

1:40,000 at A4

GDA2020 MGA56

Source: McCloy Group, December 2020
Note: Subject to Planning Approval and subject to change.
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Figure 6-3 Hydro Kurri Kurri rezoning concept master plan

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7. Mitigation measures

7.1 Construction

7.1.1 Noise

A number of construction noise impacts have been predicted at the nearest residential receivers, ranging from 1 – 6 dB(A) above noise management levels. Mitigation measures to address these impacts and assure that construction noise levels remain below relevant criterion have been provided in Table 7.1 and should be applied where reasonable and feasible. No noise levels above the NMLs of non-residential receivers or potential adjacent industrial receivers have been predicted.

Table 7.1: Standard noise mitigation measures during construction

Reference	Mitigation measure	Timing
NVIA1	Wherever possible and safe, limit works to standard hours of construction.	During construction
NVIA2	Select low-noise plant and equipment. Ensure equipment mufflers operate in a proper and efficient manner.	Prior to and during construction
NVIA3	Where possible, use quieter and less vibration emitting construction methods.	During construction
NVIA4	Only have necessary equipment on-site and turn off when not in use.	During construction
NVIA5	Where possible, concentrate noisy activities at one location and move to another as quickly as possible.	During construction
NVIA6	Vehicle movements, including deliveries outside standard hours, should be minimised and avoided where possible.	During construction
NVIA7	All plant and equipment is to be well maintained and where possible, fitted with silencing devices.	Prior to and during construction
NVIA8	Use only the necessary size and powered equipment for tasks.	During construction
NVIA9	Implement training to induct staff on noise sensitivities	Prior to and during construction
NVIA10	Where possible, consider the application of less intrusive alternatives to reverse beepers such as ‘squawker’ or ‘broadband’ alarms.	During construction
NVIA11	Consider the installation of temporary construction noise barriers or earth mounds for concentrated, noise-intensive activities.	During construction
NVIA12	Where practicable, install enclosures around noisy mobile and stationary equipment as necessary.	During construction
NVIA13	Where possible, avoid simultaneous operation of two or more noisy plant close to receivers. The offset distance between noisy plant and sensitive receivers should be maximised.	During construction

Reference	Mitigation measure	Timing
	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements.	Prior to and during construction
NVIA14	Complete routine monitoring to evaluate construction noise levels and evaluate whether the mitigation measures in place are adequate or require revision.	During construction

It was determined that cumulative impacts from the ongoing demolition and remediation of the Hydro Aluminium Smelter may increase noise levels at receivers by up to 6 dB(A). In order to mitigate the risk of cumulative noise impacts, additional mitigation measures are provided below:

- Discuss works schedules and timings with the proponents of other works to gain an understanding of when noisy work surrounding the Proposal will take place. Should respectively project schedules and work priorities change, proponents should commit to regular meetings to ensure all proponents are aware of the changes.
- Where possible, scheduling works to occur at different times of the day to prevent multiple noisy activities from taking place at the same time
- Where possible, scheduling works to take place at different locations on site to prevent noisy activities from taking place in close proximity to one another which will limit the amplification of the noise.

Additionally, as construction noise levels at the site boundary have been predicted to reach but not exceed the noise limit for industrial receivers, care should be taken to prevent noisy construction phases from being undertaken in unison, potentially leading to an exceedance of the noise limits at the boundary. Potential measures that could be applied where reasonable and feasible to mitigate this risk include scheduling noisy works to not take place in unison, selecting less noisy plant and equipment where feasible and offsetting the distances between noisy plant and equipment.

7.1.2 Vibration

No vibration impacts have been predicted as a result of the construction of the Proposal. However, in the event that the scenario described in Section 6.8.1 takes place, some vibration impacts have been predicted.

Assessing Vibration: a technical guideline, (DECC, 2006) provides general guidance for limiting vibration impacts during construction. These have again been reviewed and the relevant recommendations have been summarised below. If the scenario in Section 6.8.1 occurs, or if vibration is a concern during the construction of the project, these measures should be implemented.

Table 7.2: Vibration management measures from DECC, 2006

Control measure	Details
Controlling vibration levels from the source	▪ Choosing alternative, lower-impact equipment or methods wherever possible ▪ Scheduling the use of vibration-causing equipment at the least sensitive times of the day (wherever possible) ▪ Locating high vibration sources as far away from sensitive receiver areas as possible ▪ Sequencing operations so that vibration-causing activities do not occur simultaneously. ▪ Keeping equipment well maintained ▪ Do not conduct vibration intensive works within the recommended safe setback distances.

Control measure	Details
Consultation	Informing nearby receivers about the nature of construction phases and the vibration-generating activities.

7.2 Operation

As displayed in Section 6.4, compliance with the operational noise criterion can be achieved through the advised level of attenuation detailed in Table 5.2. Additionally, other control measures that should be adopted to mitigate noise impacts risks have been detailed in Table 7.3.

Table 7.3 Operational mitigation measures

Control Measure	Details
Selection of attenuation measures	Bespoke attenuation packages, which are provided by the suppliers of the gas turbine equipment and are specifically incorporated into the design of the equipment (i.e. a bespoke design will be done specifically to meet the requirements for the Proposal Site). Attenuation options may include: ▪ Slow fan speeds for cooling systems ▪ Improved sound enclosures ▪ Improved stack design ▪ Sound attenuation walls Care should specifically be taken when adopting plant and equipment along with attenuation to assure that the equipment can, as a minimum, perform to the sound power levels provided in the assessment. This includes seeking guarantees from manufacturers to assure the plant and equipment can perform to the compliance requirements detailed in this assessment.
Post-Commission Monitoring	Following the commissioning of the Proposal, noise verification monitoring should be performed to confirm that operational noise levels are in line with those predicted in this assessment, assuring that the noise levels meet the noise criterion. The monitoring should place a particular focus on tonality and low-frequency noise, noting that the low frequency noise levels presented in the assessment are nearing what would require a 5 dB(A) noise penalty. Where the proposal cannot achieve the required noise compliance, further attenuation would be required.

8. Conclusion

The noise and vibration impact assessment has been undertaken to assess the noise and vibration risks associated with the Proposal and to address the SEARs relevant to noise and vibration.

8.1 Construction

During the Proposal's construction, noise levels were predicted to be predominately below the NMLs. Phases 1, 3 and 8 have been predicted to produce noise levels above the NMLs by up to 1 – 6 dB(A) at residential receivers in NCA 2 and NCA 3. Construction traffic was predicted to increase daytime traffic noise levels by 0.2 dB(A), which is well below the 2 dB(A) traffic noise increase criterion. No vibration receivers have been identified within the predicted extent of vibration impact.

In order to manage the noise impacts associated with the construction stage, the application of mitigation measures from the Interim *Construction Noise Guideline* have been advised. As no construction vibration impact has been predicted, mitigation is not required. However, if the Proponent seeks to control vibration impact during the construction stage, mitigation measures from *Assessing Vibration: a technical guideline* have been suggested.

8.2 Operation

Noise modelling of the Proposal determined that operational noise impact would not exceed the relevant noise criterion for any nearby residential receivers at any time period. This included a 2 dB increase to noise levels to account for low frequency noise.

Similarly, noise levels at non-residential receivers, including the industrial receiver in NCA 2 and the educational and commercial receivers in NCA 3, as well as the industrial lots surrounding the proposal were not predicted to exceed their respective criterion.

Traffic from the operation of the Proposal was found to increase overall daytime traffic noise levels by less than 0.1 dB(A), well below the two dB(A) traffic noise increase criterion.

No vibration intensive activities have been predicted to occur during the operation of the Proposal.

9. References

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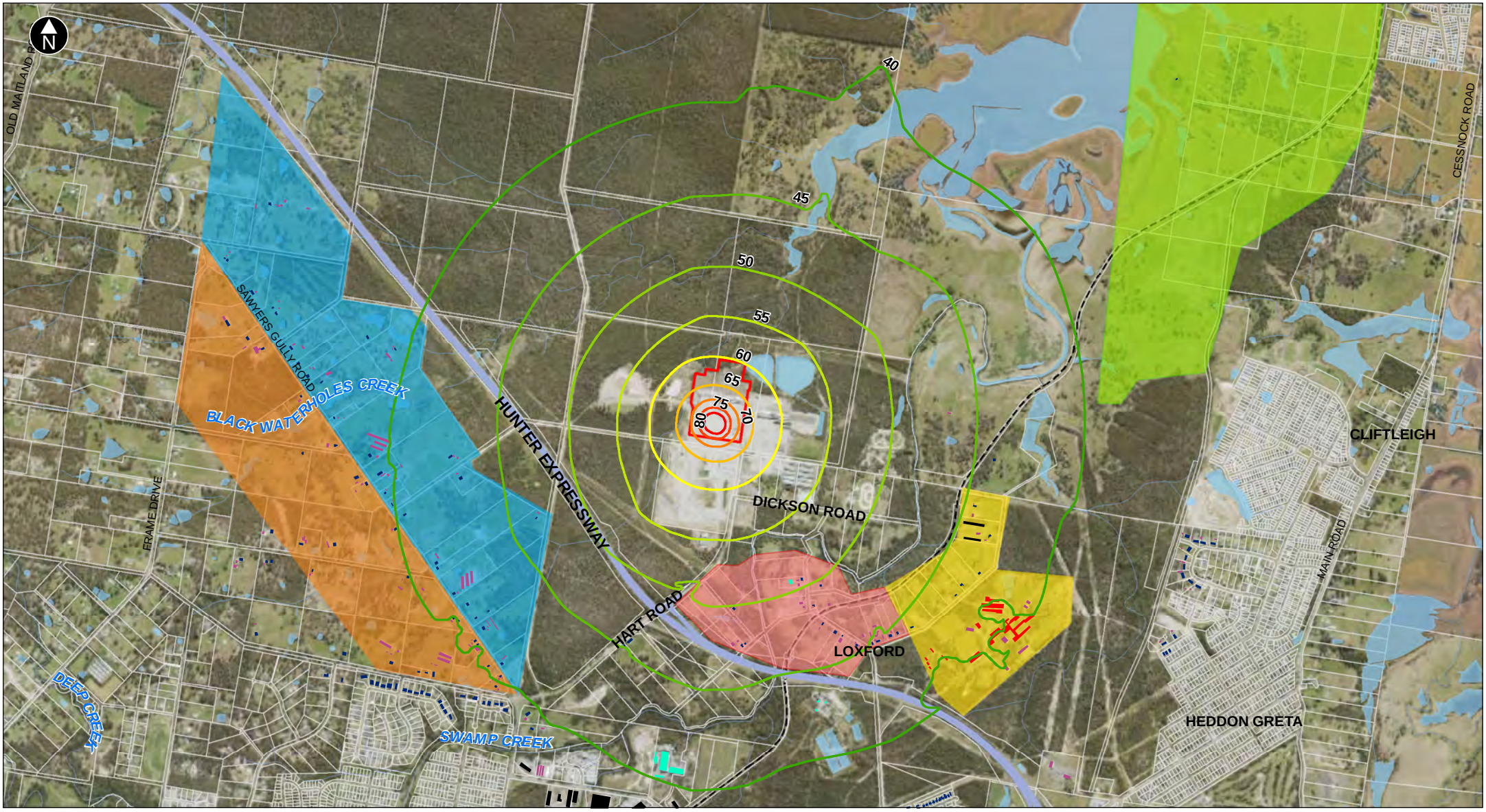
Standards Australia, (2006). *Explosives – Storage and use Part 2: Use of explosives*. AS 2187.2 – 2006. Standards Australia, Sydney, NSW

Transport for NSW, (2020). *NSW Roads Traffic Volume Counts API (online)*. Received Jan 4 2021 from: https://www.rms.nsw.gov.au/about/corporate-publications/statistics/traffic-volumes/aadt-map/index.html#/?z=6

Appendix A. Construction noise contour maps



Proposal site
Motorway
Railway
Waterbodies

Surrounding Receivers
Commercial
Educational
Industrial
Residential
Unoccupied / Unused

Noise Catchment Areas
NCA 1
NCA 2
NCA 3
NCA 4
NCA 5

Noise Contours LAeq,15min dB(A)
40
45
50
55
60
65
70
75
80

0 1 2 km

Representative frequency range: 16 Hz to 8000 Hz

Modelling parameters:
- Calculation at 1.5m above ground
- 20°C temperature and 70% humidity
- Neutral weather conditions (Pasquill Grade D with wind speed of 3 m /s)
- Softground G = 1.0
- Calculation method: Concawe

1:30,000 at A4
GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure A-1 Construction Phase 1

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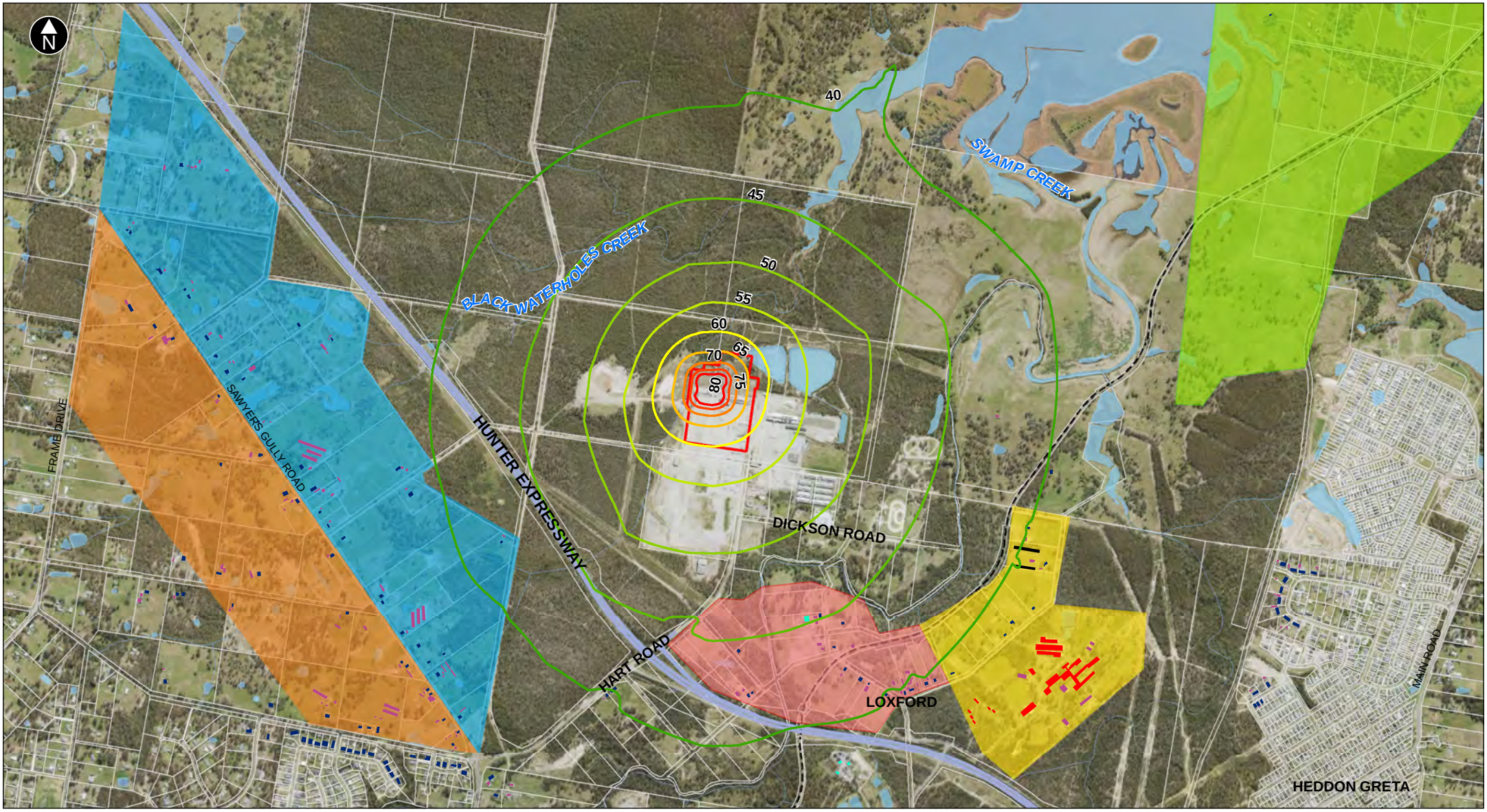

Proposal site
Motorway
Railway
Waterbodies

Surrounding Receivers
Commercial
Educational
Industrial
Residential
Unoccupied / Unused

Noise Catchment Areas
NCA 1
NCA 2
NCA 3
NCA 4
NCA 5

Noise Contours LAeq,15min dB(A)
40
45
50
55
60
65
70
75
80

0 0.5 1 km

Representative frequency range: 16 Hz to 8000 Hz

Modelling parameters:
- Calculation at 1.5m above ground
- 20°C temperature and 70% humidity
- Neutral weather conditions (Pasquill Grade D with wind speed of 3 m /s)
- Softground G = 1.0
- Calculation method: Concawe

1:25,000 at A4
GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure A-2 Construction Phase 2

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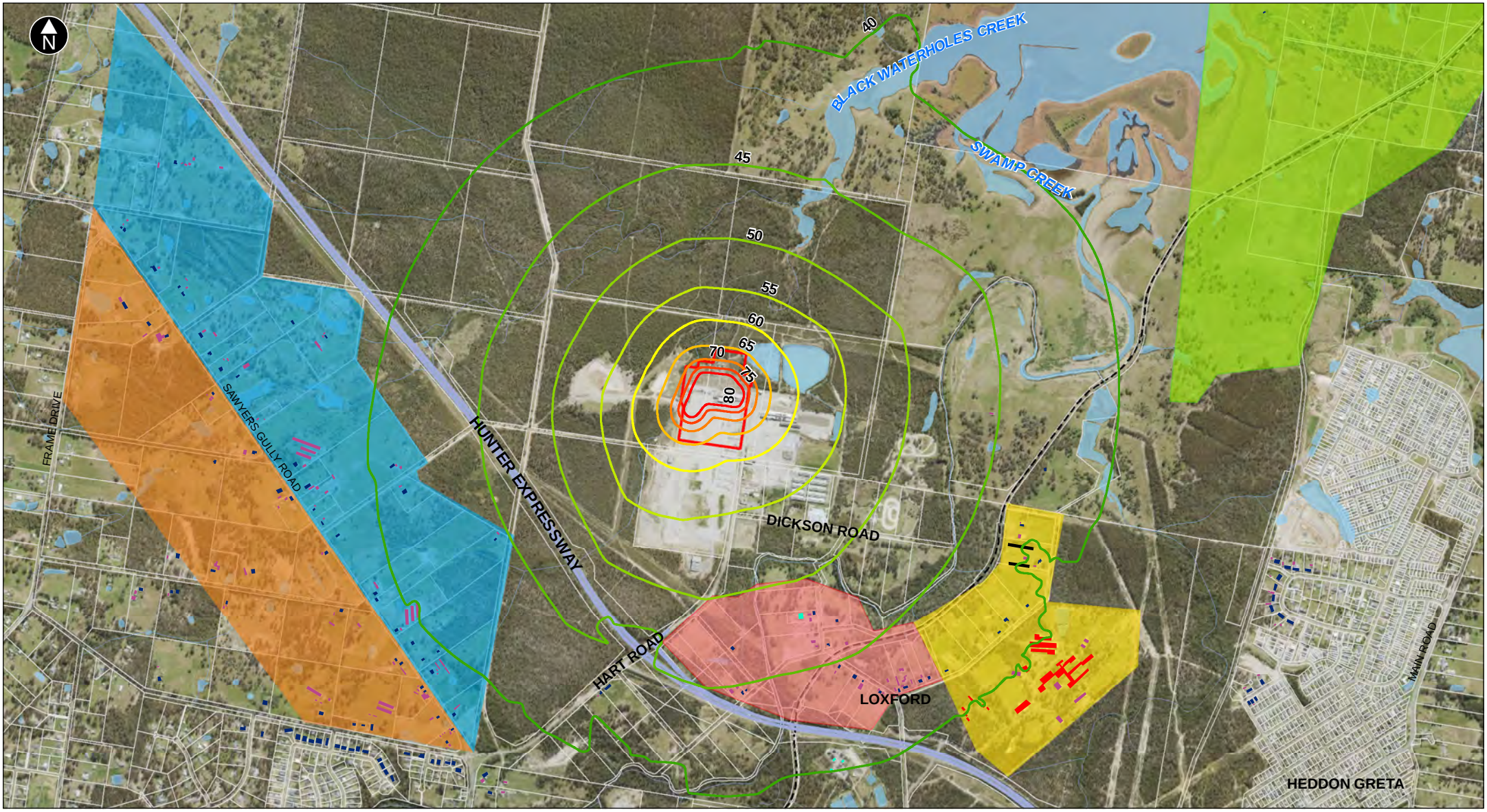

Proposal site
Motorway
Railway
Waterbodies

Surrounding Receivers
Commercial
Educational
Industrial
Residential
Unoccupied / Unused

Noise Catchment Areas
NCA 1
NCA 2
NCA 3
NCA 4
NCA 5

Noise Contours LAeq,15min dB(A)
40
45
50
55
60
65
70
75
80

0 0.5 1 km

Representative frequency range: 16 Hz to 8000 Hz

Modelling parameters:
- Calculation at 1.5m above ground
- 20°C temperature and 70% humidity
- Neutral weather conditions (Pasquill Grade D with wind speed of 3 m /s)
- Softground G = 1.0
- Calculation method: Concawe

1:25,000 at A4
GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure A-3 Construction Phase 3

snowy hydro renewable energy
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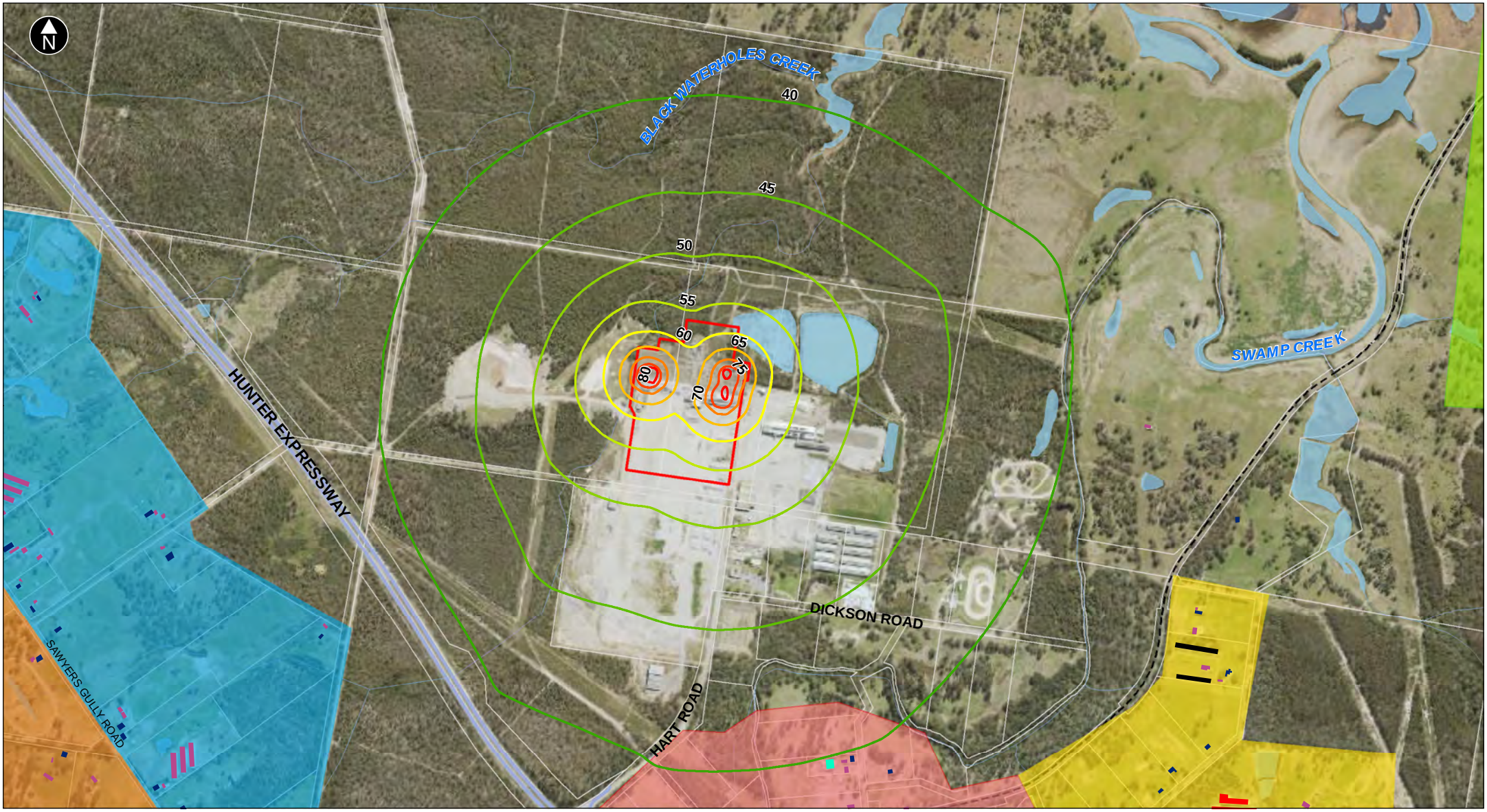

Figure A-4 Construction Phase 4

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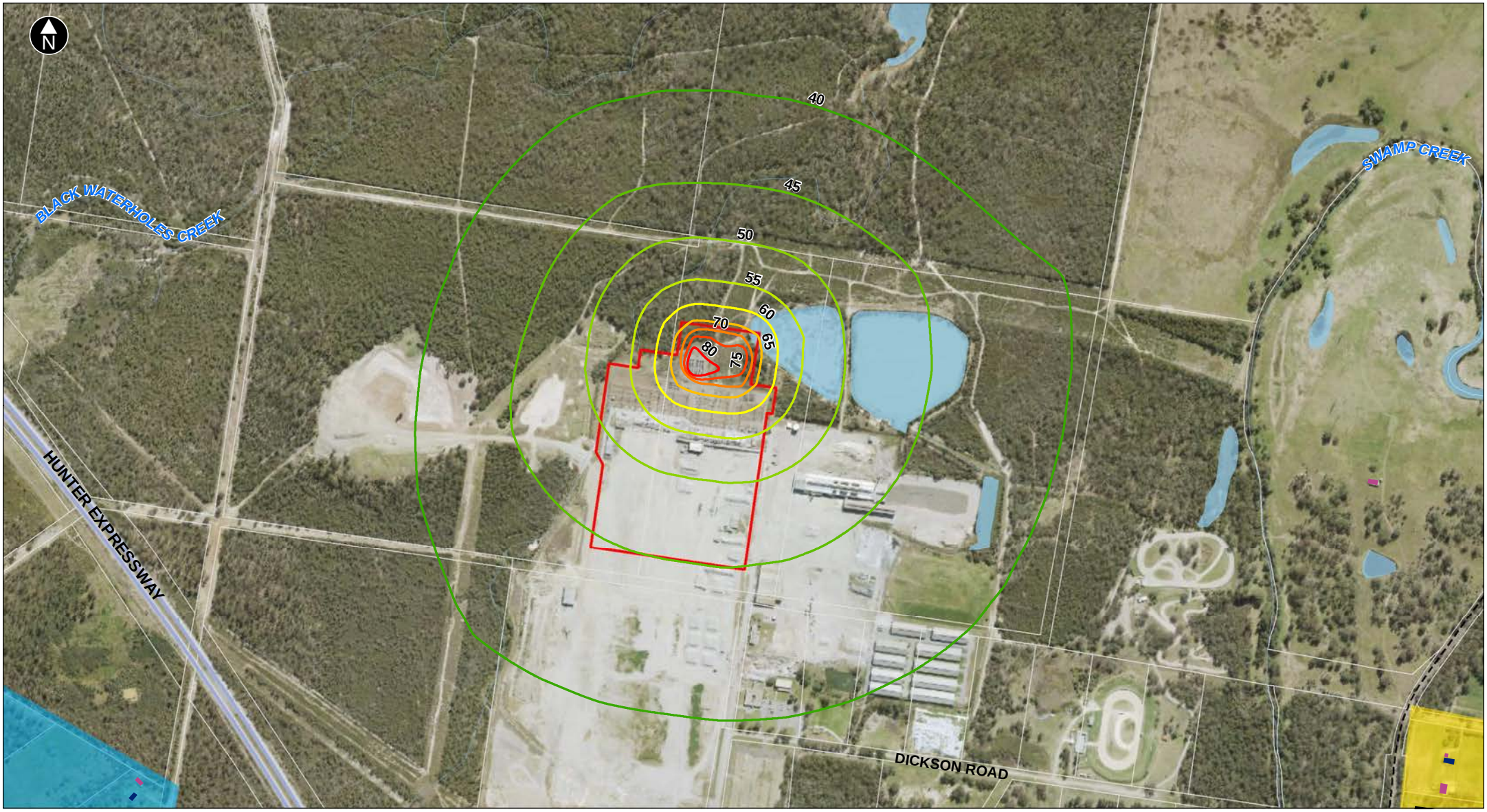

Figure A- 5 Construction Phase 5

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Figure A-6 Construction Phase 6

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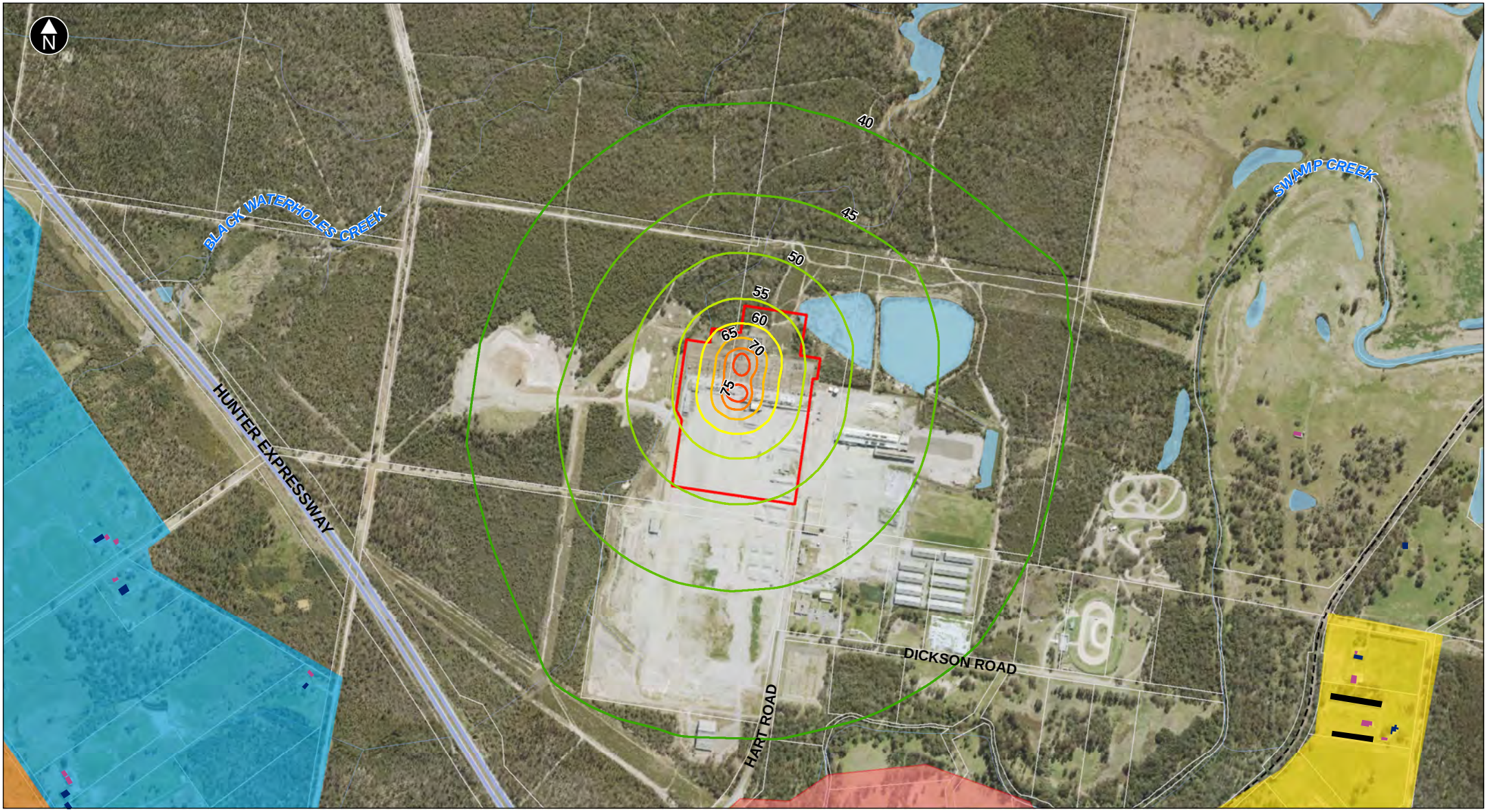

