Appendix I - GHD (2024) Malaga-Ballajura Transmission Line Noise and EMF Assessment

Malaga – Ballajura Transmission Line

Noise and EMF Assessment

Western Power

07 August 2024

→ The Power of Commitment

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[Compliance statement]

Glossary

Abbreviation	Definition
Ambient Noise	The all-encompassing noise associated within a given environment excluding noise source under consideration. It is the composite of sounds from many sources, both near and far.
Background Noise Level	For a day, evening or night period means the arithmetic average of the L_{A90} levels for each hour of that period for which the commercial, industrial or trade premises under investigation normally operates. The background level shall include all noise sources except noise from commercial, industrial or trade premises, which appear to be intrusive at the point where the background level is measured.
dB	Unit of measurement for Sound Pressure Level known as a decibel.
dB(A)	'A-weighted' decibel measurement, developed as a way to represent the sound frequency sensitivity of the human ear.
Effective noise level	The level of noise emitted from the commercial, industrial or trade premises and adjusted if appropriate for character and duration.
EPA	Environment Protection Authority.
GHD	GHD Pty Ltd
$L_{Aeq\ (Time)}$	Equivalent sound pressure level is the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring. This is considered to represent ambient noise.
$L_{A90\ (Time)}$	The A-weighted sound pressure level that is exceeded for 90 per cent of the time over which a given sound is measured. This is considered to represent the background noise.
$L_{A10\ (Time)}$	The arithmetic average of the sound pressure level that is exceeded for 10 per cent of the time specified. This is considered representative of the average maximum noise.
$L_{Amax(Time)}$	The maximum sound level recorded during a specified time interval.
$L_{Amin(Time)}$	The minimum sound level recorded during a specified time interval.
Noise Protocol	EPA Publication 1826.4 Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues (Noise Protocol) (July 2021).
Sensitive Receiver, Noise Sensitive Area	Sensitive receiver or noise sensitive area, as defined under the Noise Protocol, means: That part of the land within the apparent boundaries of any piece of land, which is within a distance of 10 metres outside the external walls of any of the following buildings – Dwelling (except Caretaker's House) and Residential Building. That part of the land within the apparent boundaries of any piece of land on which is situated any of the following buildings which is within a distance of 10 metres outside the external walls of any dormitory, ward or bedroom of such buildings – Caretaker's House, Hospital, Hotel, Institutional Home, Motel, Reformative Institution, Tourist Establishment, Work Release Hostel.
Sound Pressure Level (SPL)	The Sound Pressure Level is the change in air pressure above and below the average atmospheric pressure (amplitude) caused by a passing pressure wave; this is then converted to decibels and can be abbreviated as SPL or L_p.
Sound Power Level (SWL)	This is defined as the average rate at which sound energy is radiated from a sound source and is measured in watts (W). The Sound Power Level can be abbreviated as SWL or L_w.

Abbreviations

Abbreviation	Definition
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
CDEGS	Current Distribution, Electromagnetic fields, Grounding and Soil structure analysis
EMF	Electric and magnetic fields
ENA	Energy Networks Association
HIFREQ	Electromagnetic fields analysis (a software module of the CDEGS suite)
HV	High Voltage
Hz	Hertz
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEEE	Institute of Electrical and Electronics Engineers
kA	Kiloamperes
kV	Kilovolts
LV	Low voltage
rms	Root mean square
TWA	Time weighted average
µT	Micro tesla
V/m	Volts per metre
WHO	World Health Organisation
WP	Western Power
XLPE	Cross linked polyethylene

Contents

Table index

Figure index

Appendices

1. Introduction

GHD Pty Ltd (GHD) has been commissioned by Electricity Networks Corporation *trading as* Western Power to undertake an electromagnetic (EMF) and noise monitoring and modelling assessment for the proposed transmission line upgrade to enable placement of an additional transmission line along a 2.2 km section of easement adjacent to Marshall Road, Malaga, the NT-NBT 330kV (NREP) project (the Project).

The proposed transmission line upgrade will add an additional transmission line from the Northern Terminal Substation (NTS) to allow for future expansion of the network, utilising part of an existing line and adding new lines. A relocation of the NBT-NT-91 line to the north of the existing NBT-NT-91 in the western section of the Project intersecting with existing infrastructure adjacent Tower 5 (ID 0072) and utilising the existing NBT-NT-91 line from this point onward. The old western section of NBT-NT-91 line and NT-PJR-81 line will then be utilised to form a new line NBT-NT-92 line and NBT-NT-93 line which will continue between the updated NBT-NT-91 line (to the north) and the KW-NT-91 and MU-NT-91 lines (to the south), refer to Figure 1 for the existing transmission line layout and Figure 2 for the proposed changes to the transmission line layout. The new proposed NBT-NT-92 line will have a counterpart, the NBT-NT-93 line, both of which are expected to be 330 kV once completed and have similar current loadings as the existing 330 kV lines from the NTS.

As part of the electromagnetic (EMF) and noise monitoring and modelling assessment, GHD has undertaken field measurements for both long-term unattended and short term attended existing noise levels and existing operational electric field (E-field) and magnetic field (H-field) field levels for the area including near field testing EMF along the transmission line and under the towers. GHD has also undertaken both noise and EMF modelling of both the existing condition and proposed changes to NBT-NT-91/NT-PJR-81 lines and the addition of a new NBT-NT-92 line and NBT-NT-93 line.

This report presents the results of the assessment, including a summary of the scope of works, site location, sensitive receiver locations, noise and electromagnetic criteria, noise and electromagnetic modelling, and an overall summary of the assessment.

1.1 Purpose of this report

The purpose of this report is to present the findings of electromagnetic field strength (EMF) and noise measurements undertaken at a number of discrete locations along a section of existing northern most transmission line from the Northern Terminal Substation eastward to Tonkin Highway. The purpose of this report is to also present the findings of both EMF and Noise predictive modelling of the proposed changes to the transmission line and present predicted levels against relevant environmental noise and EMF public safety criteria.

1.2 Scope and limitations

This report: has been prepared by GHD for Western Power and may only be used and relied on by Western Power for the purpose agreed between GHD and Western Power as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Western Power arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer sections 1.3, 5.1.3, and 6.2 of this report and throughout this report). GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

GHD has prepared this report on the basis of information provided by Western Power and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has prepared the EMF and Noise models ("Model") as part of this project to support the proposed Malaga – Ballajura transmission line upgrade and these models must not be used for any other purpose or by any other person.

The Model is a representation only and does not reflect reality in every aspect. The Model contains simplified assumptions to derive a modelled outcome. The actual variables will inevitably be different to those used to prepare the Model. Accordingly, the outputs of the Model cannot be relied upon to represent actual conditions without due consideration of the inherent and expected inaccuracies. Such considerations are beyond GHD's scope.

Where information, data and assumptions ("Inputs") used as inputs into the Model are from publicly available sources or provided by or on behalf of Western Power, (including possibly through stakeholder engagements). GHD has not independently verified or checked Inputs beyond its agreed scope of work. GHD's scope of work does not include review or update of the Model as further Inputs becomes available.

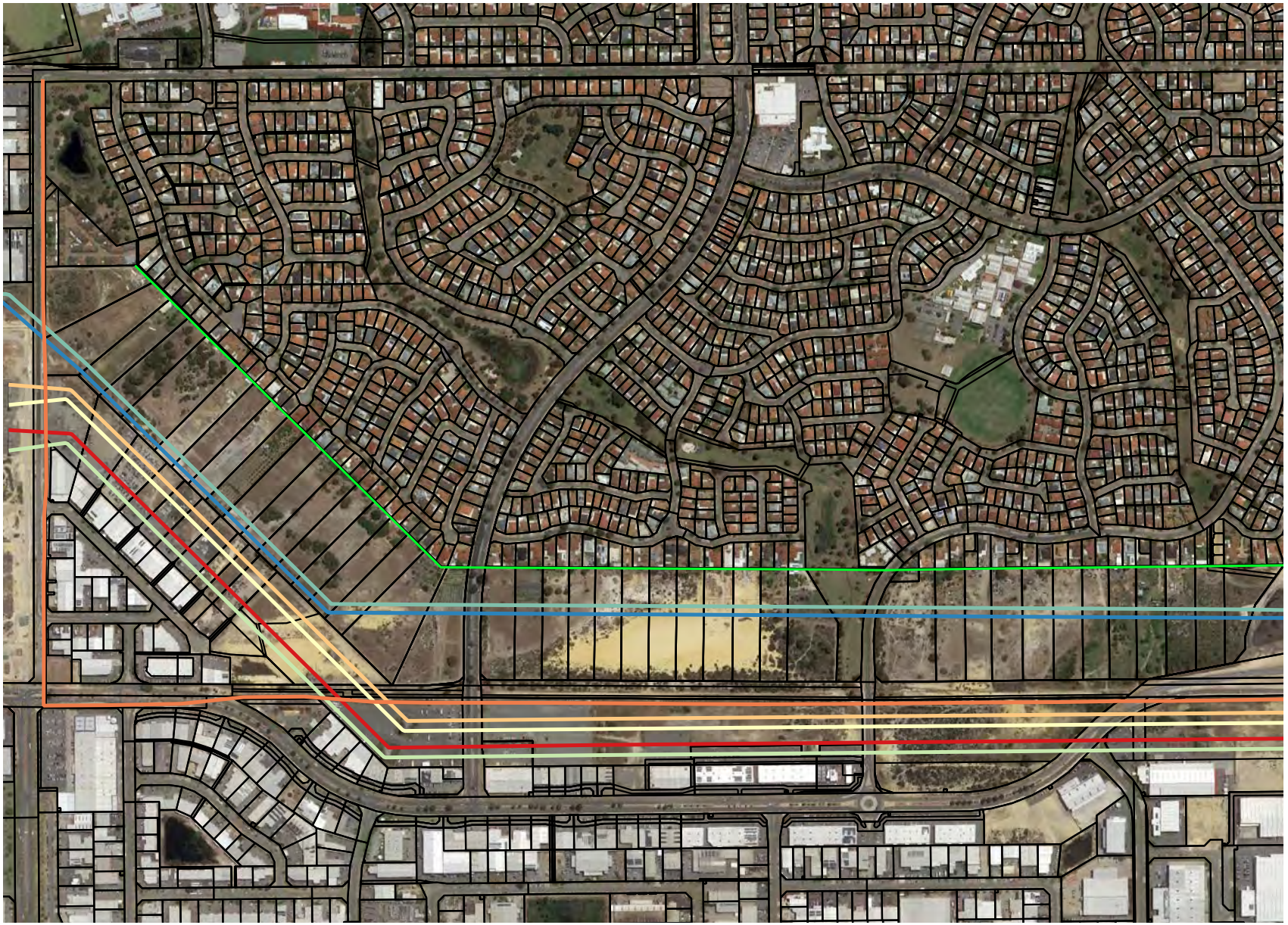
The Model is limited by the mathematical rules and assumptions that are set out in the Report or included in the Model and by the software environment in which the Model is developed.

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

1.3 Assumptions

This report has been prepared with the following assumptions having been made:

- The operating currents of the transmission conductors have been sourced from Western Power, shown in Appendix E
- Onsite noise and EMF measurements taken from various locations along the transmission line are considered representative of typical site operations and suitable for model calibration
- The location of the baseline noise monitoring was considered representative of the existing noise environment in the area for the closest sensitive receptors
- Observed operational conditions on the site were consistent with normal operating conditions that could be expected for the time of the year (July-August)
- Noise and EMF measurements are undertaken during specific dates and certain time periods, and therefore provide indicative (and not definitive) measurements for noise and EMF at the site. EMF and noise levels can also change and fluctuate at different times throughout the year (due to factors including seasonal changes, external events, or third-party intervention), and it is generally not possible to observe such changes or fluctuations where only a discrete site visit has taken place. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.
- The weather data collected using the automatic weather station (AWS) is assumed representative of local weather at the noise and EMF monitoring locations to allow removal of extraneous weather conditions from the data collected
- Weather is known to affect certain types of EMF measurement and as such weather conditions on the day of measurement were monitored and where required measurements were stopped until improved weather conditions existed
- GHD accessed a number of third-party databases as part of this assessment, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report that were caused by errors or omissions in that information. These databases include:
    - PlanWA (Department of Planning Lands and Heritage (https://espatial.dplh.wa.gov.au/);
    - Landgate (https://map-viewer-plus.app.landgate.wa.gov.au/index.html);
    - Google Maps (https://www.google.com.au/maps).
    - Main Roads WA (trafficmap - Main Roads WA).



Legend

- Allotment Boundary
- Easement Edge

Existing Transmission Lines

- GLT-NT 91 - 330 kV
- HV-Line - NT-HZM 81
- KW-NT 91 - 330 kV
- MU-NT 91 - 330 kV
- NT-GLT 82 - 132 kV
- NBT-NT 91 - 330 kV
- NT-PJR 81 - 132 kV

Paper Size ISO A4

0 0.1 0.2 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

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Existing Transmission Lines

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FIGURE 1

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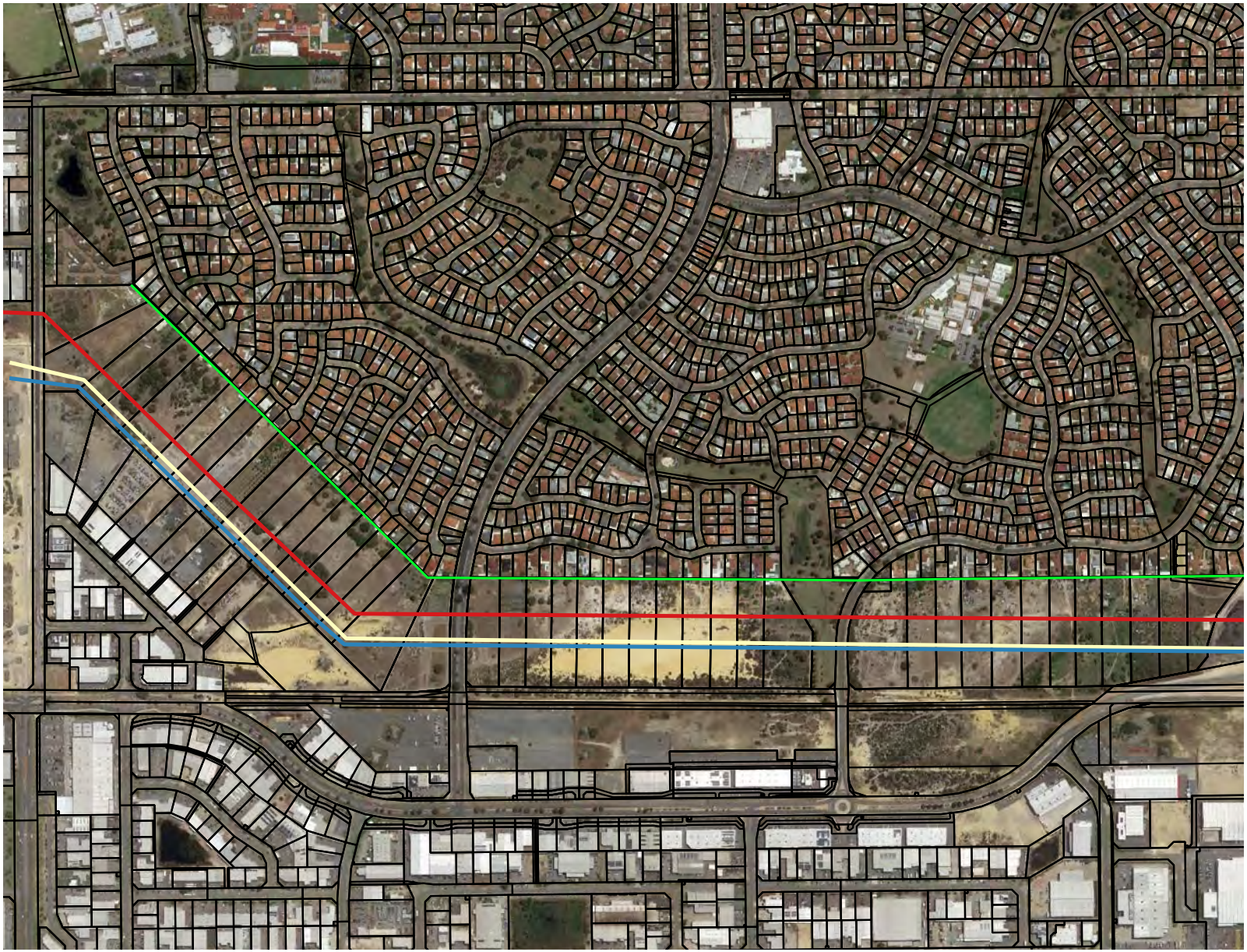

Legend

- Allotment Boundary
- Easement Edge

Proposed Transmission Lines

- Northern Section - 330 kV NBT-NT 92
- Southern Section - pt1 330 kV NBT-NT 93
- Southern Section - pt2 330 kV NBT-NT 93

Paper Size ISO A4

0 0.1 0.2 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

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Proposed Transmission Lines

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Revision No. **A**
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FIGURE 2

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1.4 Scope of works

The scope of works for the EMF and noise monitoring and modelling assessment included:

1. Field measurement (existing conditions)
2. Computational modelling of E- Field, H-Field, and noise (existing conditions and upgrade)
3. Assessment and reporting

The following table provides more detail on our proposed scope of works based on the above three key phases.

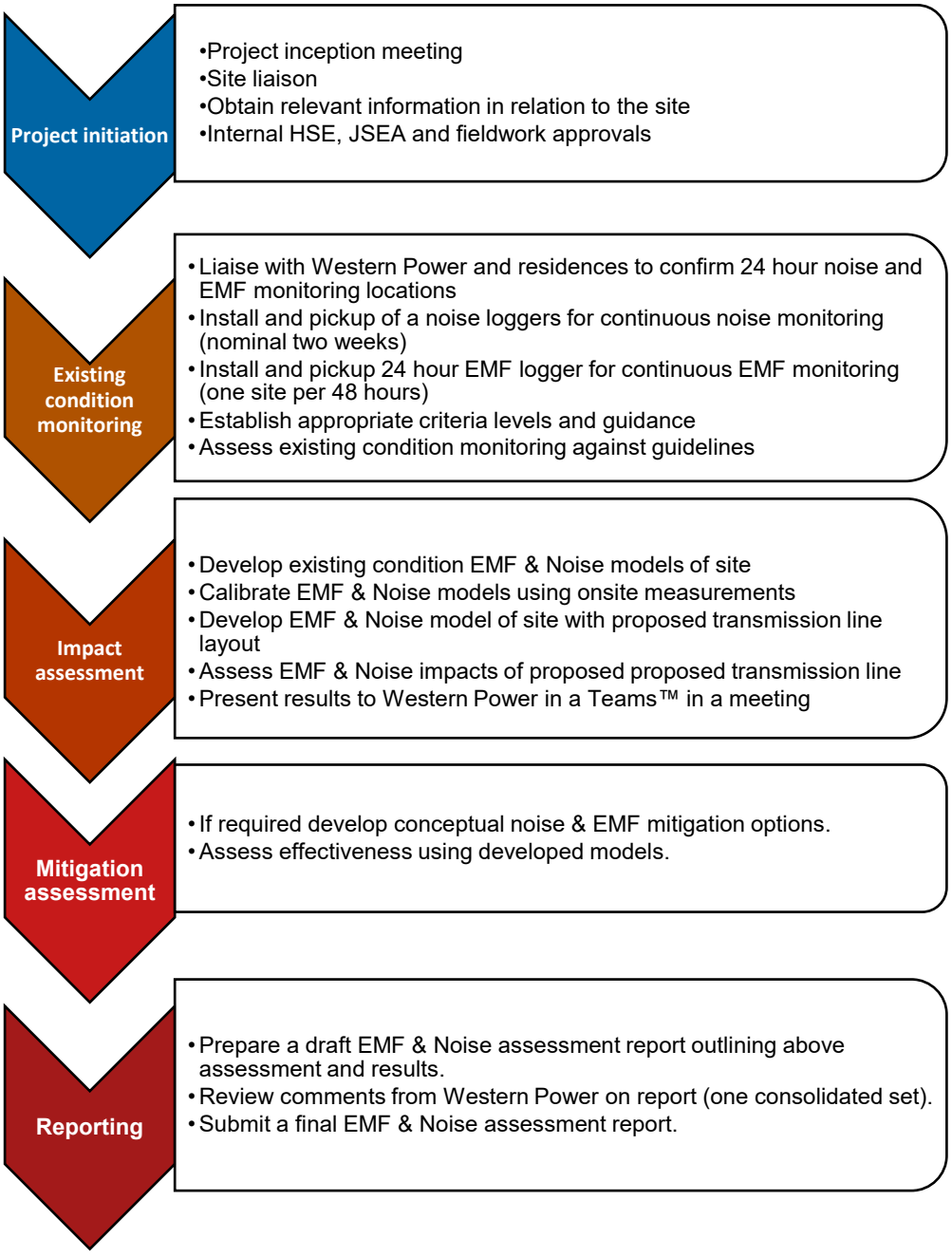
Table 1 Scope of works the connection and noise feasibility assessment

Activity	Tasks/Deliverables
Project Initiation	
Kick Off Meeting	– Project kick off meeting (carried out using Microsoft Teams) to confirm information requirements, invoicing and project management items, confirm and discuss the scope of works and site access requirements.
Noise assessment	
Attended noise measurements	– Undertake a desktop review of the site and proposed upgrade to identify and confirm key areas, property boundaries, easements, and sensitive receivers from aerial photography and planning maps.
	– Develop a Job Safety and Environmental Analysis (JSEA) and organise the preferred dates and times for testing, and associated site access
	– Seek permissions for gaining access to required sites including sensitive receiver locations and along existing high voltage (HV) transmission line
	– Undertake existing conditions noise survey within the Project area in accordance with a pre-determined test plan, documenting results during testing, including: • Transmission towers • Midspan locations • 30 m from the closest transmission line • At the easement boundary
Unattended noise measurements	– Based on GHD's review of the transmission line and relative sensitive receiver locations, determine indicative locations for existing noise monitoring for five (5) noise loggers
	– Deploy unattended noise monitors for a period of up to 7-14 days at the five locations to allow for different weather conditions. The unattended noise monitoring was then used to determine existing noise levels and provide 24-hour traces of the noise levels in the local area across various noise statistics.
	– Deploy one ultrasonic automatic weather station (AWS) at one of the unattended noise monitoring locations to capture wind speed and rainfall parameters at the microphone. The AWS was then be used to determine adverse weather conditions during the monitoring period.
	– Assess and filter noise data to remove invalid data due to extraneous noise or adverse weather conditions
	– Compare noise measurements against relevant noise legislation: • Environmental Protection Act 1986 • Environmental Protection (Noise) Regulations 1997
Noise modelling	– Undertake noise modelling using CadnaA predictive noise modelling software for two separate assessment scenarios under worst case meteorological conditions as follows: • Existing transmission line layout in operation • Proposed future transmission line layout in operation
	– The results of the onsite noise measurements were utilised to build and calibrate an existing condition noise model. Once calibrated, the existing condition model was then used to predict the noise level impacts of the proposed changes to the transmission line.

Activity	Tasks/Deliverables
	– Where the impact assessment indicates additional reduction of noise from the proposed transmission line is required, GHD in consultation with Western Power will undertake noise mitigation analysis to explore in-principle options to reduce noise levels.
EMF Assessment	
Attended EMF measurements	– Undertake a desktop review of the site and proposed upgrade to identify and confirm key areas, property boundaries, easements, and sensitive receivers from aerial photography and planning maps
	– Develop JSEA and existing condition EMF testing plan and
	– Organise preferred dates and times for testing, and associated site access and attendance by client personnel as required
	– Seek permissions for gaining access to required sites including sensitive receiver locations and along the existing HV transmission line where required
	– Undertake baseline EMF (E- Field & H-Field) survey within the Project area in accordance with a pre-determined test plan, documenting results during testing, including: • Transmission towers • Midspan locations • 30 m from the closest transmission line • At the easement boundary
	– Compare test measurements against international guidelines such as: • ICNIRP 2010, Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz - 100 kHz), noting ARPANSA have adopted this guideline. • WHO Guideline 2007, Environmental Health Criteria 238 Extremely Low Frequency Fields.
24-Hour EMF measurements	– Based on review of the transmission line and relative sensitive receiver locations, finalise indicative locations for long-term 24-hour EMF monitoring 30 metres from the transmission line midspan point for 24-hour EMF monitoring
	– Undertake 24-hour EMF monitoring to measure both E- Field & H-Field levels. Due to the general programming of class 1 EMF monitoring equipment, the ability to measure both E- Field & H-Field simultaneously is not possible and so measurements were taken over a 48 our period consecutively at each location to capture 24 hours of electric field strength monitoring followed by 24 hours of magnetic field strength monitoring.
	– Compare test measurements against international guidelines: • ICNIRP 2010, Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz - 100 kHz), noting ARPANSA have adopted this guideline • WHO Guideline 2007, Environmental Health Criteria 238 Extremely Low Frequency Fields
EMF modelling	– Review previous baseline assessment (as above) and existing information
	– Undertake predictive modelling using the CDEGS suite of software packages including HIFREQ for both E- Field & H-Field as follows: • Modelling of the existing section of HV transmission line • Modelling of the proposed changes to the section of HV transmission line • Utilisation of baseline monitoring into above predictive modelling
	– Validate model using site test results compared to simulation results of existing EM field levels
	– Compare predicted values against international guidelines: • ICNIRP 2010, Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz - 100 kHz), noting ARPANSA have adopted this guideline. • WHO Guideline 2007, Environmental Health Criteria 238 Extremely Low Frequency Fields.
	– Assess findings of the survey and theoretical assessment; assess the overall electromagnetic field impact, including compliance with applicable standards and guidelines, and any recommendations for mitigating any non-compliances, which may include precautionary measures
Deliverables	

Activity	Tasks/Deliverables
Reporting	– Provision of one DRAFT EMF & Noise Assessment Report for Western Power's review and comment prior to the FINAL EMF & Noise Assessment Report being issued.
Workshops/meetings	– A one-hour Teams™ meeting to discuss the results of the Draft Report

The following flow chart presents an overview of the scope of works associated with each key task:



2. Site location

The Project site is located between the Northern Terminal Substation and Tonkin Highway across the suburbs of Malaga to the south and Ballajura to the north in Perth Western Australia and sits approximately 11 km northeast of the Perth central business district (CBD), see Figure 3.

The following table presents images of the site with existing transmission line infrastructure and the Northern Terminal Substation (NTS), refer Table 2.

Table 2 Existing site

Existing Site	
	
Northern Terminal Substation (NTS)	View east from T3 to T2
	
View east from T5 (far left) to T4 (far left distant)	View west of T6 (centre)
	
View west of T5 from M4	View east of T4 from M4

Legend

- Easement Edge
- Tower and Mid Point Locations
- Closest Transmission Line
- Allotment Boundary

Paper Size ISO A4

0 0.1 0.2 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

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Study Area

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Date. **10/10/2023**

FIGURE 3

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3. Existing conditions

Attended short term and continuous longer term existing condition noise and EMF monitoring has been undertaken as a part of this assessment to understand existing noise and EMF levels at various locations across the Project site. The EMF monitoring included both magnetic (H-field) and electric (E-field) testing at each location.

Short term attended noise and EMF measurements were conducted simultaneously between 27 July 2023 and 30 July 2023 to define the existing noise levels and existing E-field and H-field levels for the Project at a wide number of locations providing over 100 samples of E-field and H-field levels and over 50 attended noise measurements.

Long-term (unattended) noise measurements were conducted between 25 July 2023 and 04 August 2023 to define the existing noise levels and determine the noise criteria for the Project and long-term (unattended) EMF measurements were conducted between 31 July 2023 and 04 August 2023 to define the existing E-field and H-field levels for comparison with relevant guidance and inclusion in the predictive EMF assessment for the Project

This section provides a summary of the attended and continuous noise and EMF monitoring results obtained at various locations across the site.

3.1 Measurement locations

Short term attended and long-term unattended noise and EMF levels were monitored at various locations across the Project footprint from the Northern Terminal Substation eastward to Tonkin Highway. Short term noise measurements were based on 15-minute periods to match in with the 15 minute integration periods used for long term noise monitoring and the *Environmental Protection (Noise) Regulations 1997* (the Regulations). Short term EMF measurements were based on 6-minute sample periods as per the ICNIRP guidance with a half secondly sampling rate, longer 24-hour sampling was based on the same 6-minute sliding average with a five secondly sampling rate.

The following provides more detail on the sampling locations for both the short term and long term noise and EMF measurements.

Attended short term measurements

Both attended noise and EMF levels were monitored at several locations across the site (along the existing NBT-NT-91 transmission line), including within 21 property allotments, see section 3.2.3 and 3.3.4 and Figure 4.