Figure A-7 Construction Phase 7

snowy hydro renewable energy Jacobs

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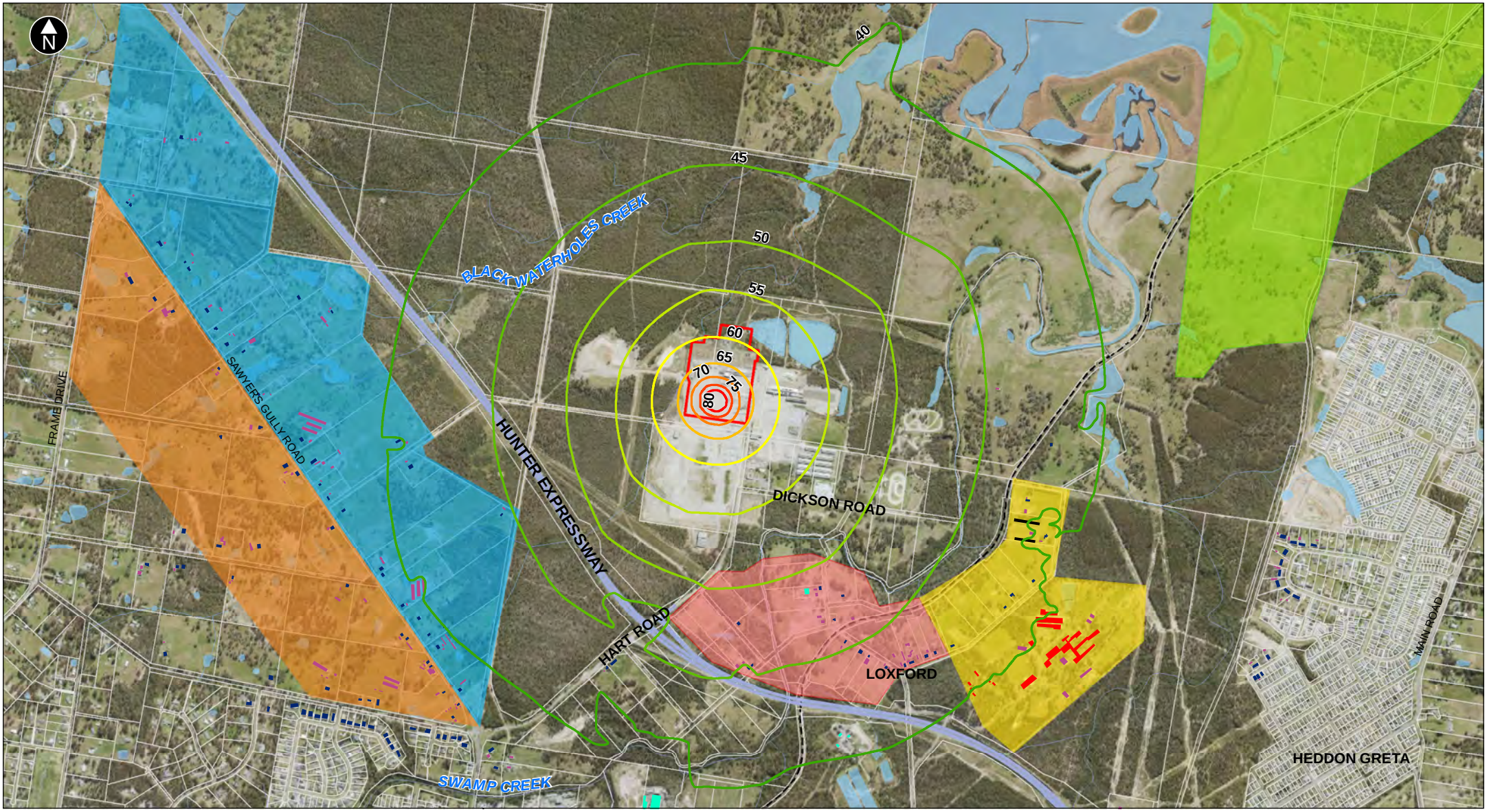

Proposal site
Motorway
Railway
Waterbodies

Surrounding Receivers
Commercial
Educational
Industrial
Residential
Unoccupied / Unused

Noise Catchment Areas
NCA 1
NCA 2
NCA 3
NCA 4
NCA 5

Noise Contours LAeq,15min dB(A)
40
45
50
55
60
65
70
75
80

0 0.5 1 km

Representative frequency range: 16 Hz to 8000 Hz

Modelling parameters:
- Calculation at 1.5m above ground
- 20°C temperature and 70% humidity
- Neutral weather conditions (Pasquill Grade D with wind speed of 3 m /s)
- Softground G = 1.0
- Calculation method: Concawe

1:25,000 at A4
GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

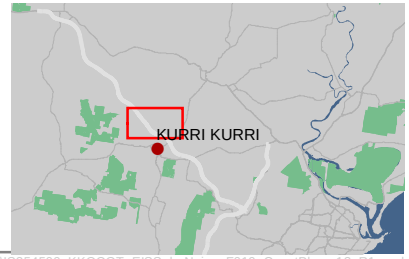

Figure A-8 Construction Phase 8

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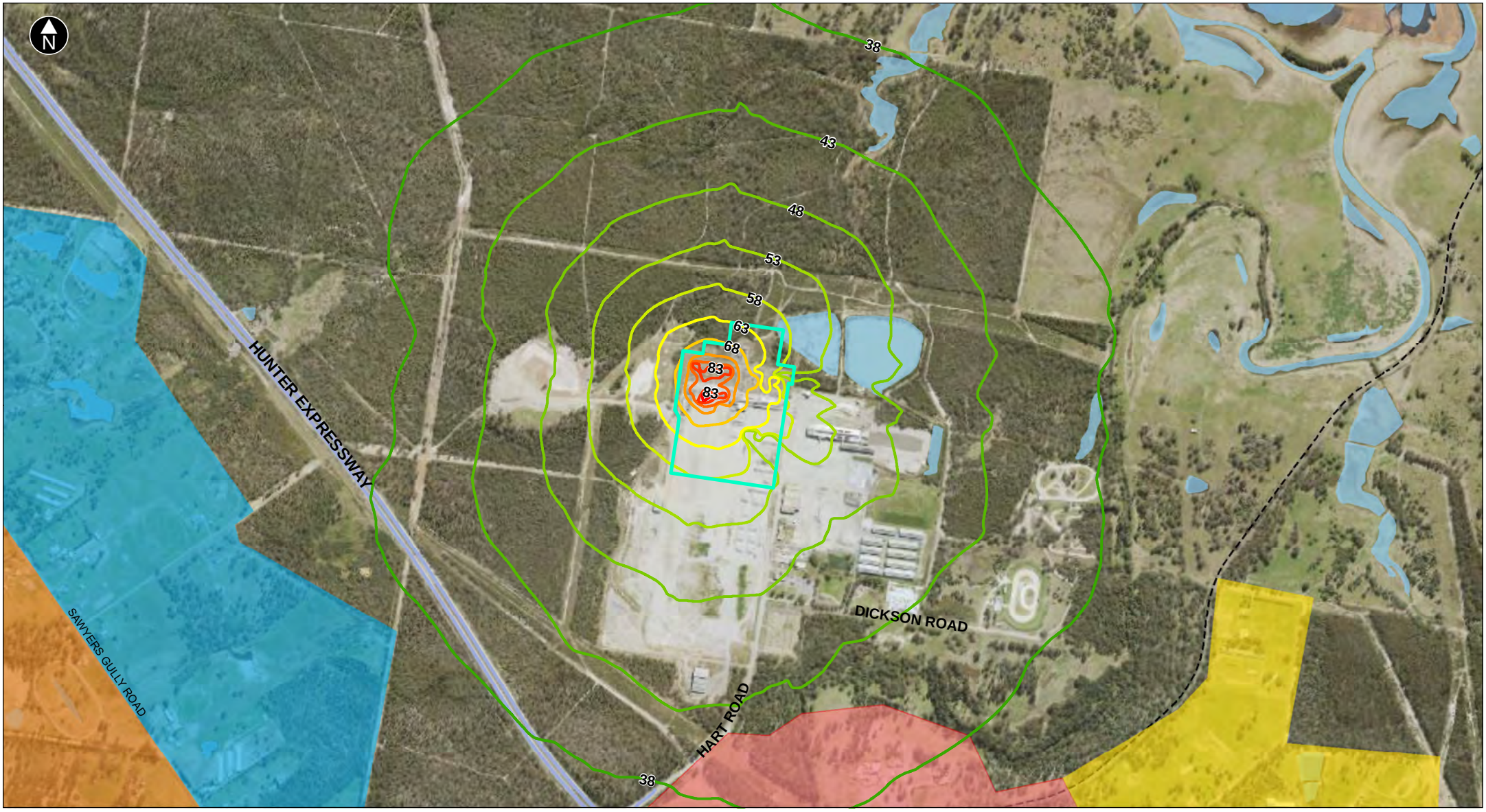
Appendix B. Operational noise contour maps

B.1 Standard meteorological conditions



Proposal site
Motorway
Railway
Waterbodies

Noise Catchment Areas
NCA 1
NCA 2
NCA 3
NCA 5

Noise Level dB(A)
38
43
48
53
58
63
68
73
78
83
88

0 0.5 1 km

Representative frequency range: 16 Hz to 8000 Hz
Modelling parameters:
- Calculation at 1.5m above ground
- 20°C temperature and 70% humidity
- Neutral weather conditions (Pasquill Grade D with wind speed of 0 m/s)
- Softground G = 1.0
- Calculation method: Concawe

1:15,000 at A4
GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure B-1 Attenuated F-Class OCGT Power Station – Standard Meteorological Conditions – dB(A)

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Created by : AA | QA by : KI

Proposal site
Motorway
Waterbodies
Exceedance of 68 dB(A) Industrial Limit
Exceedance of 63 dB(A) Commercial Limit
OCGT project setup
① Proposed Switchyard Area
② Proposed Plant Area
③ Proposed Buffer Area

0 250 500 m

Representative frequency range: 16 Hz to 8000 Hz

Modelling parameters:
- Calculation at 1.5m above ground
- 20°C temperature and 70% humidity
- Neutral weather conditions (Pasquill Grade D with wind speed of 0 m/s)
- Softground G = 1.0
- Calculation method: Concawe

1:7,500 at A4
GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure B-2 Attenuated F-Class OCGT Power Station – Standard Meteorological Conditions – dB(A)

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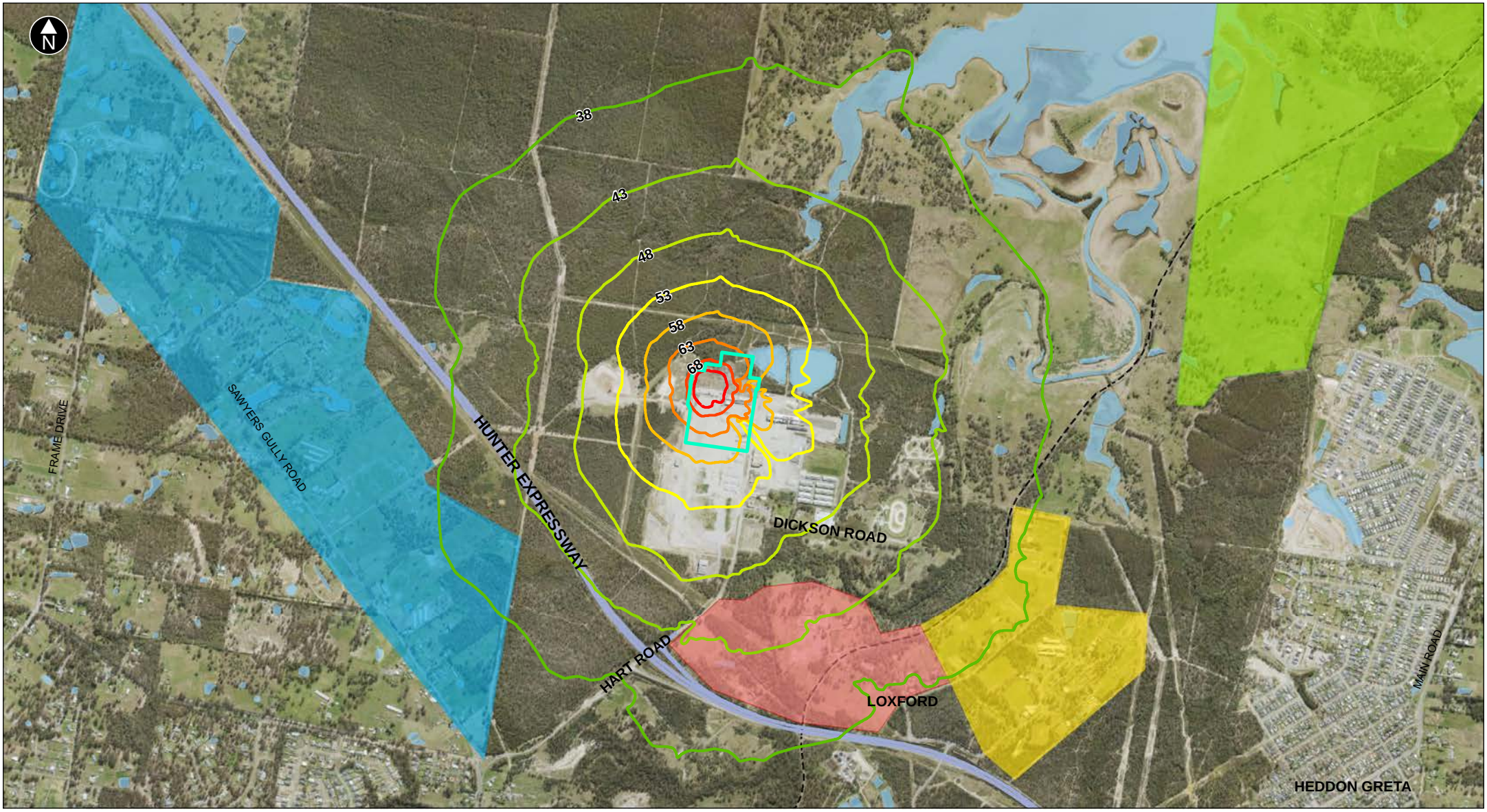
Created by : AA | QA by : KI

B.2 Noise-enhancing meteorological conditions



Proposal site
Motorway
Railway
Waterbodies

Noice catchment areas
NCA 1
NCA 2
NCA 3
NCA 4

Noise Level dB(A)
38
43
48
53
58
63
68
73

0 1 2 km

Representative frequency range: 16 Hz to 8000 Hz
Modelling parameters:
- Calculation at 1.5m above ground
- 20°C temperature and 70% humidity
- Neutral weather conditions (Pasquill Grade D with wind speed of 3 m /s)
- Softground G = 1.0
- Calculation method: Concawe

1:25,000 at A4
GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

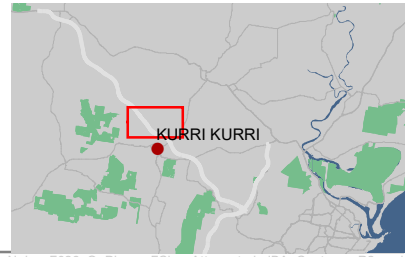


Figure B-3 Attenuated F-Class OCGT Power Station – Adverse Meteorological Conditions – dB(A)

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Proposal site
Motorway
Waterbodies
Exceedance of 68 dB(A) Industrial Limit
Exceedance of 63 dB(A) Commercial Limit
OCGT project setup

1 Proposed Switchyard Area
2 Proposed Plant Area
3 Proposed Buffer Area

0 250 500 m

Representative frequency range: 16 Hz to 8000 Hz

Modelling parameters:
- Calculation at 1.5m above ground
- 20°C temperature and 70% humidity
- Neutral weather conditions (Pasquill Grade D with wind speed of 3 m /s)
- Softground G = 1.0
- Calculation method: Concawe

1:7,500 at A4
GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

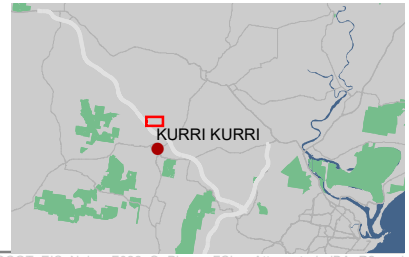

Figure B-4 Attenuated F-Class OCGT Power Station – Adverse Meteorological Conditions – dB(A)

snowy hydro renewable energy Jacobs

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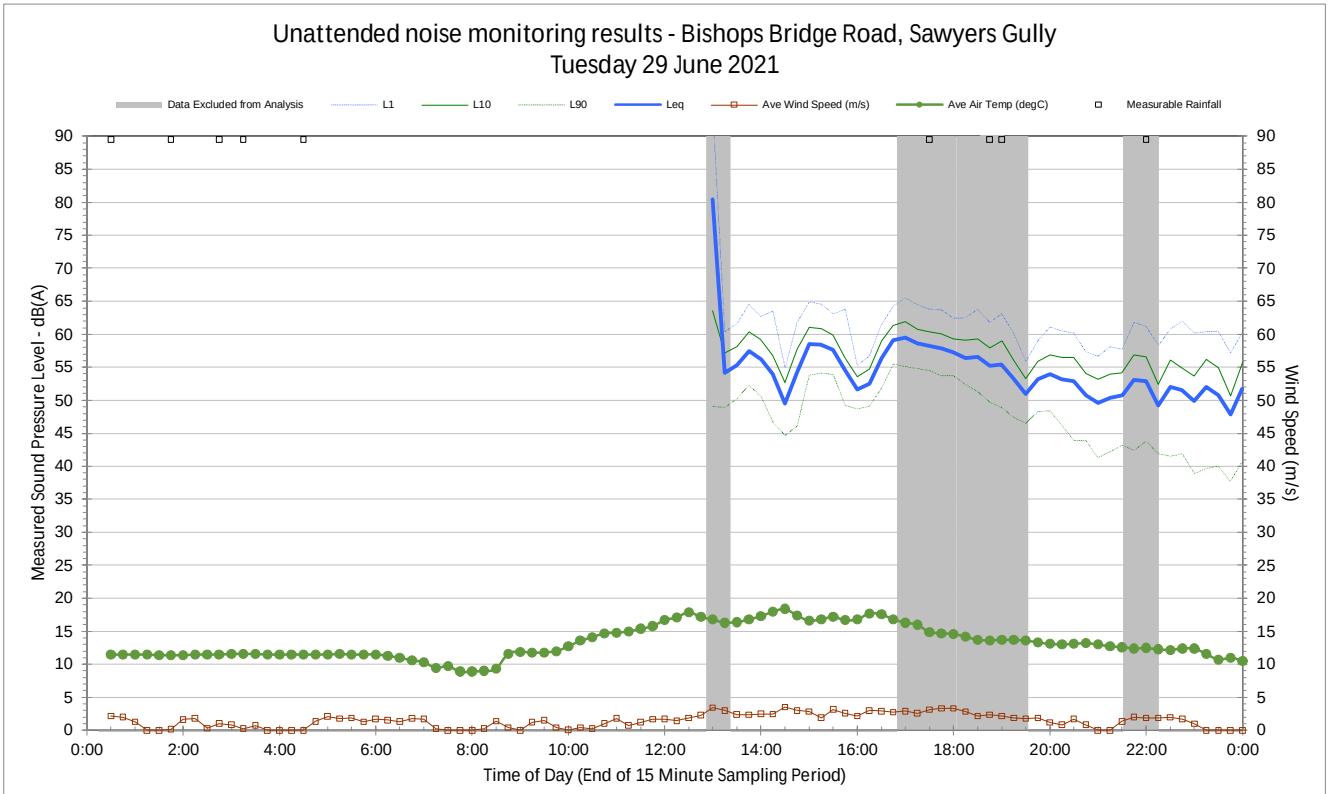
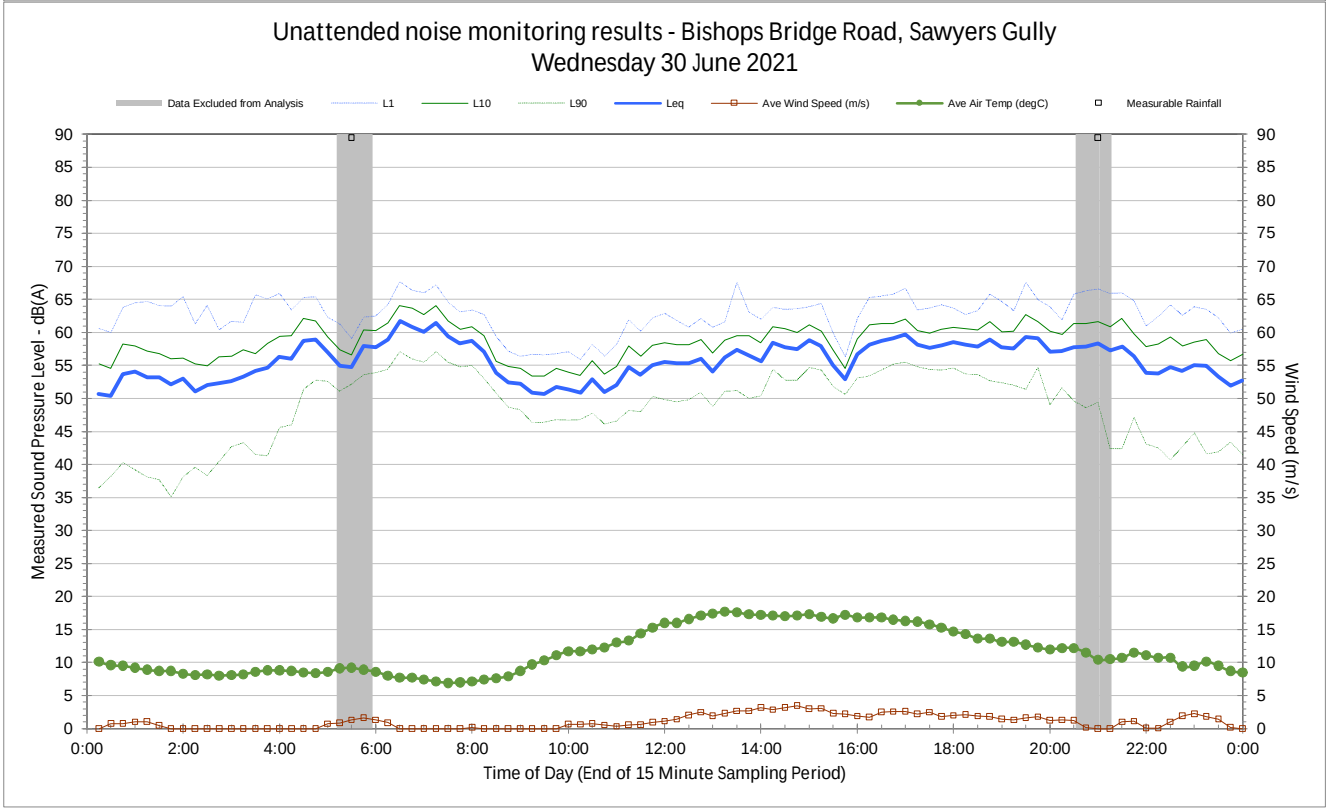
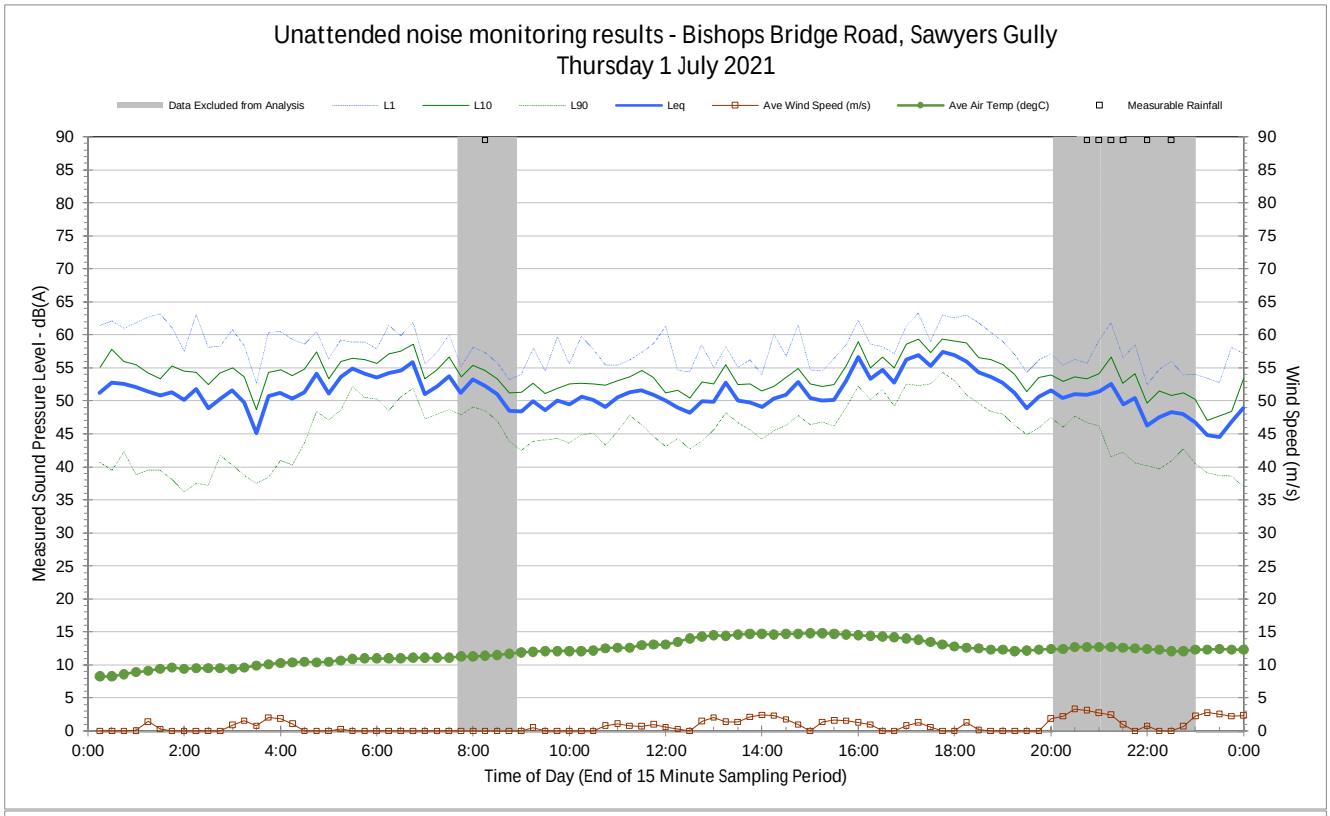
Created by : AA | QA by : KI