Measurements were taken each tower and mid span point along the Project footprint from Tower T1 (eastern most) to tower T7 (western most) as well as at several intermediary locations (21 properties), see Figure 4 and Table 4, Table 5, and Table 7 for more detail. All measurements under transmission lines and towers were taken underneath the nearest transmission line to sensitive receiver locations to the north in the Ballajura suburb. Measurements were also undertaken at 30 m from the transmission line and at the northern edge of the easement for the property where access allowed (otherwise as close as possible), providing three measurement points at each location:

– Under TL
– 30 m from TL (perpendicular to the TL and to its north)
– Easement Edge (perpendicular to the TL and to its north)

Unattended long-term measurements

Long-term (unattended) noise and EMF measurements were undertaken at several locations across the site. Noise measurements were undertaken within five (5) sensitive receiver backyards at locations facing the transmission lines. The five locations were considered representative of the ambient noise conditions experienced at the relevant noise sensitive receivers across the Project, see Figure 5 and Table 8 through Table 12. Long-term (unattended) EMF measurements were undertaken at two(2) locations at either end of the project site at a location 30 m from the transmission line, see Figure 6 and Figure 7 through Figure 10.

Legend

- Allotment Boundary
- Attended Measurement Locations
- Easement Edge
- Closest Transmission Line

Paper Size ISO A4

0 0.1 0.2 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

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Attended Measurement - Overview

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Revision No. **A**
Date. **12/10/2023**

FIGURE 4

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Legend

- Allotment Boundary
- Noise Logging Location
- Easement Edge
- Closest Transmission Line

Paper Size ISO A4

0 0.1 0.2 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

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Noise Logger Locations

Project No. **12614906**
Revision No. **A**
Date. **10/10/2023**

FIGURE 5

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Legend

- Allotment Boundary
- Easement Edge
- EMF Location
- Closest Transmission Line

Paper Size ISO A4

0 0.1 0.2 km

N

Map Projection: Transverse Mercator
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EMF Locations

Project No. **12614906**
Revision No. **A**
Date. **12/10/2023**

FIGURE 6

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3.2 EMF

The following section presents the results of the short term attended E-field and H-field monitoring for the Project. section 3.2.1 provides a summary of the instrumentation used, section 3.2.2 provides a summary of the method used for both attended and unattended measurements, section 3.2.3 presents the results of the short term attended measurements, section 3.2.4 presents the results of the long term unattended 24-hour measurements, section 3.2.5 provides a short summary of the results relative to the occupational and general public criteria outlined in section 4.

3.2.1 Instrumentation

A Wavecontrol SMP2™ field strength meter was used to provide both E & H field strength measurements for both the short term attended and long-term unattended measurements as detailed in Table 3.

Table 3 Probe details

Instrument type	Serial Number	Probe Frequencies
Wavecontrol SMP2 EMF Meter	21SN1799	E-field & H-field broadband meter
AC Probe	21WP100923	1 Hz – 400 kHz

3.2.2 Measurement method

Short term EMF measurements were based on 6-minute sample periods as per the ICNIRP guidance with a half secondly sampling rate, longer 24-hour sampling was based on the same 6-minute sliding average with a five secondly sampling rate.

Measurements were taken at each test location to capture the following:

– Magnetic field strength measurements (μT) as an RMS average with a probe range of 1 Hz – 400 kHz
– Electric field strength measurements (V/m) as an RMS average with a probe range of 1 Hz – 400 kHz

The sliding average of the measurement period and maximum and minimum values were then recorded.

The following measures were implemented to minimise interference on measurements due to fields associated with the tester's body:

– The meter was located at 1 m above ground level, supported on a wooden tripod
– The tester remain back from the field of influence during the measurement period
– An alert indicator triggered at the completion of each measurement

3.2.3 Short term attended EMF measurements

The results of the monitoring are presented in Table 4 and Table 5. Results show measured EMF levels for alternating current (AC) electric field (E-field) are compliant with the relevant public and occupational limits at all locations except under the lines at midpoint 2 (109 Guadalupe Drive allotment) which was marginally non-compliant with the general public 24-hour guideline value for electric fields (5,000 V/m) but complaint with the occupational value (10,000 V/m) and the ENA dosimetry guidance (9,900 V/m), see Table 4 and section 3.2.5 for more detail.

Measurements of EMF levels for alternating current (AC) magnetic field strength (H-field) were within the ICNIRP (2010) guideline values for general public (up to a 24-hour day) for magnetic fields (200 μT) and the occupational value (1,000 μT) and the ENA dosimetry guidance (606 μT), at all measured locations including under transmission lines, see Table 5 and Table 13 for a summary of the EMF criteria from ICNIRP (ICNIRP, 2010).

Table 4 Attended measurements - AC probe electric field (E-field) results (AC 1 Hz – 400 kHz)

Address	Location	Date/Time	Units	6 minute Average	Maximum	Minimum	Public Reference level [1]	Occupational Limit [2]	ENA Dosimetry guide [3]
4-6 Arnhem Court	**Under TL (T1)**	7/27/2023 11:24:26	v/m	**1052.2**	1675.3	1026.8	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/27/2023 11:52:22	v/m	**130**	213.6	126.3	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/27/2023 12:03:34	v/m	**32.75**	54.14	32.16	5000 v/m	10000 v/m	9900 v/m
75 Guadalupe Drive	Under TL	7/27/2023 10:13:20	v/m	**3148.2**	4681.2	3016.5	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/27/2023 10:26:08	v/m	**44.96**	79.56	44.48	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/27/2023 10:52:58	v/m	**50.35**	91.37	49.33	5000 v/m	10000 v/m	9900 v/m
85 Guadalupe Drive	**Under TL (M1)**	7/29/2023 16:08:30	v/m	**4375.2**	7032.6	4270.8	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/29/2023 16:23:46	v/m	**85.61**	153.5	81.92	5000 v/m	10000 v/m	9900 v/m
91 Guadalupe Drive	Under TL	7/29/2023 15:06:24	v/m	**3388**	4706.3	3329.7	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/29/2023 15:28:49	v/m	**41.77**	50.67	39.14	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/29/2023 15:40:07	v/m	**51.6**	69.16	49.46	5000 v/m	10000 v/m	9900 v/m
99 Guadalupe Drive	**Under TL (T2)**	7/29/2023 14:09:50	v/m	**1164.3**	1922.3	1095	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/29/2023 14:20:09	v/m	**54.98**	84.19	52.87	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/29/2023 14:46:43	v/m	**41.64**	55.35	41.14	5000 v/m	10000 v/m	9900 v/m
109 Guadalupe Drive	**Under TL (M2)**	7/29/2023 12:58:53	v/m	**5417.1**[3]	8436.7	5305.5	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/29/2023 13:23:46	v/m	**124**	213.8	120.1	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/29/2023 13:34:06	v/m	**55.06**	81.55	53.9	5000 v/m	10000 v/m	9900 v/m
16-18 Lassen Gardens	**Under TL (T3)**	7/30/2023 08:32:57	v/m	**184.7**	205.7	167.5	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/30/2023 08:51:03	v/m	**100.3**	131.3	94.29	5000 v/m	10000 v/m	9900 v/m

Address	Location	Date/Time	Units	6 minute Average	Maximum	Minimum	Public Reference level [1]	Occupational Limit [2]	ENA Dosimetry guide [3]
8 Lassen Gardens	Under TL	7/30/2023 09:26:24	v/m	**1714.7**	3027.3	1650	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/30/2023 12:36:56	v/m	**58.5**	82.6	57.29	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/30/2023 13:03:18	v/m	**22.25**	34.01	21.96	5000 v/m	10000 v/m	9900 v/m
33 Yosemite Loop	**Under TL (M3)**	7/30/2023 09:42:59	v/m	**3023**	4674.1	2925.8	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/30/2023 10:10:20	v/m	**58.57**	91.39	56.49	5000 v/m	10000 v/m	9900 v/m
41 Yosemite Loop	Under TL	7/30/2023 10:27:36	v/m	**3033**	4583.6	2959	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/30/2023 10:52:33	v/m	**51.34**	87.29	49.35	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/30/2023 11:05:24	v/m	**39.59**	60.46	38.96	5000 v/m	10000 v/m	9900 v/m
49 Yosemite Loop	**Under TL (T4)**	7/30/2023 11:33:09	v/m	**989.4**	1699.9	972.4	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/30/2023 11:43:09	v/m	**65.99**	94.75	63.44	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/30/2023 12:13:23	v/m	**38.01**	61.82	36.75	5000 v/m	10000 v/m	9900 v/m
27 Huntingdon Mews	**Under TL (M4)**	7/29/2023 10:56:42	v/m	**3667.9**	5247.8	3510.1	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/29/2023 11:06:38	v/m	**57.49**	84.34	54.02	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/29/2023 11:32:59	v/m	**38.37**	57.23	37.51	5000 v/m	10000 v/m	9900 v/m
1 Tekapo Lane	Under TL	7/29/2023 09:45:45	v/m	**2736.5**	4369.5	2605	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/29/2023 10:10:30	v/m	**202.2**	353	164.9	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/29/2023 10:27:49	v/m	**16.63**	19.75	15.71	5000 v/m	10000 v/m	9900 v/m
9 Tekapo Lane	30m from TL	7/28/2023 16:48:00	v/m	**78.97**	118.1	74.57	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/28/2023 17:00:45	v/m	**4.928**	7.35	4.533	5000 v/m	10000 v/m	9900 v/m

Address	Location	Date/Time	Units	6 minute Average	Maximum	Minimum	Public Reference level [1]	Occupational Limit [2]	ENA Dosimetry guide [3]
1 The Elms	**Under TL (M5)**	7/28/2023 15:28:20	v/m	**2767.7**	4302.5	2675.1	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/28/2023 15:51:58	v/m	**247.9**	481.2	234.9	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/28/2023 16:06:03	v/m	**2.336**	3.887	1.401	5000 v/m	10000 v/m	9900 v/m
28 Tintagel Place	Under TL	7/28/2023 14:33:42	v/m	**2263.2**	3572.5	2176.5	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/28/2023 14:44:16	v/m	**97.21**	163.9	92.61	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/28/2023 15:10:38	v/m	**4.024**	9.269	3.267	5000 v/m	10000 v/m	9900 v/m
8 Bampton Lane	Under TL	7/28/2023 11:14:51	v/m	**2080.2**	4109.5	2042.7	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/28/2023 11:26:09	v/m	**121.6**	214.1	118.4	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/28/2023 11:54:45	v/m	**4.099**	8.082	3.566	5000 v/m	10000 v/m	9900 v/m
60 Nottingham Gardens	**Under TL (M6)**	7/27/2023 14:13:01	v/m	**2514.5**	5138.2	2463.1	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/27/2023 14:22:17	v/m	**77.13**	125.7	73.13	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/27/2023 14:48:32	v/m	**3.951**	6.615	3.411	5000 v/m	10000 v/m	9900 v/m
46 Winchester Place	Under TL	7/28/2023 12:24:51	v/m	**1116.3**	1671.3	1051	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/28/2023 12:47:38	v/m	**35.99**	57.01	32.42	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/28/2023 13:03:45	v/m	**2.925**	6.209	2.147	5000 v/m	10000 v/m	9900 v/m
38 Winchester Place	**Under TL (M7)**	7/28/2023 09:09:49	v/m	**975.2**	2005.6	949.9	5000 v/m	10000 v/m	9900 v/m
	30m from TL	7/28/2023 09:21:18	v/m	**69.28**	133.3	66.99	5000 v/m	10000 v/m	9900 v/m
	Easement Edge	7/28/2023 09:56:19	v/m	**6.756**	10.72	6.336	5000 v/m	10000 v/m	9900 v/m
T1	Under TL	7/27/2023 11:24:26	v/m	**1052.2**	1675.3	1026.8	5000 v/m	10000 v/m	9900 v/m
M1	Under TL	7/29/2023 16:08:30	v/m	**4375.2**	7032.6	4270.8	5000 v/m	10000 v/m	9900 v/m

Address	Location	Date/Time	Units	6 minute Average	Maximum	Minimum	Public Reference level [1]	Occupational Limit [2]	ENA Dosimetry guide [3]
T2	Under TL	7/29/2023 14:09:50	v/m	**1164.3**	1922.3	1095	5000 v/m	10000 v/m	9900 v/m
M2	Under TL	7/29/2023 12:58:53	v/m	**5417.1**	8436.7	5305.5	5000 v/m	10000 v/m	9900 v/m
T3	Under TL	7/30/2023 08:32:57	v/m	**184.7**	205.7	167.5	5000 v/m	10000 v/m	9900 v/m
M3	Under TL	7/30/2023 09:42:59	v/m	**3023**	4674.1	2925.8	5000 v/m	10000 v/m	9900 v/m
T4	Under TL	7/30/2023 11:33:09	v/m	**989.4**	1699.9	972.4	5000 v/m	10000 v/m	9900 v/m
M4	Under TL	7/29/2023 10:56:42	v/m	**3667.9**	5247.8	3510.1	5000 v/m	10000 v/m	9900 v/m
T5	Under TL	7/29/2023 09:35:06	v/m	**1527.7**	2702.6	1452.8	5000 v/m	10000 v/m	9900 v/m
M5	Under TL	7/28/2023 15:28:20	v/m	**2767.7**	4302.5	2675.1	5000 v/m	10000 v/m	9900 v/m
T6	Under TL	7/28/2023 10:40:43	v/m	**988.5**	1444.9	961	5000 v/m	10000 v/m	9900 v/m
M6	Under TL	7/27/2023 14:13:01	v/m	**2514.5**	5138.2	2463.1	5000 v/m	10000 v/m	9900 v/m
T7	Under TL	7/28/2023 08:39:38	v/m	**476.2**	656.1	453.8	5000 v/m	10000 v/m	9900 v/m
M7	Under TL	7/28/2023 09:09:49	v/m	**975.2**	2005.6	949.9	5000 v/m	10000 v/m	9900 v/m

[1] Public reference level taken from the international Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz - 100 kHz) published in 2010 (ICNIRP, 2010).
[2] Occupational limit taken from the international Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz - 100 kHz) published in 2010 (ICNIRP, 2010).
Note: ARPANSA recognises the ICNIRP 2010 guideline for use in Australia for the protection of the general public (including the foetus) and workers from exposure to ELF EMF (Australian Government, 2023).
[3] In accordance with the ENA EMF Management Handbook Table 6.2, the electric field limit when dosimetry is considered for the general public is 9.9 kV/m, which is still complaint with the Basic Restrictions of the ICNIRP guidelines (ENA, January 2016).

Table 5 Attended measurements − AC probe magnetic field (H-field) results (AC 1 Hz – 400 kHz)

Address	Location	Date/ Time	Units	6 minute Average	Maximum	Minimum	Public Reference level [1]	Occupational Limit [2]	ENA Dosimetry guide [3]
4-6 Arnhem Court	**Under TL (T1)**	7/27/2023 11:31:32	µT	**0.9817**	1.511	0.8515	200 µT	1000 µT	606 µT
	30m from TL	7/27/2023 11:45:02	µT	**0.624**	1.231	0.419	200 µT	1000 µT	606 µT
	Easement Edge	7/27/2023 12:10:42	µT	**0.5536**	0.8993	0.2934	200 µT	1000 µT	606 µT

Address	Location	Date/ Time	Units	6 minute Average	Maximum	Minimum	Public Reference level [1]	Occupational Limit [2]	ENA Dosimetry guide [3]
75 Guadalupe Drive	Under TL	7/27/2023 10:05:35	µT	**1.643**	1.819	1.565	200 µT	1000 µT	606 µT
	30m from TL	7/27/2023 10:33:23	µT	**0.767**	1.169	0.5917	200 µT	1000 µT	606 µT
	Easement Edge	7/27/2023 10:45:43	µT	**0.5616**	1.302	0.3096	200 µT	1000 µT	606 µT
85 Guadalupe Drive	**Under TL (M1)**	7/29/2023 16:01:29	µT	**1.083**	1.374	0.9285	200 µT	1000 µT	606 µT
	30m from TL	7/29/2023 16:30:49	µT	**0.6317**	1.302	0.3924	200 µT	1000 µT	606 µT
91 Guadalupe Drive	Under TL	7/29/2023 15:13:28	µT	**1.639**	1.895	1.437	200 µT	1000 µT	606 µT
	30m from TL	7/29/2023 15:22:02	µT	**0.6231**	1.386	0.3708	200 µT	1000 µT	606 µT
	Easement Edge	7/29/2023 15:47:45	µT	**0.5791**	1.218	0.3042	200 µT	1000 µT	606 µT
99 Guadalupe Drive	**Under TL (T2)**	7/29/2023 14:03:03	µT	**1.129**	1.433	0.9496	200 µT	1000 µT	606 µT
	30m from TL	7/29/2023 14:27:14	µT	**0.6475**	1.1	0.4292	200 µT	1000 µT	606 µT
	Easement Edge	7/29/2023 14:39:34	µT	**0.5437**	1.188	0.2748	200 µT	1000 µT	606 µT
109 Guadalupe Drive	**Under TL (M2)**	7/29/2023 13:06:10	µT	**3.959**	4.333	3.475	200 µT	1000 µT	606 µT
	30m from TL	7/29/2023 13:16:58	µT	**0.6481**	1.484	0.4195	200 µT	1000 µT	606 µT
	Easement Edge	7/29/2023 13:41:17	µT	**0.5839**	1.381	0.3427	200 µT	1000 µT	606 µT
16-18 Lassens Gardens	**Under TL (T3)**	7/30/2023 08:26:01	µT	**1.033**	1.558	0.886	200 µT	1000 µT	606 µT
	30m from TL	7/30/2023 08:58:17	µT	**0.7706**	1.244	0.6071	200 µT	1000 µT	606 µT

Address	Location	Date/ Time	Units	6 minute Average	Maximum	Minimum	Public Reference level [1]	Occupational Limit [2]	ENA Dosimetry guide [3]
8 Lassens Gardens	Under TL	7/30/2023 09:18:56	µT	**1.697**	1.962	1.602	200 µT	1000 µT	606 µT
	30m from TL	7/30/2023 12:43:51	µT	**0.7317**	1.211	0.5435	200 µT	1000 µT	606 µT
	Easement Edge	7/30/2023 12:55:09	µT	**0.6015**	1.255	0.3226	200 µT	1000 µT	606 µT
33 Yosemite	**Under TL (M3)**	7/30/2023 09:51:01	µT	**2.416**	2.668	2.325	200 µT	1000 µT	606 µT
	30m from TL	7/30/2023 10:03:25	µT	**0.7677**	1.096	0.5959	200 µT	1000 µT	606 µT
41 Yosemite	Under TL	7/30/2023 10:34:38	µT	**1.923**	2.194	1.822	200 µT	1000 µT	606 µT
	30m from TL	7/30/2023 10:45:37	µT	**0.7144**	1.259	0.5237	200 µT	1000 µT	606 µT
	Easement Edge	7/30/2023 11:12:58	µT	**0.575**	1.46	0.3236	200 µT	1000 µT	606 µT
49 Yosemite	**Under TL (T4)**	7/30/2023 11:26:07	µT	**1.086**	1.541	0.9628	200 µT	1000 µT	606 µT
	30m from TL	7/30/2023 11:50:48	µT	**0.698**	1.379	0.478	200 µT	1000 µT	606 µT
	Easement Edge	7/30/2023 12:06:39	µT	**0.5778**	1.195	0.2893	200 µT	1000 µT	606 µT
27 Huntingdon Mews	**Under TL (M4)**	7/29/2023 10:49:53	µT	**1.256**	1.755	0.9973	200 µT	1000 µT	606 µT
	30m from TL	7/29/2023 11:14:13	µT	**0.6626**	1.32	0.4635	200 µT	1000 µT	606 µT
	Easement Edge	7/29/2023 11:26:08	µT	**0.5639**	1.174	0.2747	200 µT	1000 µT	606 µT
1 Tekapo Lane	Under TL	7/29/2023 09:53:08	µT	**0.8943**	1.376	0.6967	200 µT	1000 µT	606 µT
	30m from TL	7/29/2023 10:03:32	µT	**0.6472**	1.478	0.4261	200 µT	1000 µT	606 µT
	Easement Edge	7/29/2023 10:35:16	µT	**0.5602**	1.257	0.2434	200 µT	1000 µT	606 µT

Address	Location	Date/ Time	Units	6 minute Average	Maximum	Minimum	Public Reference level [1]	Occupational Limit [2]	ENA Dosimetry guide [3]
9 Tekapo Lane	30m from TL	7/28/2023 16:41:08	µT	**0.6698**	1.189	0.4255	200 µT	1000 µT	606 µT
	Easement Edge	7/28/2023 17:07:37	µT	**0.5679**	1.271	0.2652	200 µT	1000 µT	606 µT
1 The Elms	**Under TL (M5)**	7/28/2023 15:35:32	µT	**2.388**	2.659	2.24	200 µT	1000 µT	606 µT
	30m from TL	7/28/2023 15:44:29	µT	**0.9341**	1.297	0.7862	200 µT	1000 µT	606 µT
	Easement Edge	7/28/2023 16:14:01	µT	**0.567**	1.319	0.295	200 µT	1000 µT	606 µT
28 Tintagel Place	Under TL	7/28/2023 14:26:53	µT	**1.476**	1.865	1.373	200 µT	1000 µT	606 µT
	30m from TL	7/28/2023 14:51:33	µT	**0.6495**	1.154	0.4376	200 µT	1000 µT	606 µT
	Easement Edge	7/28/2023 15:03:35	µT	**0.5654**	1.254	0.2601	200 µT	1000 µT	606 µT
8 Bampton Lane	Under TL	7/28/2023 11:07:06	µT	**0.909**	1.329	0.7827	200 µT	1000 µT	606 µT
	30m from TL	7/28/2023 11:33:17	µT	**0.6382**	1.156	0.4145	200 µT	1000 µT	606 µT
	Easement Edge	7/28/2023 11:47:46	µT	**0.5447**	1.393	0.2827	200 µT	1000 µT	606 µT
60 Nottingham Gardens	**Under TL (M6)**	7/27/2023 14:05:42	µT	**1.338**	1.557	1.222	200 µT	1000 µT	606 µT
	30m from TL	7/27/2023 14:29:25	µT	**0.6584**	1.395	0.4373	200 µT	1000 µT	606 µT
	Easement Edge	7/27/2023 14:40:56	µT	**0.5519**	1.075	0.2837	200 µT	1000 µT	606 µT
46 Winchester Place	Under TL	7/28/2023 12:31:46	µT	**1.086**	1.476	0.91	200 µT	1000 µT	606 µT
	30m from TL	7/28/2023 12:40:42	µT	**0.6102**	1.439	0.3884	200 µT	1000 µT	606 µT
	Easement Edge	7/28/2023 13:11:28	µT	**0.551**	1.159	0.2932	200 µT	1000 µT	606 µT

Address	Location	Date/ Time	Units	6 minute Average	Maximum	Minimum	Public Reference level [1]	Occupational Limit [2]	ENA Dosimetry guide [3]
38 Winchester Place	**Under TL (M7)**	7/28/2023 09:02:07	µT	**1.016**	1.739	0.883	200 µT	1000 µT	606 µT
	30m from TL	7/28/2023 09:28:56	µT	**0.7129**	1.21	0.5477	200 µT	1000 µT	606 µT
	Easement Edge	7/28/2023 09:49:07	µT	**0.5563**	1.248	0.2738	200 µT	1000 µT	606 µT
T1	Under TL	7/27/2023 11:31:32	µT	**0.9817**	1.511	0.8515	200 µT	1000 µT	606 µT
M1	Under TL	7/29/2023 16:01:29	µT	**1.083**	1.374	0.9285	200 µT	1000 µT	606 µT
T2	Under TL	7/29/2023 14:03:03	µT	**1.129**	1.433	0.9496	200 µT	1000 µT	606 µT
M2	Under TL	7/29/2023 13:06:10	µT	**3.959**	4.333	3.475	200 µT	1000 µT	606 µT
T3	Under TL	7/30/2023 08:26:01	µT	**1.033**	1.558	0.886	200 µT	1000 µT	606 µT
M3	Under TL	7/30/2023 09:51:01	µT	**2.416**	2.668	2.325	200 µT	1000 µT	606 µT
T4	Under TL	7/30/2023 11:26:07	µT	**1.086**	1.541	0.9628	200 µT	1000 µT	606 µT
M4	Under TL	7/29/2023 10:49:53	µT	**1.256**	1.755	0.9973	200 µT	1000 µT	606 µT
T5	Under TL	7/29/2023 09:28:04	µT	**1.109**	1.408	0.9931	200 µT	1000 µT	606 µT
M5	Under TL	7/28/2023 15:35:32	µT	**2.388**	2.659	2.24	200 µT	1000 µT	606 µT
T6	Under TL	7/28/2023 10:47:53	µT	**0.9922**	1.303	0.852	200 µT	1000 µT	606 µT
M6	Under TL	7/27/2023 14:05:42	µT	**1.338**	1.557	1.222	200 µT	1000 µT	606 µT
T7	Under TL	7/28/2023 08:48:00	µT	**1.083**	1.438	0.947	200 µT	1000 µT	606 µT
M7	Under TL	7/28/2023 09:02:07	µT	**1.016**	1.739	0.883	200 µT	1000 µT	606 µT

[1] Public reference level taken from the international Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz - 100 kHz) published in 2010 (ICNIRP, 2010).
[2] Occupational limit taken from the international Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz - 100 kHz) published in 2010 (ICNIRP, 2010).
Note: ARPANSA recognises the ICNIRP 2010 guideline for use in Australia for the protection of the general public (including the foetus) and workers from exposure to ELF EMF (Australian Government, 2023).
[3] In accordance with the ENA EMF Management Handbook Table 6.2, the magnetic field limit when dosimetry is considered for the general public is 606 µT, which is still complaint with the Basic Restrictions of the ICNIRP guidelines (ENA, January 2016).

3.2.4 Long term unattended EMF monitoring

The results of the monitoring are presented in Figure 7 through Figure 10. Results show measured EMF levels for both the E-field and H-field (electric and magnetic) are compliant with the relevant public and occupational limits at 30 m from the nearest transmission line to sensitive receiver locations for the entire 24-hour period at both locations measured, see Figure 6.