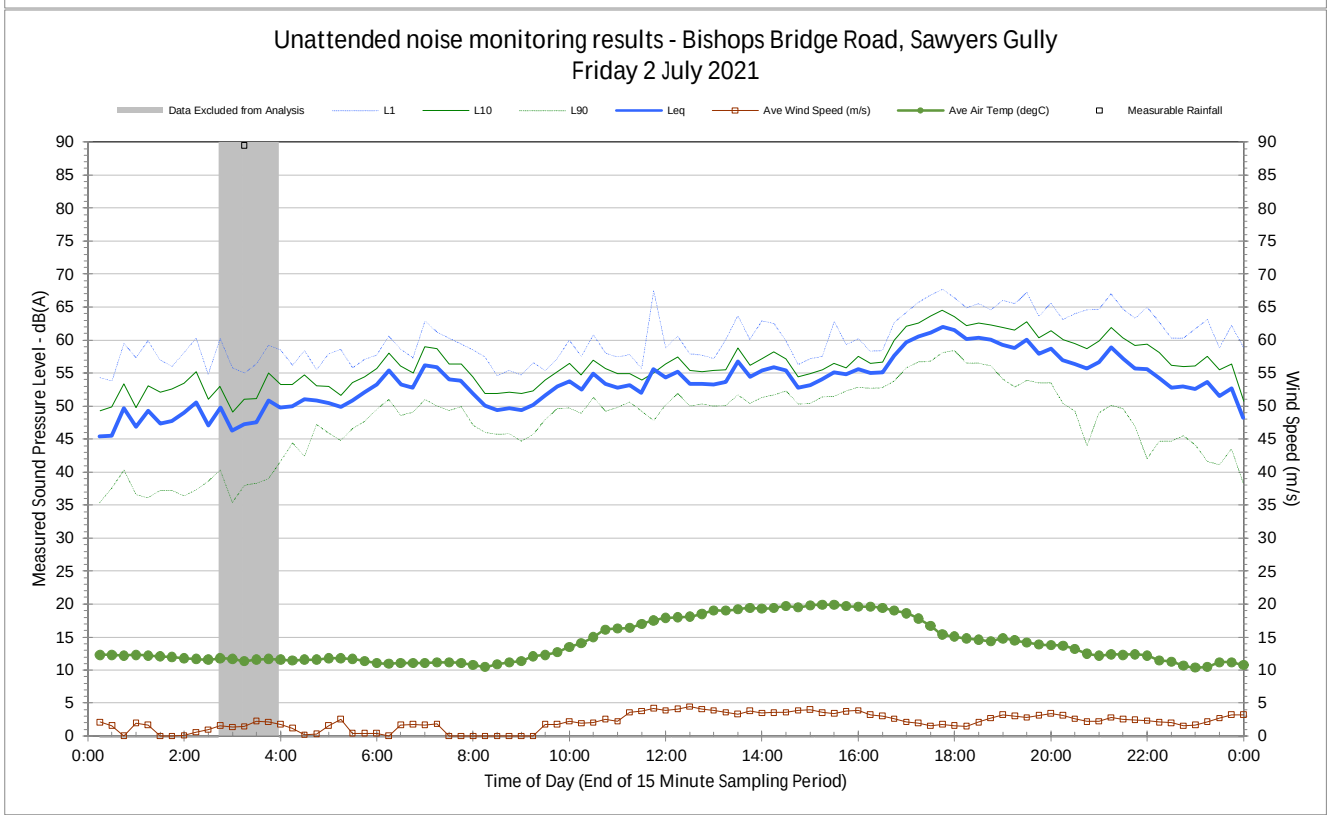
Appendix C. Background noise levels

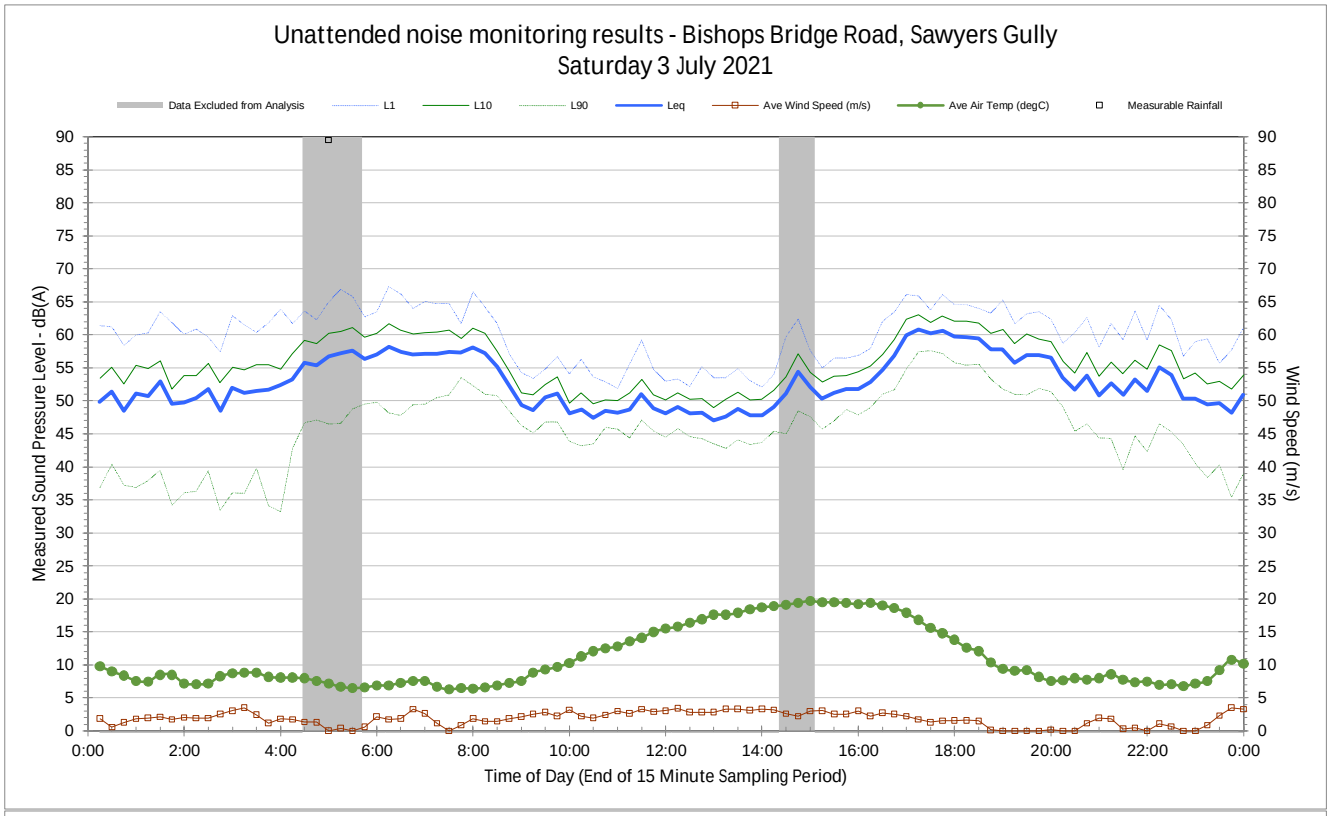
C.1 Bishops Bridge Road, Sawyers Gully

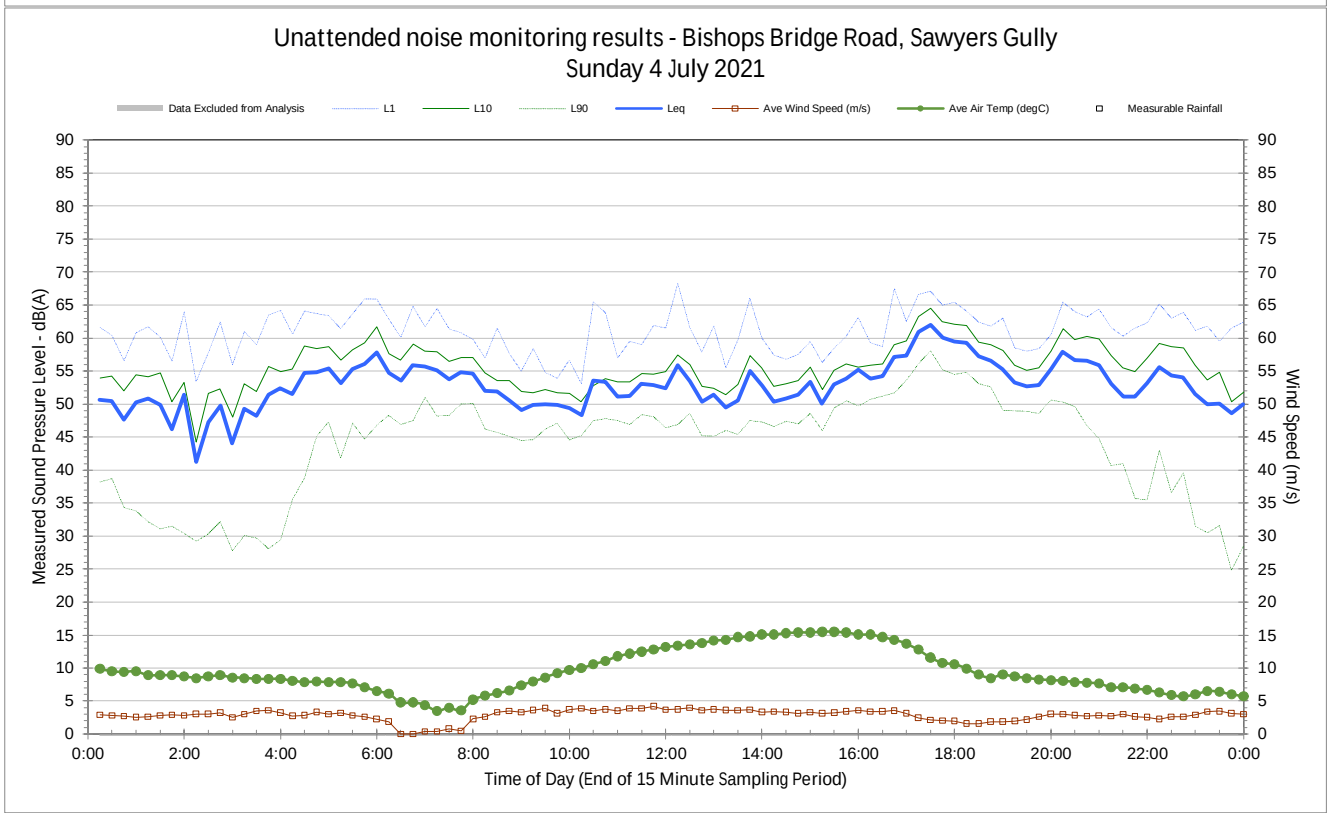


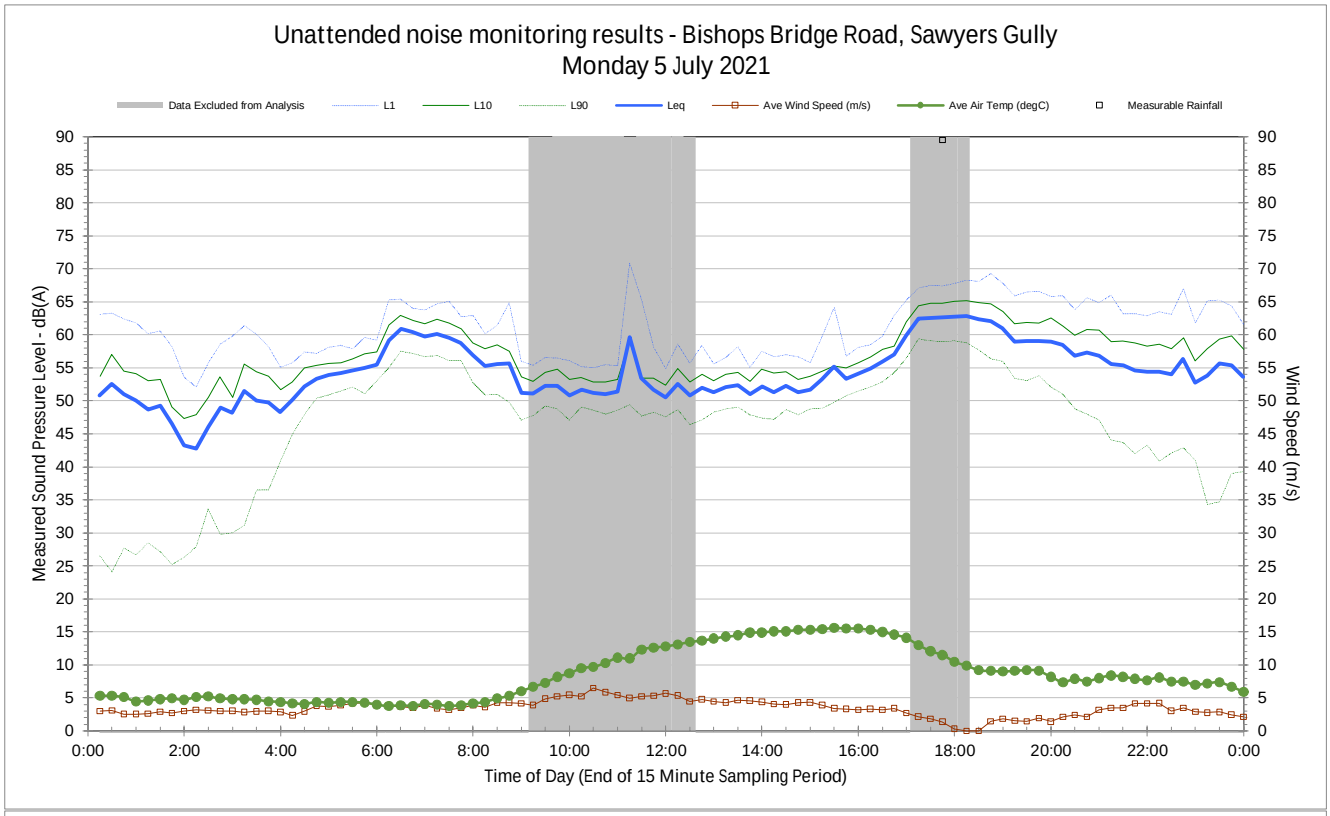


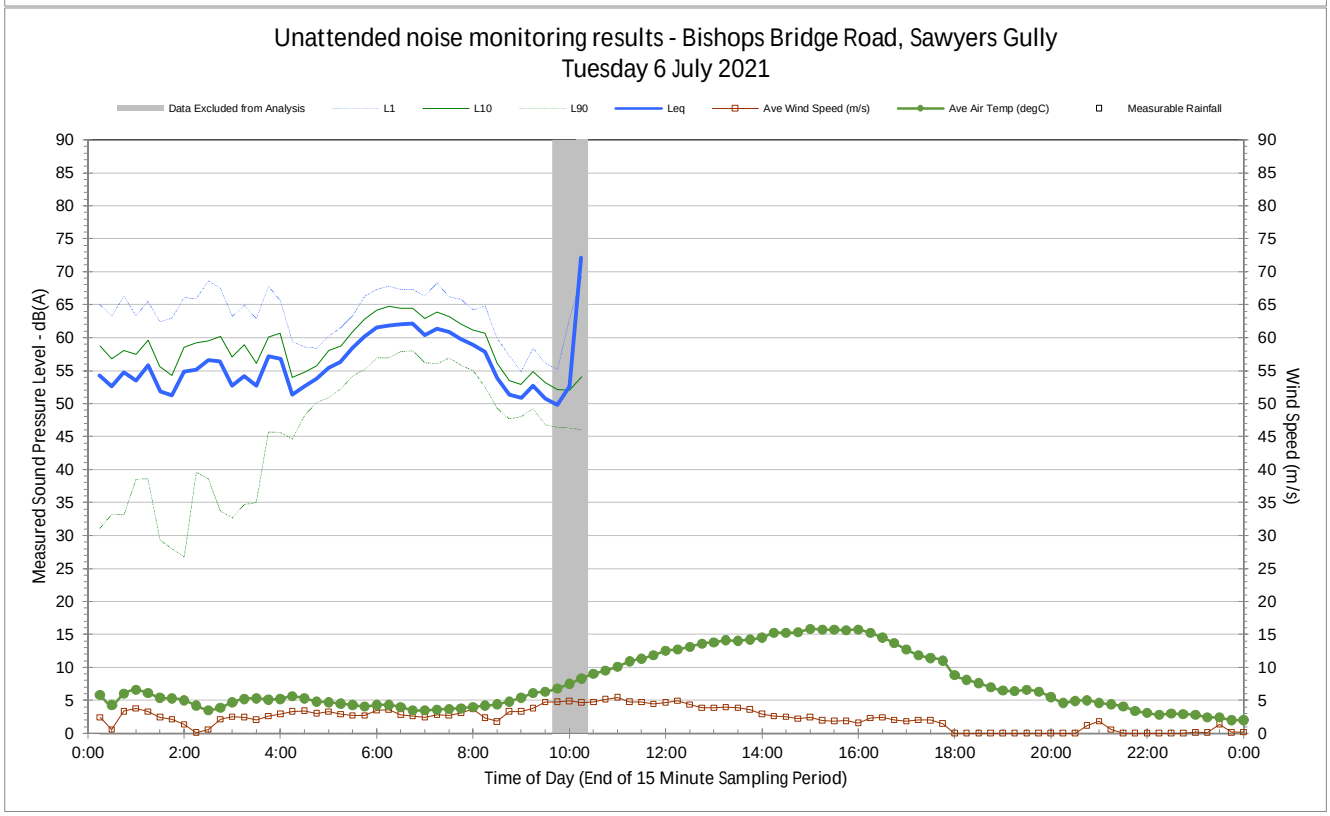

Unattended noise monitoring results - Bishops Bridge Road, Sawyers Gully
Thursday 1 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

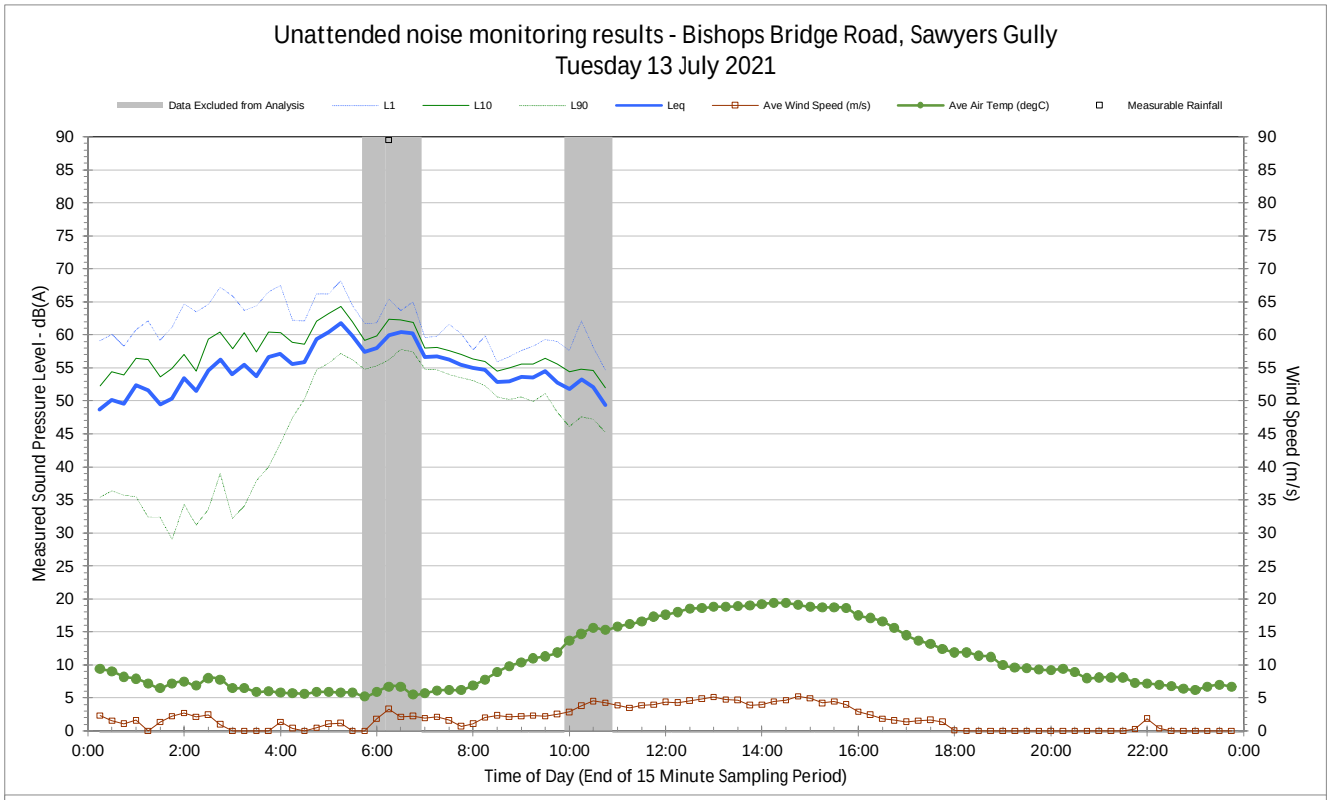

Unattended noise monitoring results - Bishops Bridge Road, Sawyers Gully
Friday 2 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

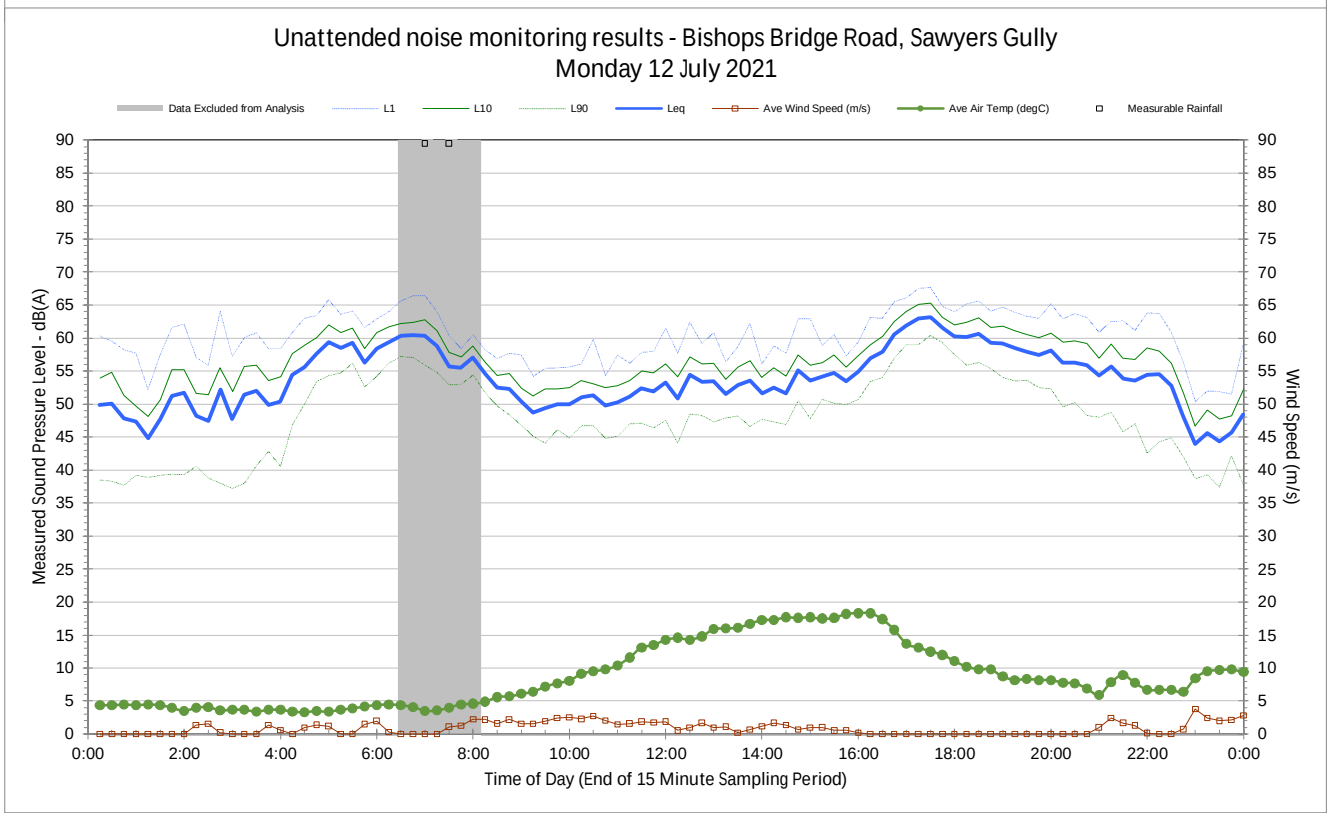

Unattended noise monitoring results - Bishops Bridge Road, Sawyers Gully
Saturday 3 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

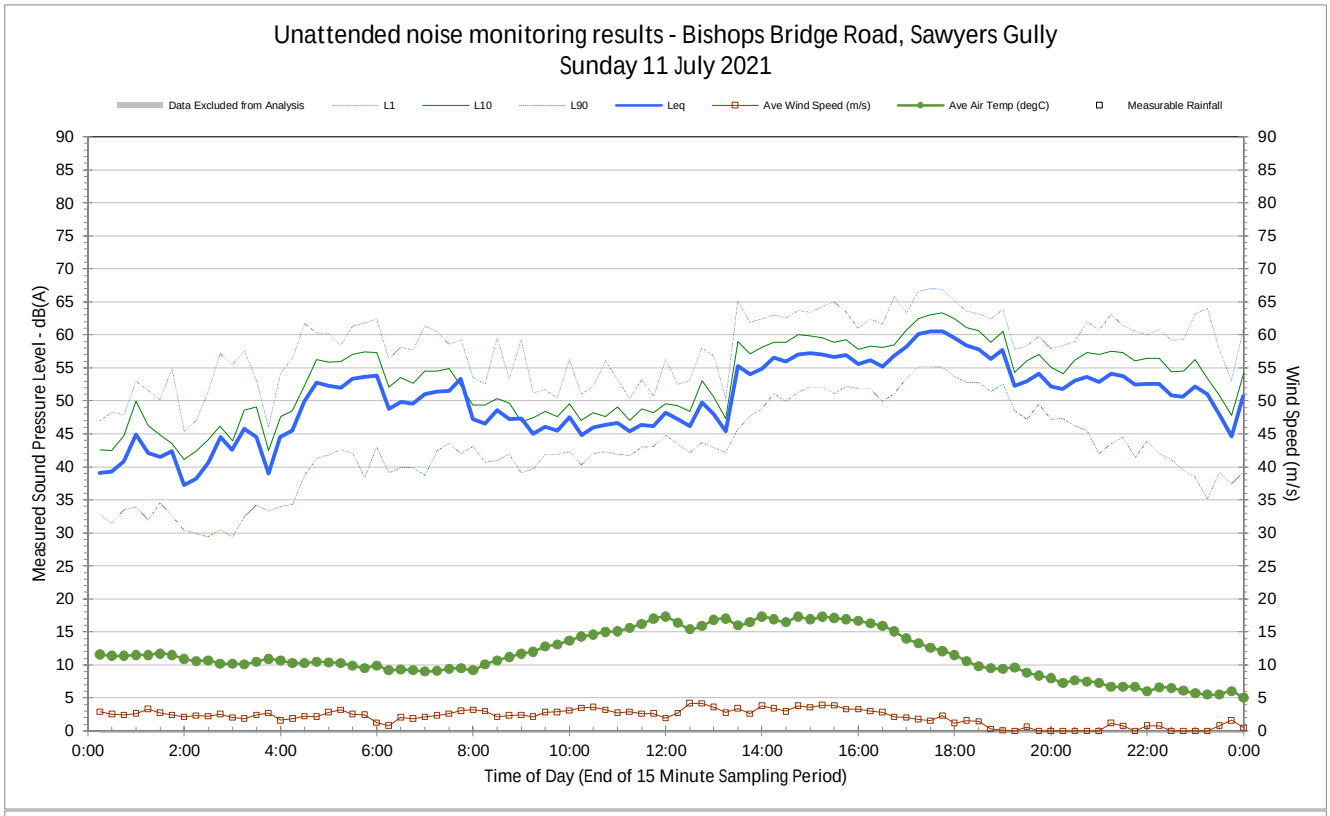

Unattended noise monitoring results - Bishops Bridge Road, Sawyers Gully
Sunday 4 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

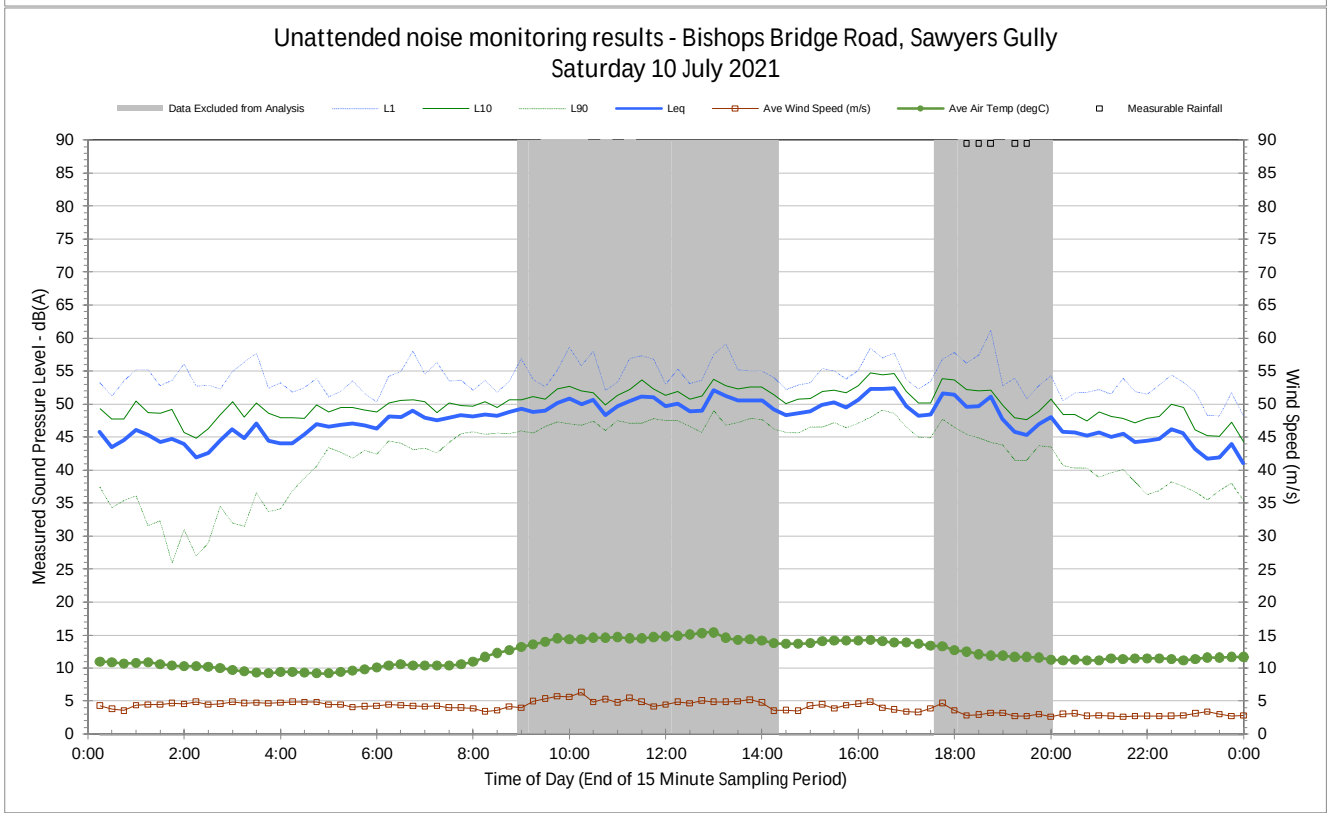

Unattended noise monitoring results - Bishops Bridge Road, Sawyers Gully
Monday 5 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

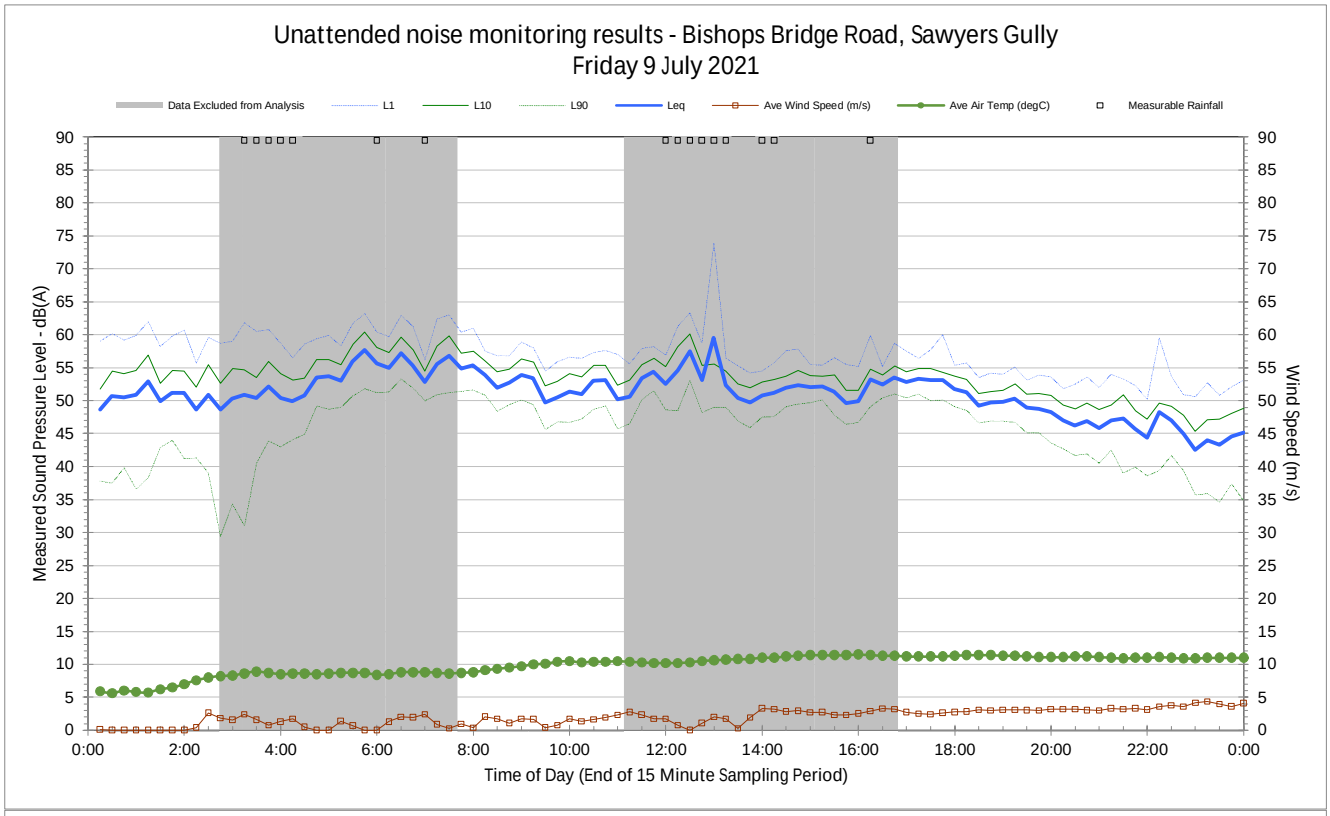

Unattended noise monitoring results - Bishops Bridge Road, Sawyers Gully
Tuesday 6 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

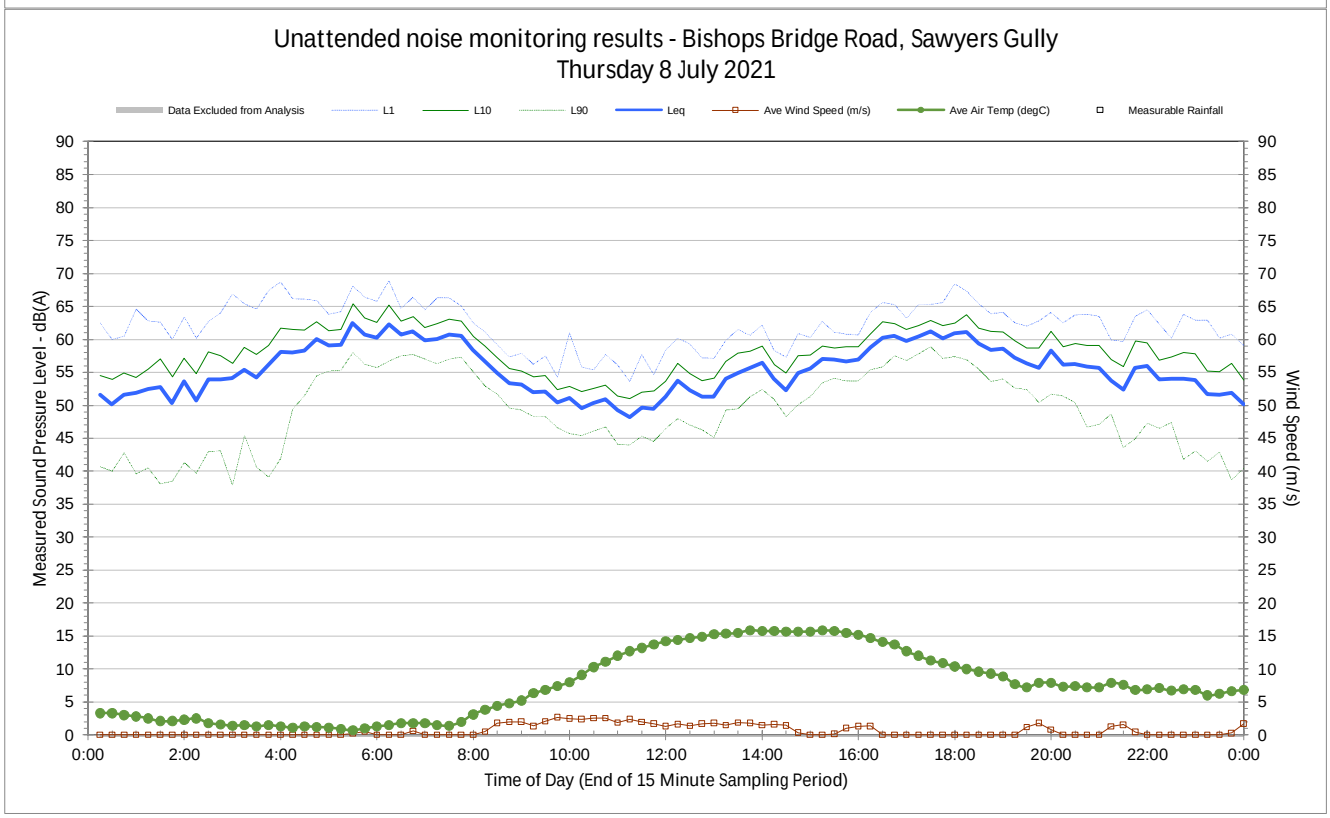

Unattended noise monitoring results - Bishops Bridge Road, Sawyers Gully
Tuesday 13 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

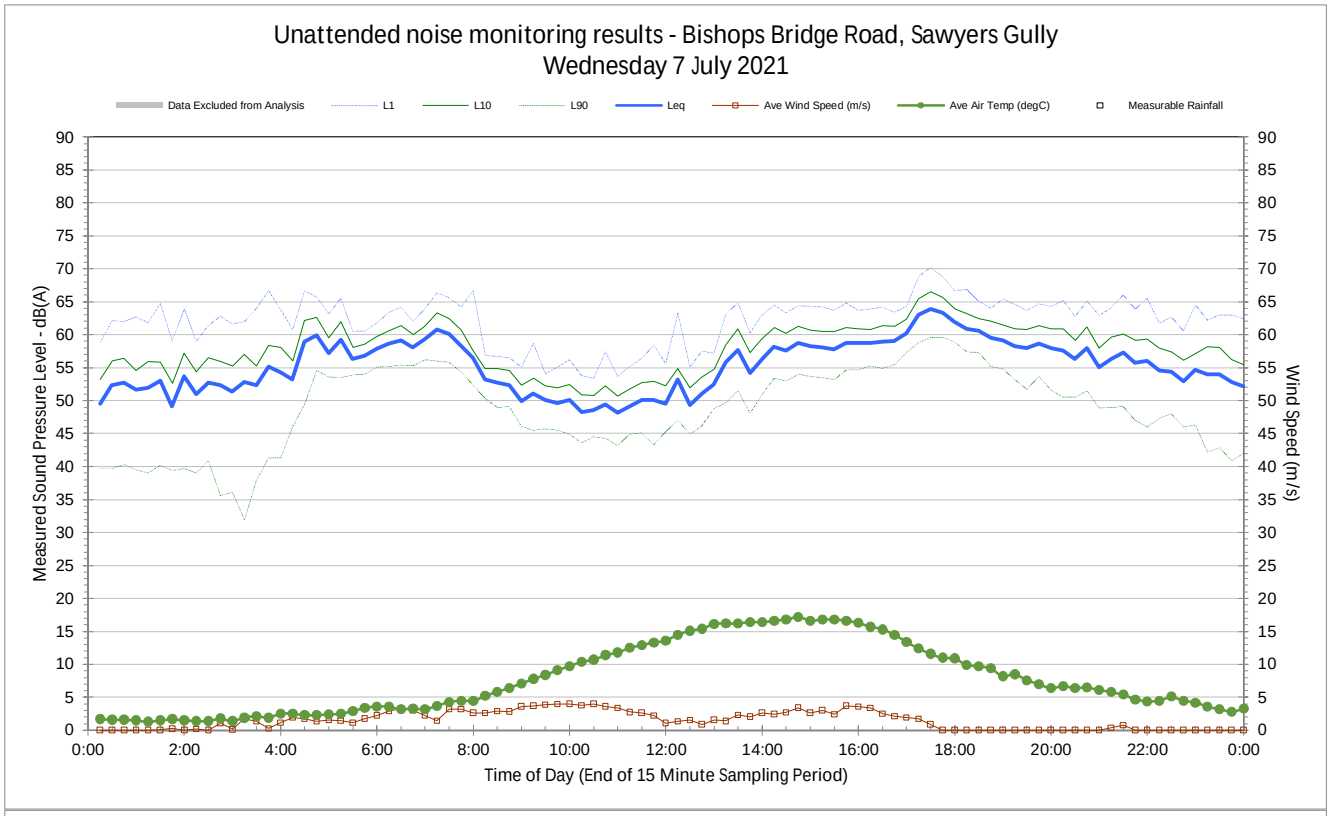

Unattended noise monitoring results - Bishops Bridge Road, Sawyers Gully
Monday 12 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