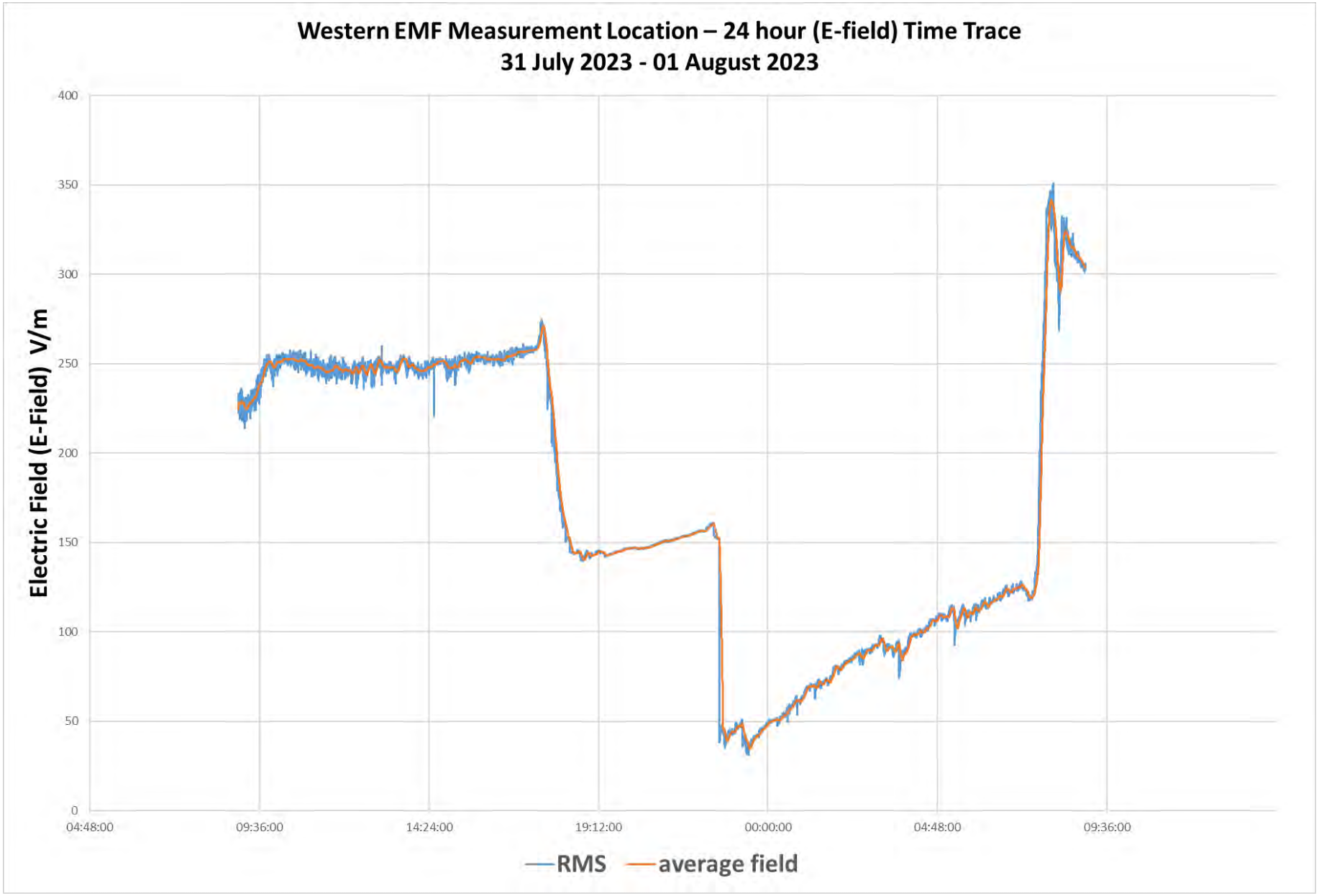


Figure 7 *Western EMF location – 24 hour E-field time trace*

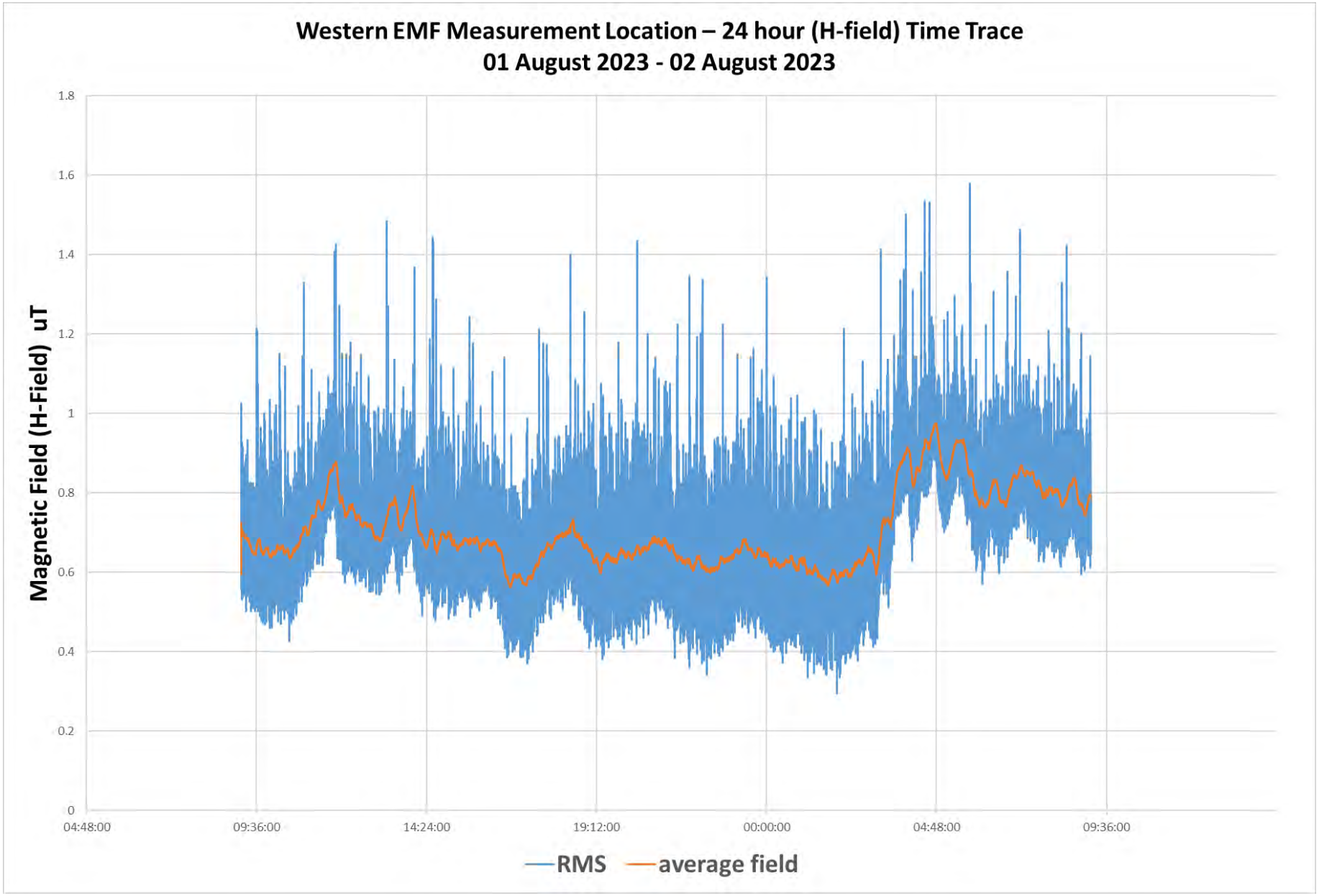


Figure 8 *Western EMF location – 24 hour H-field time trace*

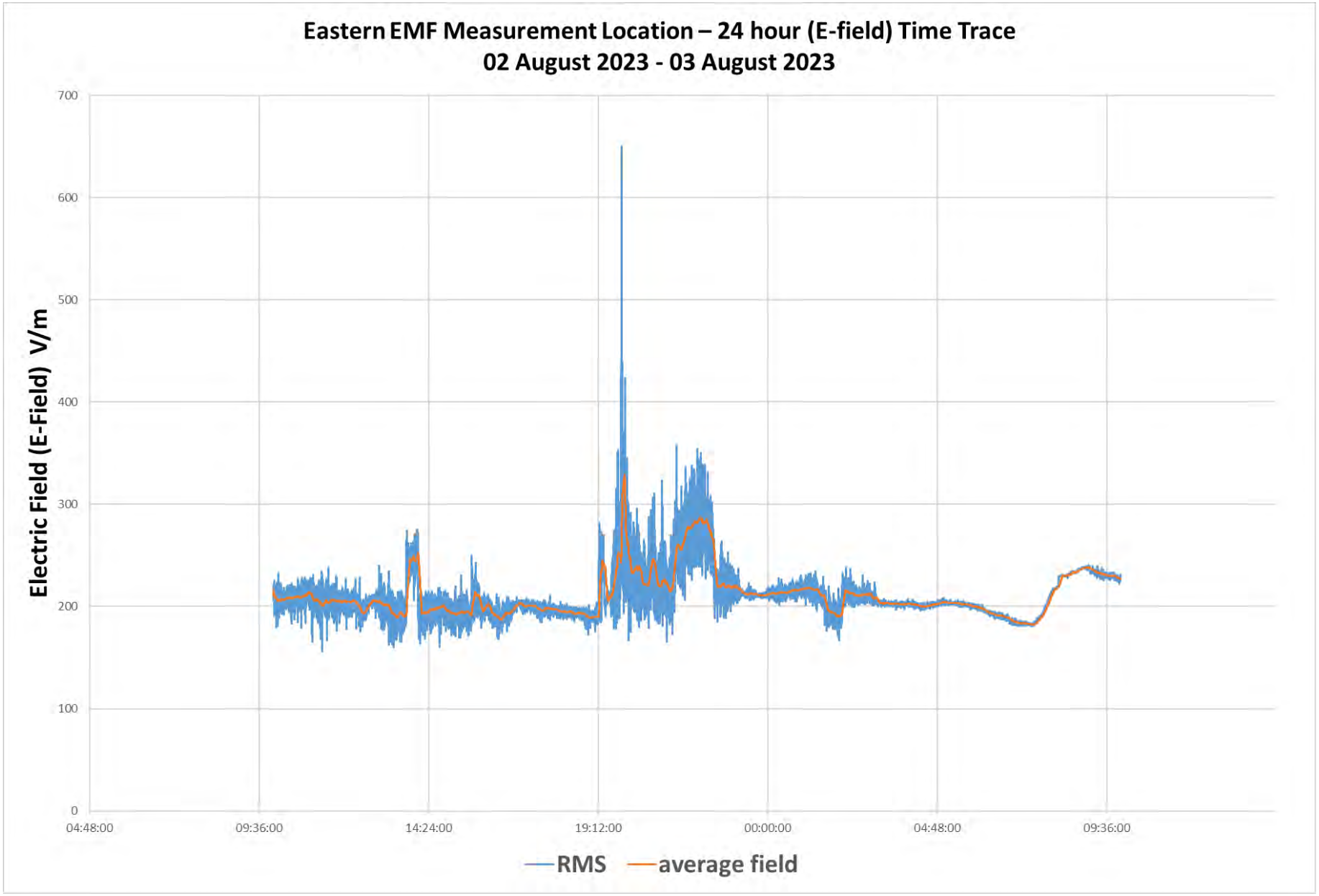


Figure 9 *Eastern EMF location – 24 hour E-field time trace*

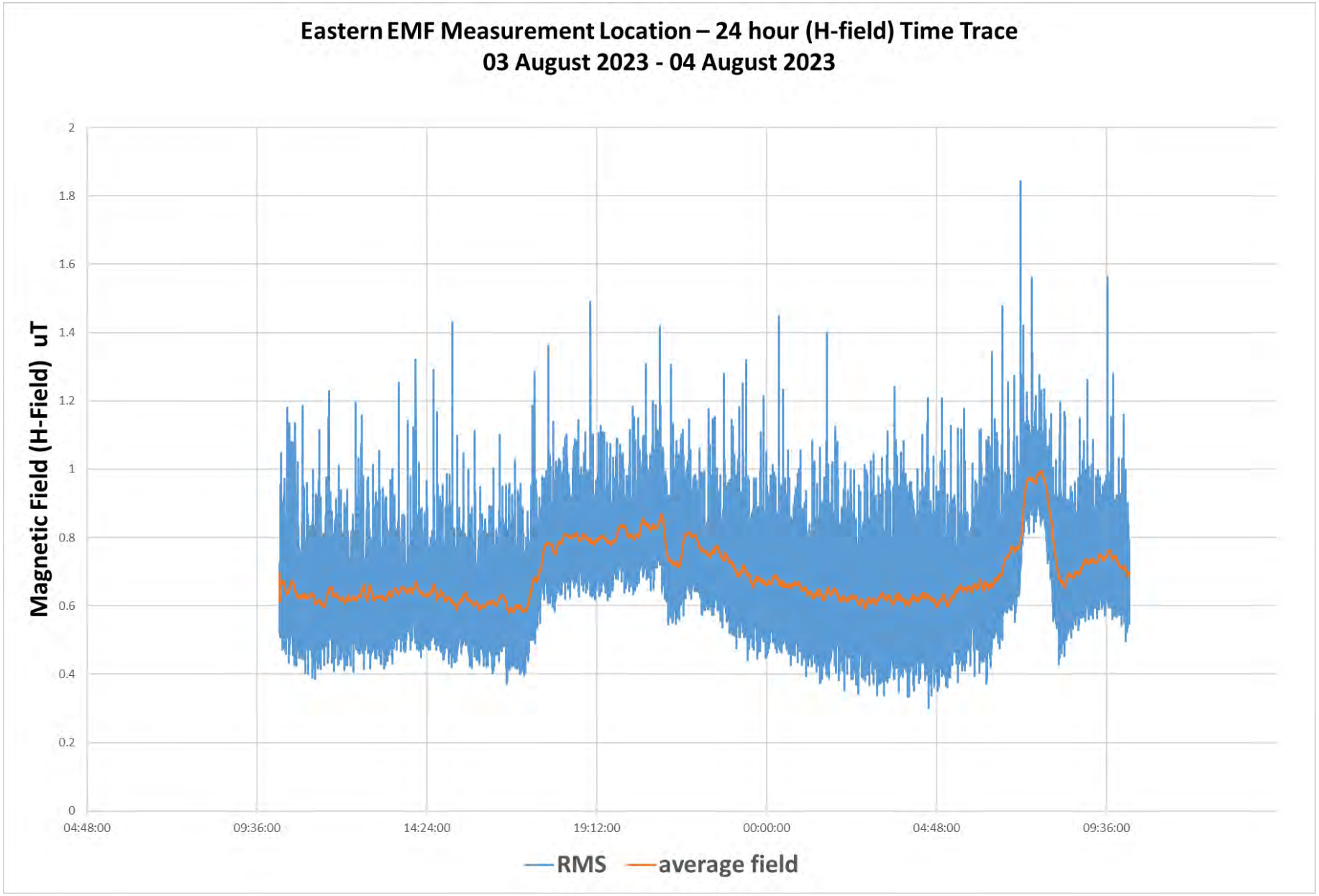


Figure 10 *Eastern EMF location – 24-hour H-field time trace*

3.2.5 Summary results

Short term attended EMF measurements

Results show measured EMF levels for both the E-field and H-field (electric and magnetic) are compliant with the relevant public and occupational limits at all locations except under the lines at midpoint 2 (109 Guadalupe Drive allotment) which was marginally non-compliant with the general public 24-hour guideline value for electric fields (5,000 V/m) but still complaint with the occupational value (10,000 V/m). It was noted that the line height above ground level at the midpoint 2 location (M2) was the lowest within the Project footprint. Note the general public 24-hour guideline is based on open spaces in which members of the public might reasonably be expected to spend a substantial part of the day. It is unlikely that this would occur at the M2 location.

Measurements of magnetic field strength (H-field) were within guideline values at all measured locations including under transmission lines for both public and occupational guidance.

Long term unattended EMF monitoring

Results show measured EMF levels for both the E-field and H-field (electric and magnetic) are compliant with the relevant public and occupational guidelines at 30 m from the nearest transmission line to sensitive receiver locations for the entire 24-hour period at both locations measured.

3.3 Noise monitoring results

The following section presents the results of the short term attended noise monitoring for the Project. section 3.3.1 provides a summary of the instrumentation used, section 3.3.2 provides a summary of the method used for both attended and unattended measurements, section 3.3.3 discusses meteorological data used in the assessment, section 3.3.4 presents the results of the short term attended measurements, section 3.3.5 presents the results of the long term unattended 24-hour measurements, section 3.3.6 provides a short summary of the results relative to the occupational and general public criteria outlined in section 4.

3.3.1 Instrumentation

Attended noise levels

Attended short term noise measurements were undertaken using a Brüel & Kjaer 2270 (Class 1) Sound Level Meter. All noise monitoring instrumentation was in current NATA calibration and field checked both before and after noise measurements were undertaken. No discrepancies equal to or greater than 1 dB were noted throughout the measurement exercise as is required under section 5.6 of Australian Standard AS 1055.2018 *Acoustics – Description and measurement of environmental noise* (Standards Australia, 2018). The details of the instrumentation used for the site noise investigations are provided in Table 6 below.

Unattended noise levels

Unattended long term noise measurements were undertaken using five Svantek 977 (Class 1) Sound Level Meters with logging functionality. All noise monitoring instrumentation was in current NATA calibration and field checked both before and after noise measurements were undertaken. No discrepancies equal to or greater than 1 dB were noted throughout the measurement exercise as is required under section 5.6 of Australian Standard AS 1055.2018 *Acoustics – Description and measurement of environmental noise* (Standards Australia, 2018). The details of the instrumentation used for the site noise investigations are provided in Table 6 below.

Table 6 summarises the site noise measurement instrumentation used during both the attended and unattended noise monitoring program.

Table 6 Noise monitoring equipment details

Type	Location	Model and Class	Serial No.	Start Time	End Time
Short term measurements	Various along Project footprint	Brüel & Kjaer Type 2270 Class 1	3009634 & 3003020	27-Jul-23 11:45 am	30-Jul-23 1:15 pm
Field calibrations all equipment	Various along Project footprint	Brüel & Kjaer Type 4231 Class 1	3027708	-	-
Long term measurements	Logger 1 69 Guadalupe Drive	SVAN 977D Class 1	SN46000	25-Jul-23 1:15 pm	04-Aug-23 10:30 am
Long term measurements	Logger 2 107 Guadalupe Drive	SVAN 977D Class 1	SN81346	25-Jul-23 3:30 pm	04-Aug-23 12:30 pm
Long term measurements	Logger 3 8 Lassen Gardens	SVAN 977D Class 1	SN69795	25-Jul-23 5:00 pm	04-Aug-23 11:00 am
Long term measurements	Logger 4 7 Tekapo Lane	SVAN 977D Class 1	SN46003	25-Jul-23 4:15 pm	04-Aug-23 11:30 am
Long term measurements	Logger 5 38 Winchester Place	SVAN 977D Class 1	SN98817	27-Jul-23 4:15 pm	04-Aug-23 11:45 am

3.3.2 Measurement method

Short term noise measurements were based on 15-minute sample periods as per the *Environmental Protection (Noise) Regulations 1997* (the Regulations) minimum representative assessment period (Western Australian Government, 31 Mar 2022). Measurements were taken at the same test locations as the short-term EMF sampling. See section 3.1 and Figure 4 and Appendix B for more detail on the attended noise measurement locations.

Long term noise measurements were based on 15-minute integrations over a period of 8-10 days. These noise loggers were placed in five sensitive receivers back yards facing south toward the transmission line. No audible tone or sound was noted coming from the transmission lines at these locations. See section 3.1 and Figure 5 and Table 6 and Appendix B for more detail on the noise logger locations.

The following measures were implemented to minimise interference on measurements:

– The meter was located at 1.2 m above ground level, supported on a tripod or pole mount solution
– Equipment was Class 1 certified
– Measurements were all free field outdoors at least 3 m from any substantial reflecting surface
– An Automatic Weather Station (AWS) was installed at logger location 2 to measure local wind speeds and rainfall to allow exclusion of extraneous weather events from the long-term unattended noise data

3.3.3 Meteorological conditions

Adverse meteorological conditions such as high winds and rainfall can contaminate noise monitoring results. Hence an Automatic Weather Station (AWS) was installed at the logger 2 location to measure local wind speeds and rainfall to allow exclusion of extraneous weather events from the long-term unattended noise data.

During the long-term noise monitoring period significant periods of rain occurred on Tuesday 25 July 2023, Wednesday 26 July 2023, and early morning Thursday 27 July 2023. Some short sporadic showers also occurred on Friday 28 July 2023 and again on Saturday 29 July 2023. The three days following this were all fine weather days with more sporadic showers occurring on Wednesday 02 August 2023 and one short event around 3am on Thursday 03 August 2023, Friday was a fine weather day.

Nighttime and early morning humidity generally ranged between 80% and 90%, with peak solar period reducing this to a range of between 45% and 65%, however Tuesday 01 August 2023 was a particularly dry day with relative humidity dropping as low as 20% and 25% between 2:00 pm and 3:00 pm.

Wind speeds generally remained at or below 2 m/s – 2.5 m/s at the monitoring locations throughout the measurement campaign, except during a period of higher winds on Wednesday 02 August 2023 during the hours between 7:30 pm and 11:00 pm.

Where the wind speed at the microphone height was determined to be greater than 5 m/s or whenever rainfall occurred, the noise data was excluded from further analysis. The excluded periods are highlighted in the noise monitoring results graphs presented in Appendix D and an image showing the AWS can be found in Appendix B.

During short term attended measurements, all measurements were taken in calm to light winds (<3 m/s) as defined in the Beaufort Wind Scale (National Weather Service, 2023), and outside any rain events.

3.3.4 Short term attended noise measurements

The results of the monitoring are presented in Table 7. The substation was noted as being audible for residents at the west end of the Project along Winchester Place, but was not discernible beyond this (further to the east).

Transmission line and tower noise is largely absent during fine weather, however a hum from coronal discharge can occur after a shower for a short time until lines and insulators dry out (~5-10 minutes) and may be audible at receiver locations closest to towers during that time. During longer periods of poor weather it is expected the same phenomenon may occur, however this is also likely to coincide with times when people remain inside to avoid the poor weather.

Photos of short term attended monitoring locations and the instrument used during noise measurements is shown in Appendix B. Locations where monitoring occurred is provided in Figure 4.

Table 7 Attended noise levels and comments on dominant noise sources

Address	Location	Noise levels – 15 minute periods				Comments
		L_{AFMax}	L_{Aeq}	L_{AF90}	L_{AFMin}	
4-6 Arnhem Court	Under TL	72	52	48	44	Transmission line hum audible, traffic dominant, hurley bike, birds chirping, cars, ute, uphill Marshal Road, skill saw across road, truck, cars.
	30m from TL	72	51	48	44	Transmission line not audible, traffic dominant, reversing beeper, distant dogs barking, distant sirens, truck.
	Easement Edge	69	53	50	47	Transmission line not audible, traffic and industrial noise dominant, birds chirping, magpies, truck.
75 Guadalupe Drive	Under TL	71	46	42	40	Transmission line not audible, traffic, cars, trucks, birds chirping, reversing beepers, dogs barking in distance 50 m.
	30m from TL	76	50	42	39	Transmission line not audible, traffic dominant then birds, traffic Marshall Road, birds chirping, light distant banging, trucks, reversing beeper, engine brakes, airplane overhead.
	Easement Edge	83	52	45	42	Transmission line not audible, traffic dominant Marshall Road, distant dogs barking, birds chirping, trucks, motorbike.
85 Gaudalupe Drive	Under TL	60	49	46	43	T1 and T2 and transmission line not audible, general traffic flow, dogs barking, birds chirping, car garage noises.
	30m from TL	63	49	46	44	T3 and transmission line not audible, general traffic flow, dogs barking, birds chirping, rustling in garage noises, car passbys.

Address	Location	Noise levels – 15 minute periods				Comments
		L_{AFMax}	L_{Aeq}	L_{AF90}	L_{AFMin}	
91 Gaudalupe Drive	Under TL	70	48	44	41	T2 and towers not audible, roosters, dogs barking, traffic flow, wind noise, birds chirping, car horns, crows.
	30m from TL	69	48	45	42	T2 audible, transmission line not audible, roosters, traffic flow, light breeze, birds and traffic, sirens along Marshal Road., garage working – drills.
	Easement Edge	76	52	48	46	T2 tower faintly audible as had minor shower before measurements, traffic noise dominant, pigeons in cap, trailer being towed, car enthusiast engines, Harley bike.
99 Gaudalupe Drive	Under TL	66	49	46	44	Transmission line audible, birds chirping, roosters, traffic along Marshall Road., trucks, breeze, birds, TL resonating softly – tonal hum, sounds like a plane drone.
	30m from TL	64	46	43	42	Transmission line humming, traffic dominant, roosters, birds chirping, car enthusiasts engines, Harley bike, motorbike.
	Easement Edge	82	53	45	42	T2 not audible, birds chirping, traffic flow, trucks and cars pass by, varying traffic.
109 Gaudalupe Drive	Under TL	75	53	45	43	Traffic dominant then birds, plane, traffic flow, sirens, car pass by, car enthusiast engines, breeze, motorbikes, dirt bikes.
	30m from TL	70	50	46	43	Transmission line not audible, birds chirping, distant crows, metal clanging, trucks in yard, car pass by, birds noise, roosters.
	Easement Edge	69	52	47	44	Transmission line not audible, traffic flow, tree noise, birds chirping, car pass by, traffic rumbling, car enthusiast engines, crows.
16-18 Lassens Gardens	Under TL	64	47	44	41	Transmission line coronal discharge @ 100Hz, general traffic flow, dogs barking, birds chirping, rustling in garage noises, car passbys.
	30m from TL	72	45	37	34	Dominant noises: birds chirping, then traffic, then transmission line coronal discharge, banging, UTE passbys.
8 Lassens Gardens	Under TL	70	44	37	34	T3 and transmission line not audible, birds are dominant then traffic hum, distant traffic flow, clanging in industrial yard.
	30m from TL	62	44	37	36	T3 and T4 and transmission line not audible, traffic, car enthusiast engines, birds, plane directly overhead, birds fly over, truck.
	Easement Edge	62	46	41	39	T3 and T4 and transmission line not audible, pigeon cooing, birds, breeze, neighbours pool pump, neighbour wheel barrel noise, cars.
33 Yosemite	Under TL	67	42	38	36	Birds, traffic flow, Marshall Road, motorbikes, car enthusiast, tree grinding, birds.
	30m from TL	66	44	37	34	T3 and T4 and transmission line not audible, birds dominant, industrial noise, pigeon cooing, plane overhead.

Address	Location	Noise levels – 15 minute periods				Comments
		L_{AFMax}	L_{Aeq}	L_{AF90}	L_{AFMin}	
41 Yosemite	Under TL	65	43	38	36	T3 and T4 and transmission line not audible, Birds dominant then cars, birds chirping, pigeon cooing, birds, traffic flow, crows, car enthusiast, car passbys.
	30m from TL	60	43	37	34	T3 and T4 and transmission line not audible, birds are the dominant noise, running loader, traffic flow, car enthusiast engines, loader bucket bang, garage noise. 4WD passby, dogs barking, motorbikes.
	Easement Edge	70	44	39	36	Birds chirping, traffic flow.
49 Yosemite	Under TL	61	46	42	39	T4 audible, transmission line not audible, traffic and sprinklers are dominant, birds chirping, sprinklers, traffic flow, cars, pigeons cooing.
	30m from TL	71	46	39	35	T4 audible, transmission line not audible, birds chirping, sprinklers, traffic flow, cars, pigeons cooing.
	Easement Edge	54	47	42	40	T4 hum audible, transmission line not audible, birds chirping crows cooing, truck, 4WD, car enthusiast engines, traffic flow is dominant.
27 Huntingdon Mews	Under TL	69	54	50	47	Transmission line and substation not audible, traffic flow, distant crows, car enthusiast on Marshall Road, birds chirping, crows, car enthusiast on Bellefin Drive.
	30m from TL	69	54	49	46	Transmission line and substation not audible, traffic flow, car enthusiast on Marshall Road, car enthusiast on Bellefin Drive. birds chirping, sirens, horn, digger/loader/forklift rattle.
	Easement Edge	67	54	50	46	Traffic flow is dominant (truck, cars, 4WDs) car enthusiast engines, breeze, trucks and cars passby.
1 Tekapo Lane	Under TL	62	49	47	45	Distant Whine either industrial or from transmission line surging. Traffic flow is dominant, roosters, wind in trees, crows, helicopter, electric chain, skill saw. Grinder in industrial area, birds chirping, distant dogs barking.
	30m from TL	85	58	46	44	Transmission line and substation not audible, traffic flow, birds chirping, car enthusiast engines, industrial noises grinding, distant crows, breeze, distant dogs barking beyond Marshal Road. cars, trucks on Weir Road., metal hammering in yard.
	Easement Edge	69	51	49	47	Transmission line and substation not audible, traffic flow, geese, birds chirping, roosters, car enthusiast engines, industrial noises grinding, traffic dominant, crows flew over, general traffic flow.
9 Tekapo Lane	30m from TL	64	48	46	45	T5 humming- crackling, traffic flow, reversing beepers, trucks in yard, banging on bikes, truck brake hiss in yard, distant chickens and roosters, grinder in industrial area, car enthusiast engines, birds chirping.
	Easement Edge	68	50	47	44	Transmission line and substation cannot be heard, distant dogs barking, birds chirping, trucks, tree noise from wind, chicken and roosters' noise, cars, industrial noise.

Address	Location	Noise levels – 15 minute periods				Comments
		L_{AFMax}	L_{Aeq}	L_{AF90}	L_{AFMin}	
1 The Elms	Under TL	62	50	46	44	Transmission line not audible, substation hum audible, traffic, trucks, wind in trees, industrial noises, car enthusiast engines, wind gust in trees, bucket rattle, reversing beepers, truck brakes, metal clanging.
	30m from TL	73	50	47	45	Transmission line not audible, substation hum cannot be distinguished from trees, reversing beepers, wind in trees, car enthusiast, plane overhead, birds chirping, metal clanging.
	Easement Edge	71	53	49	47	Traffic noise, trucks, wind in trees, continuous chicken and rooster noise, industrial banging, metal clanging, birds calling out.
28 Tintagel Place	Under TL	70	51	47	45	Transmission line not audible, substation hum audible, trucks, industrial noise, tree noise, reversing beepers, car enthusiast engines, dominant: substation, traffic, tree noise.
	30m from TL	67	51	48	45	Transmission line not audible, substation hum audible, traffic flow, reversing beepers, birds chirping, wind in trees, chain on fence pole, trucks in yard, distant horns, distant dogs barking.
	Easement Edge	72	51	46	45	Transmission line not audible, substation hum audible, traffic flow, banging in yard, birds chirping, trees rustling, birds, tin moving in wind, dogs barking, cars on Weir Road, wind gust.
8 Bampton Lane	Under TL	71	49	45	43	Transmission line not audible, reversing beepers, trucks in yard, banging in yard, some breeze, traffic on road, car enthusiast engines, birds chirping, distant sirens, transformer hum.
	30m from TL	72	49	46	43	Chain knocking on fence, wind noise, traffic noise, industrial noise, motorbike, crows, lots of low frequency noise, plane overhead, road bike on Marshall Road.
	Easement Edge	68	50	48	46	Transmission line not audible, can't distinguish audible substation hum from other noise, industrial noise, wind in trees, airplane overhead, reversing beepers, car enthusiast engines, palms moving in wind, motorbike, distant horns.
60 Nottingham Gardens	Under TL	72	49	46	45	Transmission line not audible, industrial whine noise, car workshop, sirens, traffic noise, birds chirping, reversing beeps, strong whine but still registered as broadband.
	30m from TL	62	48	46	44	Transmission line not audible, birds chirping, cars, industrial noise, reversing beepers, constant traffic flow.
	Easement Edge	65	49	47	45	Transmission line not audible, birds chirping, cars, industrial noise, reversing beepers, constant traffic flow, trucks, some wind noise, plane overhead, flag pole flapping.