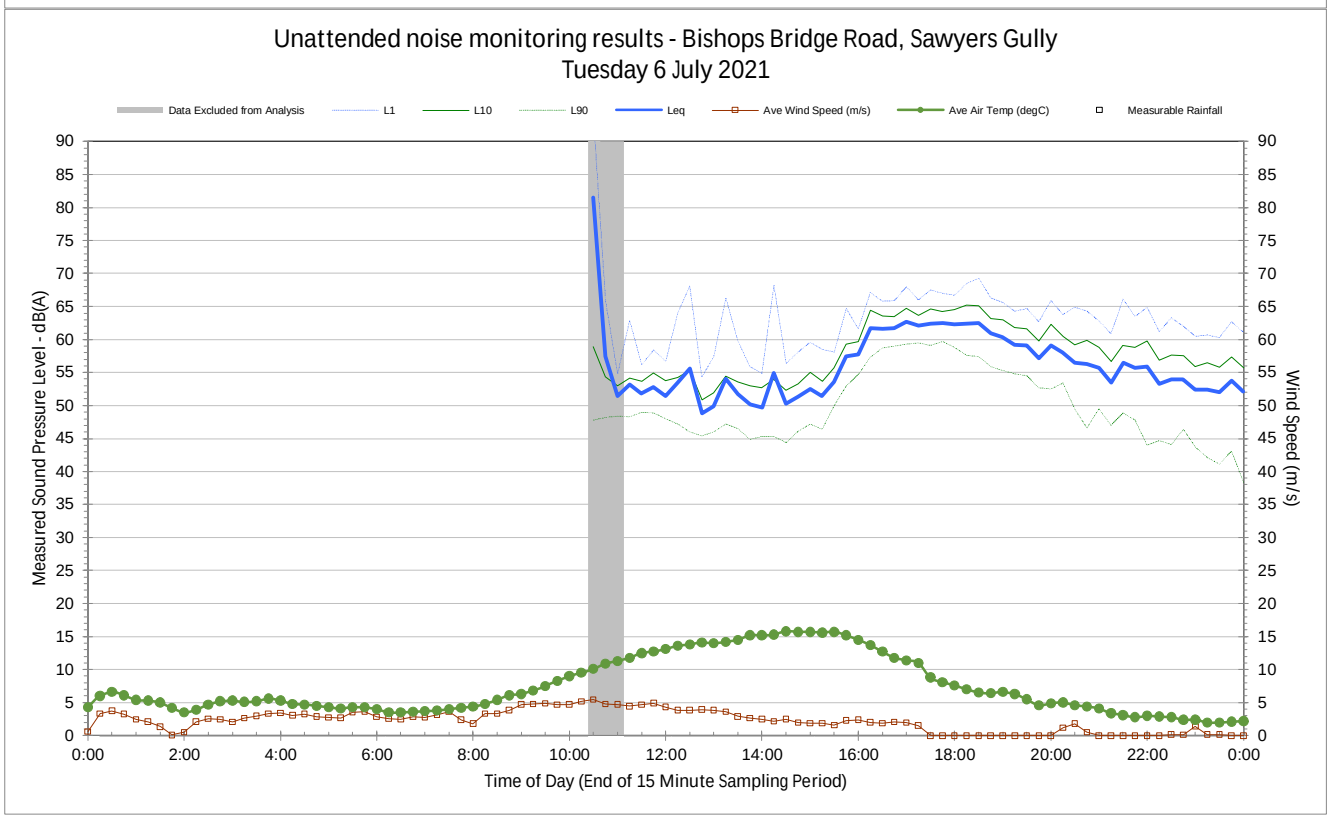

Unattended noise monitoring results - Bishops Bridge Road, Sawyers Gully
Sunday 11 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)


Unattended noise monitoring results - Bishops Bridge Road, Sawyers Gully
Saturday 10 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

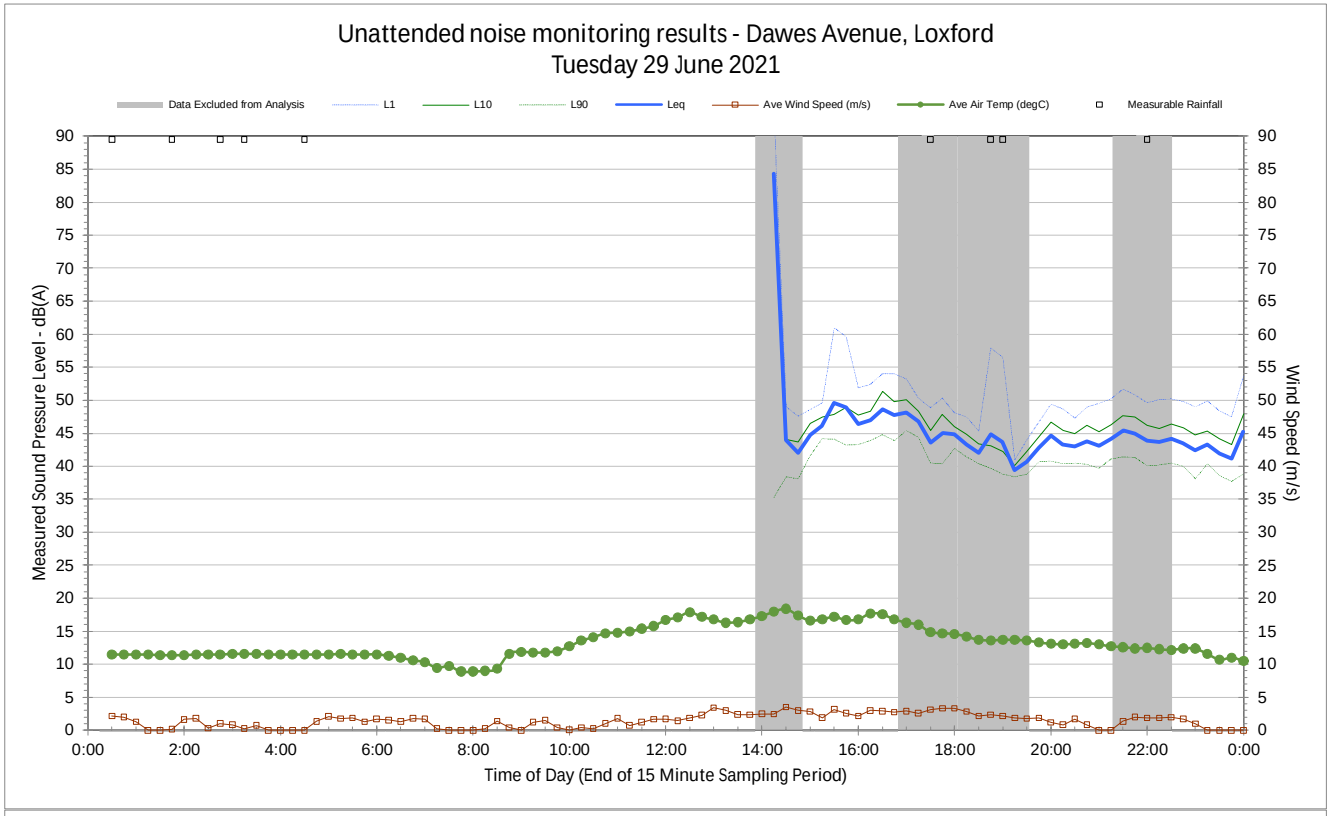

Unattended noise monitoring results - Bishops Bridge Road, Sawyers Gully
Friday 9 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

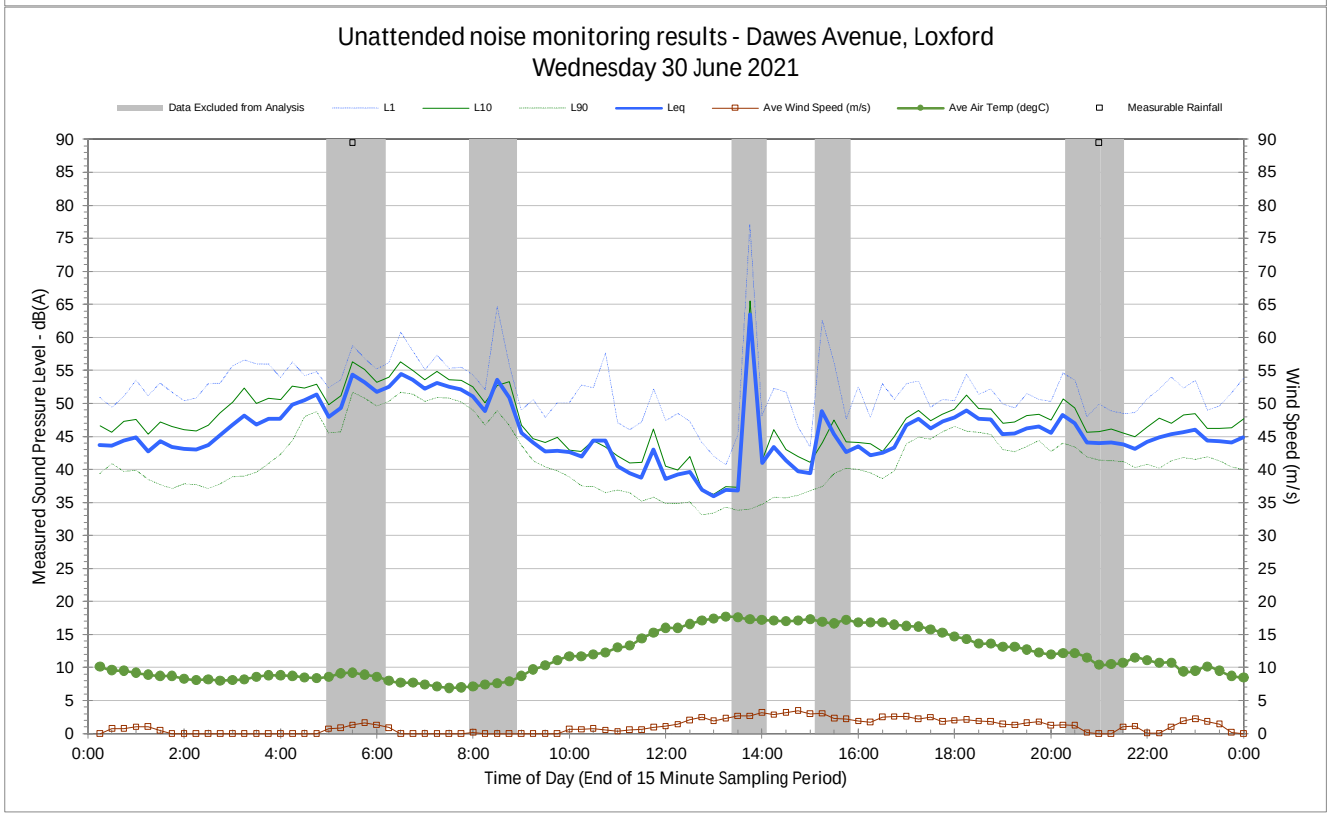

Unattended noise monitoring results - Bishops Bridge Road, Sawyers Gully
Thursday 8 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

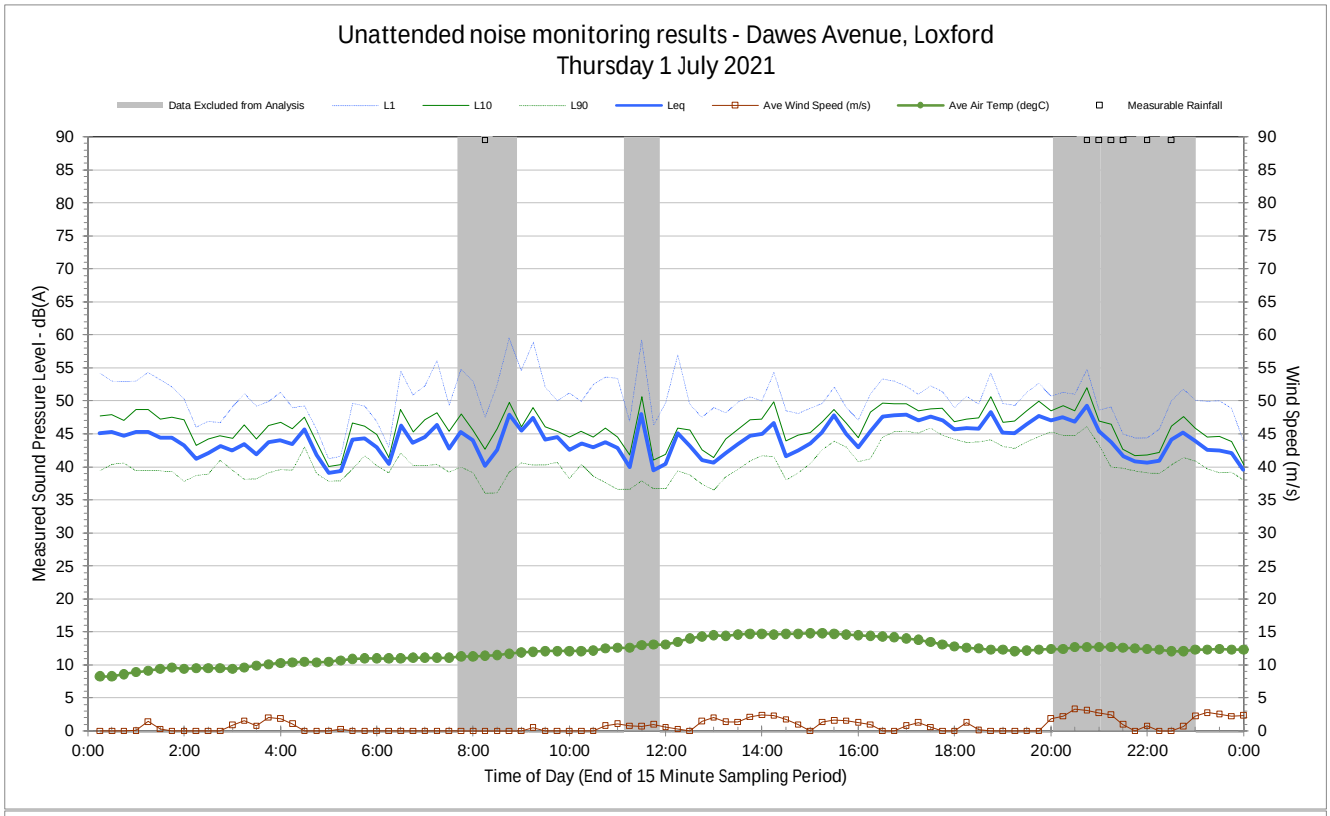

Unattended noise monitoring results - Bishops Bridge Road, Sawyers Gully
Wednesday 7 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

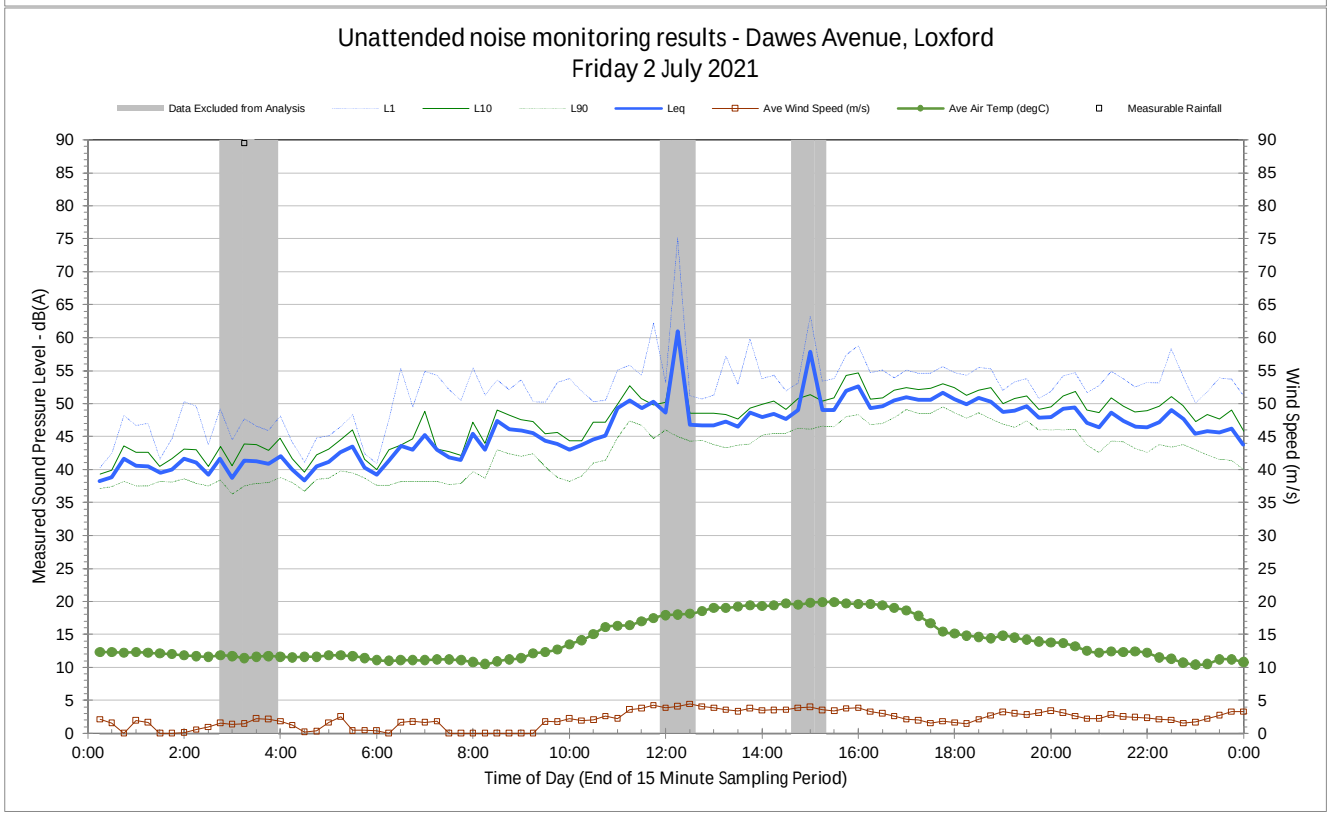

Unattended noise monitoring results - Bishops Bridge Road, Sawyers Gully
Tuesday 6 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

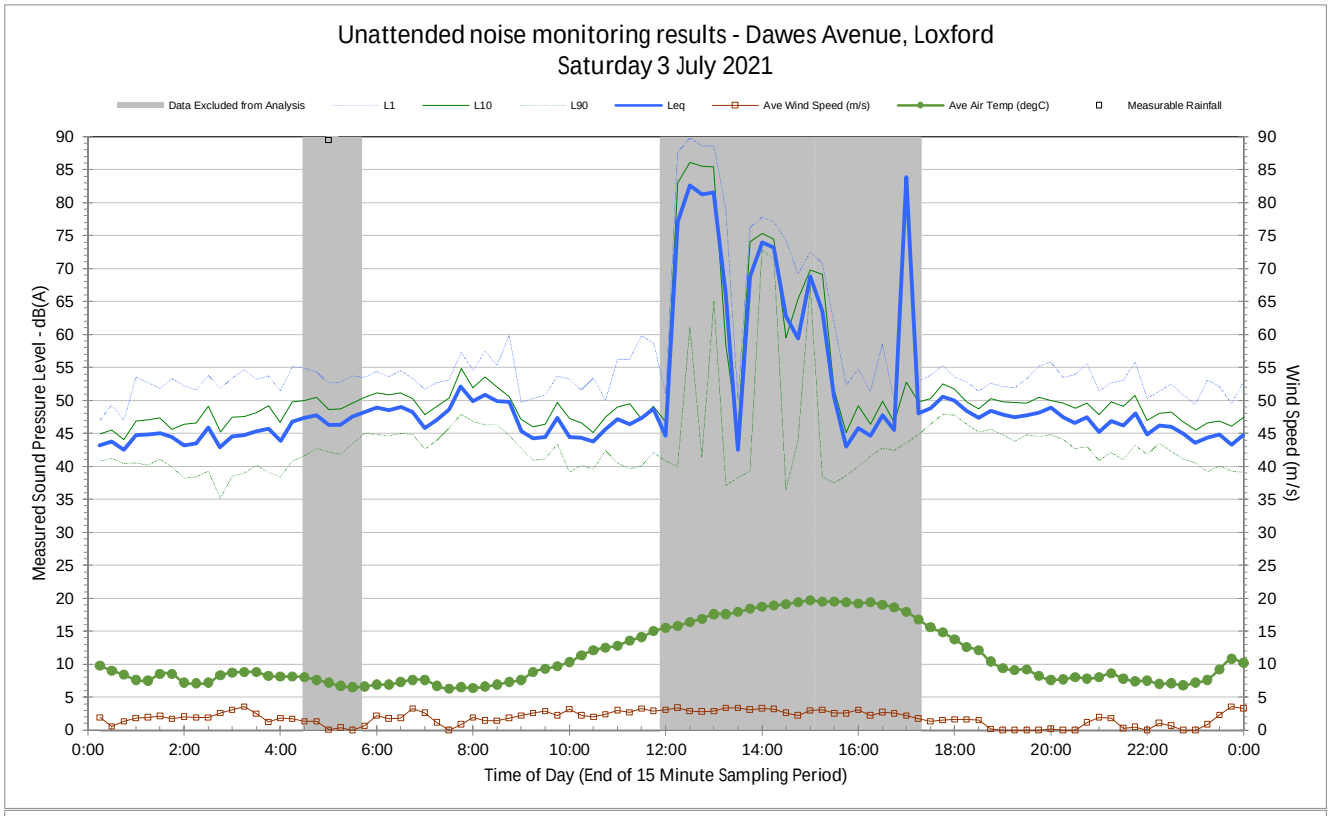
C.2 Dawes Avenue, Loxford

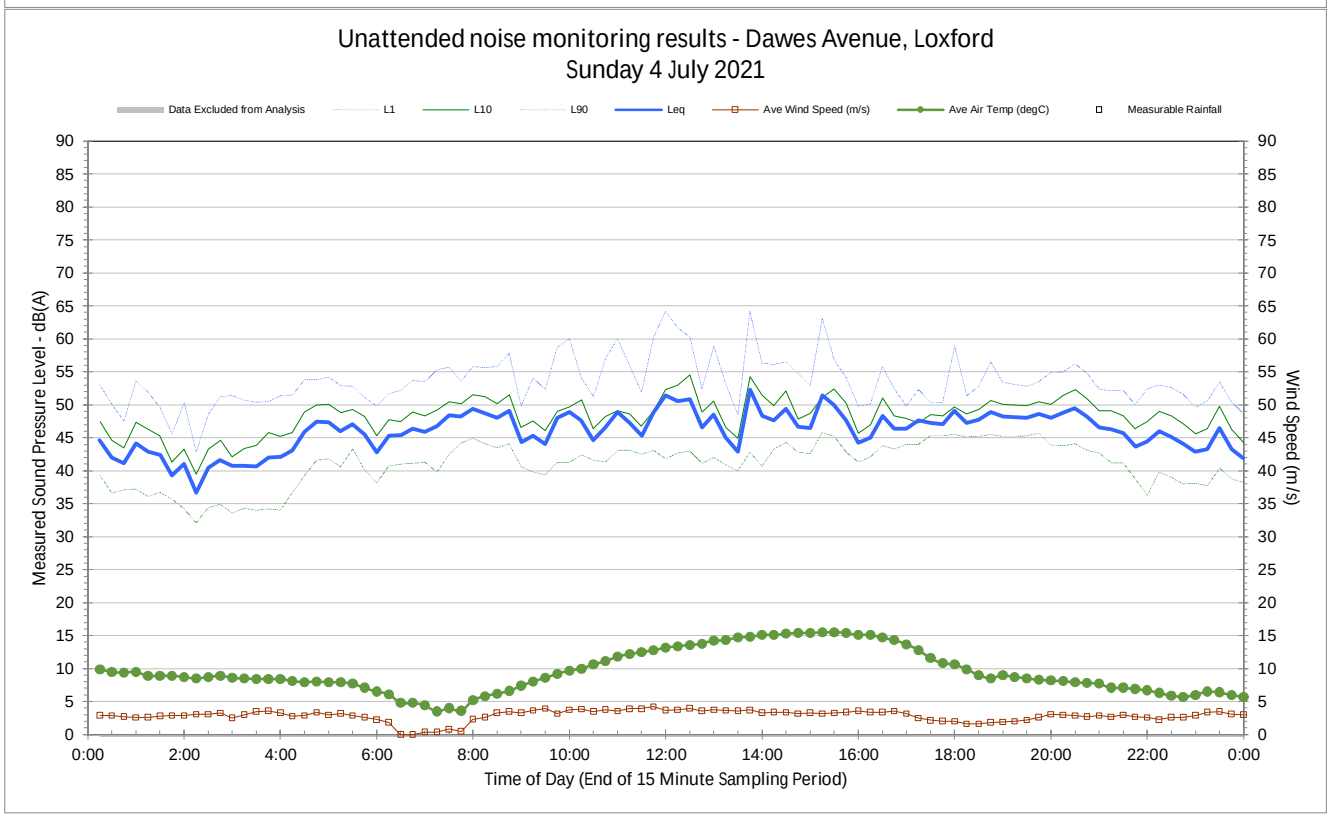


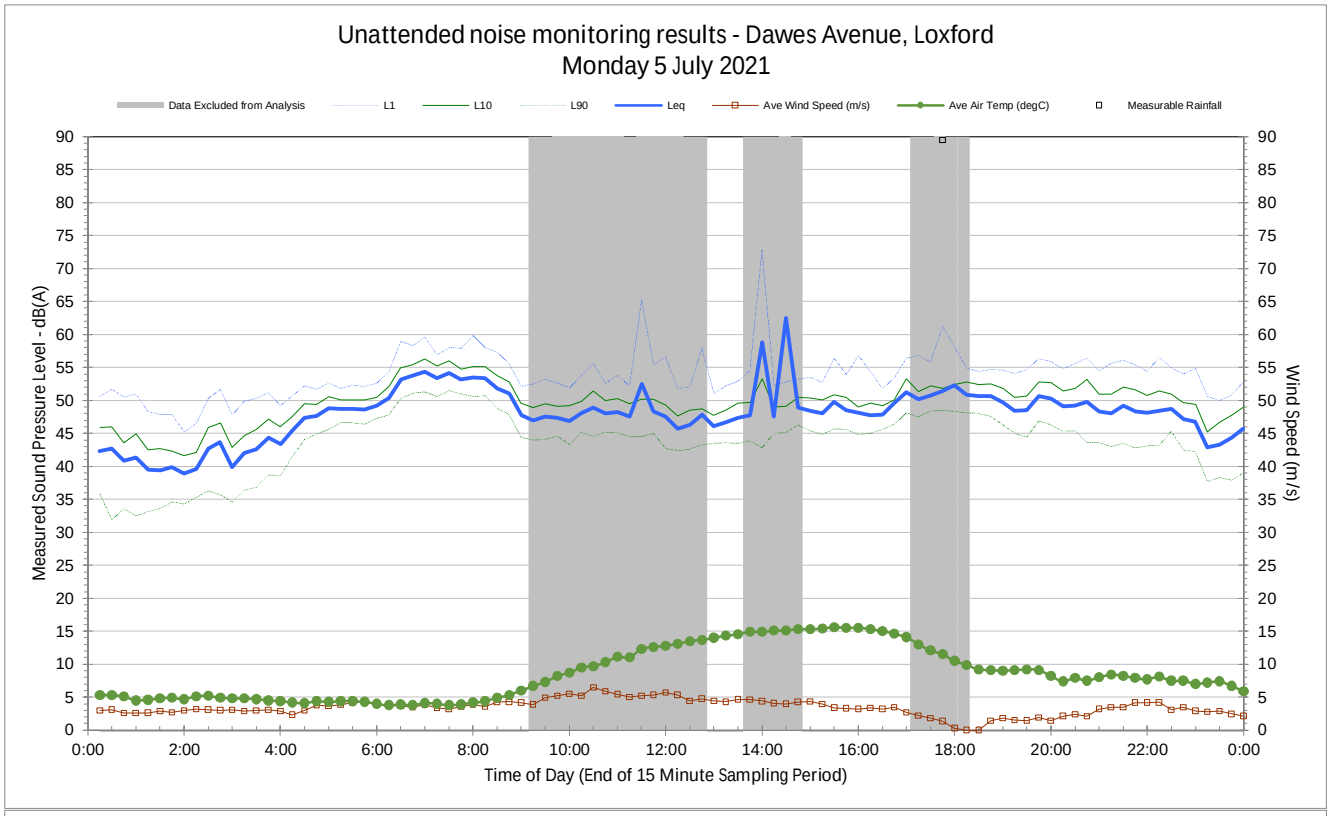


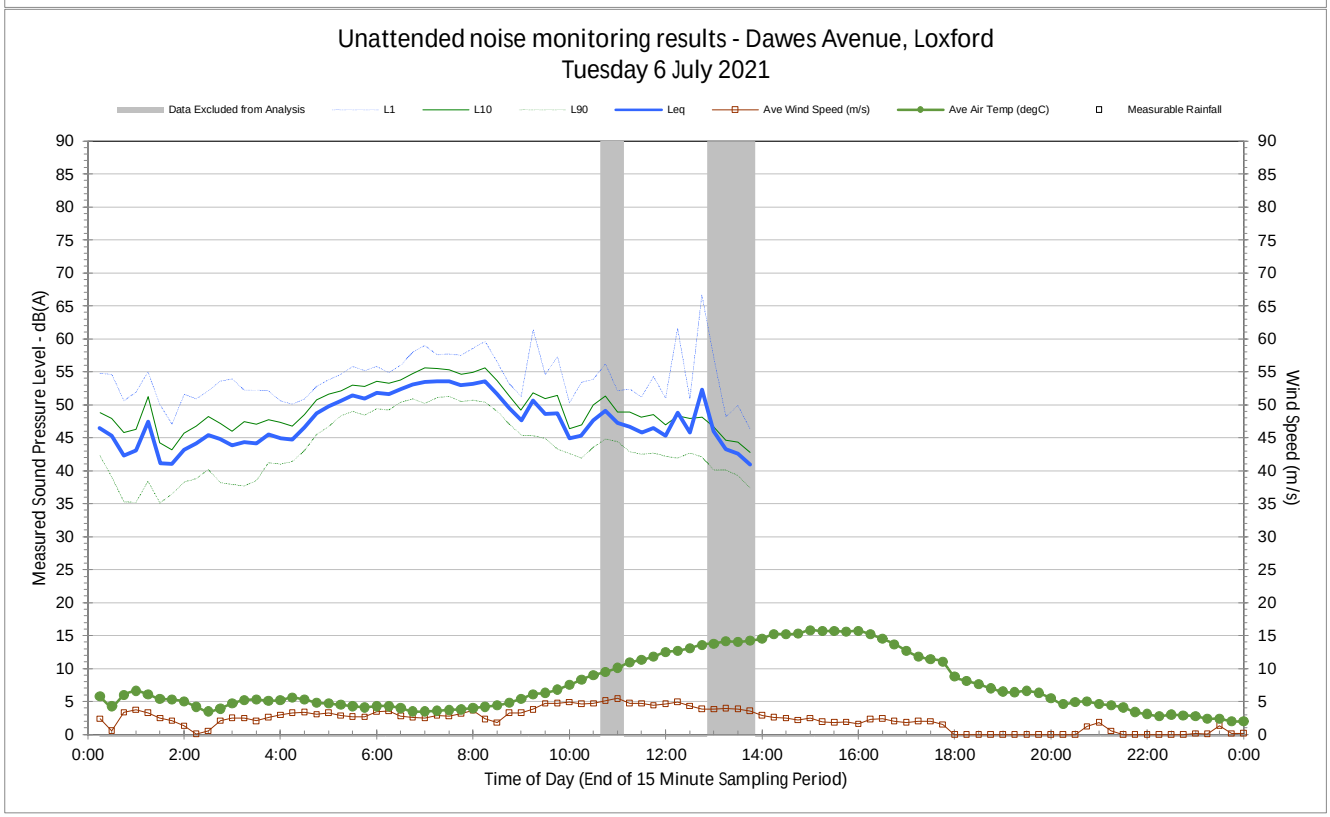

Unattended noise monitoring results - Dawes Avenue, Loxford
Thursday 1 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

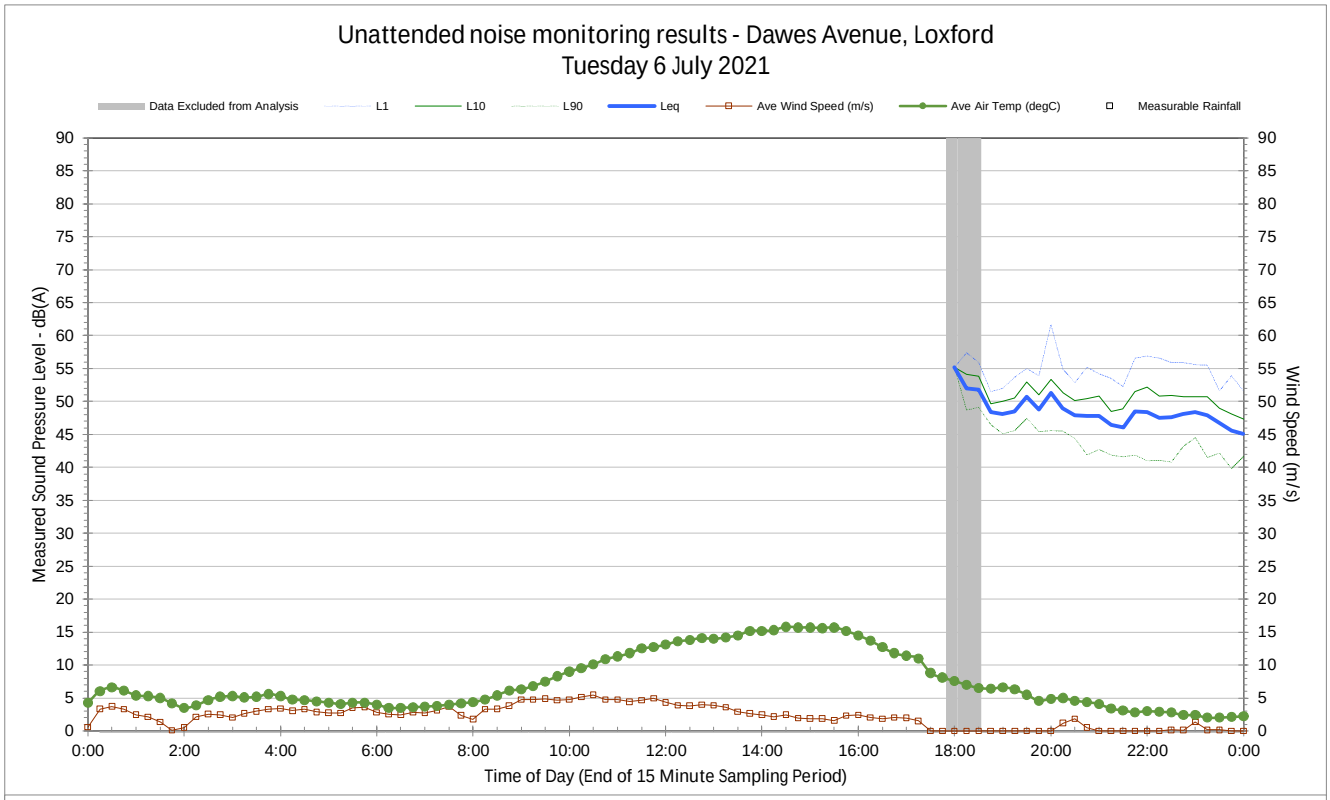

Unattended noise monitoring results - Dawes Avenue, Loxford
Friday 2 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

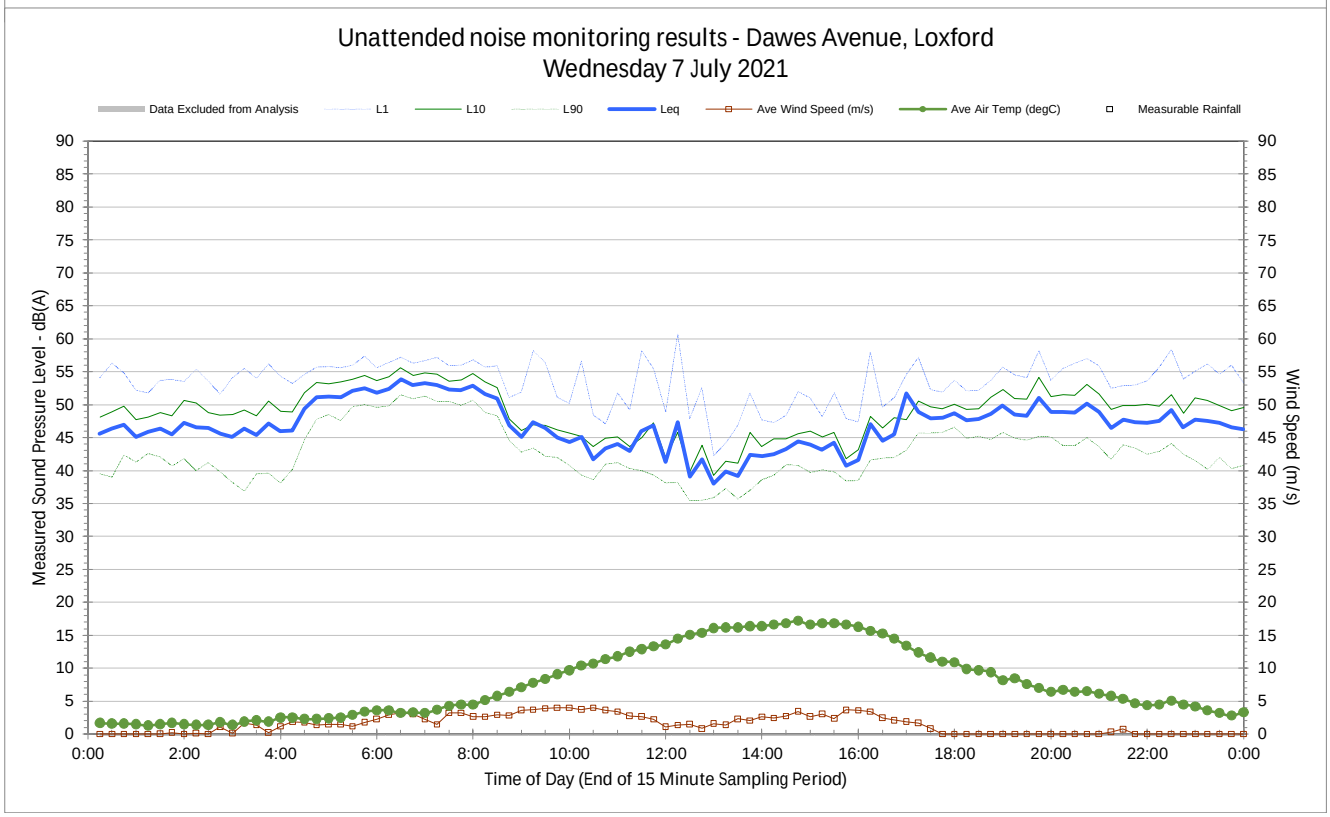

Unattended noise monitoring results - Dawes Avenue, Loxford
Saturday 3 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

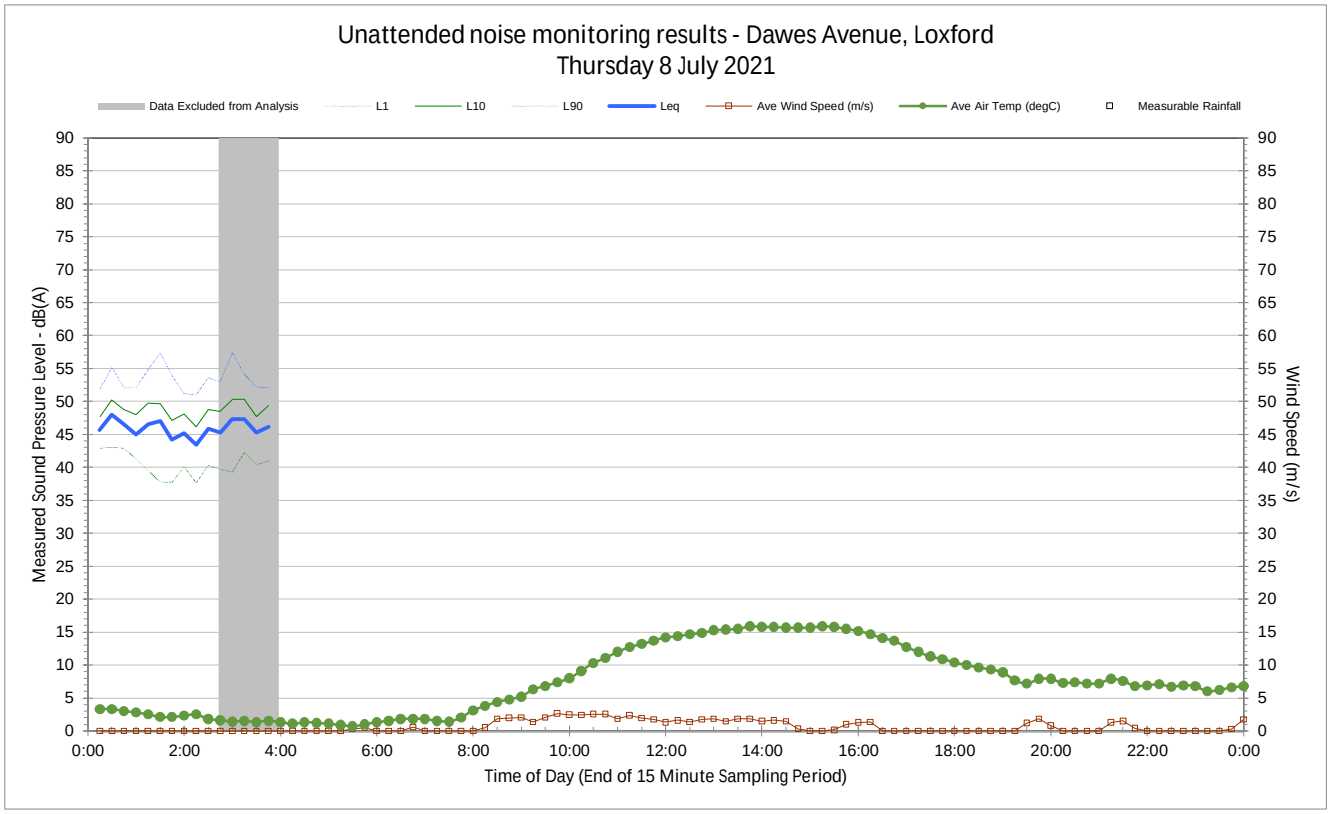

Unattended noise monitoring results - Dawes Avenue, Loxford
Sunday 4 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)


Unattended noise monitoring results - Dawes Avenue, Loxford
Monday 5 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

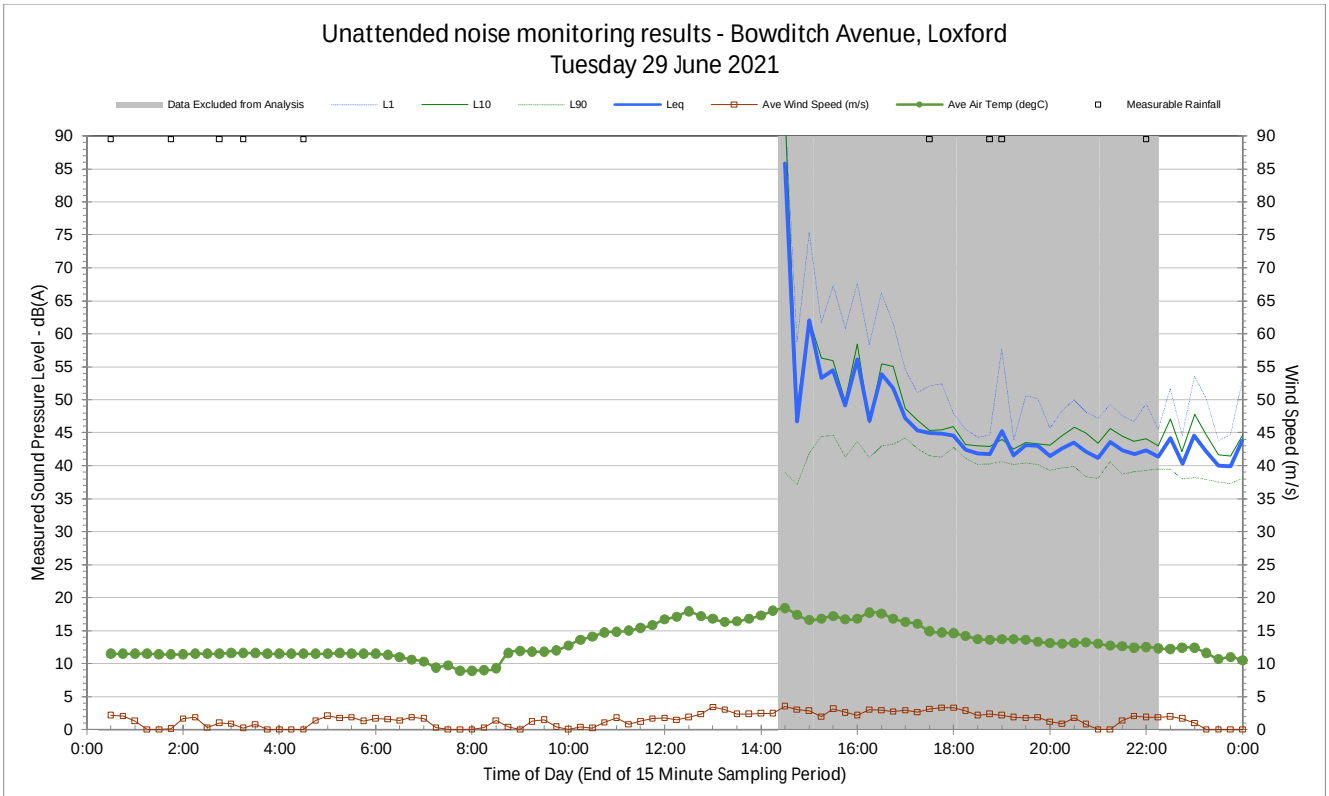

Unattended noise monitoring results - Dawes Avenue, Loxford
Tuesday 6 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

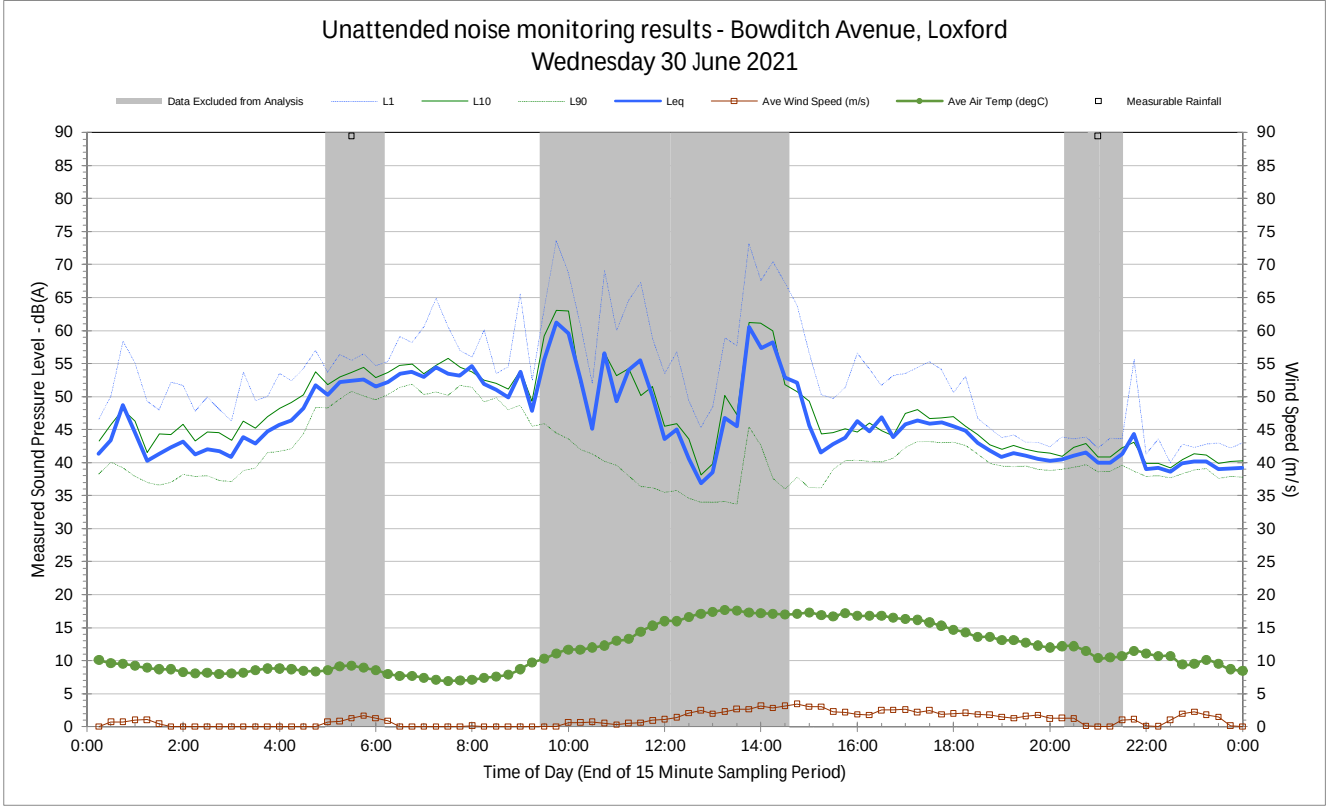

Unattended noise monitoring results - Dawes Avenue, Loxford
Tuesday 6 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

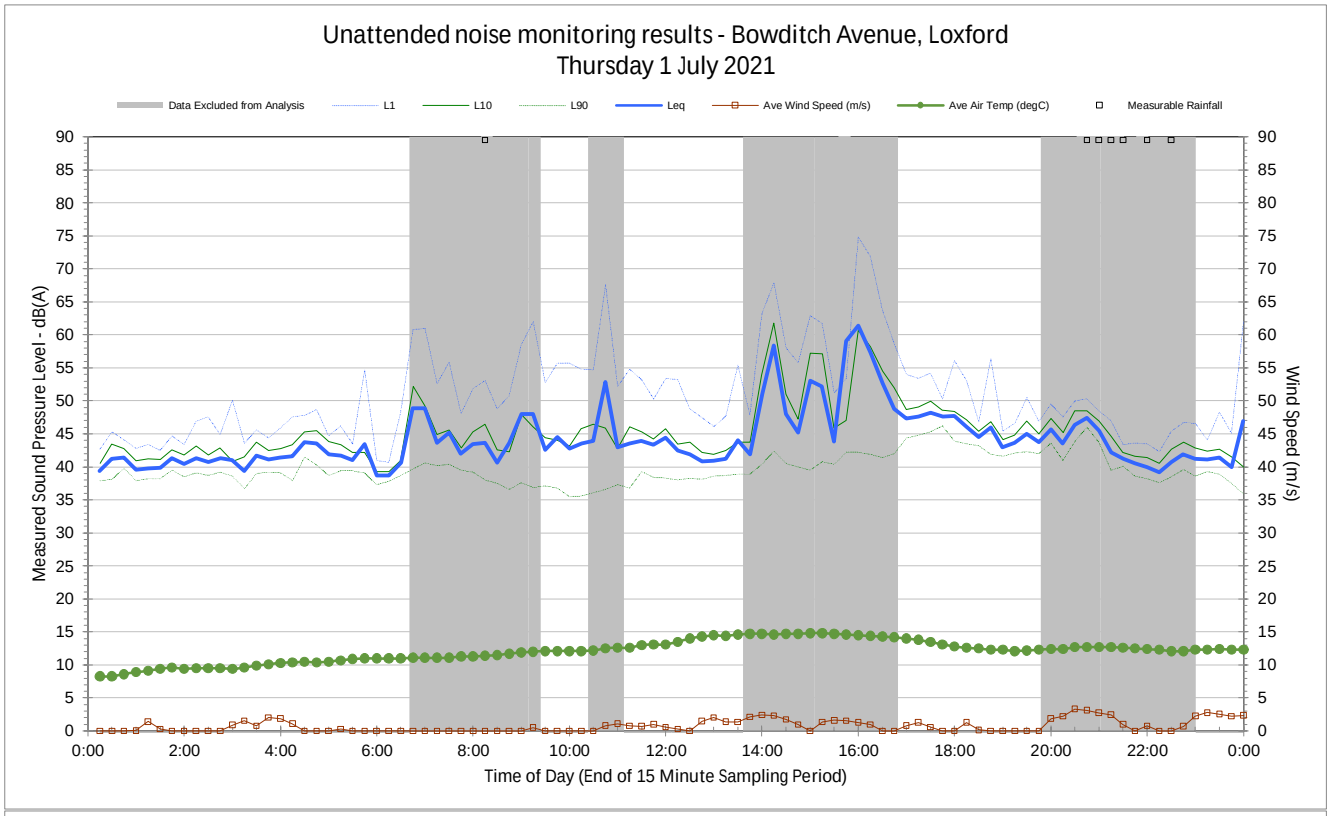

Unattended noise monitoring results - Dawes Avenue, Loxford
Wednesday 7 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

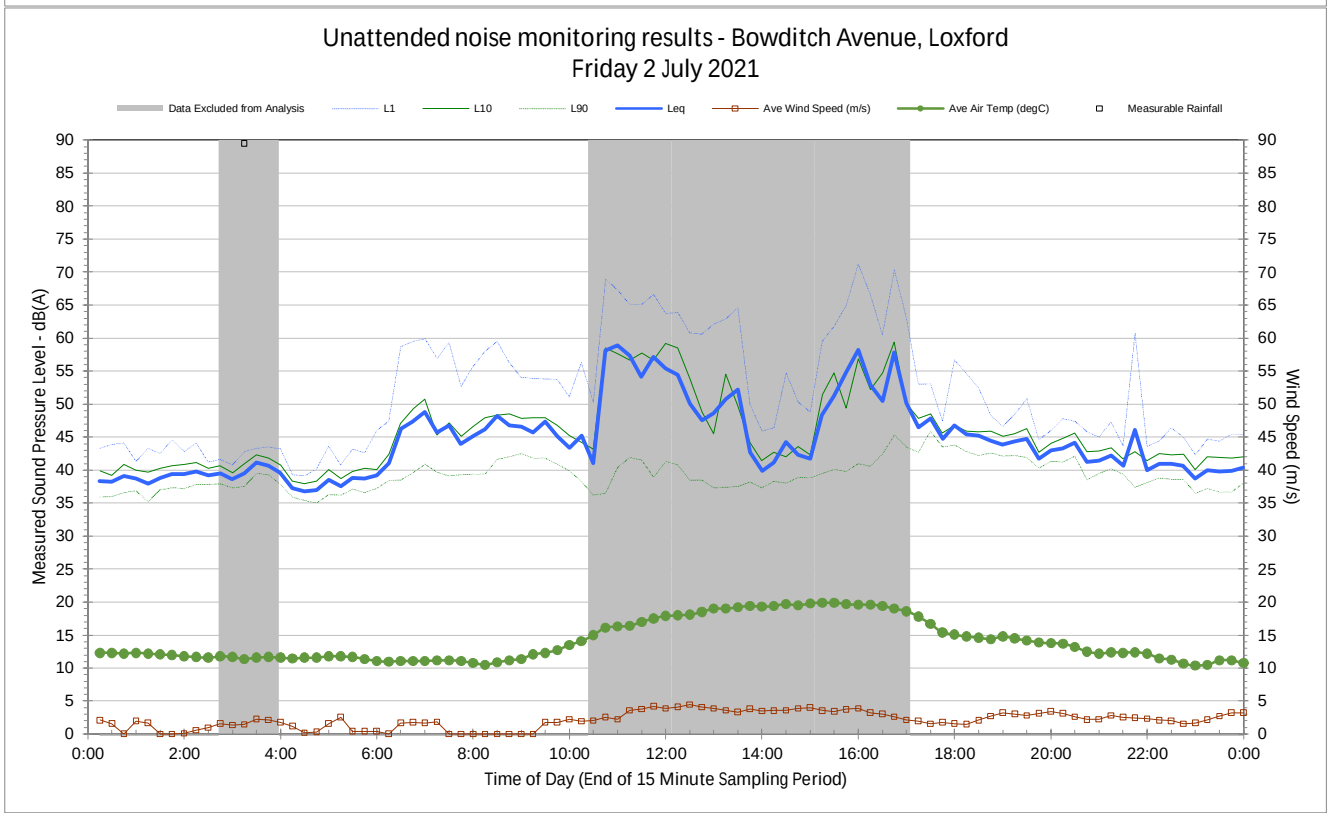

Unattended noise monitoring results - Dawes Avenue, Loxford
Thursday 8 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

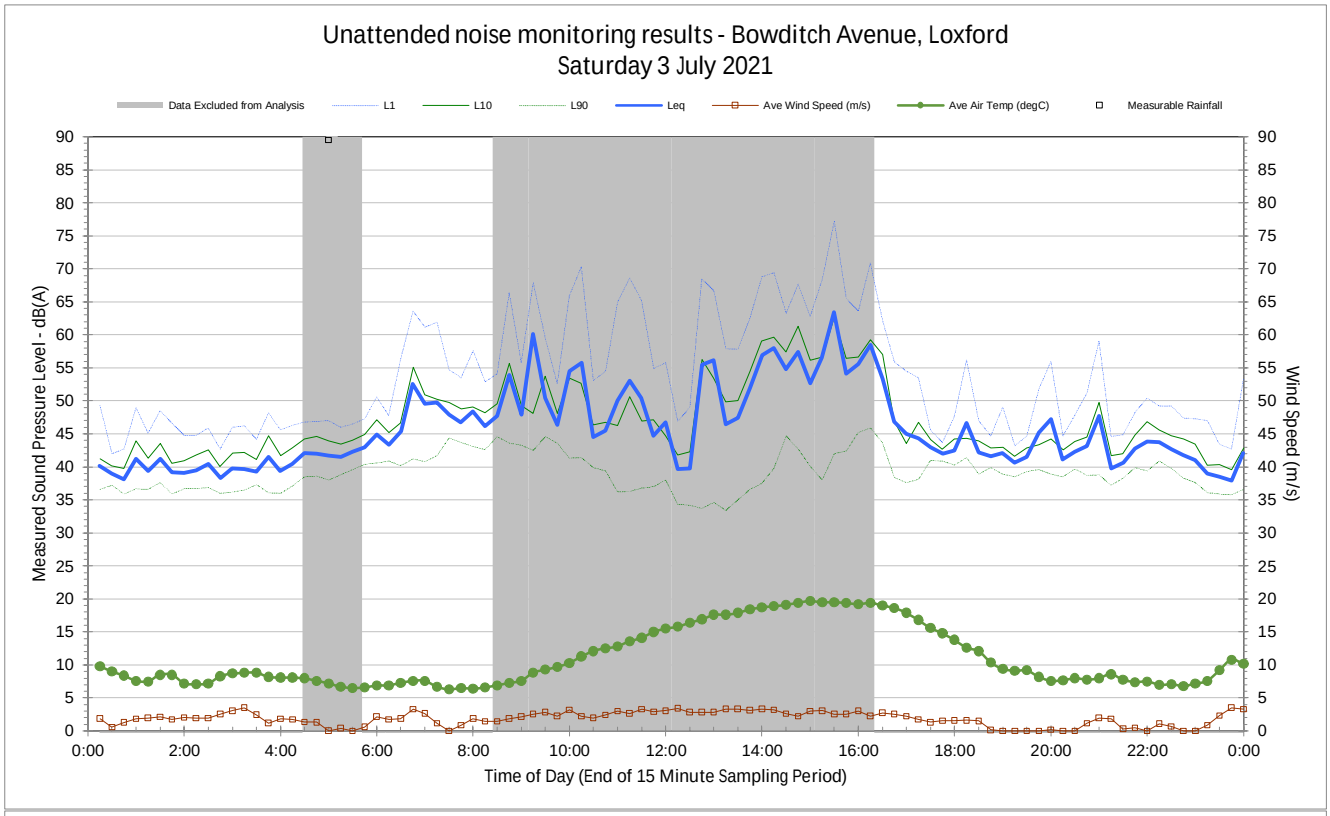
C.3 Bowditch Avenue, Loxford

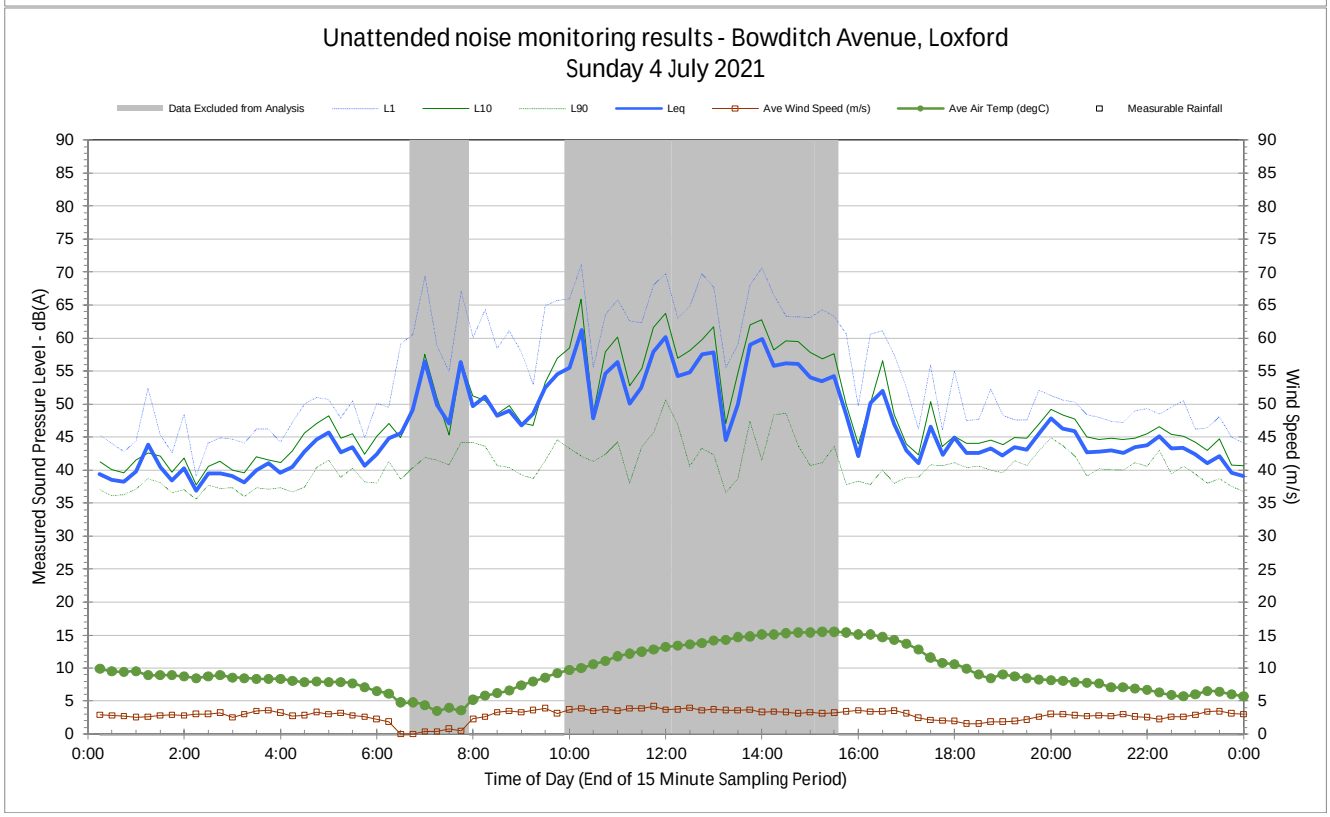


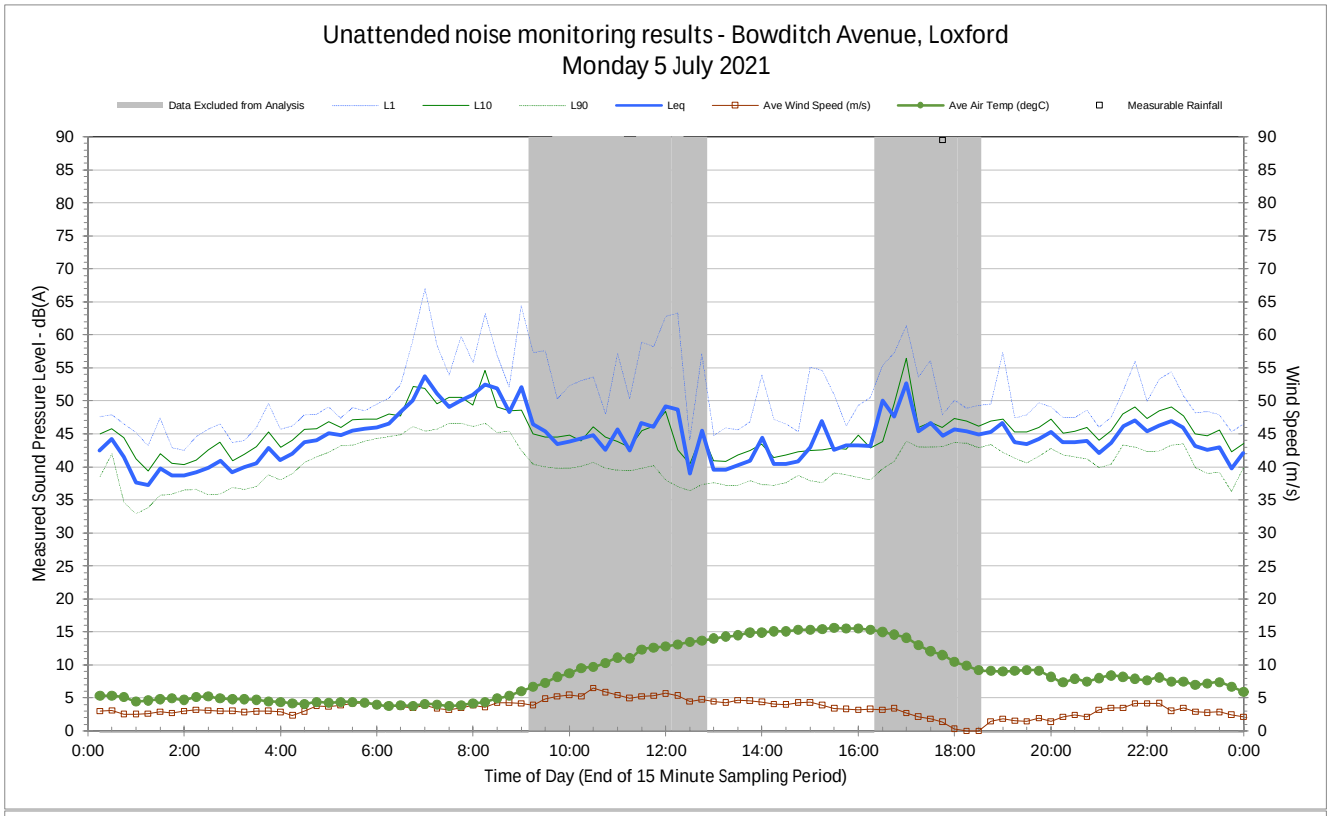


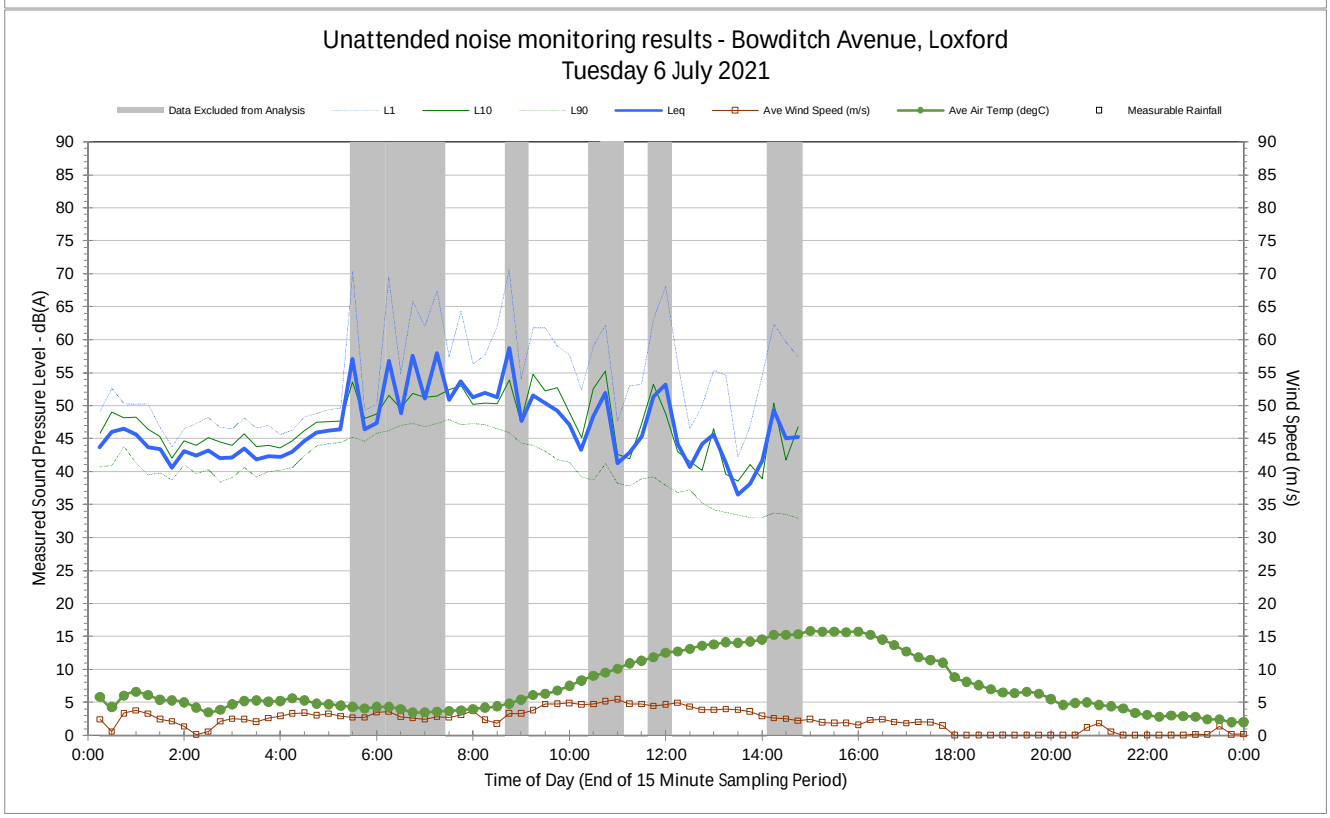

Unattended noise monitoring results - Bowditch Avenue, Loxford
Thursday 1 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