Address	Location	Noise levels – 15 minute periods				Comments
		L_{AFMax}	L_{Aeq}	L_{AF90}	L_{AFMin}	
46 Winchester Place	Under TL	72	54	50	47	Transmission line not audible, substation hum audible, traffic flow, tree noise, industrial noise, reversing beepers, birds chirping.
	30m from TL	71	51	47	44	Transmission line and substation hum audible, industrial noise, metal clanging, birds chirping, slight shower, fence squeaking as moved.
	Easement Edge	64	53	49	45	Substation hum audible, industrial and traffic noises are dominant, trucks in yard, trees in yards, bird chirping, kookaburra in trees.
38 Winchester Place	Under TL	69	53	46	44	Transmission line not audible, substation hum audible, industrial noise, ute, water birds, distant cars, traffic flow.
	30m from TL	69	51	46	44	Audible substation hum, traffic flow, hum over road, industrial sounds, small plane, distant dogs barking, tree noise in light breeze, truck, metal and trailer clanging.
	Easement Edge	67	48	44	42	Transmission line not audible, substation hum and traffic are dominant sources, industrial noise, metal clanging, motorbikes, birds chirping, trucks, car enthusiast engines.

3.3.5 Long term unattended noise monitoring

Continuous noise monitoring was performed at 5 locations along the easement line at Malaga/Ballajura. Table 6 presents the location and the equipment used for the unattended noise monitoring measurements, along with the monitoring duration for each monitoring location.

Background noise levels were generally louder to the east as you get closer to Tonkin Highway and quieter to the west on Winchester Place. Day time background noise levels ranged from 39-43 dB $L_{A90\ (15min)}$, evening time background noise levels ranged from 38-41 dB $L_{A90\ (15min)}$, nighttime background noise levels ranged from 32-37 dB $L_{A90\ (15min)}$).

Ambient noise levels were more similar across the Project and did not show a general decrease in noise from east to west. However the overall difference (ambient noise level range) between the high and low values was broader than that seen in the background data. Day time ambient noise levels ranged from 50-57 dB $L_{Aeq\ (15min)}$, evening time ambient noise levels ranged from 47-52 dB $L_{Aeq\ (15min)}$, nighttime ambient noise levels ranged from 41-51 dB $L_{Aeq\ (15min)}$).

Photos with locations of the instruments used during noise measurements are shown in Appendix B, and the summary of LA90 and LA10 noise levels measured during different times periods stipulated in the Noise Regulations, are provided in Table 8 to

Table 12. Noise logger charts are provided in Appendix D.

Table 8 Logger 1 unattended L_{A10} and L_{Aeq} noise levels, dB(A)

Date	ABL Day LA90	ABL Evening LA90	ABL Night LA90	LAeq Day	LAeq Evening	LAeq Night
Tuesday-25-Jul-23	42*	40*	33*	54*	45*	50*
Wednesday-26-Jul-23	49*	46*	42*	55*	51*	54*
Thursday-27-Jul-23	44	41	34	53	46	44
Friday-28-Jul-23	43	40	34	51	45	44
Saturday-29-Jul-23	44	41	38	51	46	46
Sunday-30-Jul-23	39	42	39	48	47	47
Monday-31-Jul-23	40	46	37	51	52	50
Tuesday-1-Aug-23	41	39	29	51	45	43
Wednesday-2-Aug-23	42*	40*	41	49*	59*	52
Thursday-3-Aug-23	45	48	38	52	51	50
Friday-4-Aug-23	44*	-	-	53*	-	-
Average	**43**	**41**	**37**	**52**	**52**	**50**

The above data set was filtered for potentially spurious results caused by adverse weather conditions.

"Grey*" text indicates some data missing for the period due to a lack of data for the required period.

"--" denotes data excluded due to potentially spurious results caused by adverse weather conditions or a lack of data for the required period.

Table 9 Logger 2 unattended L_{A10} and L_{Aeq} noise levels, dB(A)

Date	ABL Day LA90	ABL Evening LA90	ABL Night LA90	LAeq Day	LAeq Evening	LAeq Night
Tuesday-25-Jul-23	42*	38*	33*	52*	44*	48*
Wednesday-26-Jul-23	47*	44*	39*	57*	48*	51*
Thursday-27-Jul-23	41	38	33	59	44	45
Friday-28-Jul-23	41	40	33*	57	46	41*
Saturday-29-Jul-23	43	39	35	55	43	53
Sunday-30-Jul-23	37	40	36	59	44	47
Monday-31-Jul-23	39	43	34	57	49	48
Tuesday-1-Aug-23	39	39	30	56	45	43
Wednesday-2-Aug-23	42*	39*	38	59*	56*	49
Thursday-3-Aug-23	42	45	36	57	50	49
Friday-4-Aug-23	39*	-	-	57*	-	-
Average	**41**	**39**	**34**	**57**	**49**	**41**

The above data set was filtered for potentially spurious results caused by adverse weather conditions.

"Grey*" text indicates some data missing for the period due to a lack of data for the required period.

"--" denotes data excluded due to potentially spurious results caused by adverse weather conditions or a lack of data for the required period.

Table 10 Logger 3 unattended L_{A10} and L_{Aeq} noise levels, dB(A)

Date	ABL Day LA90	ABL Evening LA90	ABL Night LA90	LAeq Day	LAeq Evening	LAeq Night
Tuesday-25-Jul-23	40*	37*	32*	47*	43*	50*
Wednesday-26-Jul-23	47*	44*	40*	51*	47*	53*
Thursday-27-Jul-23	39	39	35	48	44	51
Friday-28-Jul-23	43	40	34*	49	43	41*
Saturday-29-Jul-23	44	40	36	50	44	50
Sunday-30-Jul-23	35	40	37	47	44	49
Monday-31-Jul-23	36	41	35	50	48	51
Tuesday-1-Aug-23	39	38	31	52	44	51
Wednesday-2-Aug-23	40*	39*	40	48*	60*	52
Thursday-3-Aug-23	44	44	38	54	47	53
Friday-4-Aug-23	39*	-	-	50*	-	-
Average	**40**	**40**	**36**	**50**	**51**	**51**

The above data set was filtered for potentially spurious results caused by adverse weather conditions.

"Grey*" text indicates some data missing for the period due to a lack of data for the required period.

"--" denotes data excluded due to potentially spurious results caused by adverse weather conditions or a lack of data for the required period.

Table 11 Logger 4 unattended L_{A10} and L_{Aeq} noise levels, dB(A)

Date	ABL Day LA90	ABL Evening LA90	ABL Night LA90	LAeq Day	LAeq Evening	LAeq Night
Tuesday-25-Jul-23	40*	37*	32*	57*	42*	46*
Wednesday-26-Jul-23	47*	44*	37*	51*	47*	48*
Thursday-27-Jul-23	39	38	33	49	43	43
Friday-28-Jul-23	42	39	33*	49	43	40*
Saturday-29-Jul-23	42	38	31	49	43	42
Sunday-30-Jul-23	34	37	33	48	42	42
Monday-31-Jul-23	36	41	31	49	48	45
Tuesday-1-Aug-23	40	37	29	50	44	40
Wednesday-2-Aug-23	41*	38*	38	49*	60*	48
Thursday-3-Aug-23	41	43	34	49	46	46
Friday-4-Aug-23	37*	-	-	49*	-	-
Average	**40**	**38**	**33**	**51**	**51**	**45**

The above data set was filtered for potentially spurious results caused by adverse weather conditions.

"Grey*" text indicates some data missing for the period due to a lack of data for the required period.

"--" denotes data excluded due to potentially spurious results caused by adverse weather conditions or a lack of data for the required period.

Table 12 Logger 5 unattended L_{A10} and L_{Aeq} noise levels, dB(A)

Date	ABL Day LA90	ABL Evening LA90	ABL Night LA90	LAeq Day	LAeq Evening	LAeq Night
Thursday-27-Jul-23	41*	38	32	49*	46	44
Friday-28-Jul-23	43	40	34*	50	45	40*
Saturday-29-Jul-23	39	38	31	47	43	40
Sunday-30-Jul-23	34	35	32	59	41	41
Monday-31-Jul-23	34	36	31	48	48	43
Tuesday-1-Aug-23	39	39	30	50	45	42
Wednesday-2-Aug-23	41*	39*	35	51*	53*	45
Thursday-3-Aug-23	37	39	33	48	45	45
Friday-4-Aug-23	33*	-	-	51*	-	-
Average	**39**	**38**	**32**	**52**	**47**	**43**

The above data set was filtered for potentially spurious results caused by adverse weather conditions.

"Grey*" text indicates some data missing for the period due to a lack of data for the required period.

"--" denotes data excluded due to potentially spurious results caused by adverse weather conditions or a lack of data for the required period.

3.3.6 Summary results

Short term attended noise measurements

The substation was noted as being audible for residents at the west end of the Project along Winchester Place, but was not discernible beyond this (further to the east).

Transmission line and tower noise is largely absent during fine weather, however a hum from coronal discharge can occur after a shower for a short time until lines and insulators dry out (~5-10 minutes) and may be audible at receiver locations closest to towers during that time. During longer periods of poor weather it is expected the same phenomenon may occur, however this is also likely to coincide with times when people remain inside to avoid the poor weather.

Long term unattended noise monitoring

Background noise levels were generally louder to the east as you get closer to Tonkin Highway and quieter to the west on Winchester Place. Day time background noise levels ranged from 39-43 dB $L_{A90\ (15min)}$, evening time background noise levels ranged from 38-41 dB $L_{A90\ (15min)}$, nighttime background noise levels ranged from 32-37 dB $L_{A90\ (15min)}$).

Ambient noise levels were more similar across the Project and did not show a general decrease in noise from east to west. However, the overall difference (ambient noise level range) between the high and low values was broader than that seen in the background data. Day time ambient noise levels ranged from 50-57 dB $L_{Aeq\ (15min)}$, evening time ambient noise levels ranged from 47-52 dB $L_{Aeq\ (15min)}$, nighttime ambient noise levels ranged from 41-51 dB $L_{Aeq\ (15min)}$).

4. Criteria

The following section provides a summary of both the noise and EMF criteria and guidance relevant to this Project.

4.1 EMF Criteria

In 1989, the National Health and Medical Research Council (NHMRC) published the *Interim Guidelines on Limits of Exposure to 50/60 hertz (Hz) Electric and Magnetic Fields – Radiation Health Series No. 30.* More recently, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) took over responsibility for maintenance and review of the council's publications on radiation. ARPANSA is concerned with occupational, residential, and general public exposure to both electric and magnetic fields. It is the role of ARPANSA to assess the relevant scientific research and provide expert advice. This forms the basis for the protection of the Australian public from any harmful effects of radiation. The recommendations in ARPANSA Standards are based on published scientific literature and international guidance.

The limits in the ARPANSA Standards are closely aligned with the 1998 guidelines of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 gigahertz (GHz)), which are endorsed by the World Health Organization (WHO).

In 2002, ARPANSA published the radiation protection series document (No 3) *Radiation Protection Standard – Maximum Exposure Levels to Radiofrequency Fields – 3 kilohertz (kHz) to 300 GHz*, and the *Radiation Protection Standard – Exposure Limits for Electric & Magnetic Fields – 0 Hz to 3 kHz – Public Consultation Draft – 7 December 2006* for public consultation. This interim document as well as the Radiation Health Series No. 30 have since both been withdrawn in favour of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines for *Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz - 100 kHz)* published in 2010.

The ICNIRP 2010 Guideline is aimed at preventing the established health effects resulting from exposure to ELF EMF. The ICNIRP ELF guidelines are consistent with ARPANSA's understanding of the scientific basis for the protection of the general public (including the foetus) and workers from exposure to ELF EMF and are now recognised as the guideline for use in Australia, see Table 13.

For DC magnetic fields, ICNIRP Guidelines published in Health Physics 96(4):504 – 514 (2009) provide exposure limits to static magnetic fields. The guidelines were developed based on a review of biological effects reported from exposure to static field, and other relevant publications, see Table 13.

Note: for this project, only the alternating current ELF EMF guidance is relevant and so the DC guidance is for informational purposes only.

Table 13 ***ICNIRP (2010) recommended ELF EMF limits of exposure (ARPANSA endorsed) and ICNIRP Guidelines (2009) for DC magnetic fields limit of exposure***

Exposure characteristics	Electric Field Strength (V/m) [a] (rms)	Magnetic Flux Density (μT) (rms)
ELF EMF		
Occupational (whole working day)	10,000	1,000
General public (up to a 24-hour day) [b]	5,000	200
DC Magnetic fields [c]		
Occupational (exposure of head and of truck/of limbs)	N/A	2,000,000/8,000,000
General public (exposure of any part of the body)		400,000

Note: For ELF EMF, all values in root-mean-square (rms) are derived from Tables 3 and 4 of ICNIRP criteria 2010. For DC magnetic fields, all values are derived from Table 2 of ICNIRP guidelines 2009.

[a] units have been converted from kilovolt per meter (kV/m) to volt per meter (V/m) where 1 kV/m = 1,000 V/m

[b] General public restriction applies to open spaces in which members of the public might reasonably be expected to spend a substantial part of the day, such as recreational areas, meeting grounds and the like.

[c] exposure limits for DC magnetic fields should be viewed operationally as spatial peak exposure limits.

4.2 Noise criteria

4.2.1 Regulations and guidelines

The noise emissions from Western Power's towers and transmission lines are governed by the state noise regulations, namely the *Environmental Protection (Noise) Regulations 1997* (the Regulations). The Regulations define any premise used for the purpose of providing electricity as an Industrial or utility premises, refer to the excerpt from Schedule 1 — Classification of premises Part A — Industrial and utility premises, Sub clause 1 of the Regulations below:

1. *Premises used for the purpose of providing sewerage, electricity, gas, drainage, passenger transport or other similar services.*

   (Western Australian Government, 31 Mar 2022)

4.2.2 Noise sensitive premises

Schedule 1 — *Classification of premises* Part C — *Noise sensitive premises*, of the *Environmental Protection (Noise) Regulations 1997 defines a sensitive receiver as* (Western Australian Government, 31 Mar 2022)*:*

1. *Premises occupied solely or mainly for residential or accommodation purposes.*
2. *Rural premises.*
3. *Premises used for the purpose of —*

   a) *a caravan park or camping ground; or*

   b) *a hospital having accommodation for less than 150 in-patients; or*

   c) *a sanatorium, home or institution for care of persons, a rehabilitation centre, home or institution for persons requiring medical or rehabilitative treatment; or*

   d) *education — school, college, university, technical institute, academy or other educational centre, lecture hall or other premises used for the purpose of instruction; or*

   e) *public worship; or*

   f) *a tavern, hotel, club premises, reception lodge or other premises which provides accommodation for the public; or*

   g) *aged care; or*

   h) *child care; or*

   i) *a prison or detention centre; or*

   j) *a water storage dam or a catchment for a water storage dam.*
4. *Any other premises not referred to in Part A or Part B of this Schedule.*

4.2.3 Assigned noise level

The assigned noise level for a premises is determined by reference to Part 2 — *Allowable noise emissions*, Division 1 — *General provisions*, Regulation 8 — *Assigned levels* Sub clause 3 — *Table 1* of the Regulations. Regulation 8 sets out the maximum allowable noise levels (assigned noise levels (dB)) based on different times of day/evening/night and type of premise (i.e., noise sensitive, commercial, industrial, or utility) applicable at the location receiving the noise.

The assigned noise levels of various parameters (L_{A10}, L_{A1} and L_{Amax}) are also dependent on an influencing factor (IF) calculated in accordance with the regulations as detailed in Schedule 3 of the Regulations, taking into account the amount of industrial and commercial land and the presence of major roads adjacent to the noise receiver.

A summary of the assigned noise levels from Regulation 8 is presented in Table 14.

Table 14 Assigned noise levels from the Regulations

Type of premises receiving noise	Time of day		Assigned noise level. dB(A)		
			L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area (Highly sensitive area means: That area (if any) of noise sensitive premises comprising a building, or a part of a building, on the premises that is used for a noise sensitive purpose and/or any other part of the premise within 15 metres of that building or part of a building).	Day	7:00 am to 7:00 pm Monday to Saturday.	45 + IF [a]	55 + IF [a]	65 + IF [a]
		9:00 am to 7:00 pm Sunday and public holidays.	40 + IF [a]	50 + IF [a]	65 + IF [a]
	Evening	7:00 pm to 10:00 pm all days.	40 + IF [a]	50 + IF [a]	55 + IF [a]
	Night	10:00 pm on any day to 7:00 am Monday to Saturday and until 9:00 am Sunday and public holidays.	35 + IF [a]	45 + IF [a]	55 + IF [a]
Noise sensitive premises [b]: any area other than highly sensitive area.	All hours		60	75	80
Commercial premises					
Industrial and utility premises other than those in the Kwinana Industrial Area	All hours		65	80	90

Note:

[a] IF (influencing factor) is calculated in accordance with the regulations as detailed in Schedule 3 of the Regulations

[b] Noise sensitive premises as defined in Schedule 1 — Classification of premises Part C — Noise sensitive premises).

4.2.4 Influencing factor

The influencing factor for a premises is determined by reference to Schedule 3 — *Determination of influencing factor on noise sensitive premises*, Part 1 — *Terms used* and Part 2 — *Influencing factor*, of the Regulations, which can be summarised in the following steps:

1. Using an appropriate land use map draw two concentric circles around the receiving point, one of 100 m radius and another of 450 m radius centred on the measurement point on the noise sensitive premises.
2. Calculate the percentage of each circle that is taken up with Type A-industrial and utility premises and Type B-commercial premises. Note that the industrial and commercial areas in the inner circle are also counted in the outer circle.
3. Determine if a transport factor (TF) is required:
    a. Major road (more than 15,000 vehicles/day)
        i. where any point inside the road reserve is present in the relevant inner circle, a transport factor of 6 dB is applied
        ii. where any point inside the road reserve is present in the relevant outer circle, a transport factor of 2 dB is applied
    b. Secondary road (6000 - 15,000 vehicles/day)
        i. where any point inside the road reserve is present in the relevant inner circle, a transport factor of 2 dB is applied

4. Determine the influencing factor to the nearest dB in accordance with the following formula:
    a. Influencing Factor in dB = 1/10 (sum of Type A percentages for both circles) + 1/20 (sum of Type B percentages for both circles) + transport factor or 6, whichever is the lesser amount (Note that the fractions of the land use types in the inner circle are included in both circles)

       or

    b. (Percent industrial in small circle + percent industrial in a large circle) x 1/10 = I + (Percent commercial in small circle + percent commercial in large circle) x 1/20 = C + TF
    c. Once the IF is determined, this values is then added to the Day, Evening, and night time assigned noise levels in Table 14 to provide the noise criteria for the project

4.2.5 Assigned noise levels

Noise sensitive premises were broken up into five key areas spanning across the Project east to west. Long term unattended noise measurements were undertaken within each of the five areas at a representative noise sensitive premises for a period of 8-10 days to provide an assessment of the existing conditions within each area, refer section 3. These five areas were then assessed against the local planning scheme to determine an influencing factor and the assigned noise level for each of five areas based on the representative noise sensitive location.

The land in the Project area is predominantly zoned 'residential' with some industrial premises, a major road to the east (Tonkin Highway), and a secondary road to the south (Marshall Road), resulting in influencing factors of between 2 and 3 across the Project, refer Table 15 and assigned noise levels as presented in Table 16.

Table 15 Influencing factor (IF) calculated for noise sensitive receivers

Receiver	Address	Grouping	Assigned noise sensitive premises	IF
Logger 1	69 Guadalupe Drive	A	69 - 81 Guadalupe Drive 4 - 12 Arnhem Court	3
Logger 2	107 Guadalupe Drive	B	83 - 111 Guadalupe Drive	1
Logger 3	8 Lassen Gardens	C	33 - 53 Yosemite Loop 2 - 18 Lassen Gardens Lassen Park	1
Logger 4	7 Tekapo Lane	D	26 - 28 Tintagel Place 1 - 7 The Elms 20 - 24 Castlemore Mews 9 - 1 Tekapo Lane 27 - 31 Huntingdon Mews 55 -59 Yosemite Loop	2
Logger 5	38 Winchester Place	E	32 - 58 Winchester Place 60 Nottingham Gardens 2 - 8 Bampton Lane 21 - 23 Saltwood Court	3

Table 16 Assigned L_{A10} dB(A) noise levels for noise sensitive receivers

Nearest receivers	Grouping	Location	Assigned noise level L_{A10}, dB(A)			
			Day Mon-Sat 7:00 am to 7:00 pm	Day Sunday and public holidays 9:00 am to 7:00 pm	Evening 7:00 pm to 10:00 pm all days	Night Mon-Sat 10:00 pm to 7:00 am and Sunday and public holidays 10:00 pm to 9:00 am
Logger 1	A	69 Guadalupe Drive	48	43	43	38
Logger 2	B	107 Guadalupe Drive	46	41	41	36
Logger 3	C	8 Lassen Gardens	46	41	41	36
Logger 4	D	7 Tekapo Lane	47	42	42	37
Logger 5	E	38 Winchester Place	48	43	43	38

4.2.6 Annoying noise characteristics

Part 2 — *Allowable noise emissions,* Division 1 — *General provisions*, Regulation 7 — *Prescribed standard for noise emissions*, of the Regulations requires that the noise character received at sensitive receivers must be 'free' of annoying characteristics such as tonality, modulation, and impulsiveness when assessed under Regulation 9 — *Intrusive or dominant noise characteristics, where:*

- Tonality is the difference between the A-weighted sound pressure level in any one third octave band and the arithmetic average of the A-weighted sound pressure levels in the two adjacent one-third octave bands is greater than 3 dB in terms of $L_{Aeq, T}$ where the period T is greater than 10 percent of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A, Slow}$ levels.
- Modulation is a variation in the emission of noise that is more than 3 dB LA, Fast or is more than 3 dB LA, Fast in any one third octave band and is present for at least 10 percent of the representative assessment period, and is regular, cyclic and audible.
- Impulsiveness is defined as present where the difference between $L_{A\ peak}$ and $L_{A\ slow\ max}$ is more than 15 dB when determined for a single representative event.

Where these characteristics are present than an adjustment to the measured or calculated received levels as set out in Table 17 is undertaken.

Table 17 Annoying noise character adjustments

Adjustment where noise emission is not music (adjustments are cumulative to a maximum of 15 dB)			Adjustment where noise emission is music	
Where tonality is present	Where modulation is present	Where impulsiveness is present	Where impulsiveness is not present	Where impulsiveness is present
+5 dB	+5 dB	+10 dB	+10 dB	+15 dB

Note:

Following on site attended monitoring and post processing of key measurement samples undertaken at tower T5 and adjacent Logger 1 opposite tower T1 both during an audible corona discharge event (rain event), noise spectra were tested against the tonality requirements of the Regulations, No tonality was noted in the spectra coming from the source and so no adjustment is required for tonality.

Due to the nature of operation of a transmission line, no modulation or impulsiveness of the source was noted and so no adjustment is required for these items.

5. EMF modelling

The following section provides a summary of the EMF modelling undertaken as part of the transmission line noise assessment for the proposed Malaga transmission line upgrade.

5.1 Assessment methodology

5.1.1 General approach

The following approach was taken for conducting the EMF assessment:

– The existing 132 kV and 330 kV feeders were modelled and the normal operation simulated, for comparison of simulated magnetic and electrical field levels with test results. The model was then calibrated to increase the accuracy between simulated and measured values.
– The proposed system was then simulated using the calibrated EMF model to evaluate compliance of the proposed design with electric and magnetic field reference levels.

5.1.2 Operating currents

The present normal operating phase currents, provided from Western Power, are as follows:

– 330 kV feeder NBT-NT 91 = 2,063 A summer rating, 2,457 A winter rating
– 132 kV feeder NT-PJR 81 = 1,812 A summer rating, 2,152 A winter rating

5.1.3 Assumptions

The following assumptions have been made in the EMF modelling and simulation of this system:

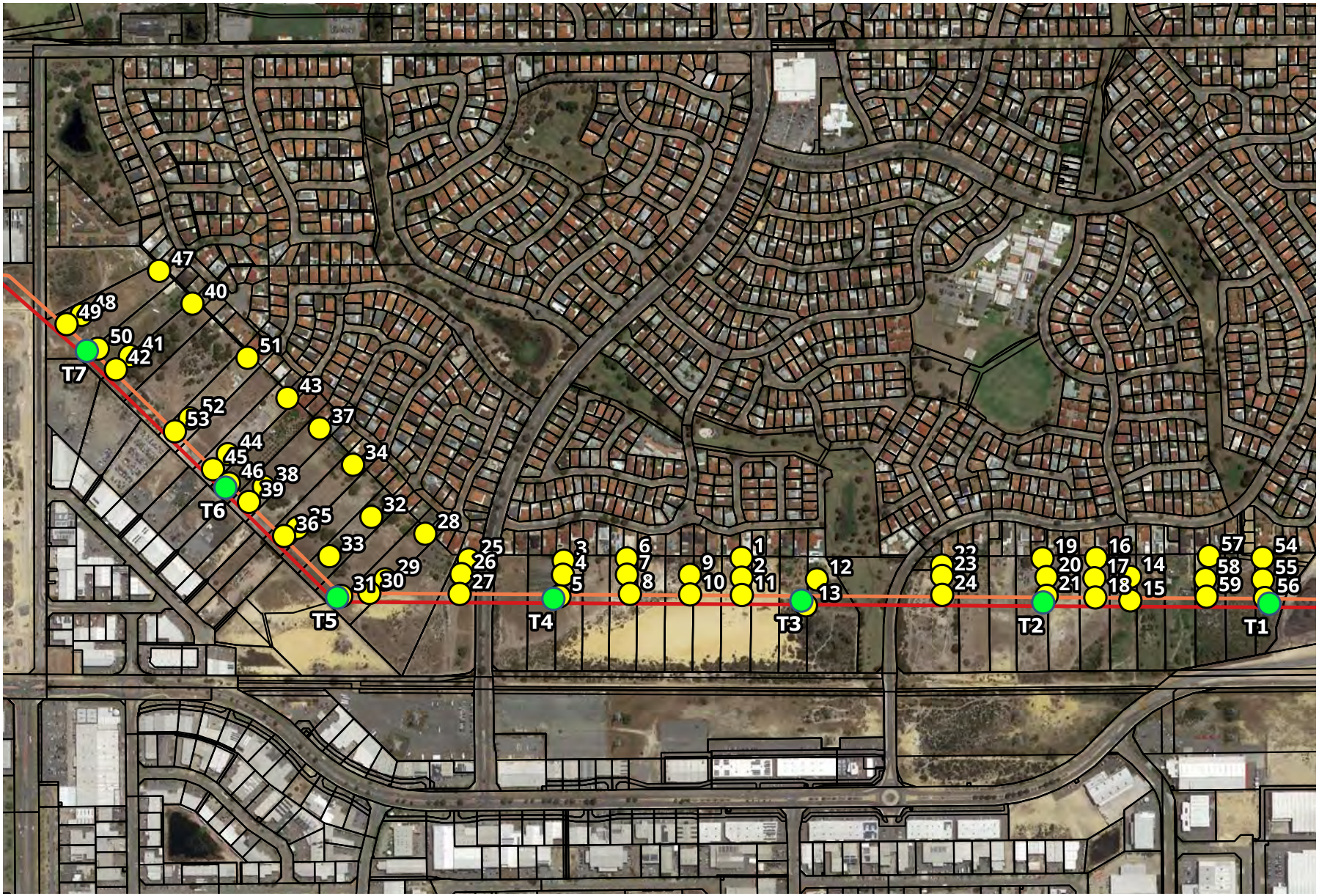
– Only the feeders that are being modified have been considered in this model
– All tested and simulated measurements have been taken at 1 m above the ground
– The software model was calibrated by scaling the load current based on average magnetic and electric field values taken from site testing in section 3.2.3
– The proposed 330 kV feeders will be loaded at the same level as the existing 330 kV feeders, in accordance with Western Power's advice
– The heights of the three phases for each tower are approximately 30, 40 and 50 m high, based on Western Power's standard drawings, and
– Each feeder has a shielding OHEW above it

5.2 Existing scenario

5.2.1 Model setup

The layout of the existing feeder configuration is shown in Figure 11, with the 330 kV feeder NBT-NT 91 in orange, and the 132 kV feeder in red. All data points taken from the EMF testing on site have been shown as yellow pins.

Each phase was energised to the specified operating phase voltage, and load resistances were specified to set phase currents.



Legend

- Allotment Boundary
- EMF Testing Locations
- Tower Locations

Existing Tranmission Lines

- NBT-NT 91 - 330 kV
- NT-PJR 81 - 132 kV

Paper Size ISO A4

0 0.1 0.2 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

GHD

Western Power Pty Ltd.

Western Power EMF and noise monitoring

Exisiting Feeder Route and Test Points

Project No. **12614906**
Revision No. **A**
Date. **10/10/2023**

FIGURE 11

Document Path: \\ghdnet\ghd\AU\Perth\Projects\61\12614906\GIS\Maps\Working\12614906_BaseMap.qgz
Print Date: 10/10/2023

Data Source:Google Earth Imagery 2023.
Created By: ylim

5.2.2 Initial simulation

The system was initially modelled in CDEGS with each feeder energised with the currents listed in section 5.1.2. A profile was set up for each of the actual test result locations, where the simulated electrical and magnetic field values were compared against the actual values. The full results are shown in Table 18.

Table 18 EMF modelling & test results

ID	Coordinates	Magnetic field (μT)			Electric field (V/m)		
		Measured	Simulated	% Diff[1]	Measured	Simulated	% Diff[1]
1	31.853634° S, 115.905859° E	0.6015	2.39	25%	22.25	42.5	52%
2	31.853927° S, 115.905859° E	0.7317	5.09	14%	58.5	170.6	34%
3	31.853650° S, 115.902783° E	0.5778	2.94	20%	38.01	29.3	130%
4	31.853857° S, 115.902767° E	0.698	4.92	14%	65.99	172.9	38%
5	31.854175° S, 115.902702° E	1.086	8.96	12%	989.4	1018.3	97%
6	31.853625° S, 115.903874° E	0.575	2.64	22%	39.59	37	107%
7	31.853866° S, 115.903874° E	0.7144	4.87	15%	51.34	159.6	32%
8	31.854150° S, 115.903923° E	1.923	8.97	21%	3033	974.8	311%
9	31.853878° S, 115.904964° E	0.7677	4.65	17%	58.57	126.6	46%
10	31.854167° S, 115.904964° E	2.416	9.17	26%	3023	978.2	309%
11	31.854183° S, 115.905859° E	1.697	9.29	18%	1714.7	971.8	176%
12	31.853963° S, 115.907161° E	0.7706	4.65	17%	100.3	167.9	60%
13	31.854346° S, 115.906966° E	1.033	10.07	10%	184.7	978.2	19%
14	31.853971° S, 115.912581° E	0.6317	4.71	13%	85.61	140.2	61%
15	31.854321° S, 115.912581° E	1.083	9.31	12%	4375.2	1040	421%
16	31.853691° S, 115.911995° E	0.5791	2.38	24%	51.6	41.2	125%
17	31.853988° S, 115.911963° E	0.6231	4.97	13%	41.77	172.2	24%
18	31.854268° S, 115.911979° E	1.639	8.92	18%	3388	968.1	350%
19	31.853687° S, 115.911068° E	0.5437	2.43	22%	41.64	39.9	104%
20	31.853963° S, 115.911133° E	0.6475	4.91	13%	54.98	165.4	33%
21	31.854240° S, 115.911133° E	1.129	9.91	11%	1164.3	962.3	121%
22	31.853776° S, 115.909326° E	0.5839	3	19%	55.06	29.26	188%
23	31.853931° S, 115.909326° E	0.6481	4.65	14%	124	125.8	99%
24	31.854211° S, 115.909326° E	3.959	9.05	44%	5417.1	942.4	575%
25	31.853617° S, 115.901139° E	0.5639	2.81	20%	38.37	32.4	118%
26	31.853833° S, 115.901009° E	0.6626	4.96	13%	57.49	186.9	31%
27	31.854126° S, 115.900977° E	1.256	8.53	15%	3667.9	986	372%
28	31.853231° S, 115.900391° E	0.5602	1.44	39%	16.63	46.74	36%
29	31.853898° S, 115.899691° E	0.6472	6.56	10%	202.2	431	47%
30	31.854097° S, 115.899414° E	0.8943	8.52	10%	2736.5	975	281%
31	31.854138° S, 115.898926° E	1.109	8.83	13%	1527.7	1043	146%
32	31.852974° S, 115.899463° E	0.5679	5.94	10%	4.928	46.01	11%
33	31.8535480° S, 115.89873° E	0.6698	1.25	54%	78.97	250.5	32%
34	31.852201° S, 115.899154° E	0.567	5.94	10%	3.273	27.8	12%

ID	Coordinates	Magnetic field (μT)			Electric field (V/m)		
		Measured	Simulated	% Diff[1]	Measured	Simulated	% Diff[1]
35	31.853125° S, 115.898177° E	0.9341	5.98	16%	247.9	326.4	76%
36	31.853243° S, 115.897949° E	2.388	8.95	27%	2767.7	1039	266%
37	31.85166° S, 115.898584° E	0.5654	0.61	93%	4.024	23.3	17%
38	31.852511° S, 115.897607° E	0.6495	4.74	14%	97.21	152.6	64%
39	31.852734° S, 115.897347° E	1.476	8.93	17%	2263.2	1044	217%
40	31.849797° S, 115.896403° E	0.551	0.52	106%	2.925	23.7	12%
41	31.850562° S, 115.895313° E	0.6102	4.7	13%	35.99	165	22%
42	31.850757° S, 115.895068° E	1.086	8.58	13%	1116.3	977.8	114%
43	31.851204° S, 115.898031° E	0.5447	0.59	92%	4.099	25	16%
44	31.852026° S, 115.896989° E	0.6382	5.06	13%	121.6	200.7	61%
45	31.852246° S, 115.896729° E	0.909	9.06	10%	2080.2	1062	196%
46	31.852458° S, 115.897005° E	0.9922	8.92	11%	988.5	1044	95%
47	31.849308° S, 115.895833° E	0.5563	0.49	114%	6.756	23.7	29%
48	31.849943° S, 115.894482° E	0.7129	5.03	14%	69.28	229.2	30%
49	31.850081° S, 115.894222° E	1.016	8.75	12%	975.2	1032	94%
50	31.850448° S, 115.894759° E	1.083	8.55	13%	476.2	977	49%
51	31.850606° S, 115.897347° E	0.5519	0.56	99%	3.951	24.4	16%
52	31.851493° S, 115.896338° E	0.6584	5.22	13%	77.13	151	51%
53	31.851681° S, 115.896077° E	1.338	9.02	15%	2514.5	1061	237%
54	31.853711° S, 115.914876° E	0.5536	2.32	24%	32.75	43.7	75%
55	31.854032° S, 115.914876° E	0.624	5.14	12%	130	195.7	66%
56	31.854305° S, 115.914909° E	0.9817	8.92	11%	1052.2	985	107%
57	31.853678° S, 115.913949° E	0.5616	2.16	26%	50.35	44.8	112%
58	31.854016° S, 115.913883° E	0.767	4.99	15%	44.96	172.5	26%
59	31.8542770° S, 115.91390° E	1.643	8.9	18%	3148.2	966.9	326%

1. Measured value divided by simulated value

Factors that contribute to the variation between the simulated and actual values include:

– In the majority of cases, the simulated magnetic field values are more conservative than the measured values. This is likely due to the simulation of the feeders at maximum current rating, whereas during testing, the feeders were operating below the maximum rating.

– The electric field simulated values which are lower than the measured data are typically along the measurement points very close to the feeder. This area is more likely to be subject to the superposition of electric fields from other feeders to the south, which were not modelled.

It is noted that for the measurements along the residential boundary to the north of the feeders, the model is conservative.

5.2.3 Calibration

To modify the software model to improve accuracy with measured data, the following methodology was adopted to calibrate the model:

– The data points were split into six sections, including the tiers closest, middle and furthest from the line for both the NW-SE section of the line and E-W section of the line, as shown in Figure 12 and Figure 13

– Each of these sections were averaged for simulated and measured results, with the scaling factor for each condition recorded. These averages have been summarised in Table 19.

Table 19 Average EMF test results

Group ID	Description	Magnetic field (μT)			Electric field (V/m)		
		Measured	Simulated	% diff	Measured	Simulated	% diff
A	Underneath NW-SE section	1.229	8.811	14%	1744.600	1025.480	170%
B	50 m from NW-SE section	0.690	4.818	14%	116.285	238.300	49%
C	Adjacent to property boundary on NW-SE section	0.558	2.011	28%	5.823	30.081	19%
D	Underneath E-W section	1.654	9.167	18%	2596.475	981.000	265%
E	50 m from E-W section	0.691	4.876	14%	72.793	163.025	45%
F	Adjacent to property boundary on E-W section	0.571	2.563	22%	41.069	37.784	109%

The property boundaries are closest to Groups C and F for the northwest-southeast (NW-SE) spans of the transmission lines and east-west (E-W) spans of the transmission lines, respectively, these are the data sets that are considered for the calibrated model.

Legend

Allotment Boundary

Tower Locations

EMF Testing Location

Group A

Group B

Group C

Existing Tranmission Lines

NBT-NT 91 - 330 kV

NT-PJR 81 - 132 kV

Paper Size ISO A4

0 0.1 0.2 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

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Test Location Groups A - C

Project No. **12614906**
Revision No. **A**
Date. **12/10/2023**

FIGURE 12

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Print Date: 12/10/2023

Data Source:Google Earth Imagery 2023.
Created By: ylim

Legend

- Allotment Boundary
- Tower Locations

EMF Testing Location

- Group D
- Group E
- Group F

Existing Tranmission Lines

- NBT-NT 91 - 330 kV
- NT-PJR 81 - 132 kV

Paper Size ISO A4

0 0.1 0.2 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

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Test Location Groups D - F

Project No. **12614906**
Revision No. **A**
Date. **12/10/2023**

FIGURE 13

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Print Date: 12/10/2023

Data Source:Google Earth Imagery 2023.
Created By: ylim

5.2.4 Calibrated simulation

Because each line of points generated a significantly different percentage difference, an iterative approach was used to alter the scaling values used to calibrate the model. The highest value along each profile was recorded and compared to the reference levels in Table 18. The simulated plots in CDEGS have been included in Appendix A-1.

Table 20 Summary of results from calibrated model - existing

Parameter		Scaling factor (%)[3]	Phase current (A)		Phase load resistance (Ω)		Simulated field intensity at property boundary		Reference level[5]
			132 kV	330 kV	132 kV	330 kV	Original (unscaled) value	Scaled value[4]	
Original		100 %	2,152	2,457	35.41	77.54			
Group C[1]	Magnetic	28 %	603	688	126.48	276.94	0.75 µT	2.69 µT	200 µT
	Electric	19 %	409	467	186.39	408.13	9.14 V/m	48.12 V/m	5000 V/m
Group F[2]	Magnetic	22 %	473	541	160.97	352.47	0.64 µT	2.92 µT	200 µT
	Electric	109 %	2,346	2,678	32.49	71.14	53.54 V/m	49.12 V/m	5000 V/m

1. *Property boundary on NW-SE section*
2. *Property boundary on E-W section*
3. *Average value divided by average measured value (Percentage difference listed in* Table 19*)*
4. *Original value multiplied by % scaling factor*
5. *Refer to* Table 18*.*

As the projected field intensities for all scenarios for both the initial and scaled versions are well below the reference levels, the system is currently compliant.

5.3 Proposed scenario

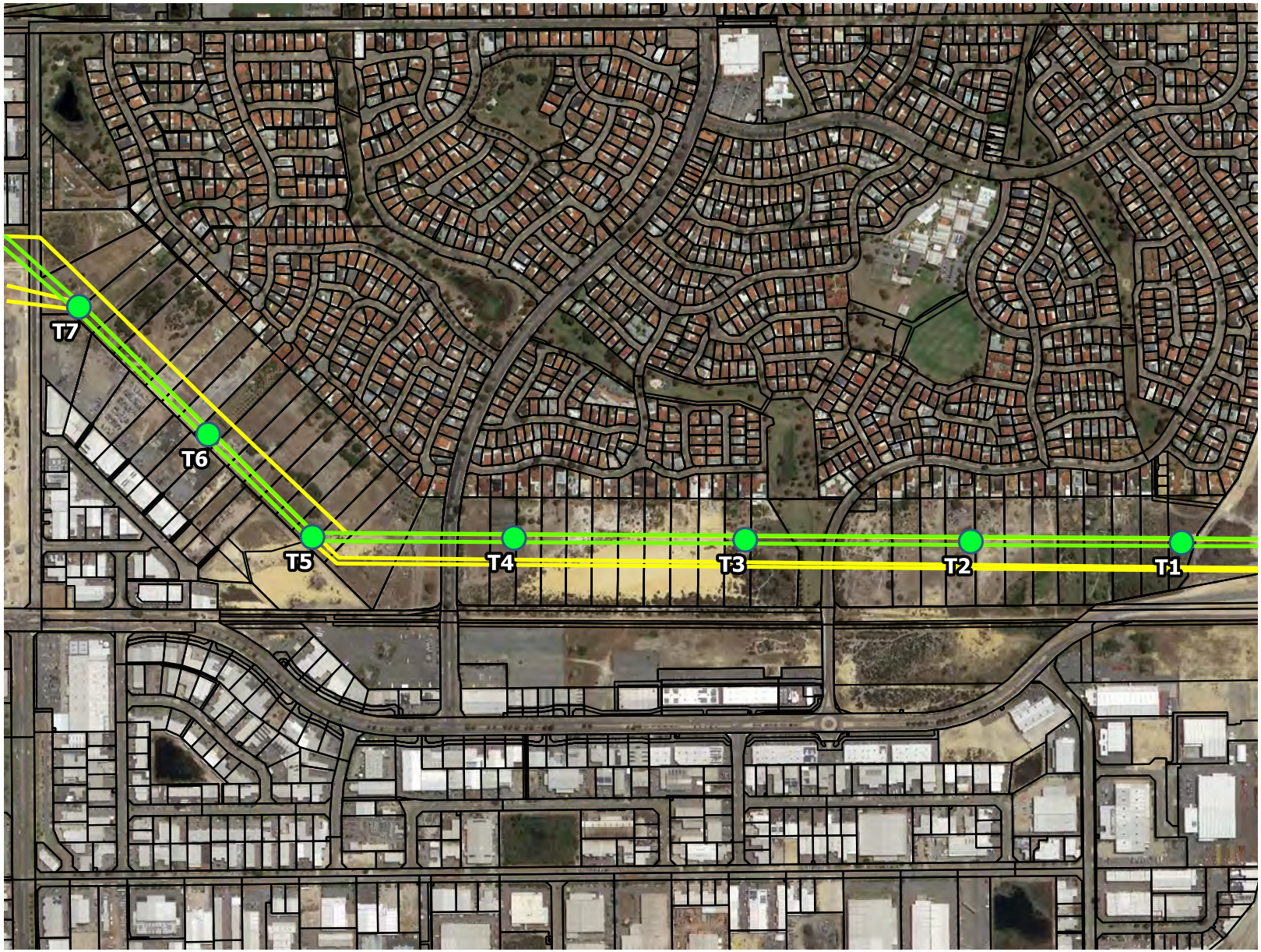
5.3.1 Model setup

The proposed configuration is shown in Figure 14. The proposed locations of the structures with the 330 kV feeders are shown in yellow and are as follows, listed from top to bottom.

– New TL 330 kV NBT-NT 92
– New TL 330 kV NBT-NT 93 (Part 1)
– New TL 330 kV NBT-NT 93 (Part 2)

The two existing feeders are overlaid in green for comparison.

The model was energised using the operating phase currents provided in 5.1.2 for the existing 330 kV feeder.



Legend

- Allotment Boundary
- Tower Locations

Existing Tranmission Lines

- NBT-NT 91 - 330 kV
- NT-PJR 81 - 132 kV

Proposed TLs

- Northern Section - 330 kV NBT-NT 92
- Southern Section - pt1 330 kV NBT-NT 93
- Southern Section - pt2 330 kV NBT-NT 93

Paper Size ISO A4

0 0.1 0.2 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

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Proposed Feeder Configuration

Project No. **12614906**
Revision No. **A**
Date. **10/10/2023**

FIGURE 14

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Print Date: 10/10/2023

Data Source:Google Earth Imagery 2023.
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5.3.2 Simulation

As was done for the existing system, the proposed system was run both for the provided phase currents and scaled to the respective average value from Table 19 for electric and magnetic fields for both the eastern and western sections of the property boundary. The simulated plots in CDEGS have been included in Appendix A-2.

Table 21 Summary of results from calibrated model – proposed

Parameter		Scaling factor (%)	Field intensity at property boundary		Reference level [3]	% of value for proposed configuration [4]
			Scaled value	Original value		
Original		100 %				
Group C[1]	Magnetic	28 %	0.84 µT	2.99 µT	200 µT	111 %
	Electric	19 %	15.06 V/m	79.28 V/m	5000 V/m	165 %
Group F[2]	Magnetic	22 %	0.66 µT	2.99 µT	200 µT	102 %
	Electric	109 %	79.53 V/m	72.96 V/m	5000 V/m	149 %

1. *Property boundary on western section (where feeder goes NW-SE)*
2. *Property boundary on eastern section (where feeder goes E-W)*
3. *Refer to simulated values in proposed scenario in* Table 18.
4. *Refer to Table* 20

As the projected field intensities for all scenarios for both the initial and scaled versions are well below the reference levels, the proposed system will be compliant.

5.3.3 Influence contours

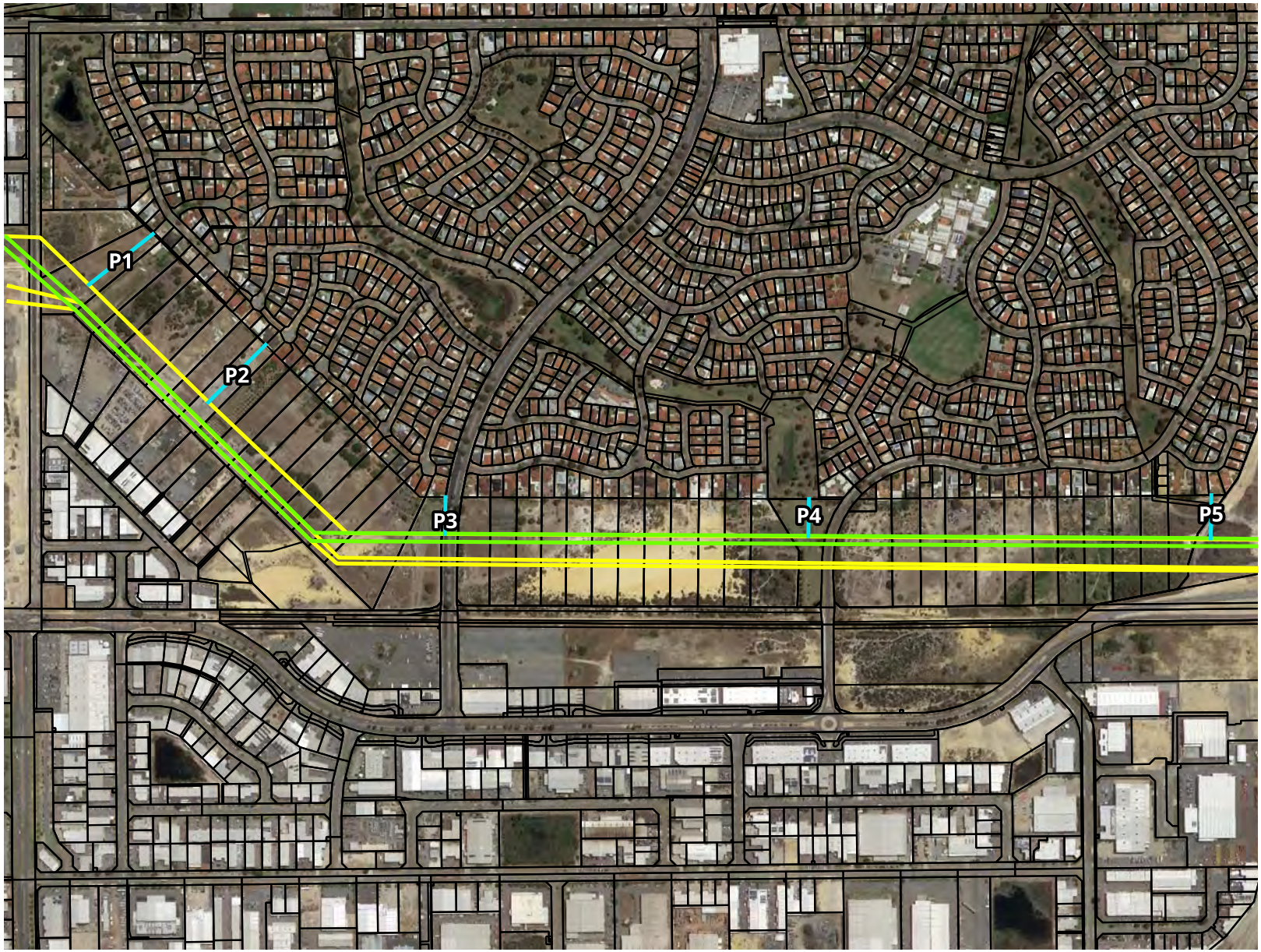
The results obtained for the proposed system assess only the residential property boundary, with a parallel separation to the nearest feeder of approximately 65 m and 140 m away, for the eastern and western sections, respectively. However, for future installations, a profile was developed at five separate locations, where the drop in magnetic or electric field intensity is graphed and will hence identify any points closer to the feeders where these are expected to be above the reference level.

The results have been summarised in Table 22 and contours shown in Figure 15.

Table 22 Worst case magnetic and electric fields directly under feeders

Profile number	Location	Maximum value (scaled)	
		Magnetic field (µT)	Electric field (V/m)
1	NW corner of W span	2.2	173
2	Middle of W span	1.9	186
3	Feeder bend	2.1	785
4	Middle of W span	1.3	959
5	E corner of E span	1.3	927

As all the simulated values for both unscaled and scaled values are predicted to be within the reference levels in Table 13, there will be no hazardous magnetic or electric fields should the property boundaries be moved closer to the lines for the proposed configuration.



Legend

- Allotment Boundary
- Contour profiles

Existing Tranmission Lines

- NBT-NT 91 - 330 kV
- NT-PJR 81 - 132 kV

Proposed TLs

- Northern Section - 330 kV NBT-NT 92
- Southern Section - pt1 330 kV NBT-NT 93
- Southern Section - pt2 330 kV NBT-NT 93

Paper Size ISO A4

0 0.1 0.2 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

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Location of Contour Profiles

Project No. **12614906**
Revision No. **A**
Date. **12/10/2023**

FIGURE 15

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Print Date: 12/10/2023

Data Source:Google Earth Imagery 2023.
Created By: ylim

5.4 Summary

Based on the existing test data recorded, the proposed feeder scenario, conservative parameters and assumptions, the modifications of feeder routes immediately east of the Northern Terminal Substation are predicted to be compliant with ICNIRP reference levels for electric or magnetic fields at the residential property boundary to the north of the transmission line easements.

6. Noise modelling

The amount of corona and therefore audible coronal noise produced by a transmission line is a function of the transmission line voltage, conductor diameter, the location of the conductors relative to each other, the site elevation (above sea level), conductor and hardware condition, and local meteorology. The transmission line power flow does not affect the amount of corona produced and corona typically becomes less noticeable at lower voltages below 330 kV.

The following section provides a summary of the noise modelling undertaken as part of the proposed transmission line relocation to enable placement of an additional transmission line along a section of easement adjacent to Marshall Road, Malaga.

6.1 Modelling algorithm

Noise modelling was undertaken using Computer Aided Noise Abatement (CadnaA) Version 2023 noise modelling software to predict the effects of operational related noise from the Project site.

CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA calculates environmental noise propagation according to ISO 9613-2, “Acoustics – Attenuation of sound during propagation outdoors” and other algorithms. Propagation calculations take into account sound intensity losses due to geometrical spreading, terrain effects, atmospheric absorption and ground absorption.

The ISO 9613-2 algorithm also takes into account the presence of a well-developed moderate ground-based temperature inversion, such as commonly occurs on clear, calm nights or ‘downwind’ conditions, which are favourable to sound propagation. As a result, predicted received noise levels are expected to represent a worst-case scenario, however given the relatively small distances involved, enhancement of noise due to weather is expected to be minimal at the closest sensitive receiver locations.

6.2 Assumptions

The following general settings were used in the model:

- Modelling is based on atmospheric conditions of 10 °C and 70 percent relative humidity, to provide a worst-case scenario
- Ground absorption coefficient of 0.75, where G=0 is acoustically reflective ground and G=1 is acoustically absorptive ground, noting the site is made up of largely of sandy soils, bare sand and grassland areas
- Reflections were set to first order reflection
- Sound propagation is calculated according to ISO 9613-2 algorithm, *“Acoustics – Attenuation of sound during propagation outdoors”*
- Receptors have been positioned at a height of 1.5 m above floor level
- All noise sources modelled are operating continuously and simultaneously throughout the day, evening, and night periods
- Post processing found no requirement for any annoying noise characteristic adjustment
- Noise source emission levels were established based on a combination of GHD information, client supplied information, publically available data, and using empirical and predictive methods
- The proposed 330 kV feeders will be loaded at the same level as the existing 330 kV feeders, in accordance with Western Power’s advice
- The heights of the three phases for each tower are approximately 30, 40 and 50 m high, based on Western Power’s standard drawings
- Point sources were used to emulate corona noise emissions at lattice tower structures. Line sources were used to emulate conductor noise emissions for each phase along the transmission line.

6.3 Model calibration

The developed computational noise model was validated based on the various onsite noise measurements as summarised in section 3.3 and laboratory testing of audible coronal discharge. The predicted noise levels were scaled until the calibrated noise model compared to the measured levels at fixed locations and distances from the transmission line and towers in the model.

The comparison of predicted noise levels vs the measured noise levels indicate that the developed noise model results are on average within 1 dB of the measured noise levels and is therefore considered calibrated to on-site conditions.

6.4 Scenarios

It was noted while undertaking on site measurements that audible noise levels from the transmission line and lattice tower structures was barely audible during fair weather, however during light a rain event audible noise emissions increased noticeably when standing near to a tower location. In order to emulate the change in audible noise experienced during a rain event. four noise modelling scenarios were undertaken, as follows:

– Existing conditions – Fair Weather
– Existing conditions – Poor Weather (Rain event)
– Proposed relocation of the NBT-NT-91 – Fair Weather
– Proposed relocation of the NBT-NT-91 – Poor Weather (Rain event)

6.5 Tonality

As discussed in section 4.2.6 the noise character received at sensitive receivers must be ‘free’ of annoying characteristics such as tonality, modulation, and impulsiveness when assessed under Regulation 9 — *Intrusive or dominant noise characteristics.*

No tonality penalty was applied based on assessment of measured spectra as described in section 4.2.6.
No modulation or impulsiveness allowance is required as part of this assessment.

6.6 Noise emission levels

The developed computational noise model (and consequently assessment undertaken in this report) is based on overall noise emissions from the site, refer to Table 23 for a list of noise sources, octave band spectra, and overall sound power levels (Lw) used in the modelling.

Table 23 Sound power of equipment modelled

Noise source	Octave centre frequency (Hz) dB(A)									L_w dB(A)	L_{lin} (dB)
	31.5	63	125	250	500	1000	2000	4000	8000		
Transmission Line	18	31	33	36	43	46	40	37	39	49	61
Tower conductor/insulator interface	54	67	69	72	79	82	76	73	75	85	97

Note: Noise source spectra have been sourced from GHD's database, online data, and measured data.

6.7 Predicted noise levels

Predicted noise levels from the proposed transmission line relocation are provided in Table 24 for both the 'Existing conditions' and 'Proposed relocation' scenarios.

The 'Existing conditions' model is predicted to comply at all sensitive receiver locations for all periods (Day, Evening, and Night) during a worst case corona discharge event.

The 'Proposed relocation' model noise level is predicted to comply with strictest limits at all sensitive receiver locations for all periods (Day, Evening, and Night) during a worst case corona discharge event.

No tonality penalty was required based on an assessment of measured spectra as described in section 4.2.6. The predicted contours are presented in Appendix C.