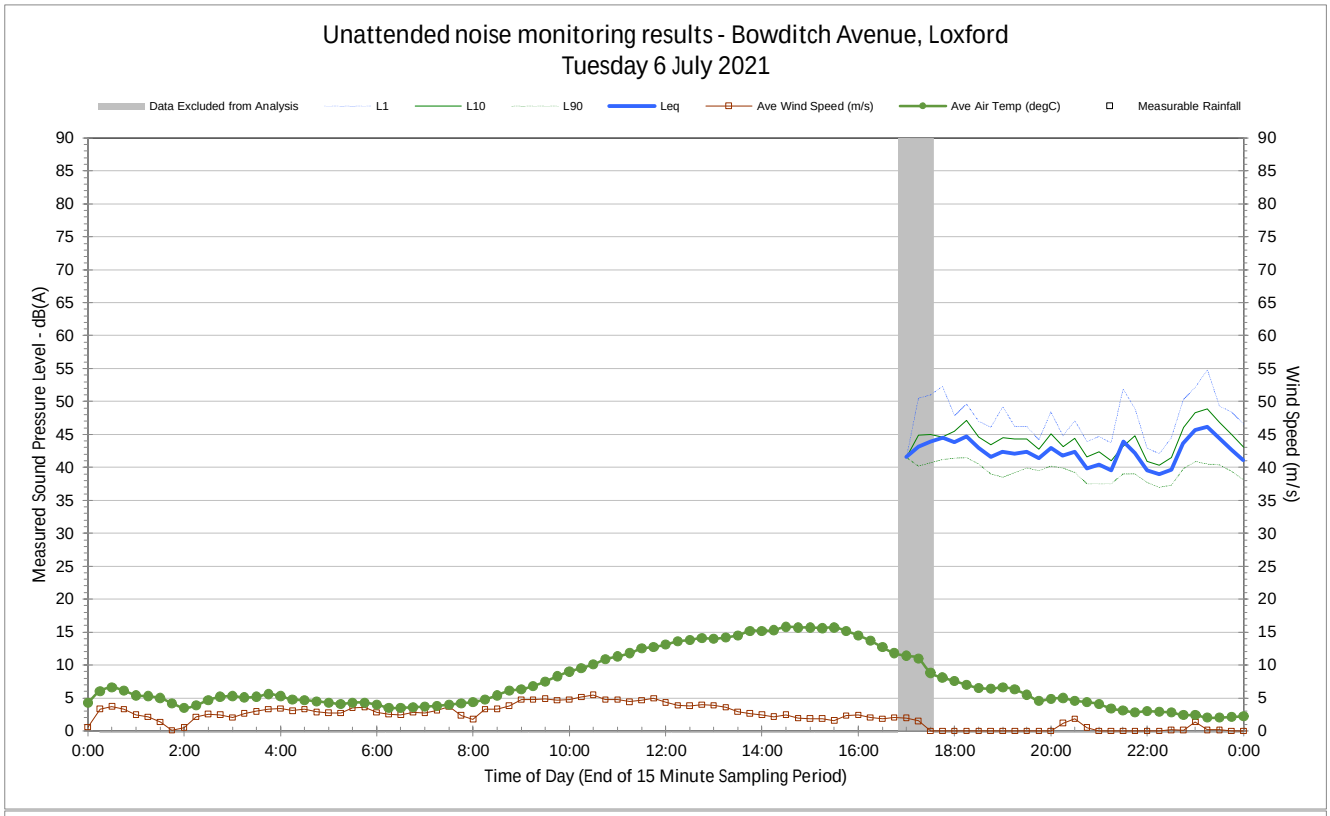

Unattended noise monitoring results - Bowditch Avenue, Loxford
Friday 2 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

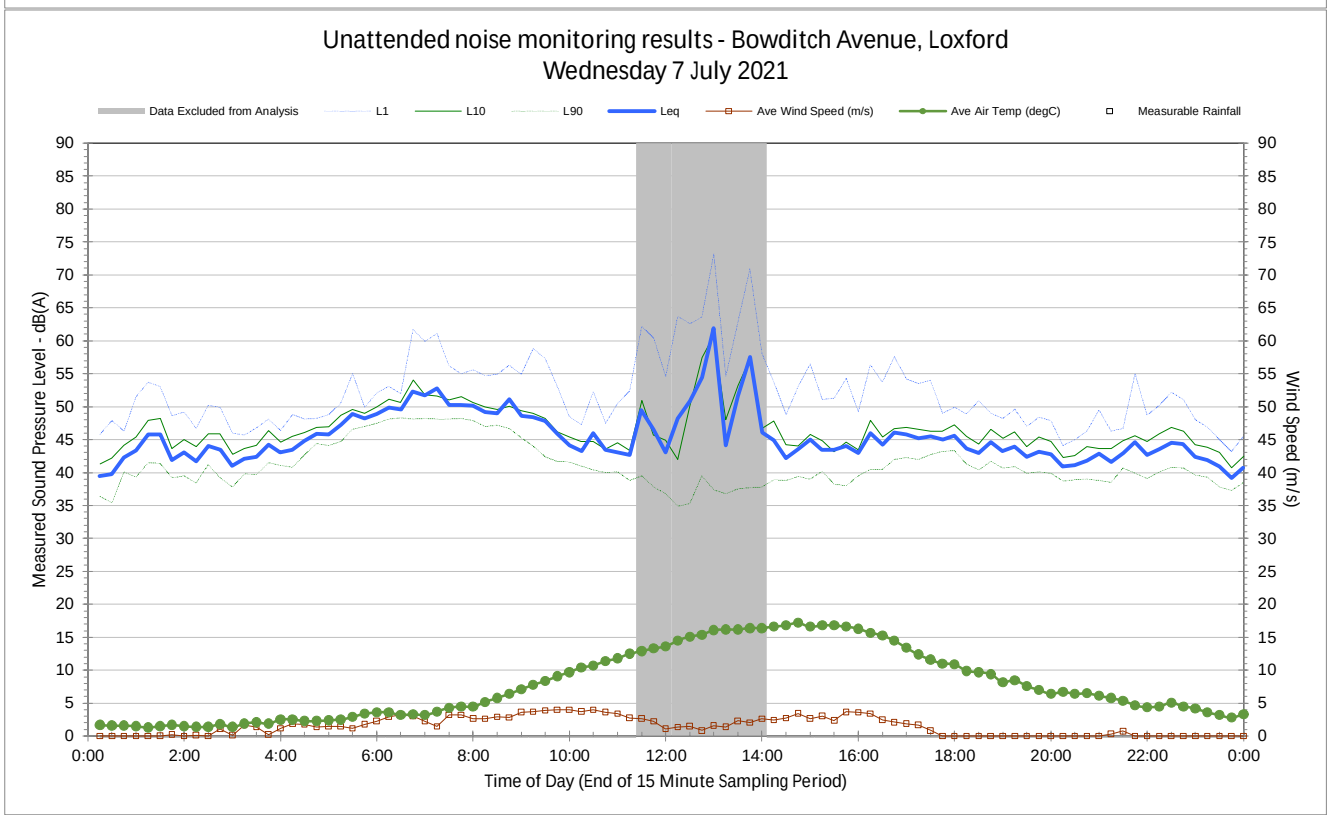

Unattended noise monitoring results - Bowditch Avenue, Loxford
Saturday 3 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

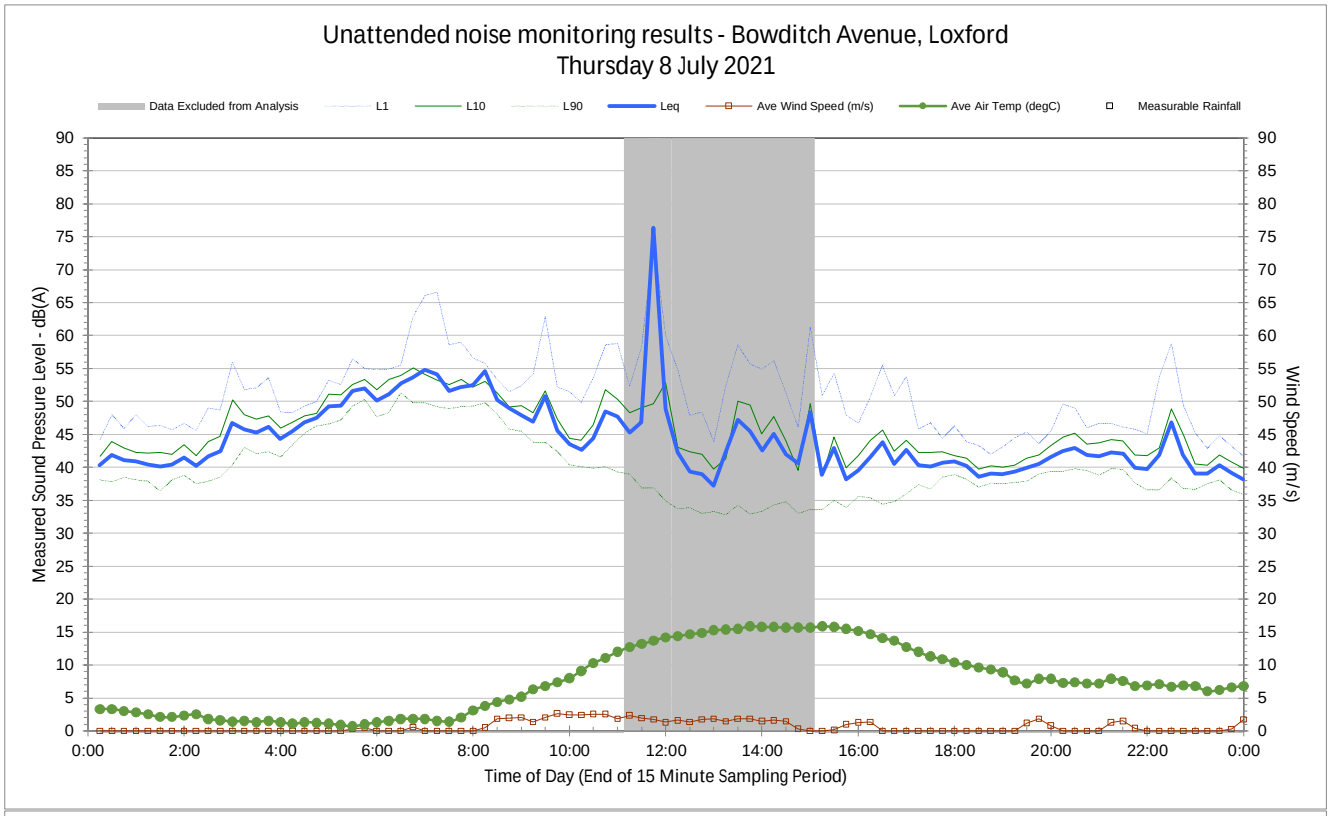

Unattended noise monitoring results - Bowditch Avenue, Loxford
Sunday 4 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

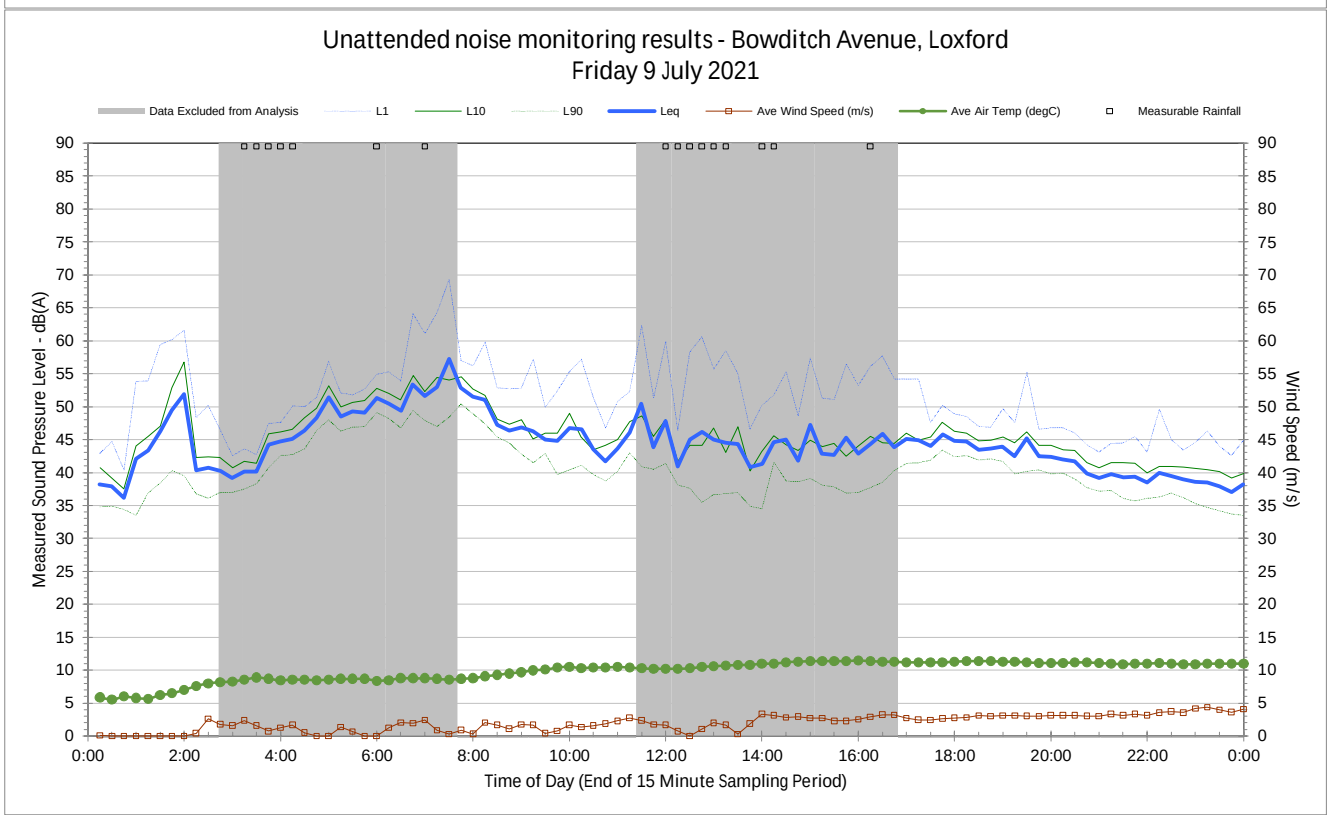

Unattended noise monitoring results - Bowditch Avenue, Loxford
Monday 5 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

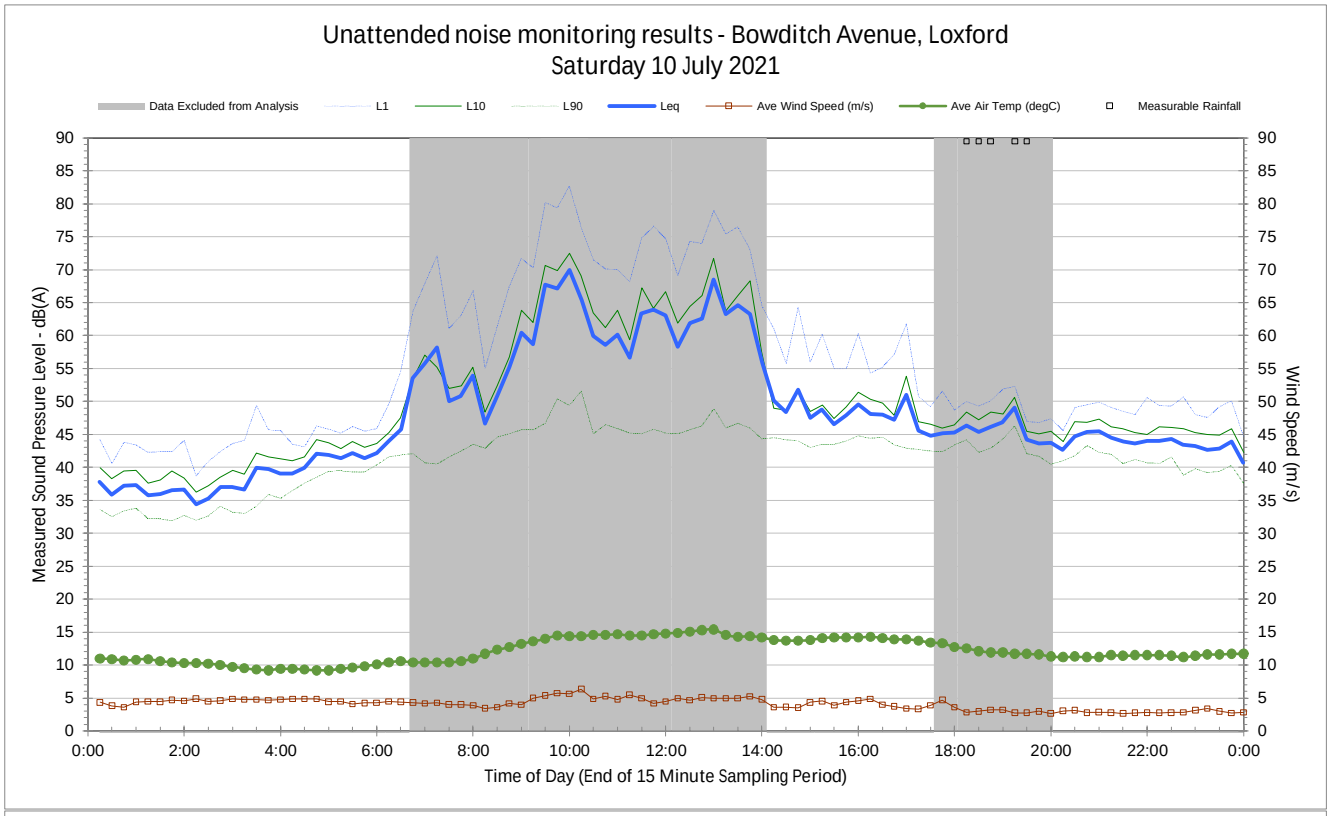

Unattended noise monitoring results - Bowditch Avenue, Loxford
Tuesday 6 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

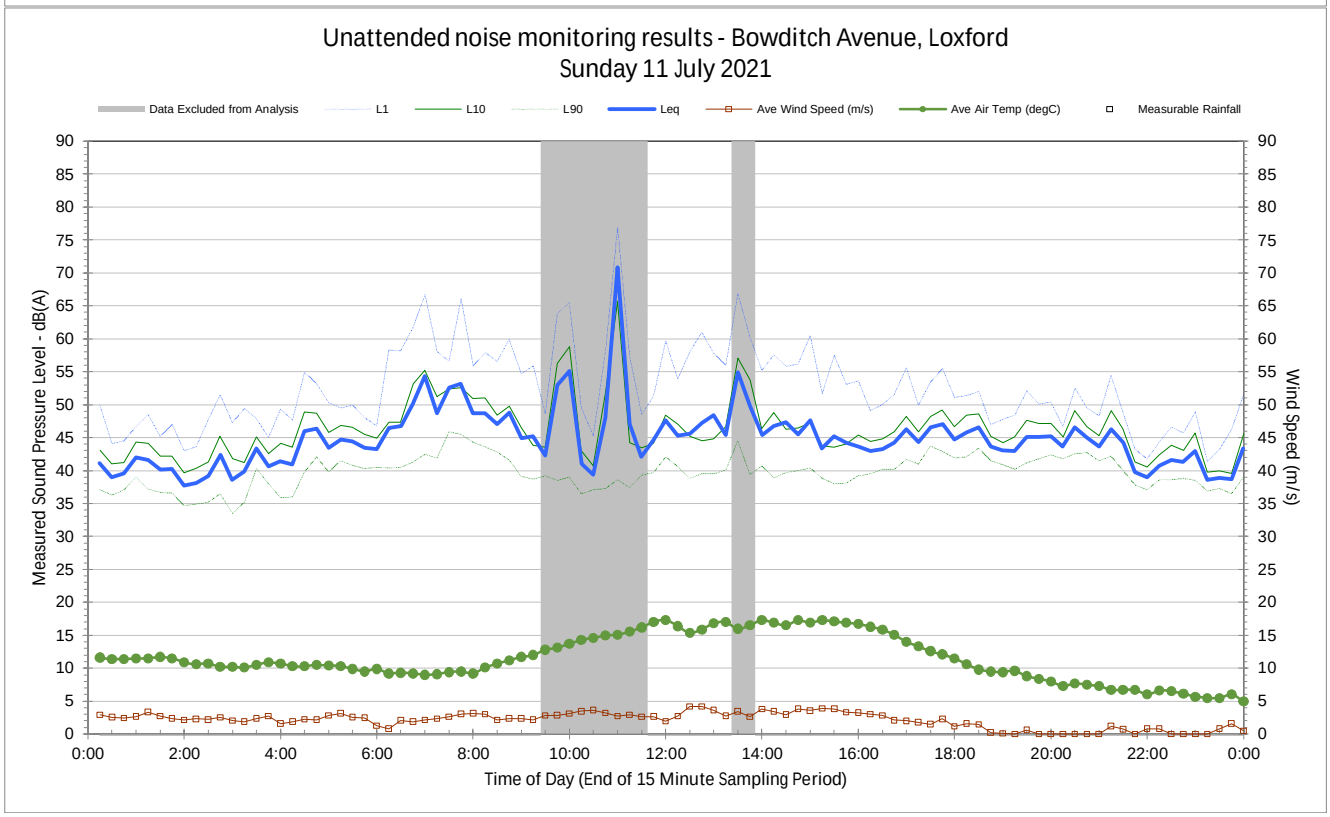

Unattended noise monitoring results - Bowditch Avenue, Loxford
Tuesday 6 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

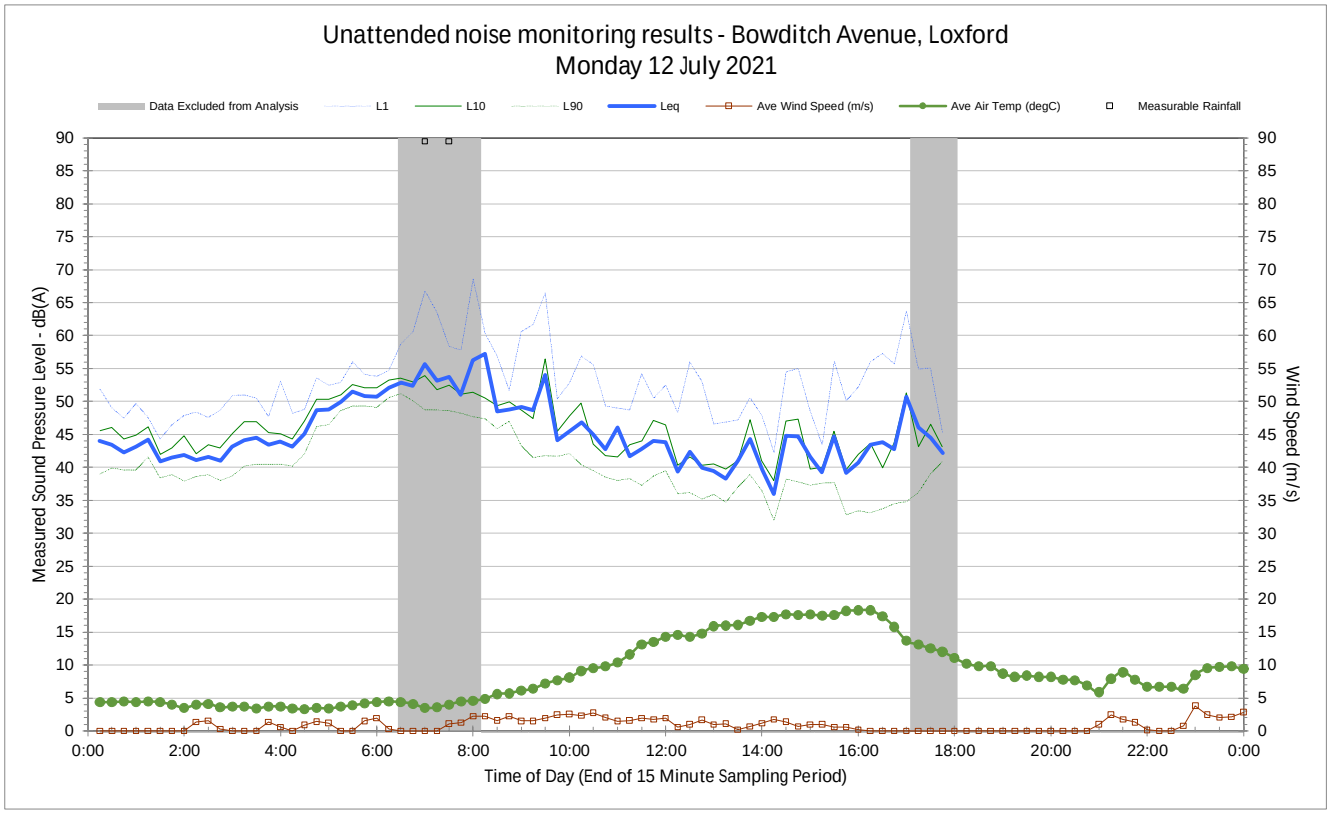

Unattended noise monitoring results - Bowditch Avenue, Loxford
Wednesday 7 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)


Unattended noise monitoring results - Bowditch Avenue, Loxford
Thursday 8 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

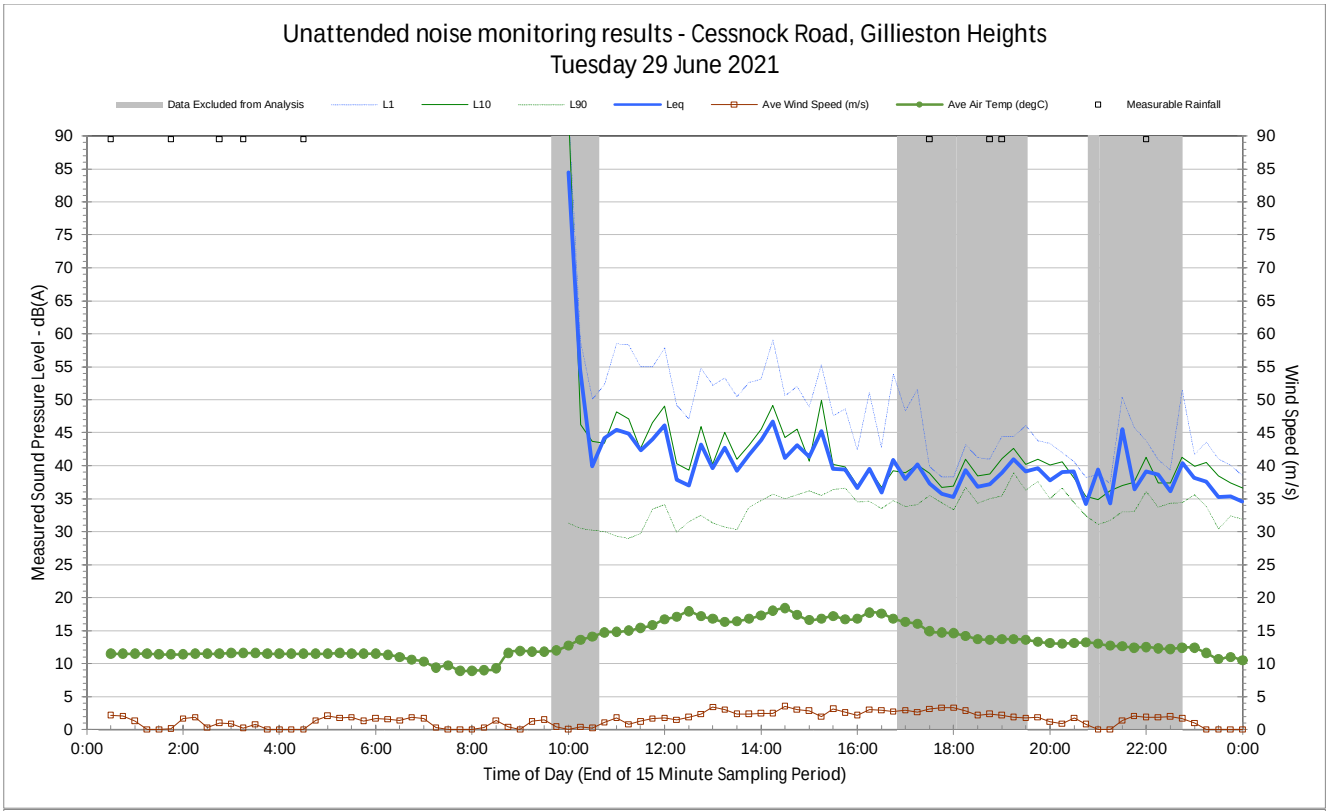

Unattended noise monitoring results - Bowditch Avenue, Loxford
Friday 9 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

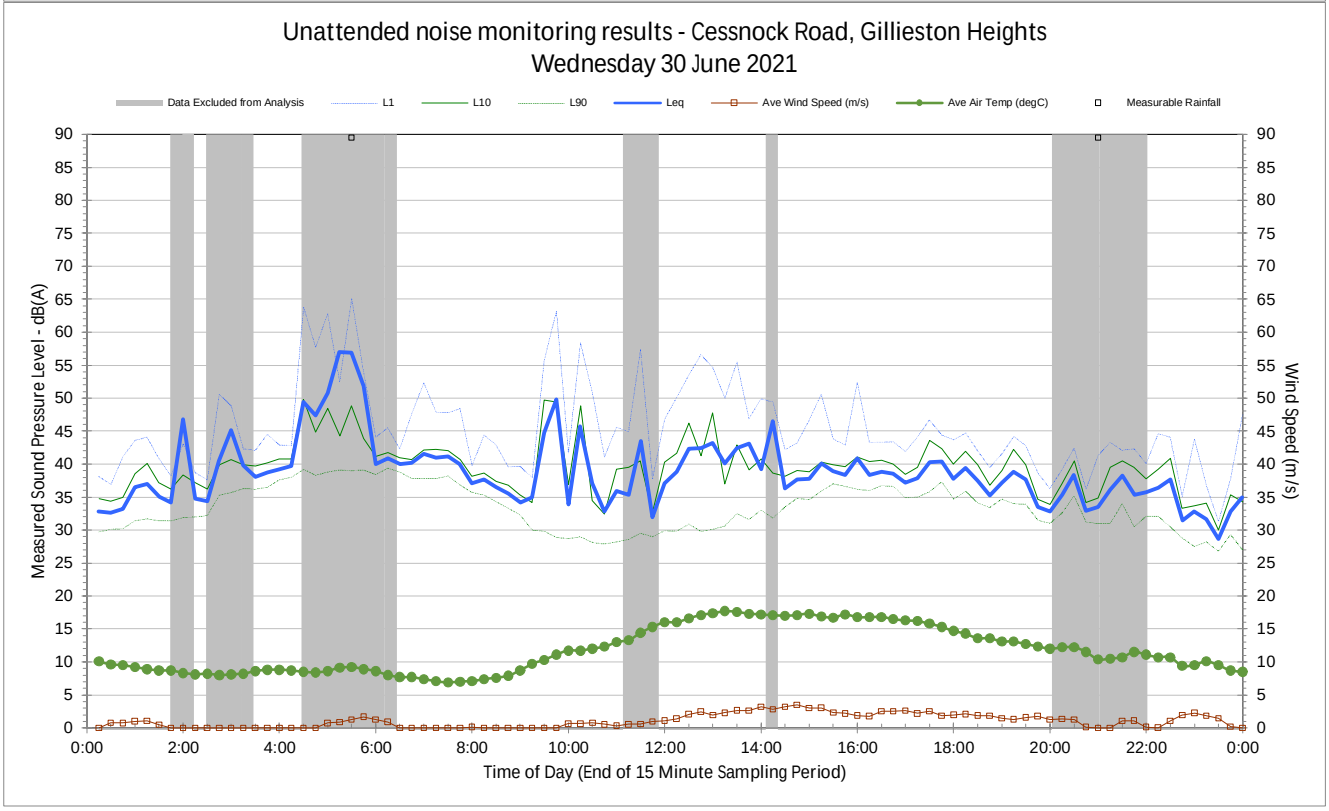

Unattended noise monitoring results - Bowditch Avenue, Loxford
Saturday 10 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