Table 24 Predicted sound pressure levels at modelled receivers

#	Sensitive receiver	Period	Noise criteria L_{A10} dB(A)	Predicted noise levels - L_{A10} dB(A)				Complies	
				Existing Fair Weather	Existing Poor Weather	Proposed Fair Weather	Proposed Poor Weather	Existing Condition	Proposed Relocation
1	32 Winchester Place	Day	48	13	31	13	33	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
2	34 Winchester Place	Day	48	13	31	13	33	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
3	36 Winchester Place	Day	48	12	31	13	33	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
4	38 Winchester Place	Day	48	13	32	14	33	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
5	40 Winchester Place	Day	48	13	32	13	33	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
6	42 Winchester Place	Day	48	13	32	14	33	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
7	44 Winchester Place	Day	48	13	32	14	33	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
8	46 Winchester Place	Day	48	13	31	14	33	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
9	48 Winchester Place	Day	48	13	31	14	33	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y

#	Sensitive receiver	Period	Noise criteria L_{A10} dB(A)	Predicted noise levels - L_{A10} dB(A)				Complies	
				Existing Fair Weather	Existing Poor Weather	Proposed Fair Weather	Proposed Poor Weather	Existing Condition	Proposed Relocation
10	52 Winchester Place	Day	48	13	31	14	33	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
11	58 Winchester Place	Day	48	13	32	14	33	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
12	60 Nottingham Gardens	Day	48	13	32	14	33	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
13	2 Bampton Lane	Day	48	13	32	14	34	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
14	4 Bampton Lane	Day	48	13	32	14	34	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
15	6 Bampton Lane	Day	48	13	32	14	34	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
16	8 Bampton Lane	Day	48	13	32	14	34	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
17	23 Saltwood Court	Day	48	13	32	15	34	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
18	21 Saltwood Court	Day	48	14	32	15	34	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
19	26 Tintagel Place	Day	47	14	32	15	34	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
20	28 Tintagel Place	Day	47	14	32	15	34	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
21	7 The Elms	Day	47	14	32	15	34	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
22	5 The Elms	Day	47	14	32	15	33	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y

#	Sensitive receiver	Period	Noise criteria L_{A10} dB(A)	Predicted noise levels - L_{A10} dB(A)				Complies	
				Existing Fair Weather	Existing Poor Weather	Proposed Fair Weather	Proposed Poor Weather	Existing Condition	Proposed Relocation
23	3 The Elms	Day	47	14	32	15	33	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
24	1 The Elms	Day	47	14	32	15	33	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
25	20 Castlemore Mews	Day	47	14	32	15	34	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
26	22 Castlemore Mews	Day	47	14	32	15	34	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
27	24 Castlemore Mews	Day	47	14	32	15	34	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
28	9 Tekapo Lane	Day	47	14	32	15	34	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
29	7 Tekapo Lane	Day	47	15	32	15	34	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
30	5 Tekapo Lane	Day	47	15	33	16	34	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
31	3 Tekapo Lane	Day	47	15	33	16	35	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
32	1 Tekapo Lane	Day	47	16	33	16	35	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
33	31 Huntingdon Mews	Day	47	16	33	17	35	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
34	29 Huntingdon Mews	Day	47	16	33	17	35	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
35	27 Huntingdon Mews	Day	47	16	33	17	35	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y

#	Sensitive receiver	Period	Noise criteria L_{A10} dB(A)	Predicted noise levels - L_{A10} dB(A)				Complies	
				Existing Fair Weather	Existing Poor Weather	Proposed Fair Weather	Proposed Poor Weather	Existing Condition	Proposed Relocation
36	59 Yosemite Loop	Day	47	16	34	17	35	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
37	57 Yosemite Loop	Day	47	16	34	17	36	Y	Y
		Evening	42					Y	Y
		Night	37					Y	Y
38	55 Yosemite Loop	Day	46	16	35	17	36	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
39	53 Yosemite Loop	Day	46	16	35	17	36	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
40	51 Yosemite Loop	Day	46	16	35	17	36	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
41	49 Yosemite Loop	Day	46	16	35	17	36	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
42	47 Yosemite Loop	Day	46	16	34	17	36	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
43	45 Yosemite Loop	Day	46	16	33	16	35	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
44	43 Yosemite Loop	Day	46	16	33	16	35	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
45	41 Yosemite Loop	Day	46	16	32	16	34	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
46	39 Yosemite Loop	Day	46	16	32	16	34	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
47	37 Yosemite Loop	Day	46	16	32	16	34	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
48	35 Yosemite Loop	Day	46	16	31	16	33	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y

#	Sensitive receiver	Period	Noise criteria L_{A10} dB(A)	Predicted noise levels - L_{A10} dB(A)				Complies	
				Existing Fair Weather	Existing Poor Weather	Proposed Fair Weather	Proposed Poor Weather	Existing Condition	Proposed Relocation
49	33 Yosemite Loop	Day	46	16	31	16	33	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
50	2 Lassen Gardens	Day	46	16	32	16	34	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
51	4 Lassen Gardens	Day	46	16	32	16	34	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
52	6 Lassen Gardens	Day	46	16	32	16	34	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
53	8 Lassen Gardens	Day	46	16	33	16	35	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
54	10 Lassen Garden	Day	46	16	33	16	35	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
55	12 Lassen Gardens	Day	46	16	34	16	36	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
56	14 Lassen Gardens	Day	46	16	34	16	36	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
57	16 Lassen Gardens	Day	46	16	35	16	36	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
58	18 Lassen Gardens	Day	46	16	35	16	36	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
59	Lot 14223 Lassen Park	Day	46	16	33	17	35	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
60	111 Guadalupe Drive	Day	46	16	32	16	34	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
61	109 Guadalupe Drive	Day	46	16	32	16	35	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y

#	Sensitive receiver	Period	Noise criteria L_{A10} dB(A)	Predicted noise levels - L_{A10} dB(A)				Complies	
				Existing Fair Weather	Existing Poor Weather	Proposed Fair Weather	Proposed Poor Weather	Existing Condition	Proposed Relocation
62	107 Guadalupe Drive	Day	46	16	32	16	34	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
63	105 Guadalupe Drive	Day	46	16	33	16	35	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
64	103 Guadalupe Drive	Day	46	16	33	16	35	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
65	101 Guadalupe Drive	Day	46	16	34	16	35	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
66	99 Guadalupe Drive	Day	46	16	34	17	36	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
67	97 Guadalupe Drive	Day	46	16	35	17	36	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
68	95 Guadalupe Drive	Day	46	16	35	17	36	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
69	93 Guadalupe Drive	Day	46	16	34	16	35	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
70	91 Guadalupe Drive	Day	46	16	34	16	35	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
71	89 Guadalupe Drive	Day	46	16	33	16	34	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
72	87 Guadalupe Drive	Day	46	16	32	16	34	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
73	85 Guadalupe Drive	Day	46	16	32	16	34	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y
74	83 Guadalupe Drive	Day	46	15	32	16	34	Y	Y
		Evening	41					Y	Y
		Night	36					Y	Y

#	Sensitive receiver	Period	Noise criteria L_{A10} dB(A)	Predicted noise levels - L_{A10} dB(A)				Complies	
				Existing Fair Weather	Existing Poor Weather	Proposed Fair Weather	Proposed Poor Weather	Existing Condition	Proposed Relocation
75	81 Guadalupe Drive	Day	48	16	32	16	34	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
76	79 Guadalupe Drive	Day	48	16	32	16	34	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
77	77 Guadalupe Drive	Day	48	16	32	16	34	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
78	75 Guadalupe Drive	Day	48	16	33	16	34	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
79	73 Guadalupe Drive	Day	48	16	33	16	35	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
80	71 Guadalupe Drive	Day	48	15	34	16	35	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
81	69 Guadalupe Drive	Day	48	16	35	17	36	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
82	4-6 Arnhem Court	Day	48	16	35	16	36	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
83	8 Arnhem Court	Day	48	16	35	16	36	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
84	10 Arnhem Court	Day	48	16	35	16	36	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y
85	12 Arnhem Court	Day	48	15	35	15	36	Y	Y
		Evening	43					Y	Y
		Night	38					Y	Y

Note:

* A +5 dB(A) penalty for tonality has been applied to all predicted noise levels.

* Noise criteria are based on assigned noise levels + influencing factors for the five representative noise sensitive receiver areas, Groups A-E.

6.8 Summary

The ‘Existing conditions’ models for both fair weather and a rain event were predicted to comply at all sensitive receiver locations for all periods (Day, Evening, and Night) during a worst case corona discharge event.

The ‘Proposed relocation’ models for both fair weather and a rain event were predicted to comply with strictest limits at all sensitive receiver locations for all periods (Day, Evening, and Night) during a worst case corona discharge event.

It is also noted that measured nighttime ambient noise levels at the five logger locations ranged from 41-51 dB $L_{Aeq\ (15min)}$ which is 5-15 dB louder than the strictest night time criteria of 36 L_{A10} dB(A) which will provide masking to any noise emissions generated from the transmission lines and tower structures. Further ambient noise levels are expected to be higher during a rain event due to the associated noise level increase from wet roads, rain fall and winds that are often associated with a rain event, adding further masking to any noise emissions generated from the transmission lines and tower structures.

7. Conclusion

7.1 EMF

Existing EMF measurements

Short term attended EMF measurements

Results show measured EMF levels for both the E-field and H-field (electric and magnetic) are compliant with the relevant public and occupational limits at all locations except under the lines at midpoint 2 (109 Guadalupe Drive allotment) which was marginally non-compliant with the general public 24-hour guideline value for electric fields (5,000 V/m) but still complaint with the occupational value (10,000 V/m) and the ENA dosimetry guidance (9,900 V/m) (ENA, January 2016). It was noted that the line height above ground level at the midpoint 2 location (M2) was the lowest within the Project footprint. Note the general public 24-hour guideline is based on open spaces in which members of the public might reasonably be expected to spend a substantial part of the day. It is unlikely that this would occur at the M2 location.

Measurements of magnetic field strength (H-field) were within guideline values at all measured locations including under transmission lines for both public and occupational guidance.

Long term unattended EMF monitoring

Results show measured EMF levels for both the E-field and H-field (electric and magnetic) are compliant with the relevant public and occupational guidelines at 30 m from the nearest transmission line to sensitive receiver locations for the entire 24-hour period at both locations measured.

Existing conditions model

The projected field intensities for all scenarios for both the initial and scaled versions are well below the reference levels, the system is currently compliant.

Proposed scenario

Based on the existing test data recorded, the proposed feeder scenario, conservative parameters and assumptions, the modifications of feeder routes immediately west of the Northern Terminal Substation are predicted to be compliant with ICNIRP reference levels for electric or magnetic fields at the residential property boundary to the north of the transmission line easements.

7.2 Noise

Existing noise measurements

Short term attended noise measurements

Transmission line and tower noise is largely absent during fine weather, however a hum from coronal discharge can occur after a shower for a short time until lines and insulators dry out (~5-10 minutes) and may be audible at receiver locations closest to towers during that time. During longer periods of poor weather it is expected the same phenomenon may occur, however this is also likely to coincide with times when people remain inside to avoid the poor weather.

The substation was noted as being audible for residents at the west end of the Project along Winchester Place but was not discernible beyond this (further to the east).

Long term unattended noise monitoring

Background noise levels were generally louder to the east closer to Tonkin Highway and quieter to the west on Winchester Place. Day time background noise levels ranged from 39-43 dB $L_{A90\ (15min),}$ evening time background noise levels ranged from 38-41 dB $L_{A90\ (15min),}$ nighttime background noise levels ranged from 32-37 dB $L_{A90\ (15min)}$).

Ambient noise levels were more similar across the Project and did not show a general decrease in noise from east to west. However the overall difference (ambient noise level range) between the high and low values was broader than that seen in the background data. Day time ambient noise levels ranged from 50-57 dB $L_{Aeq\ (15min),}$ evening

time ambient noise levels ranged from 47-52 dB $L_{Aeq\ (15min),}$ nighttime ambient noise levels ranged from 41-51 dB $L_{Aeq\ (15min)}$).

Existing conditions model

The 'Existing conditions' models for both fair weather and a rain event were predicted to comply with the strictest nighttime noise criteria of 36 dB(A) at all sensitive receiver locations for all periods (Day, Evening, and Night) during a worst case corona discharge event.

Proposed scenario

The 'Proposed relocation' models for both fair weather and a rain event were predicted to comply with the strictest nighttime noise criteria of 36 dB(A) at all sensitive receiver locations for all periods (Day, Evening, and Night) during a worst case corona discharge event.

8. References

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Appendices

Appendix A

CDEGS simulation outputs

A-1 Existing system

A-1-1 Original values

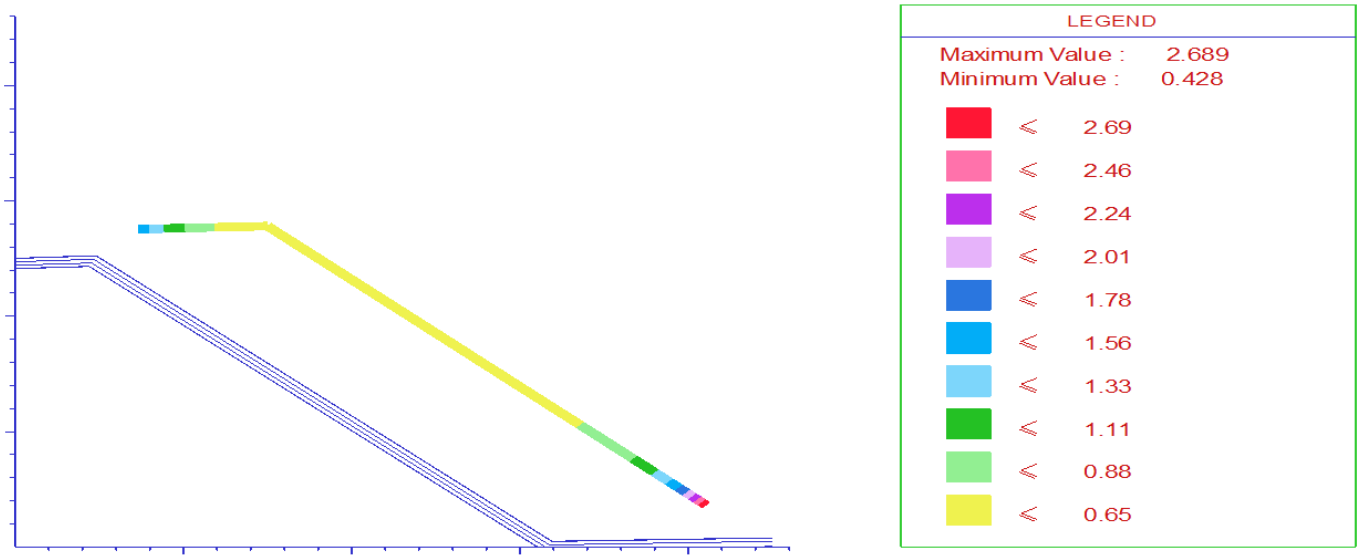


Figure A **Magnetic fields along western property boundary – original**

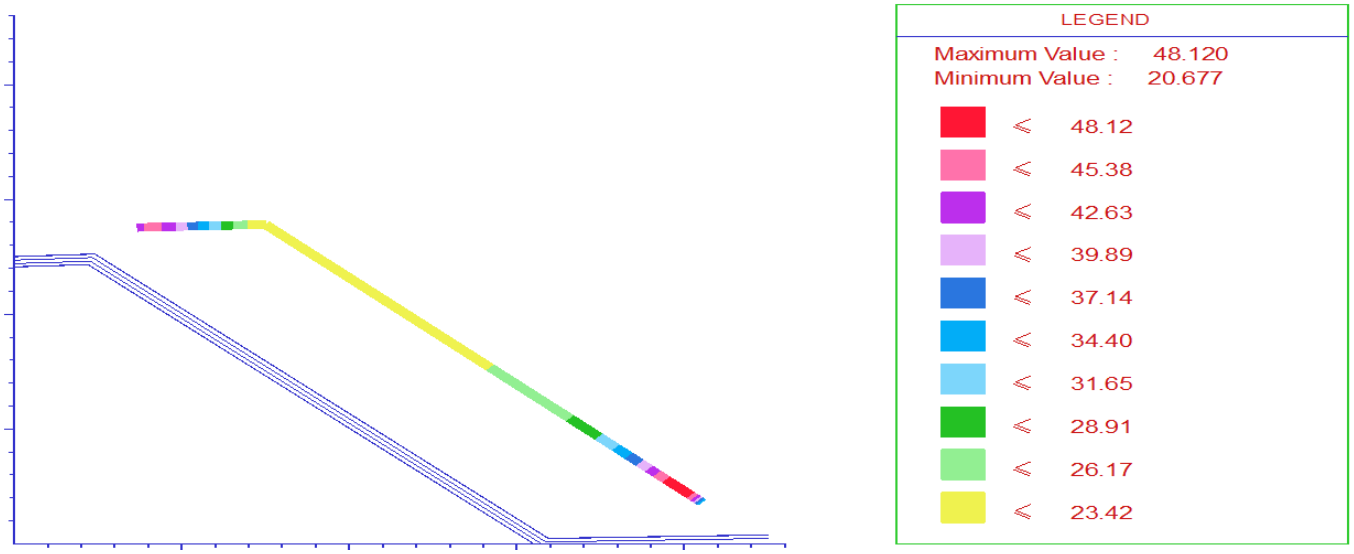


Figure B **Electric fields along western property boundary – original**

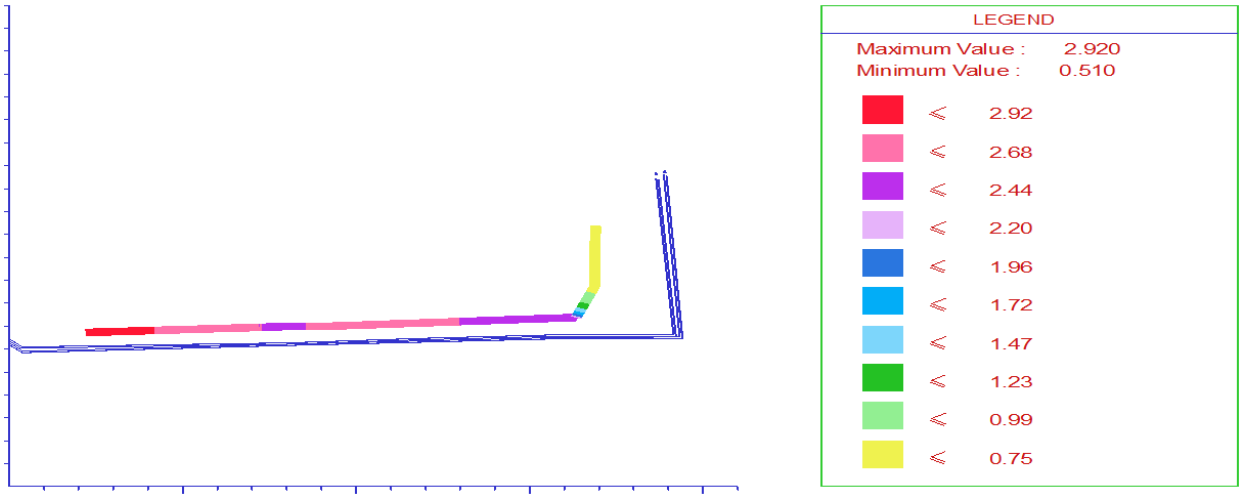


Figure C **Magnetic fields along eastern property boundary – original**

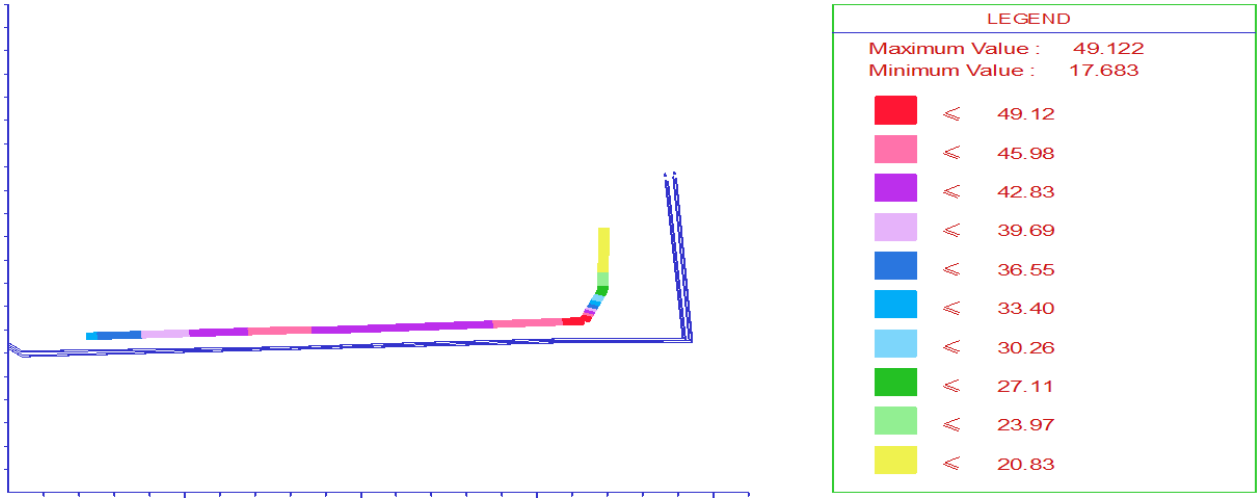


Figure D **Electric fields along eastern property boundary – original**

A-1-2 Scaled values

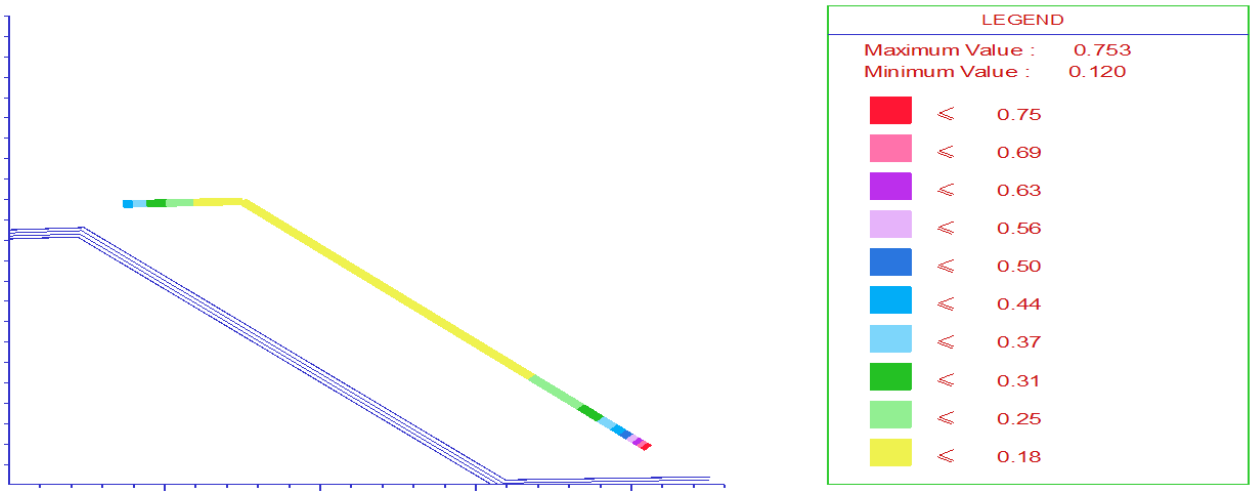


Figure E **Magnetic fields along western property boundary – scaled to 28%**

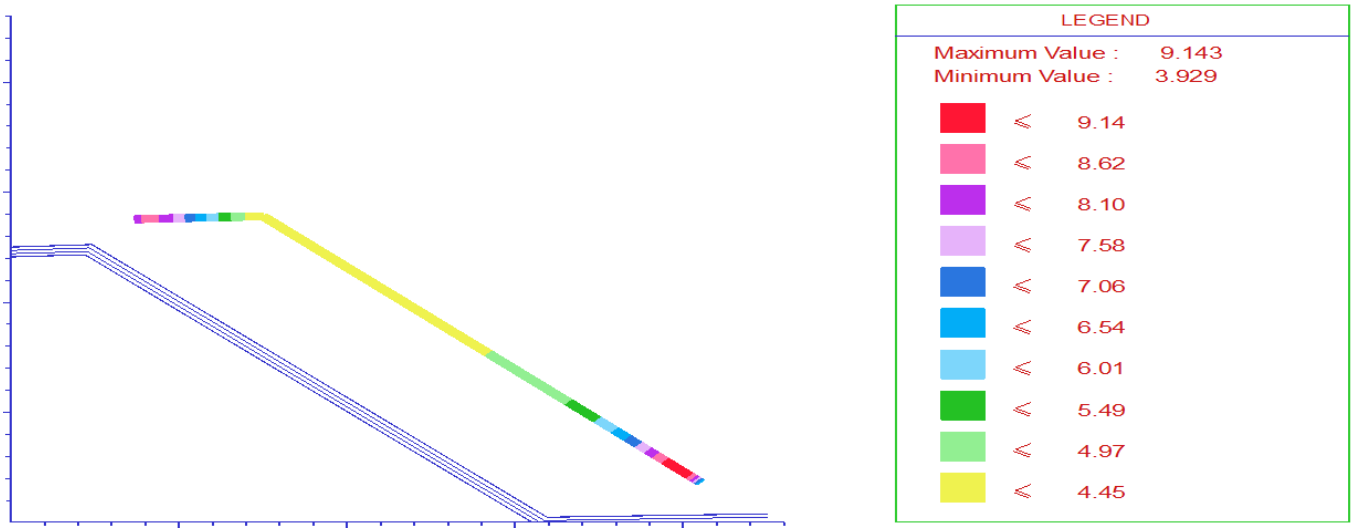


Figure F **Electric fields along western property boundary – scaled to 19%**

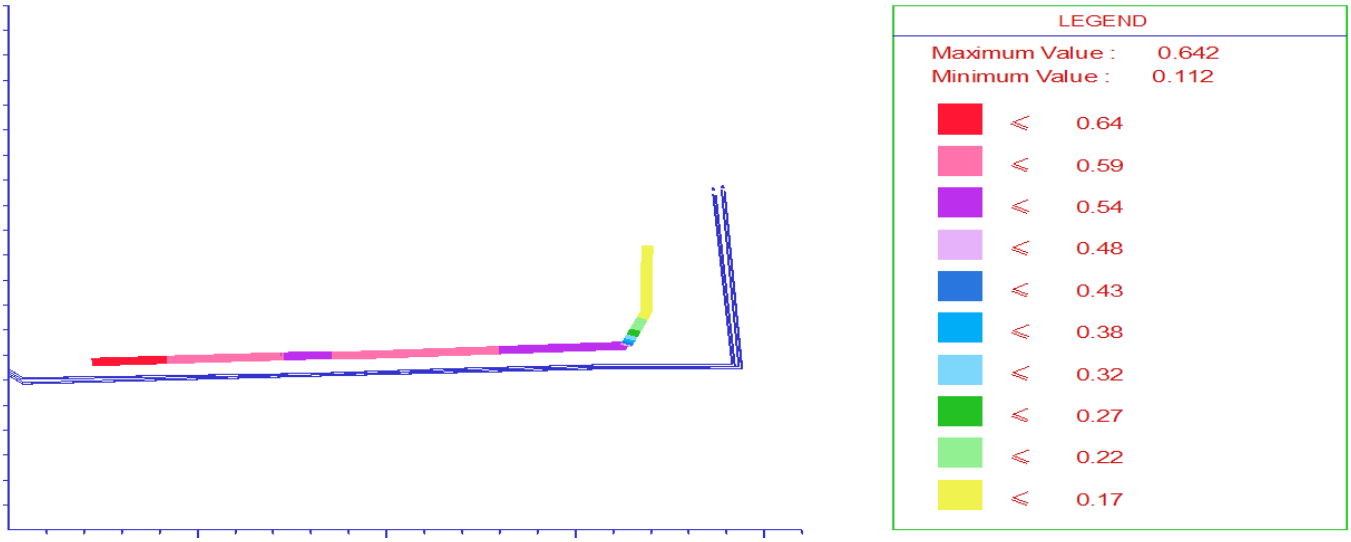


Figure G **Magnetic fields along eastern property boundary – scaled to 22%**

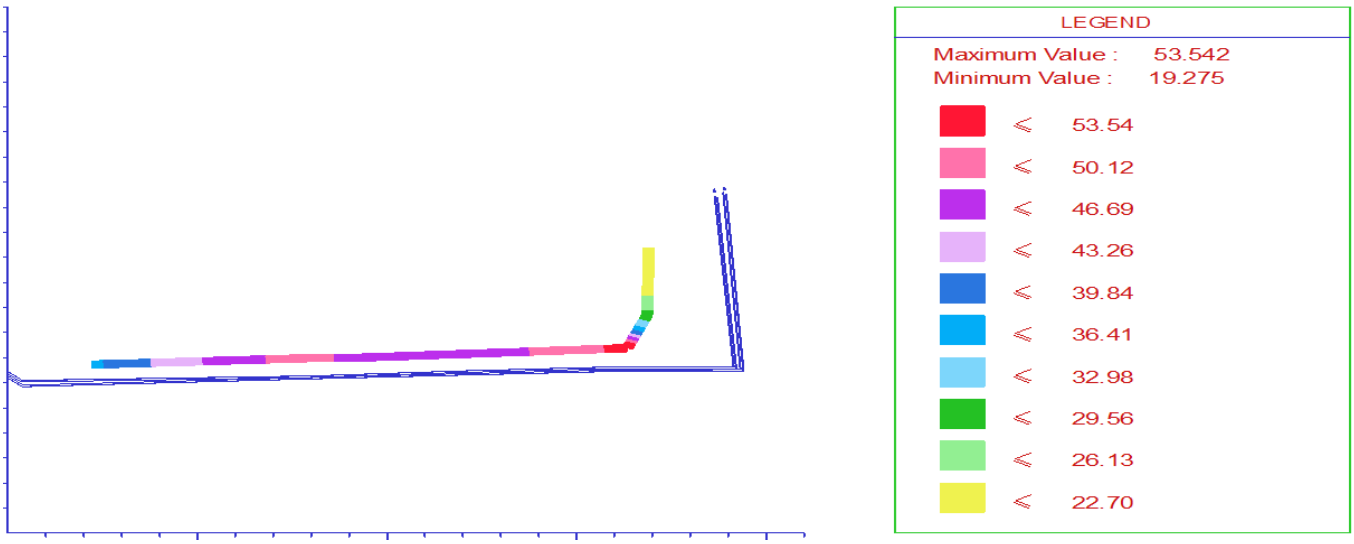


Figure H **Electric fields along eastern property boundary – scaled to 109%**

A-2 Proposed system

A-2-1 Original values

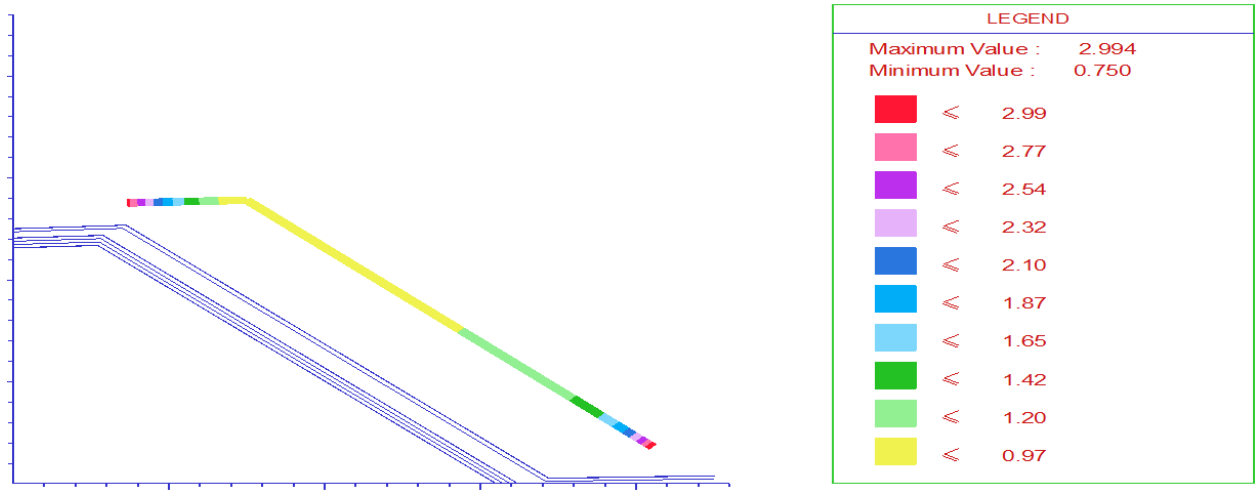


Figure I **Magnetic fields along western property boundary – original**

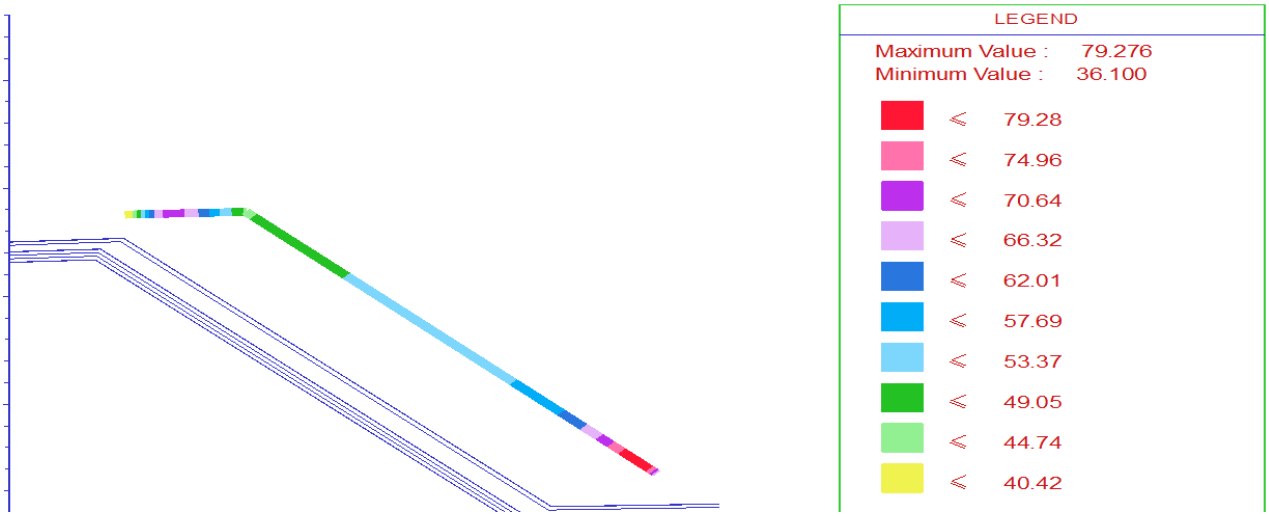


Figure J **Electric fields along western property boundary – original**

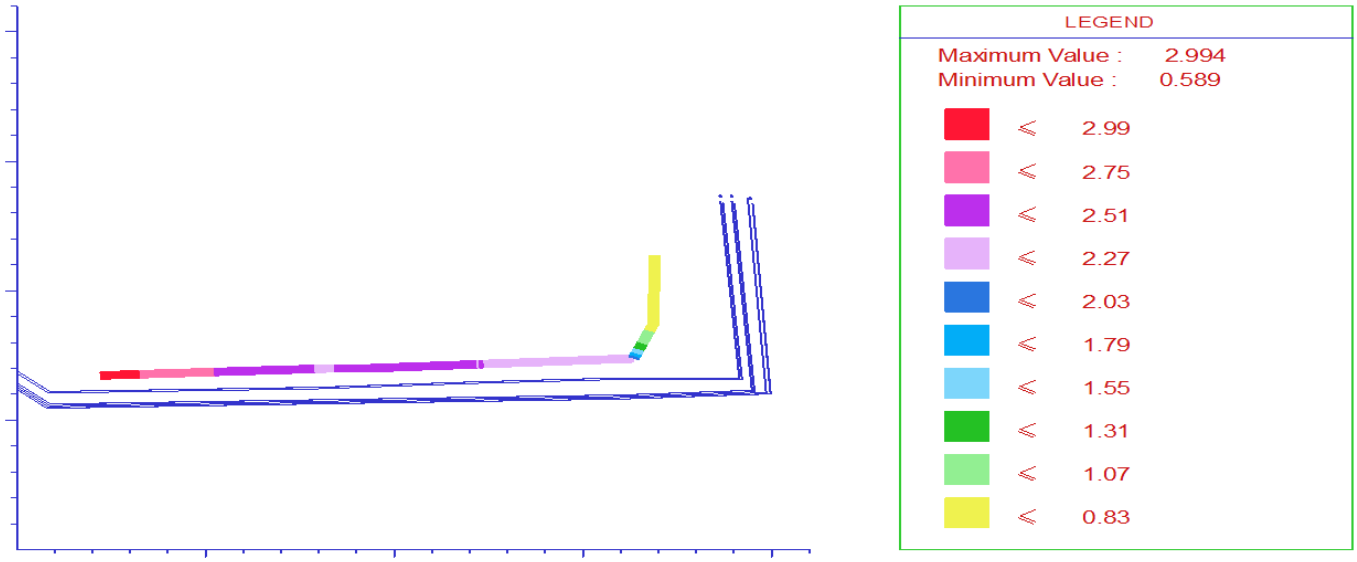


Figure K **Magnetic fields along eastern property boundary – original**

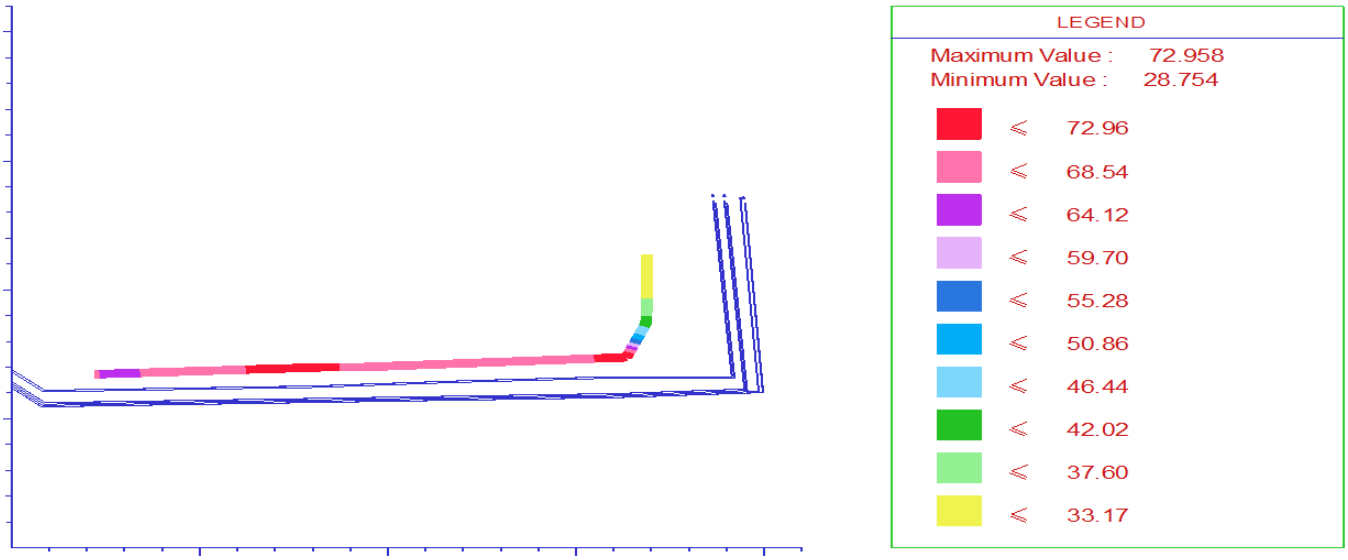


Figure L **Electric fields along eastern property boundary – original**

A-2-2 Scaled values

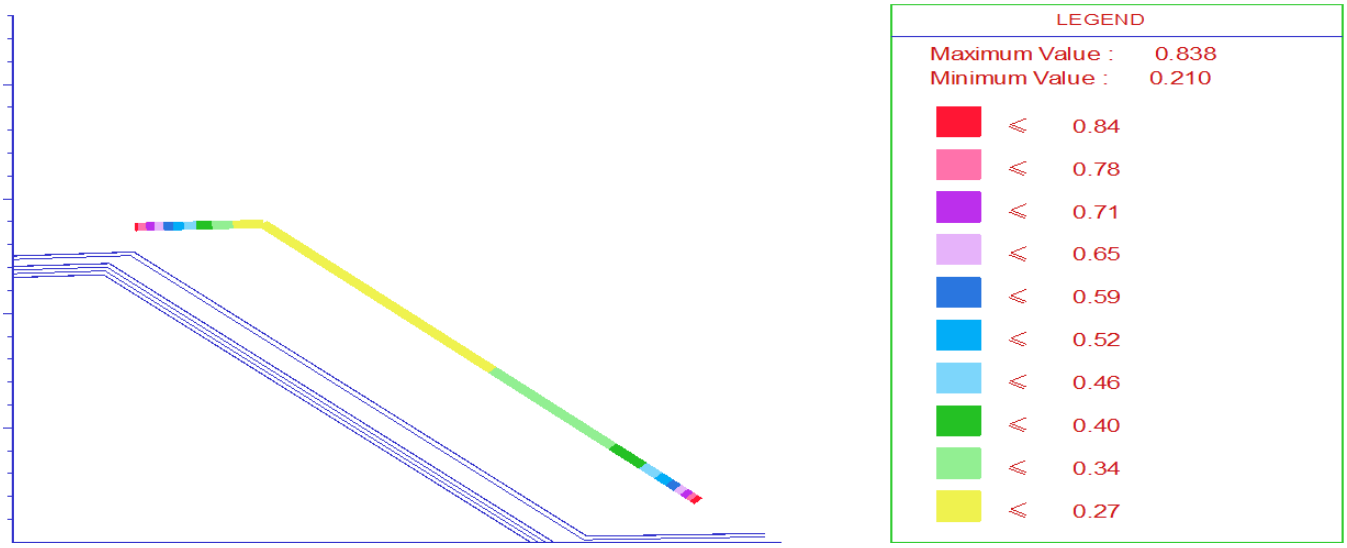


Figure M **Magnetic fields along western property boundary – scaled to 28%**

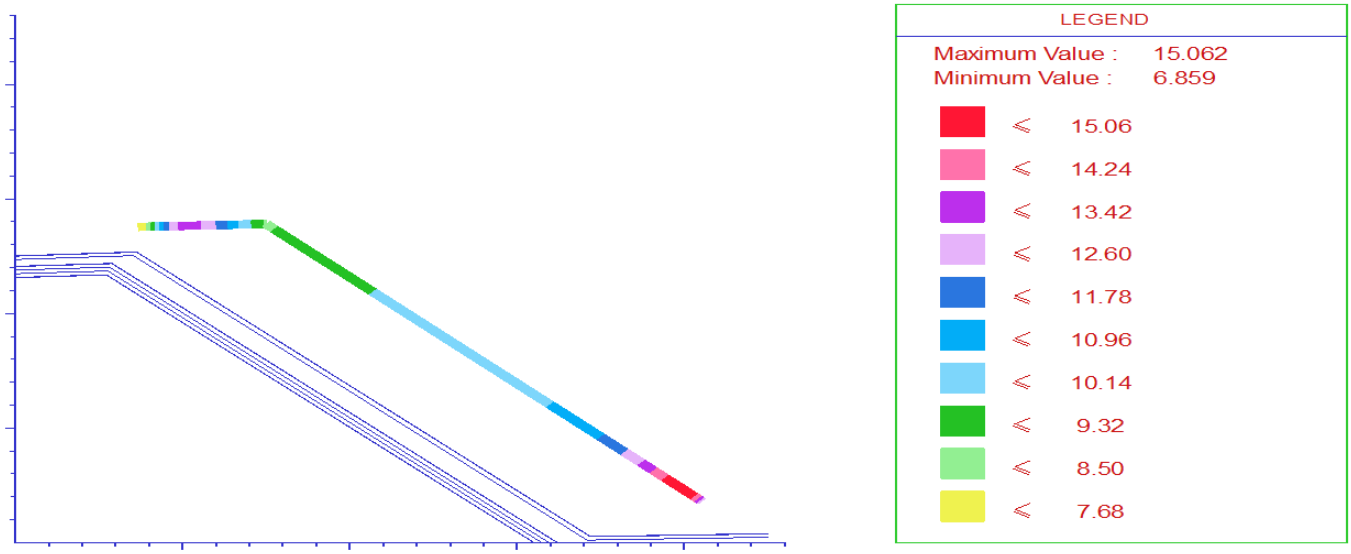


Figure N **Electric fields along western property boundary – scaled to 19%**

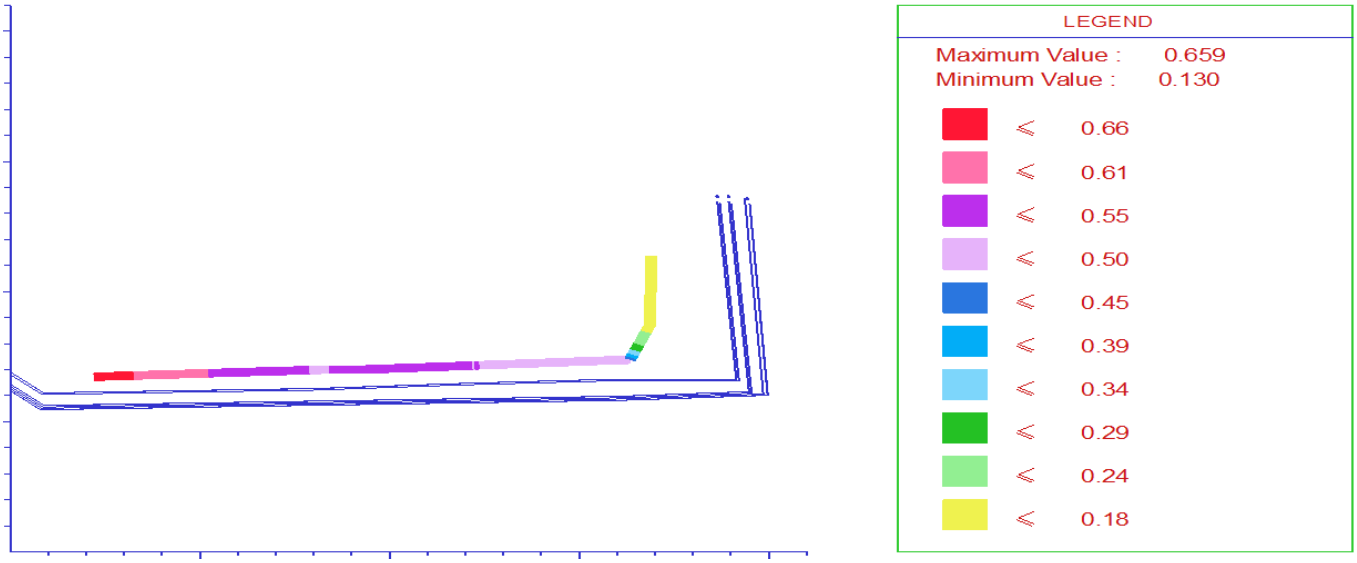


Figure O **Magnetic fields along eastern property boundary – scaled to 22%**

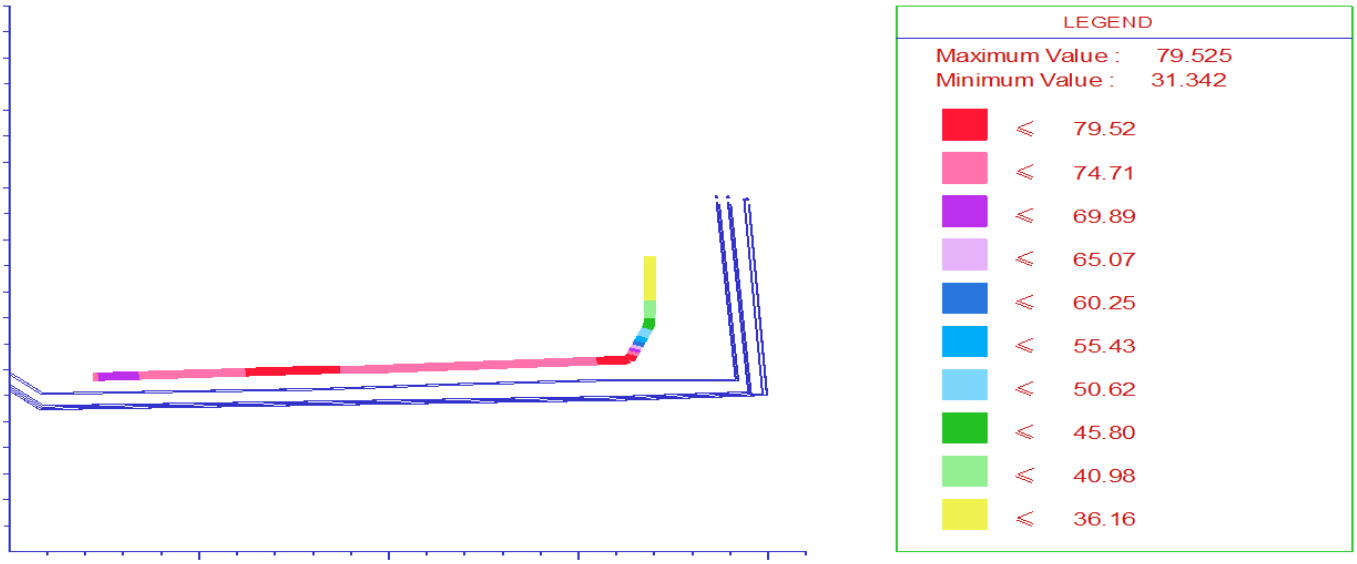


Figure P **Electric fields along eastern property boundary – scaled to 109%**

A-2-3 Magnetic field contours (unscaled)

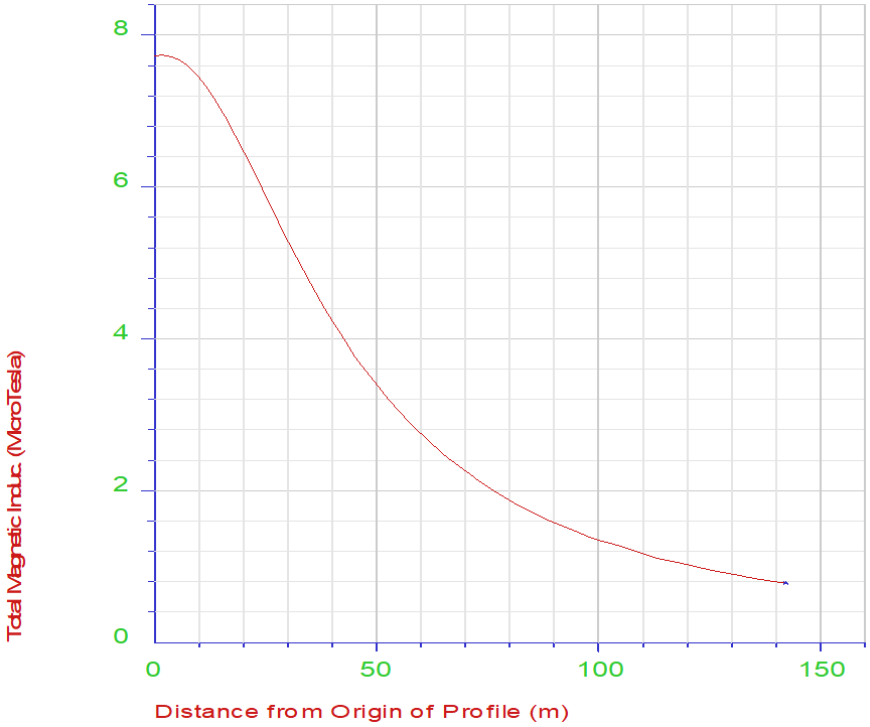


Figure Q **Magnetic field contour for profile 1**

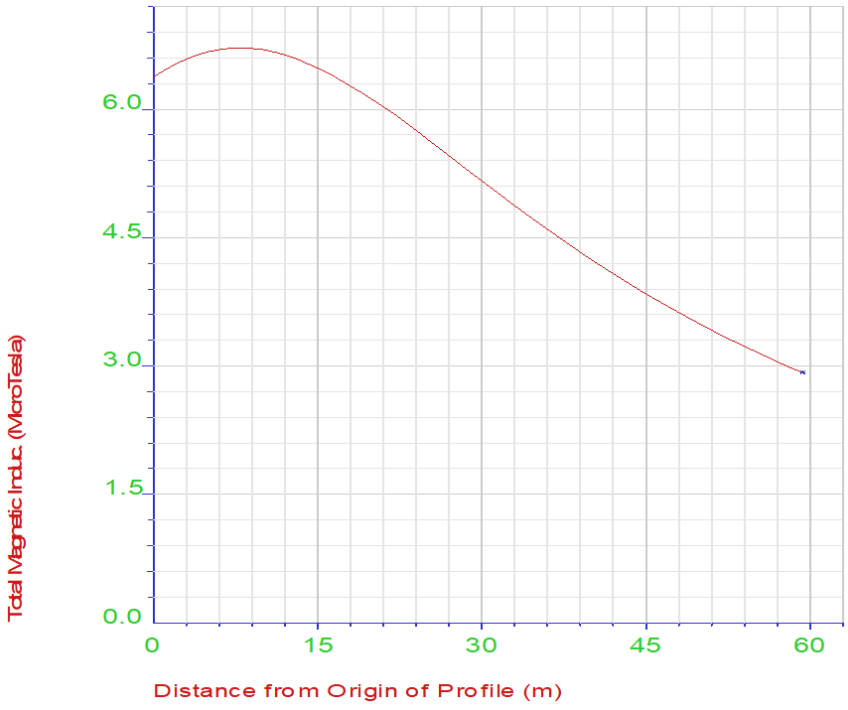


Figure R **Magnetic field contour for profile 2**

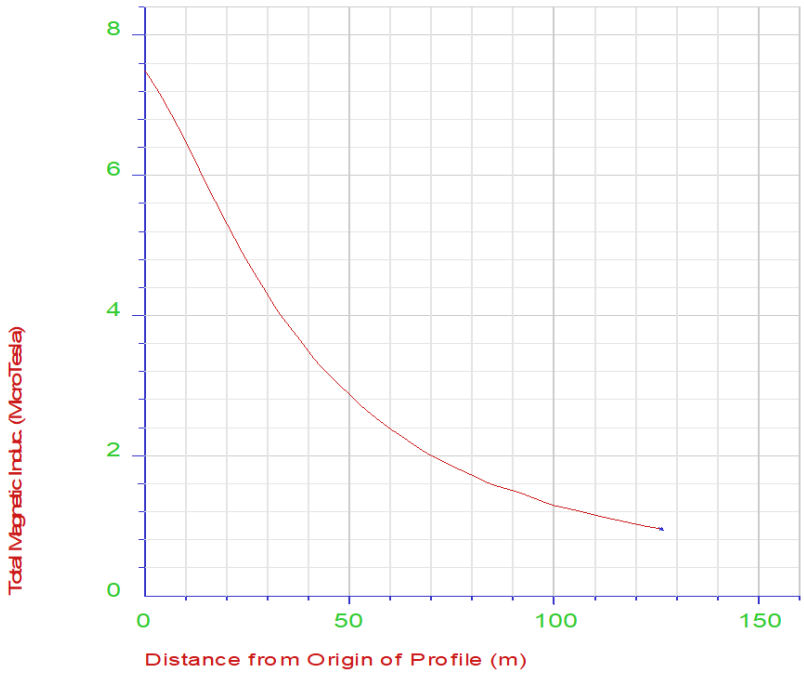


Figure S **Magnetic field contour for profile 3**

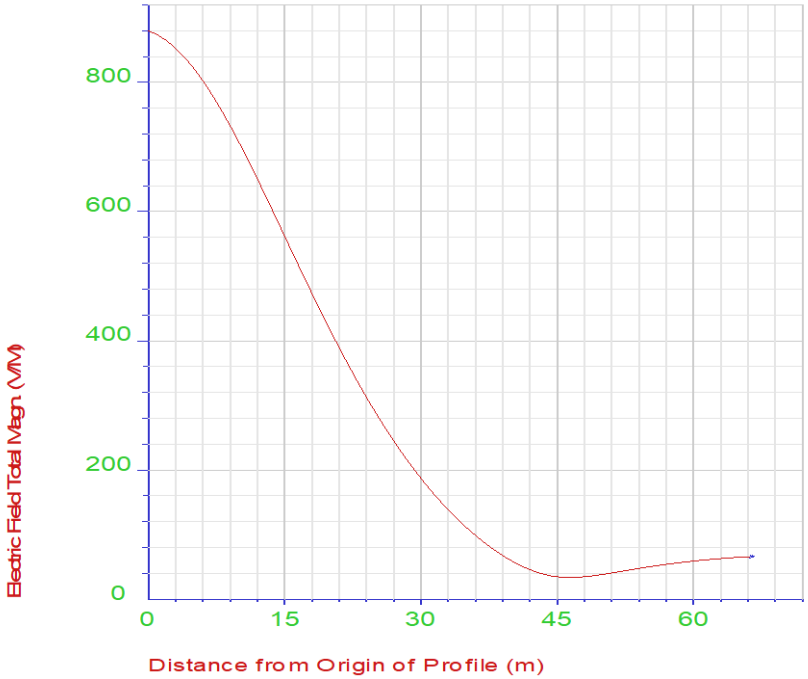


Figure T **Magnetic field contour for profile 4**

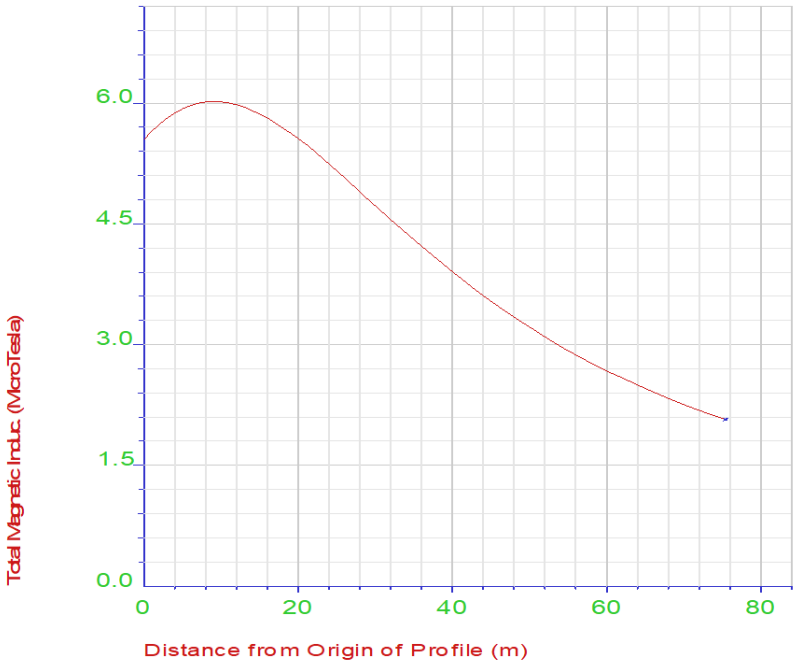


Figure U **Magnetic field contour for profile 5**

A-2-4 Electric field contours (unscaled)