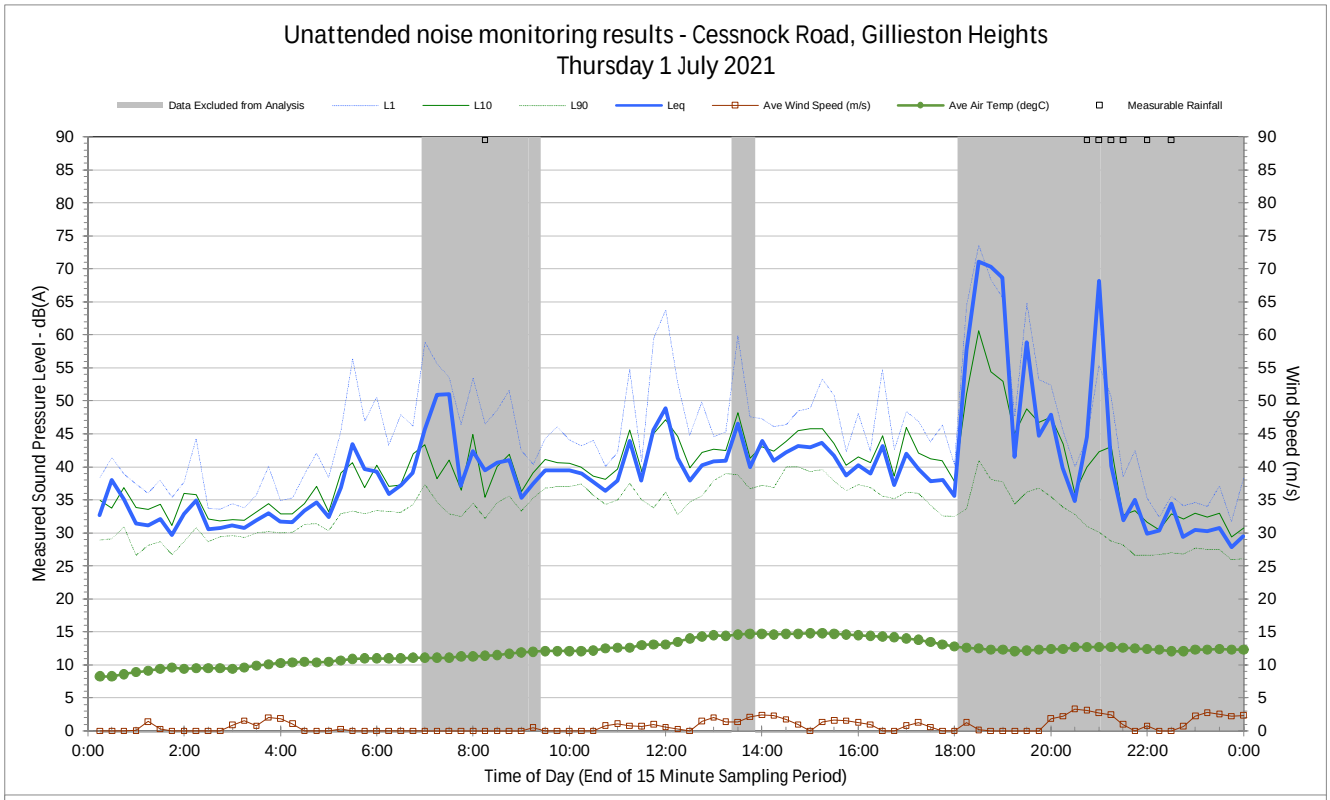

Unattended noise monitoring results - Bowditch Avenue, Loxford
Sunday 11 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

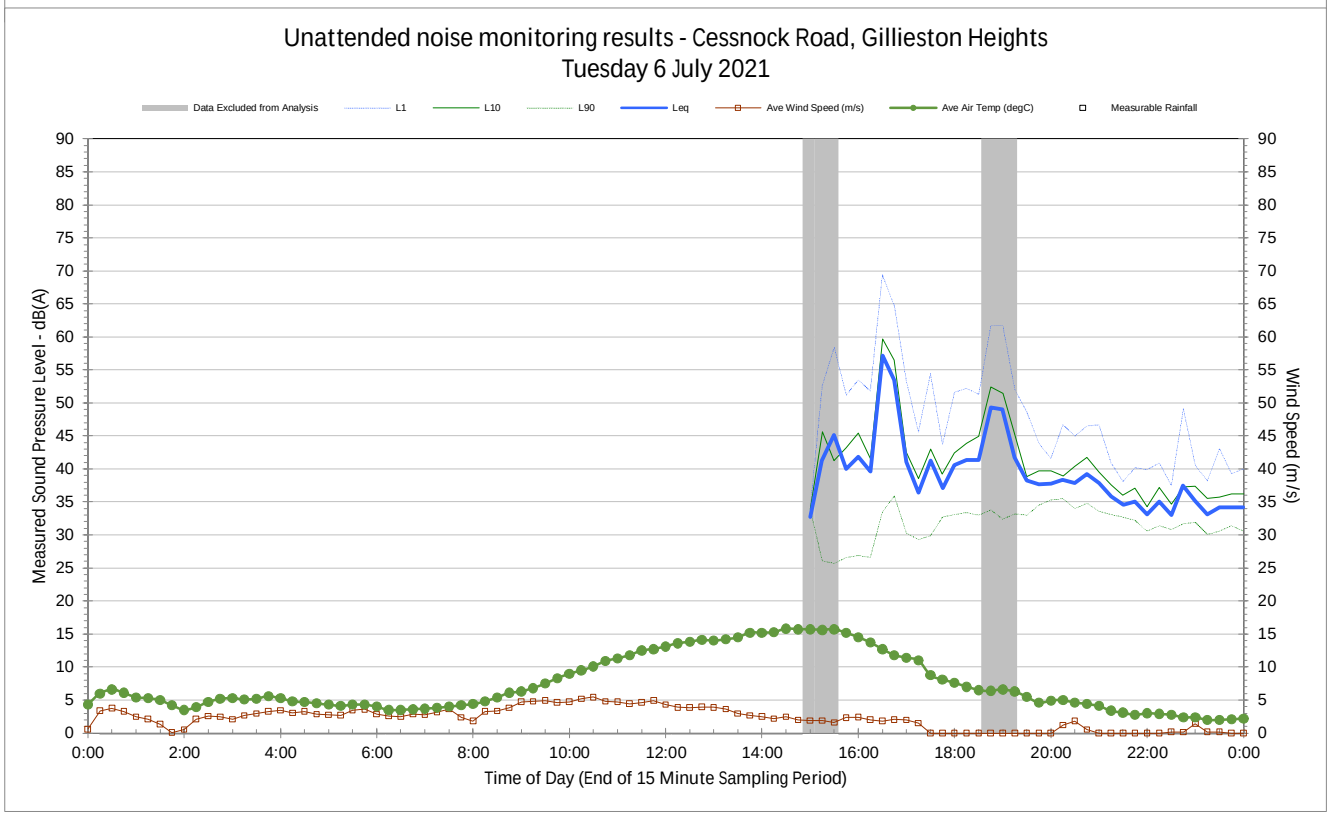

Unattended noise monitoring results - Bowditch Avenue, Loxford
Monday 12 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

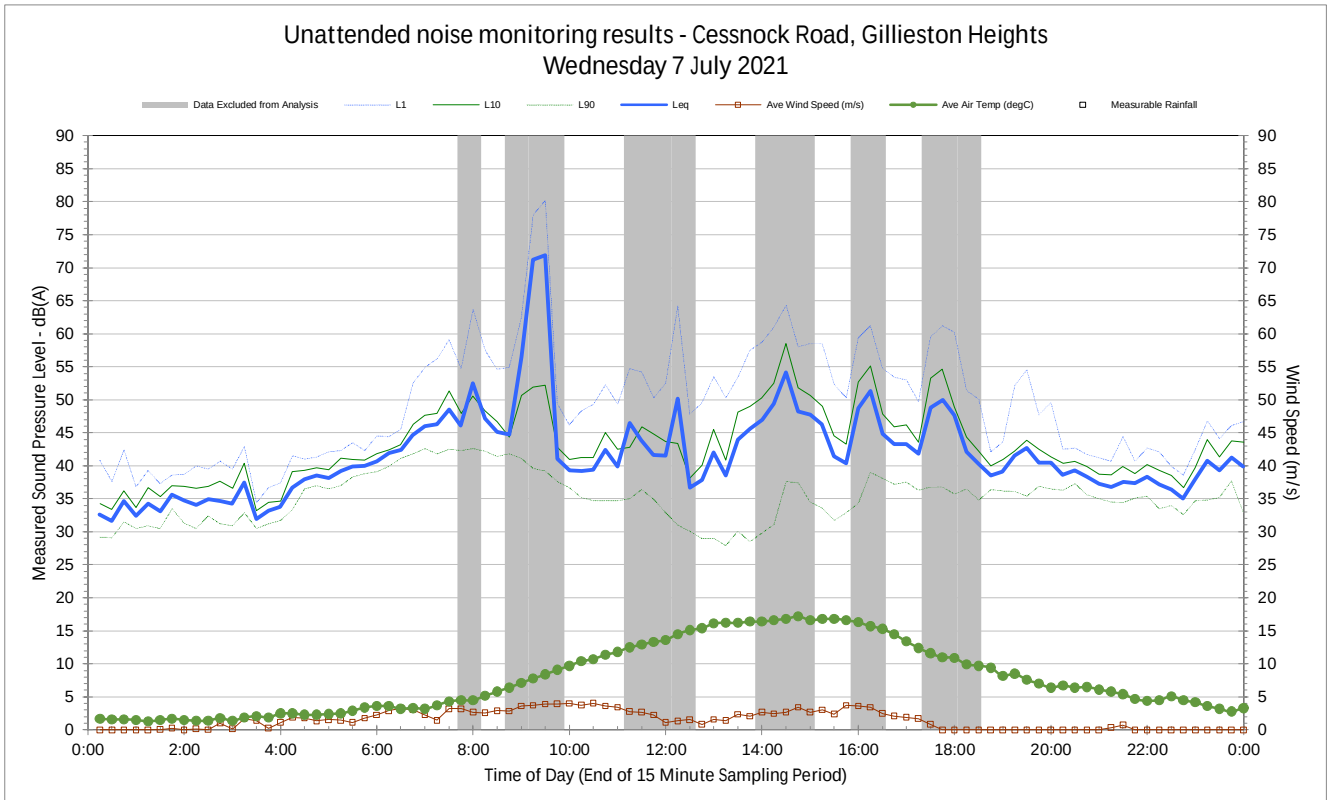
C.4 Cessnock Road, Gillieston Heights

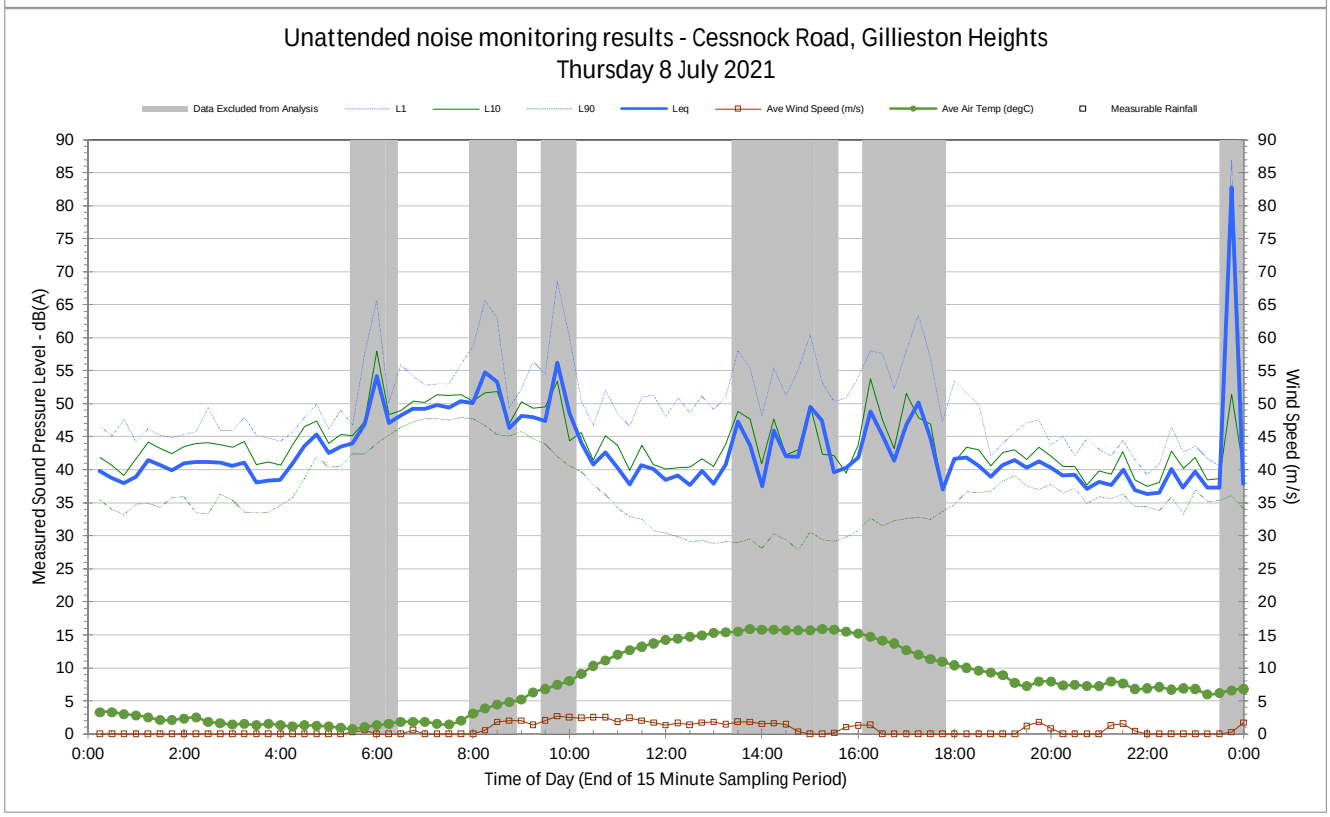




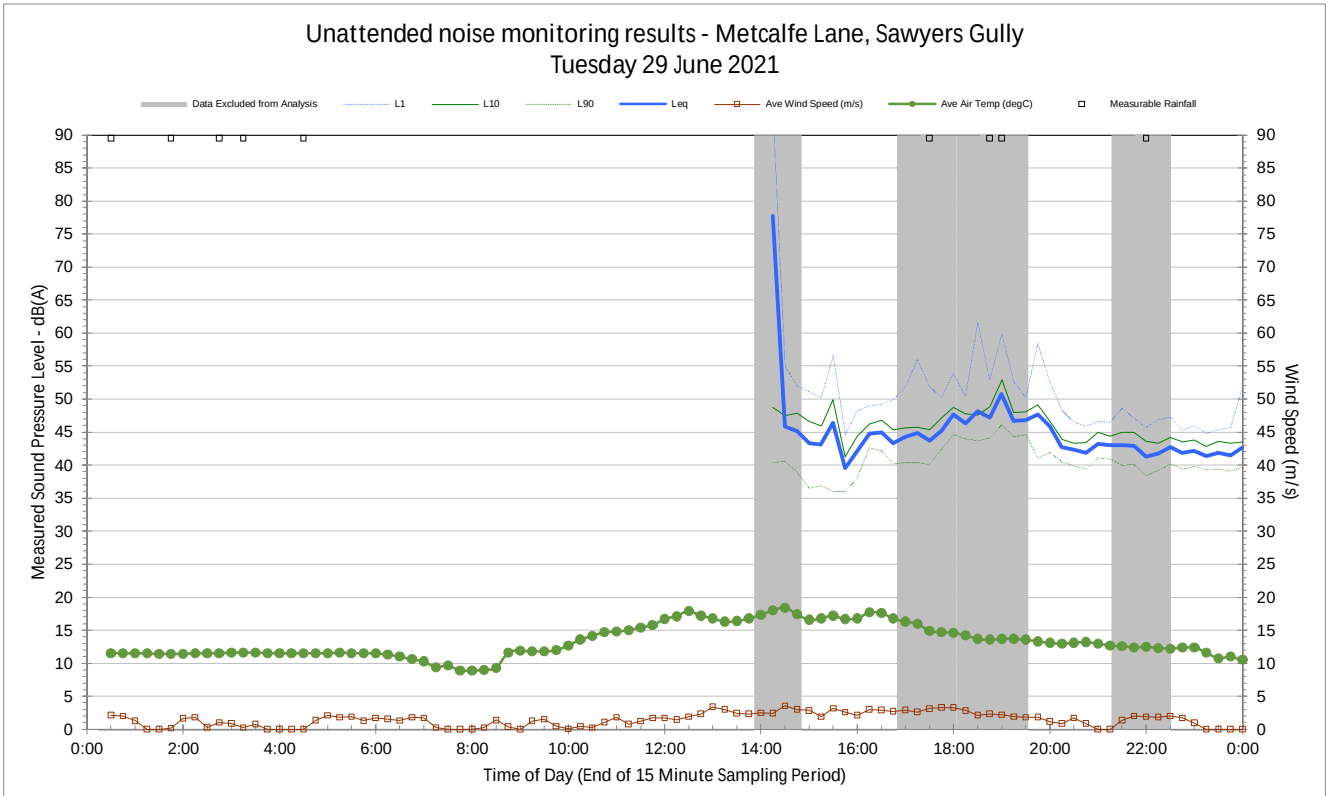

Unattended noise monitoring results - Cessnock Road, Gillieston Heights
Thursday 1 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

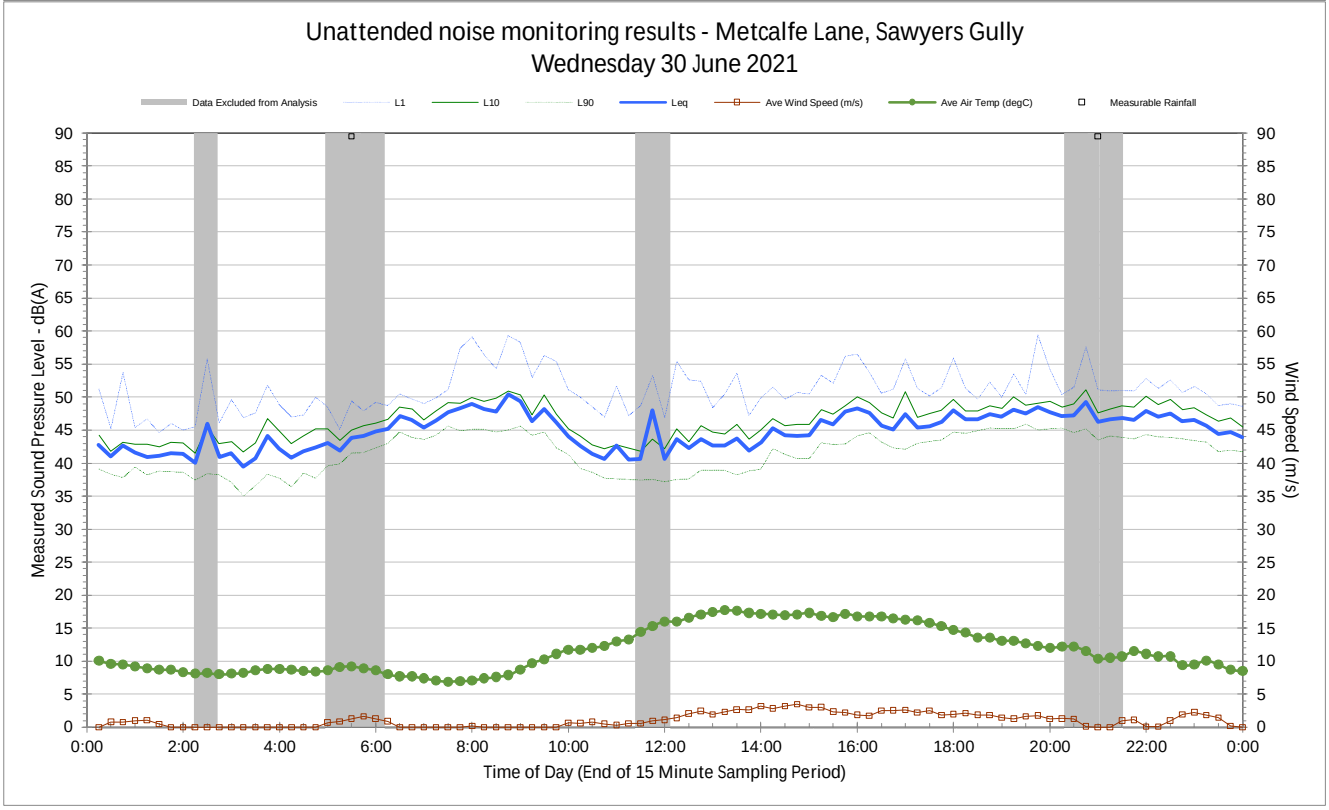

Unattended noise monitoring results - Cessnock Road, Gillieston Heights
Tuesday 6 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

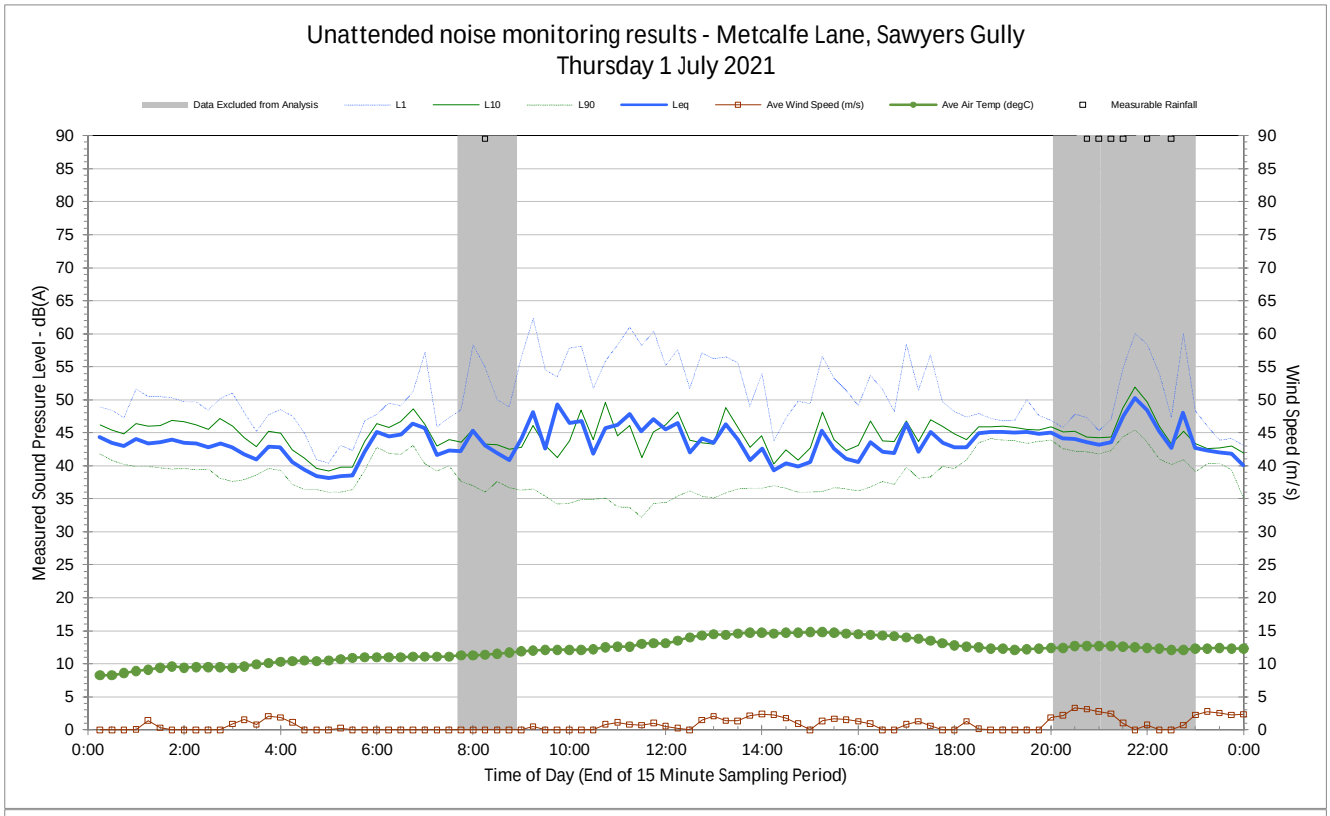

Unattended noise monitoring results - Cessnock Road, Gillieston Heights
Wednesday 7 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

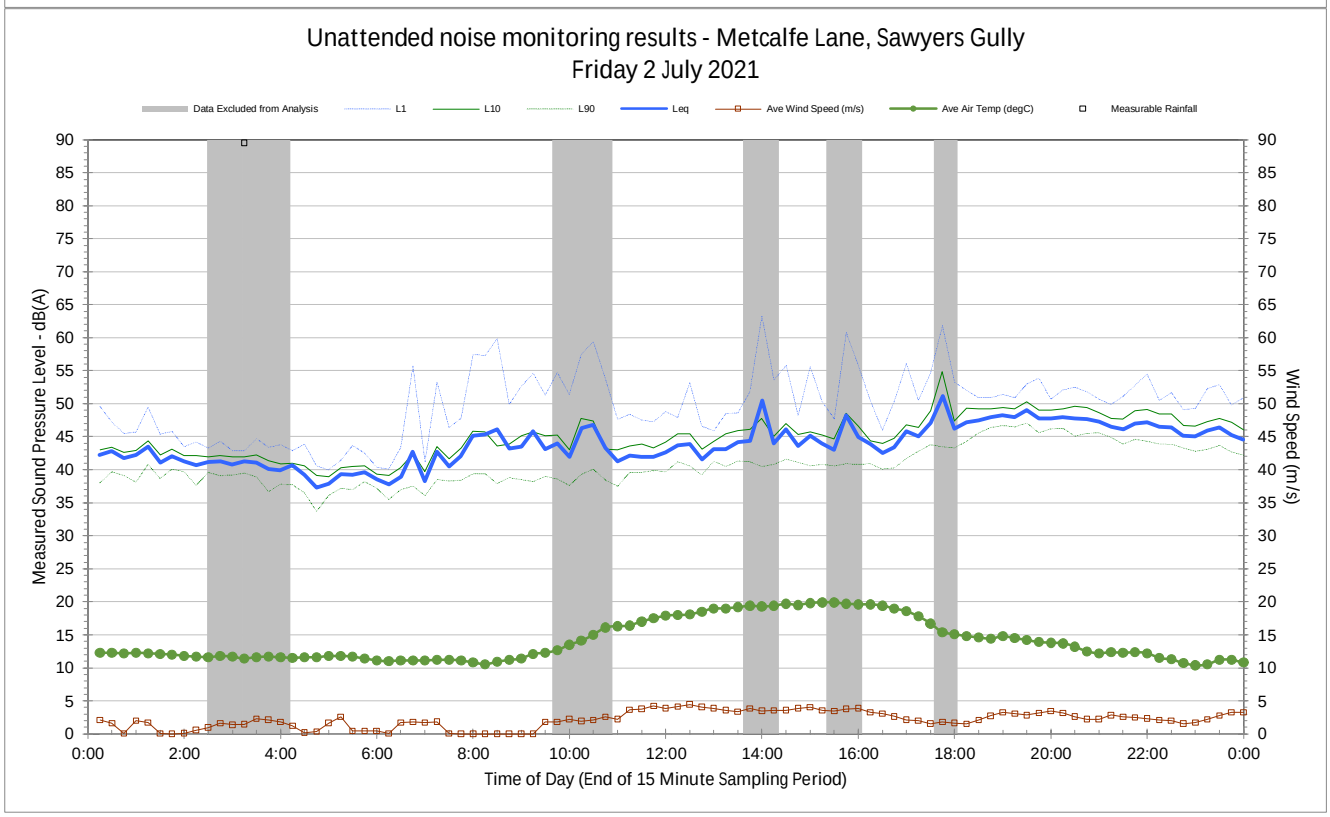

Unattended noise monitoring results - Cessnock Road, Gillieston Heights
Thursday 8 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

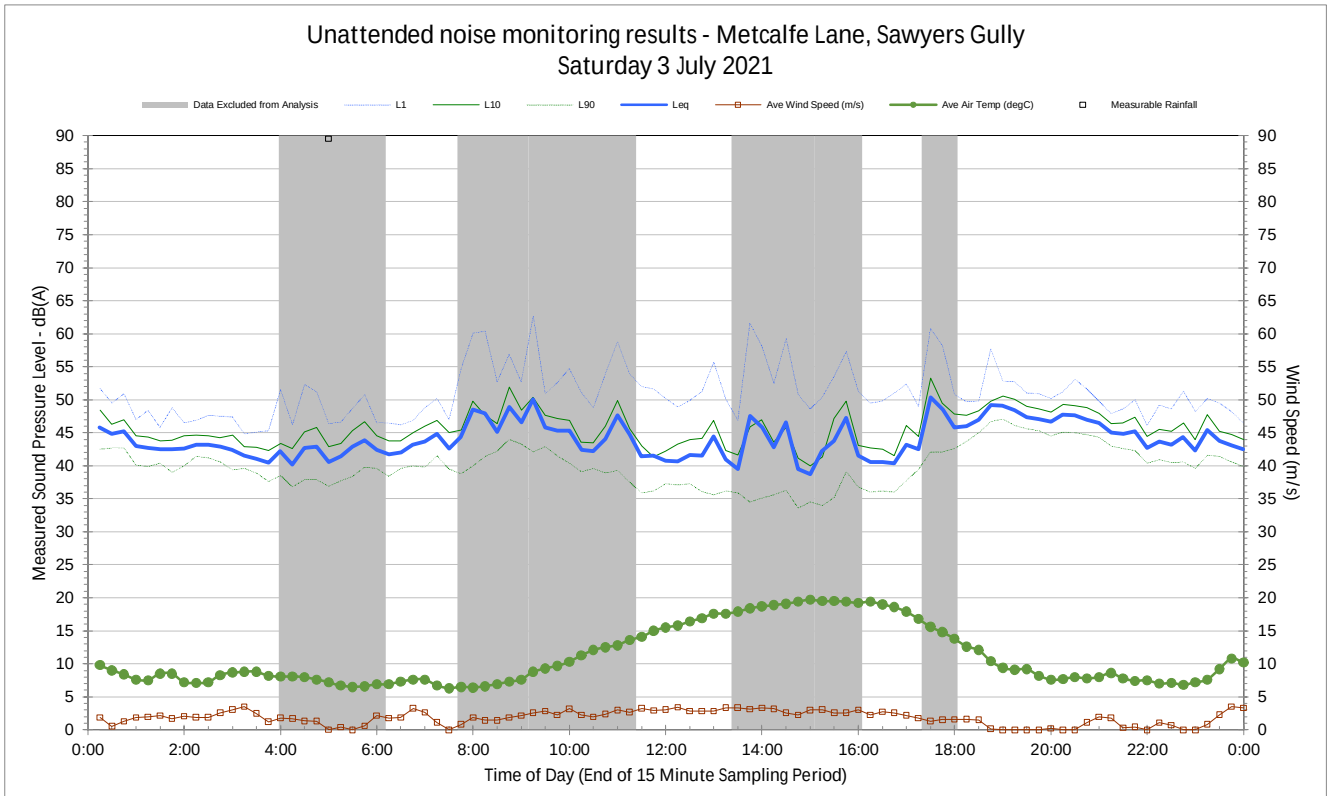
C.5 Metcalfe Lane, Sawyers Gully

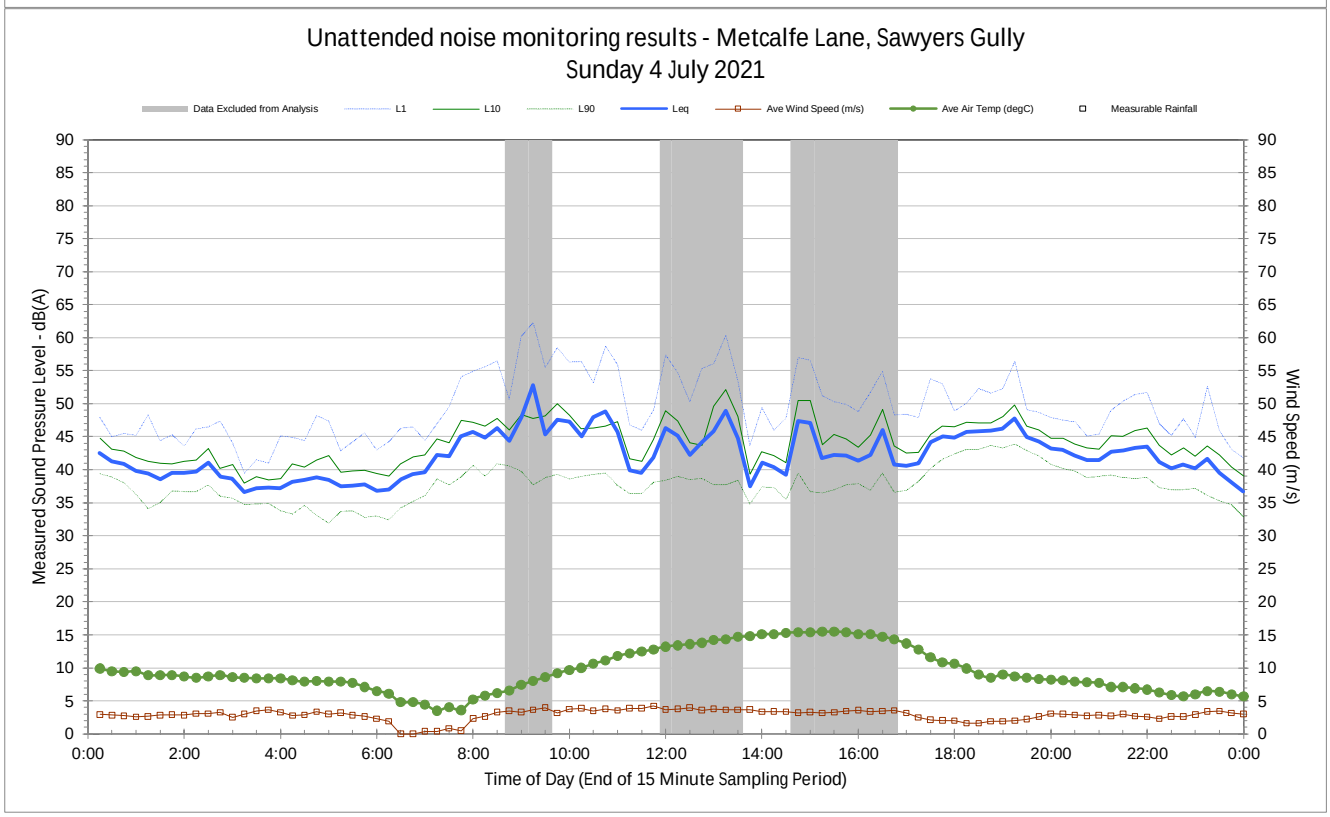


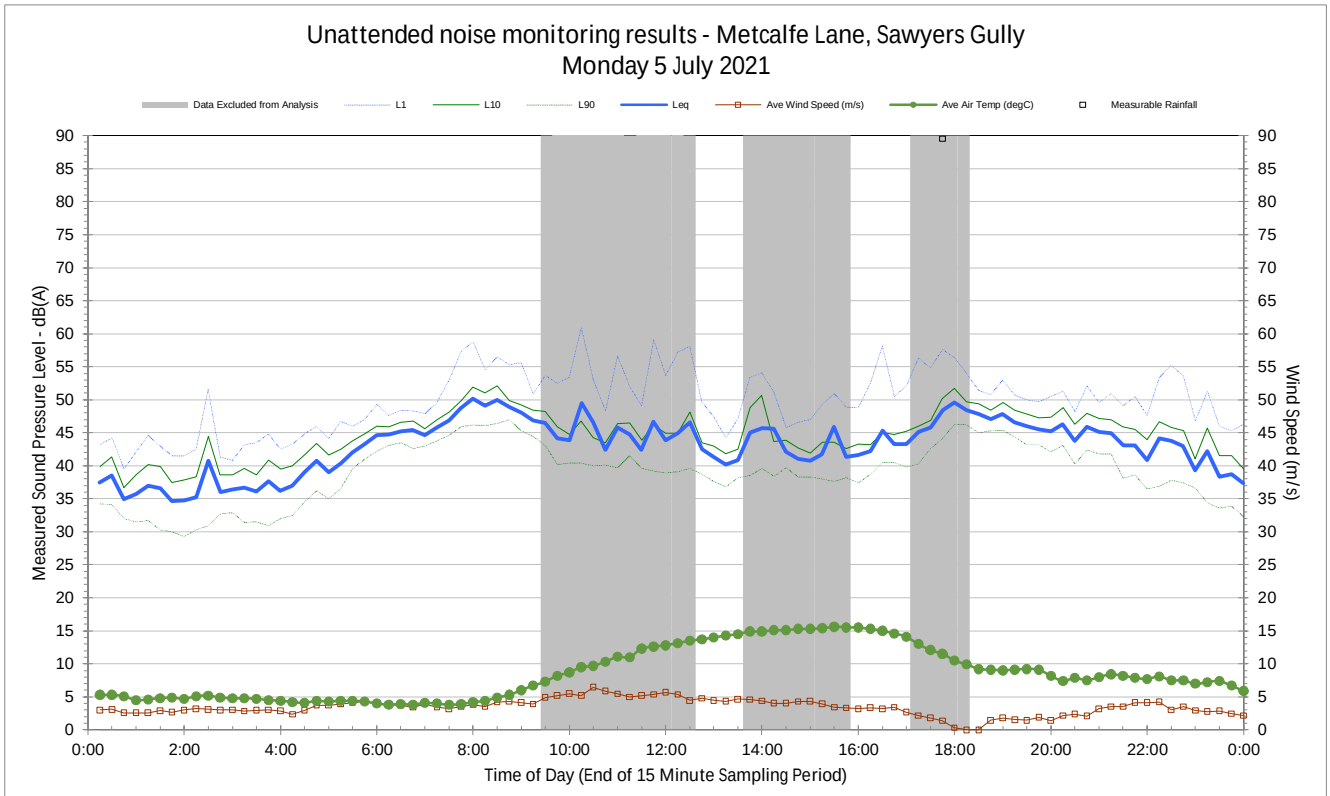


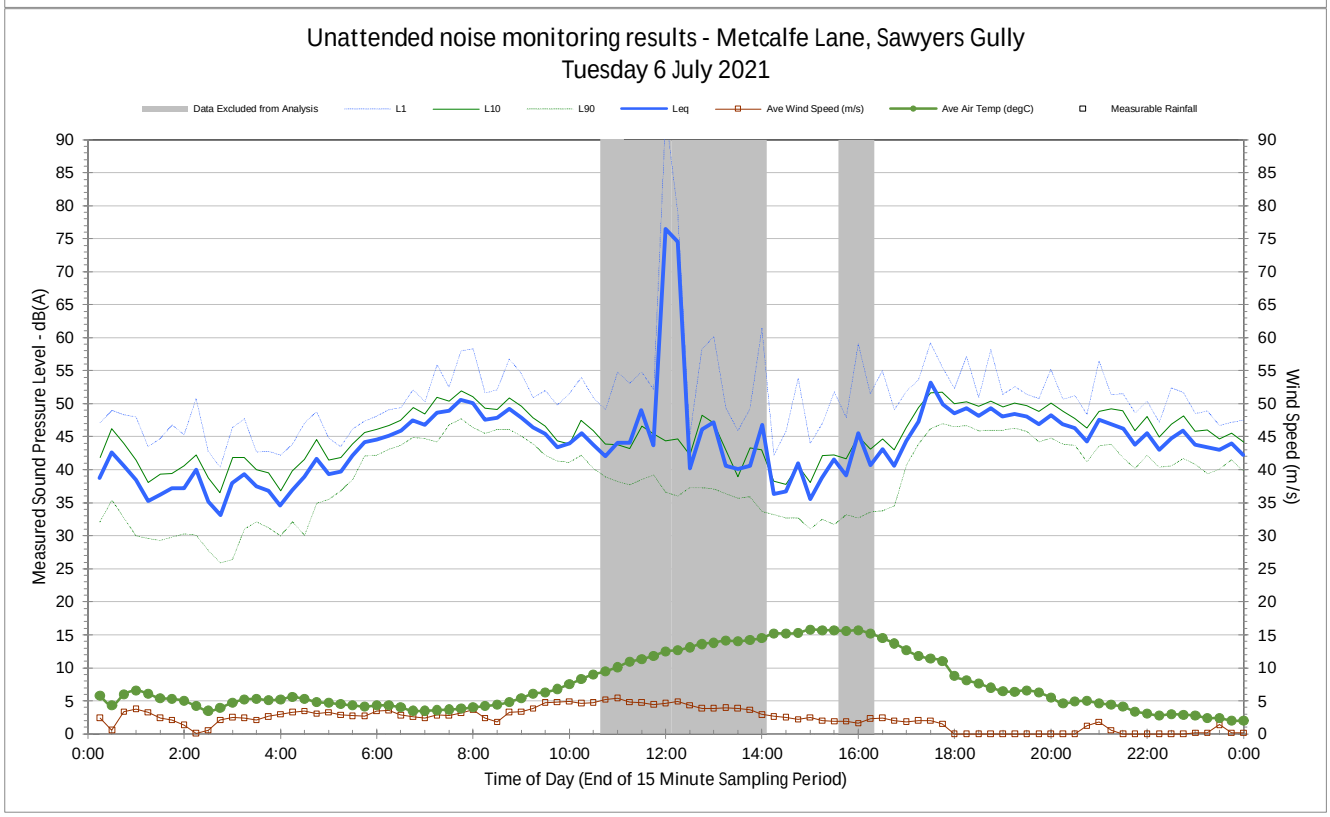

Unattended noise monitoring results - Metcalfe Lane, Sawyers Gully
Thursday 1 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

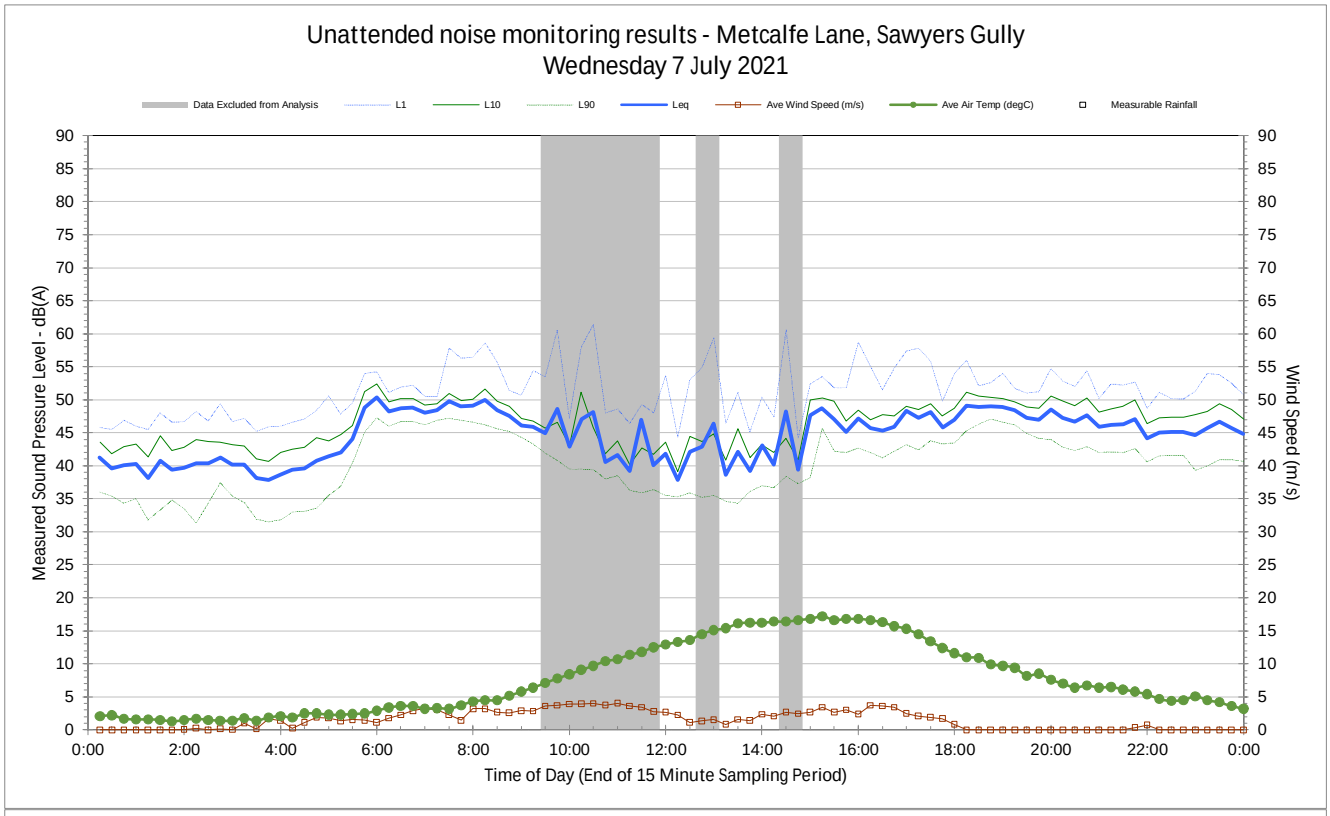

Unattended noise monitoring results - Metcalfe Lane, Sawyers Gully
Friday 2 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

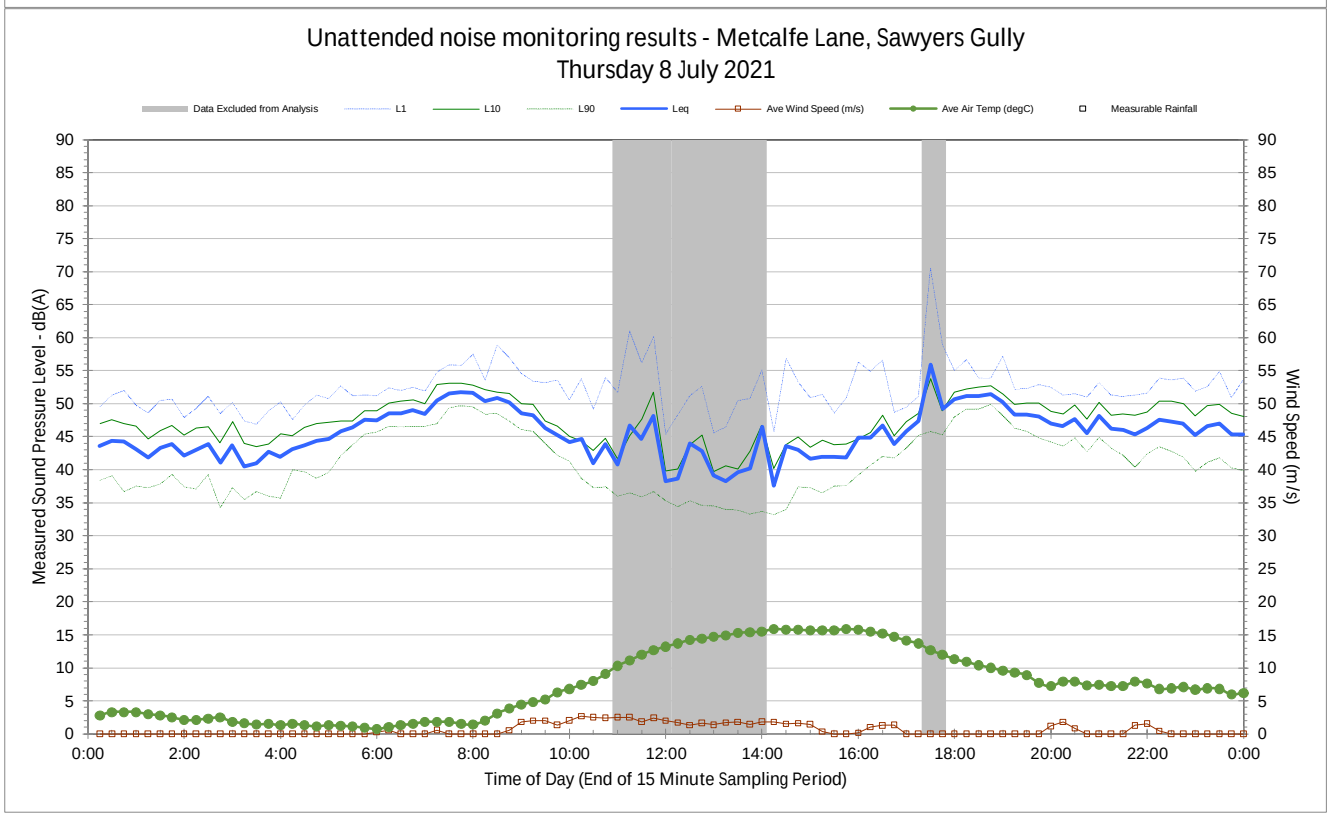

Unattended noise monitoring results - Metcalfe Lane, Sawyers Gully
Saturday 3 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

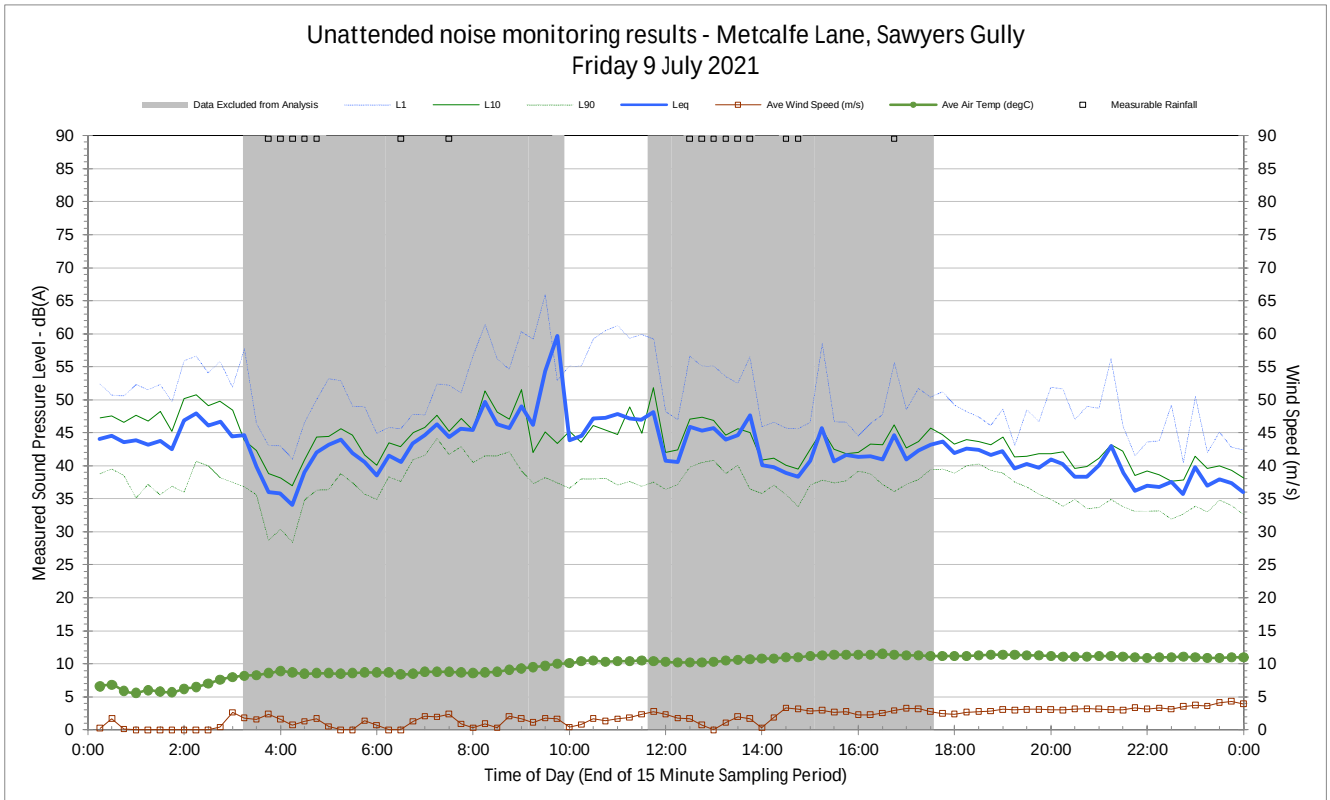

Unattended noise monitoring results - Metcalfe Lane, Sawyers Gully
Sunday 4 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

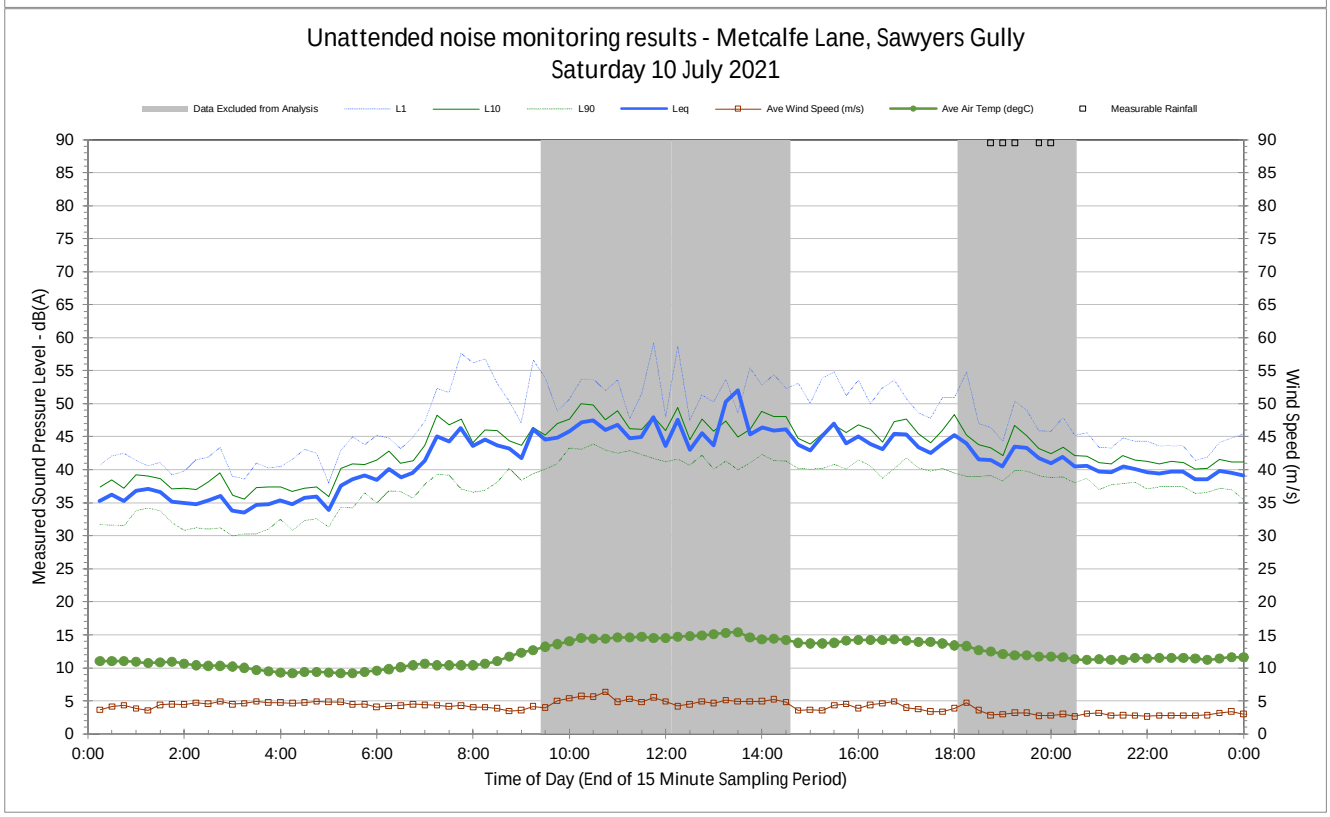

Unattended noise monitoring results - Metcalfe Lane, Sawyers Gully
Monday 5 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

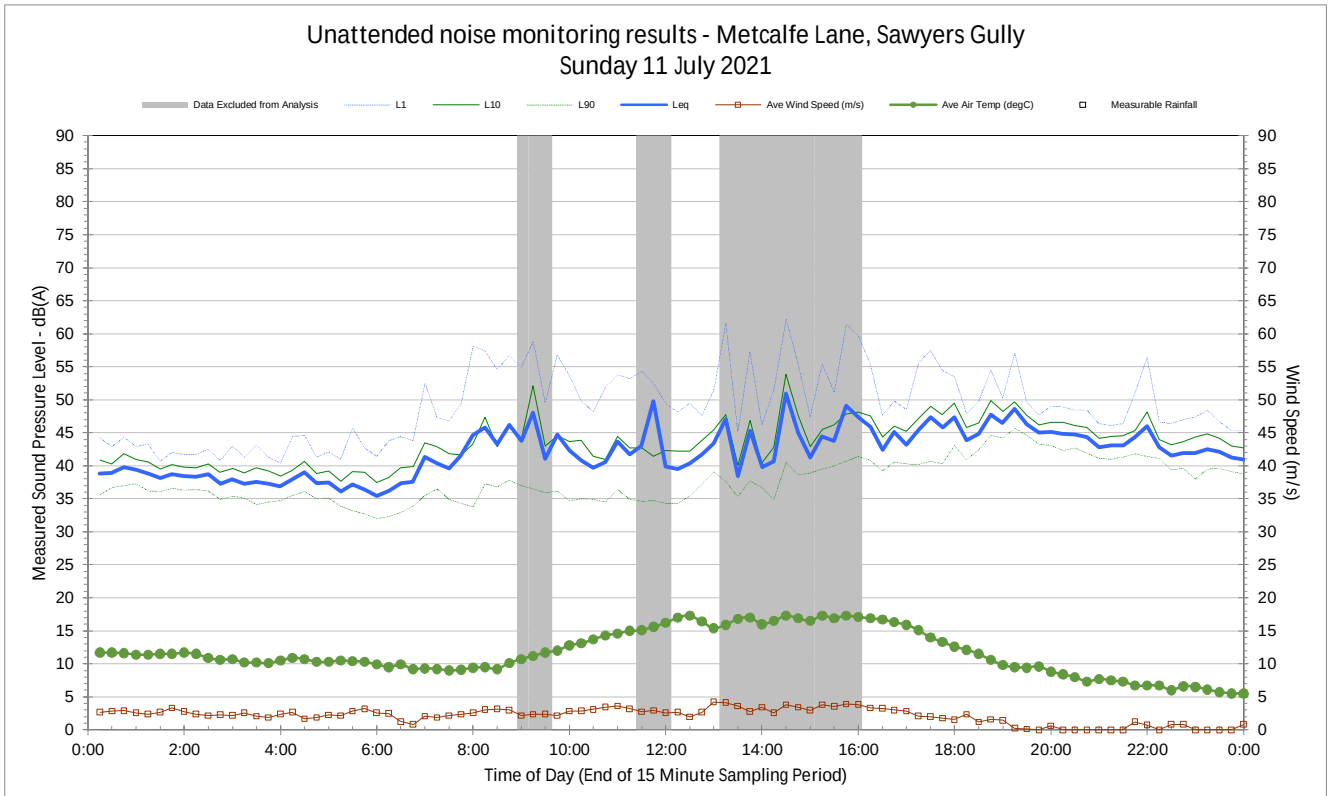

Unattended noise monitoring results - Metcalfe Lane, Sawyers Gully
Tuesday 6 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

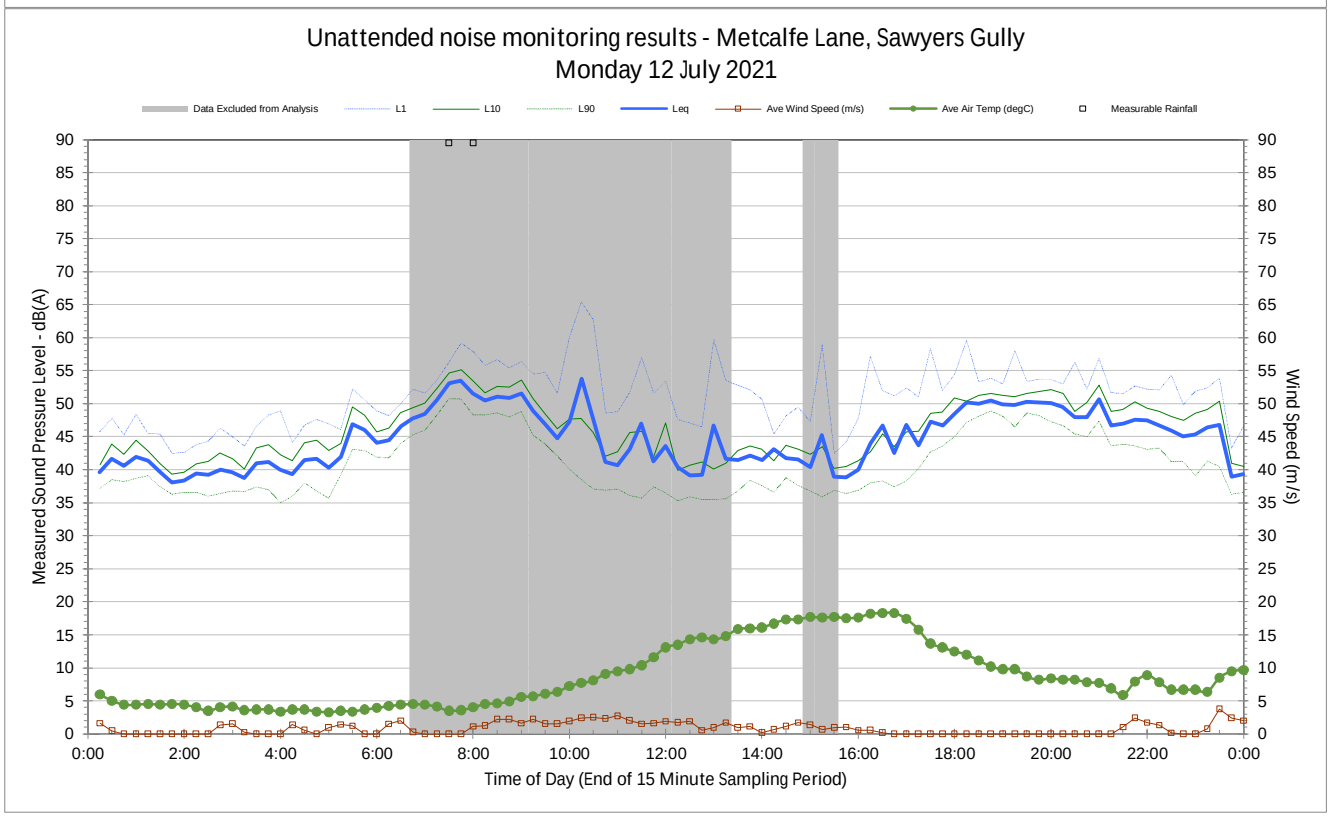

Unattended noise monitoring results - Metcalfe Lane, Sawyers Gully
Wednesday 7 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

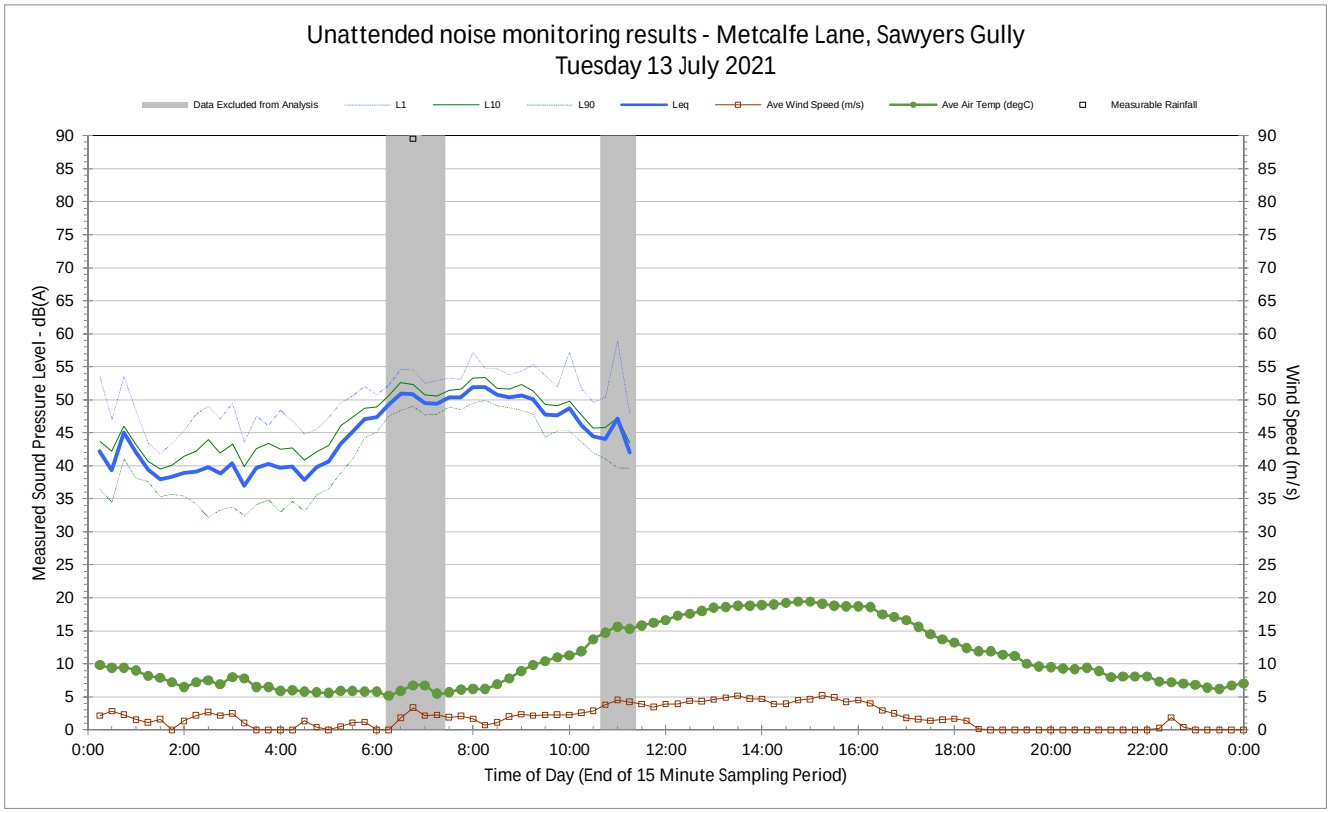

Unattended noise monitoring results - Metcalfe Lane, Sawyers Gully
Thursday 8 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)


Unattended noise monitoring results - Metcalfe Lane, Sawyers Gully
Friday 9 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)


Unattended noise monitoring results - Metcalfe Lane, Sawyers Gully
Saturday 10 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)


Unattended noise monitoring results - Metcalfe Lane, Sawyers Gully
Sunday 11 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)


Unattended noise monitoring results - Metcalfe Lane, Sawyers Gully
Monday 12 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)


Unattended noise monitoring results - Metcalfe Lane, Sawyers Gully
Tuesday 13 July 2021
Data Excluded from Analysis
L1
L10
L90
Leq
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measurable Rainfall
Measured Sound Pressure Level - dB(A)
Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00