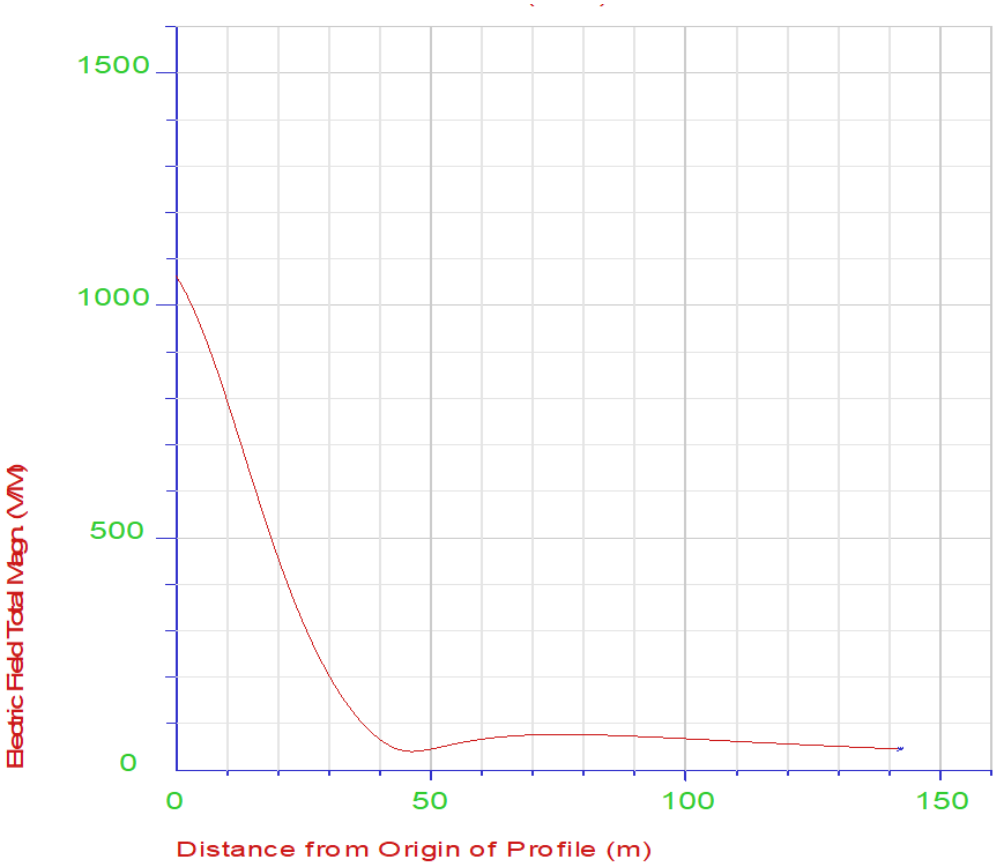


Figure V **Electric field contour for profile 1**

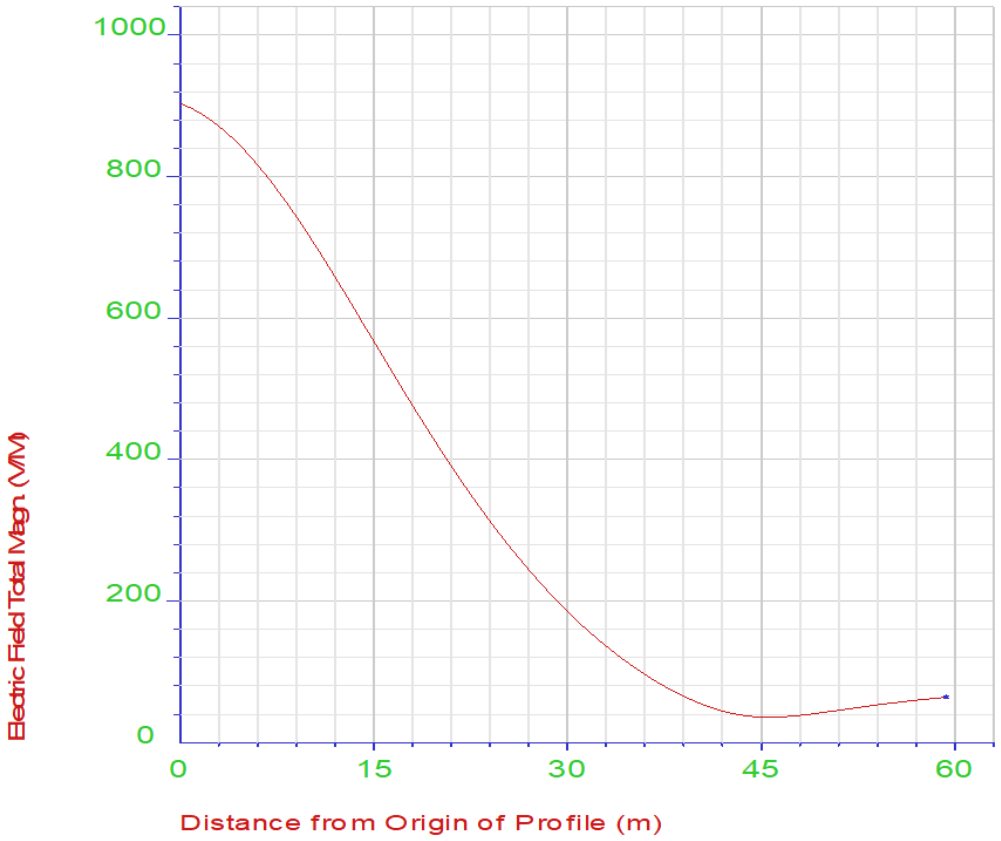


Figure W **Electric field contour for profile 2**

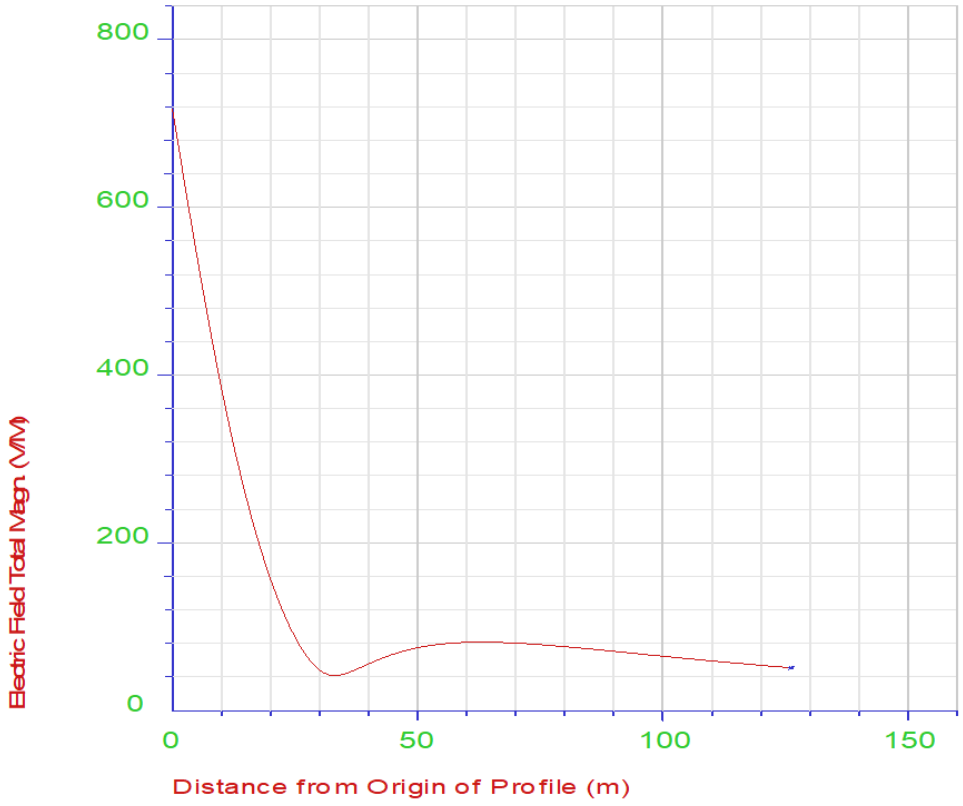


Figure X ***Electric field contour for profile 3***

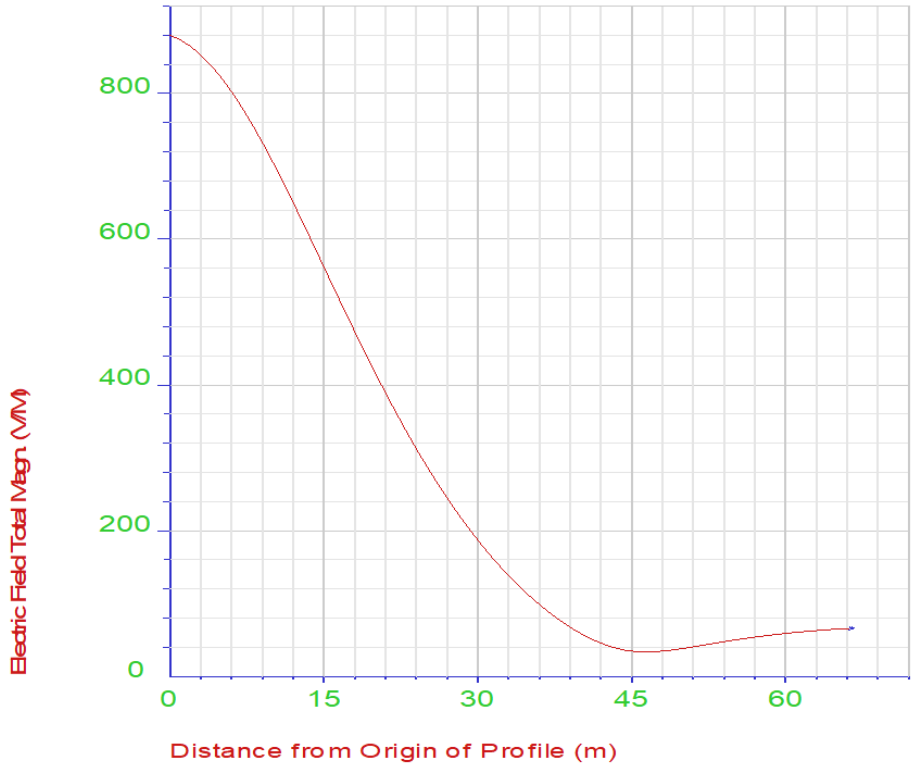


Figure Y **Electric field contour for profile 4**

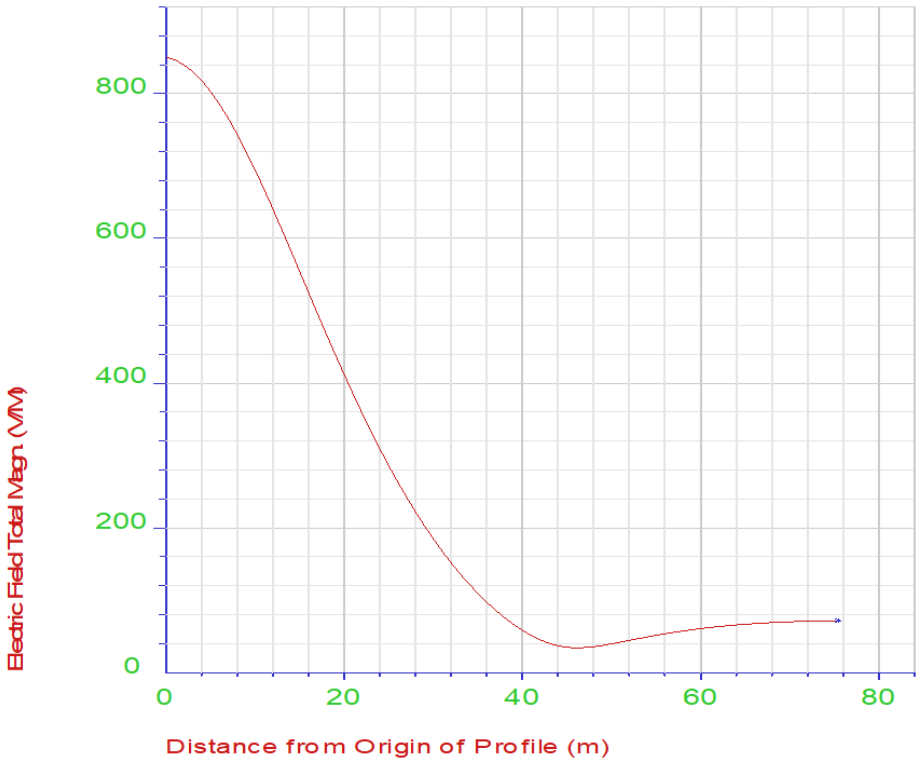


Figure Z **Electric field contour for profile 5**

Appendix B

Monitoring photos

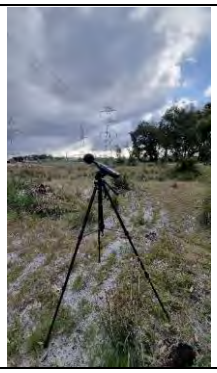
The following tables provide images of the monitoring undertaken for the:

- Short Term Attended Noise and EMF Monitoring
- Long Term Unattended Noise Monitoring
- Long Term Unattended EMF Monitoring

Table: Short Term Attended Noise and EMF Monitoring Photos

Address	Location		
	Under TL (T1)	30m from TL	Easement Edge
4-6 Arnhem Court			
75 Guadalupe Drive			
85 Guadalupe Drive			No Photo
91 Guadalupe Drive			
99 Guadalupe Drive		No Photo	

Address	Location		
	Under TL (T1)	30m from TL	Easement Edge
109 Guadalupe Drive			
16-18 Lassen Gardens			- 
8 Lassen Gardens			
33 Yosemite Loop			
41 Yosemite Loop			
49 Yosemite Loop			

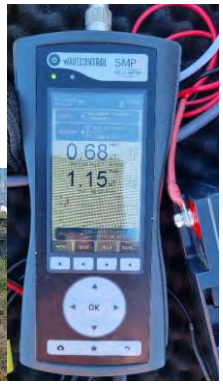
Address	Location		
	Under TL (T1)	30m from TL	Easement Edge
27 Huntingdon Mews			
1 Tekapo Lane			
9 Tekapo Lane	- 		
1 The Elms			
28 Tintagel Place			No Photo

Address	Location		
	Under TL (T1)	30m from TL	Easement Edge
8 Bampton Lane			
60 Nottingham Gardens			
46 Winchester Place			
38 Winchester Place			

Table: Long Term Unattended Noise Monitoring Photos

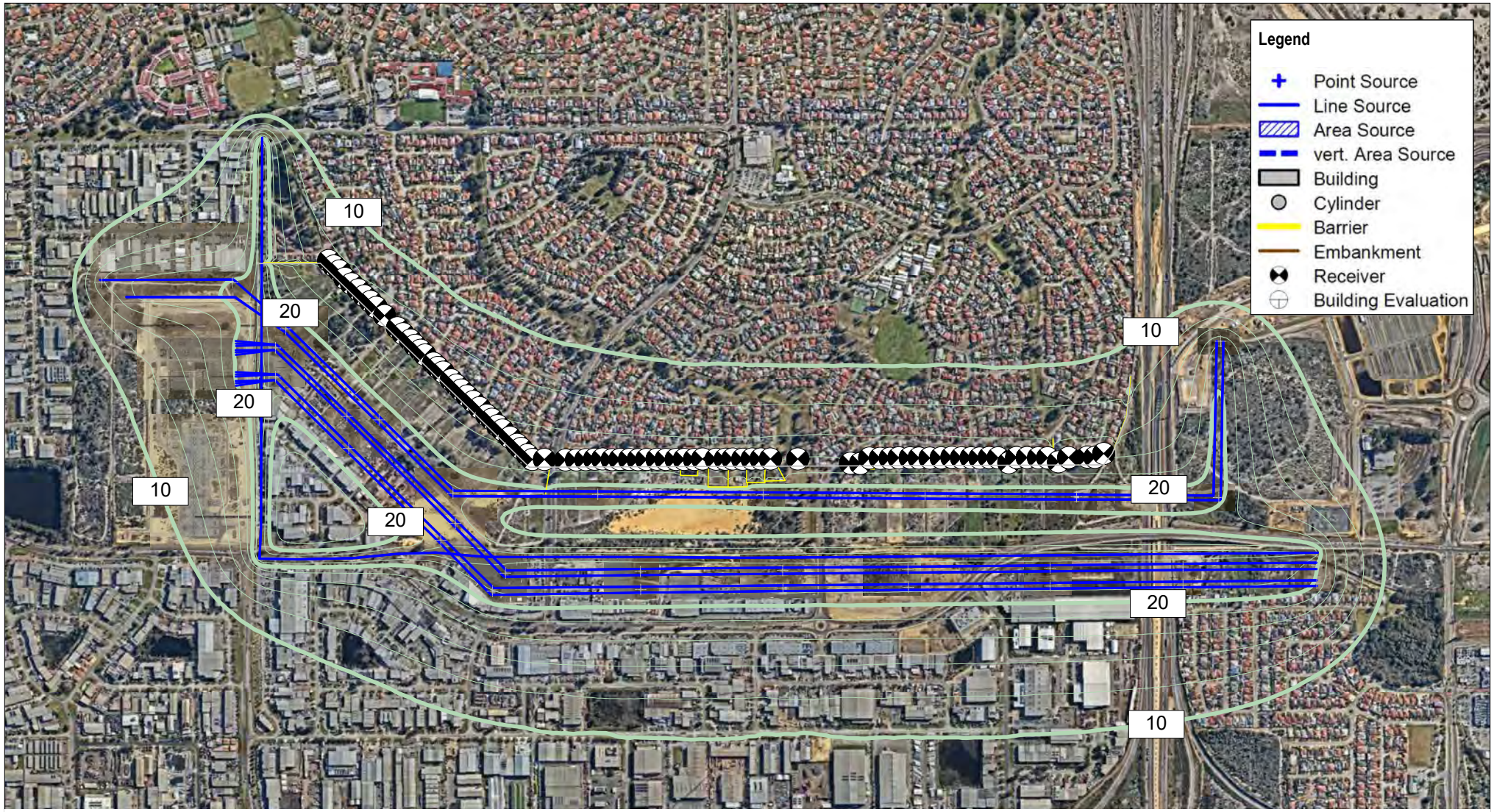
Monitoring location	Image
Noise Logger 1 69 Guadalupe Drive	
Noise Logger 2 107 Guadalupe Drive	
Noise Logger 3 8 Lassen Gardens	
Noise Logger 4 7 Tekapo Lane	
Noise Logger 5 38 Winchester Place	

Table: Long Term Unattended EMF Monitoring Photos

Monitoring location	Image
EMF Logger 1 60 Nottingham Gardens	  
EMF Logger 2 85 Guadalupe Drive	  

Appendix C

Predicted noise contours



Paper Size ANSI B

0 100 200 300 400 500 m

N

GHD

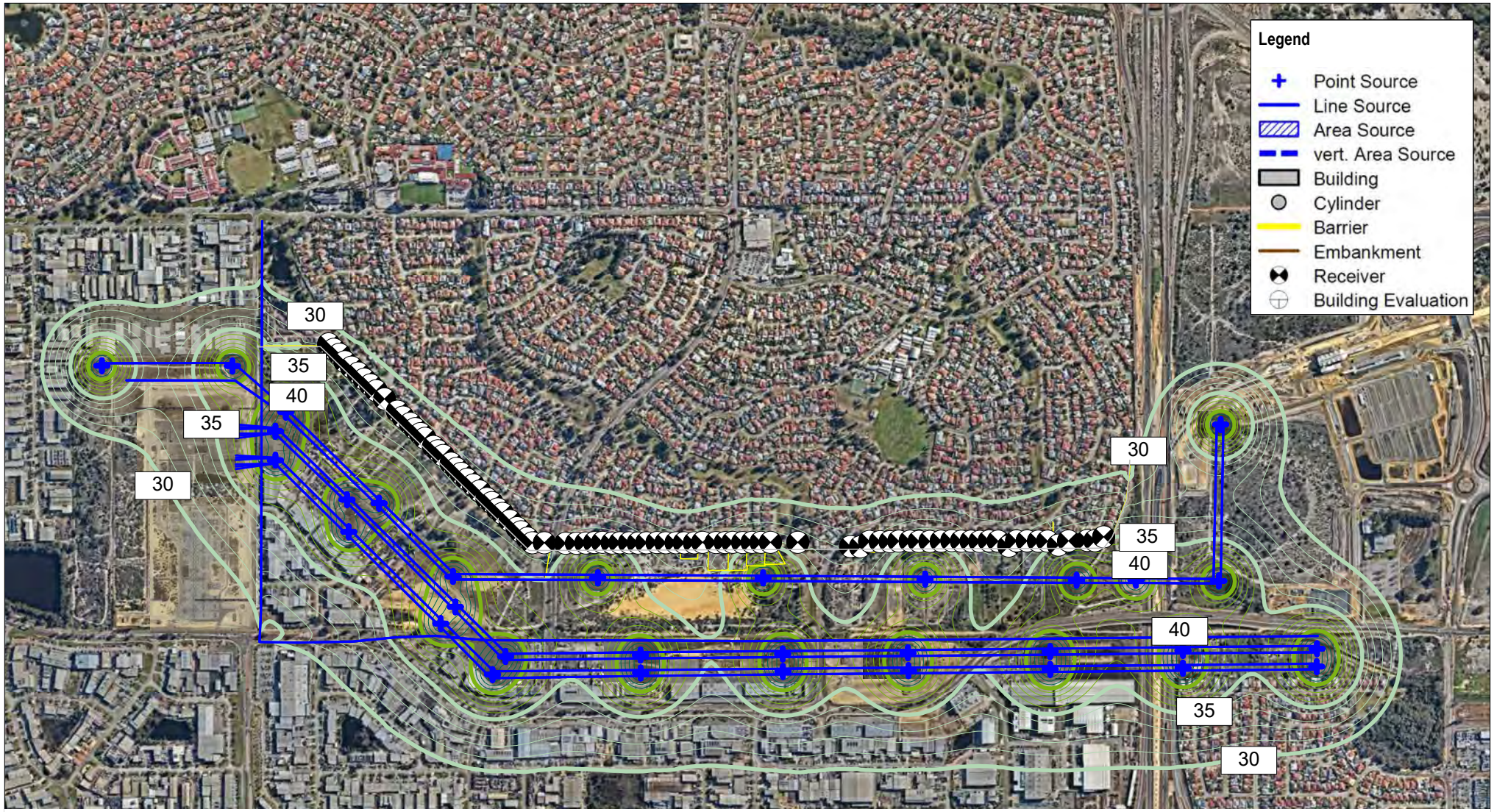
EMF and Noise Monitoring
Western Power
Noise Assessment

Existing Condition - Fair Weather

Project No. **12614906**
Revision No. **0**
Date **12.10.2023**

FIGURE C1

\\ghdnet\ghd\AU\Perth\Projects\61\12614906\Tech\Noise\05_Modelling\12614906_Existing_Model_NoPointSources.cna
Imagery source:



Paper Size ANSI B

0 100 200 300 400 500 m

N

GHD

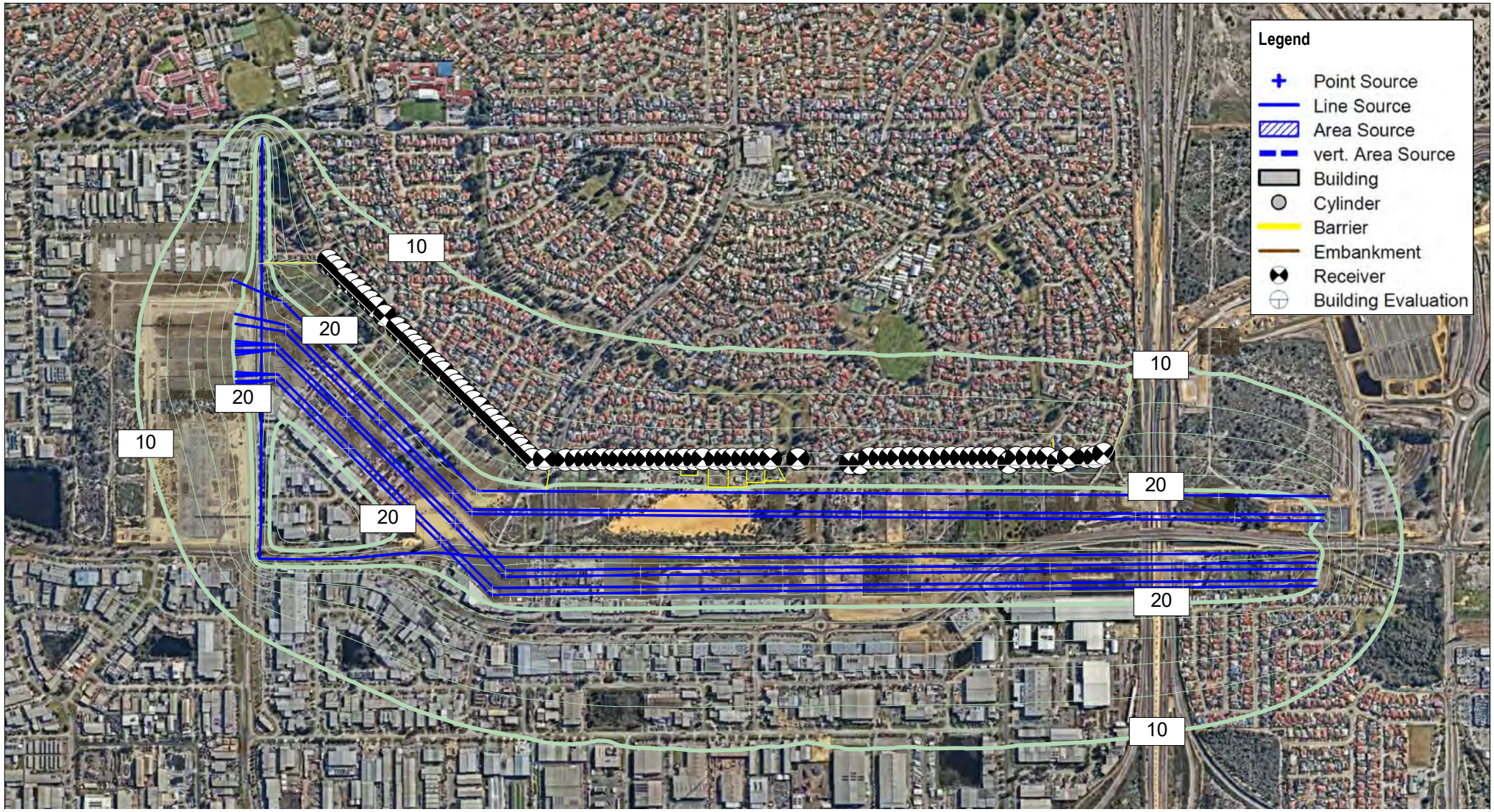
EMF and Noise Monitoring
Western Power
Noise Assessment

Existing Condition - Rain Event

Project No. **12614906**
Revision No. **0**
Date **12.10.2023**

FIGURE C2

\\ghdnet\ghd\AU\Perth\Projects\61\12614906\Tech\Noise\05_Modelling\12614906_Existing_Model_Rain_Event.cna
Imagery source:



Paper Size ANSI B

0 100 200 300 400 500 m

N

GHD

EMF and Noise Monitoring
Western Power
Noise Assessment

Proposed Relocation - Fair Weather

Project No. **12614906**
Revision No. **0**
Date **12.10.2023**

FIGURE C3

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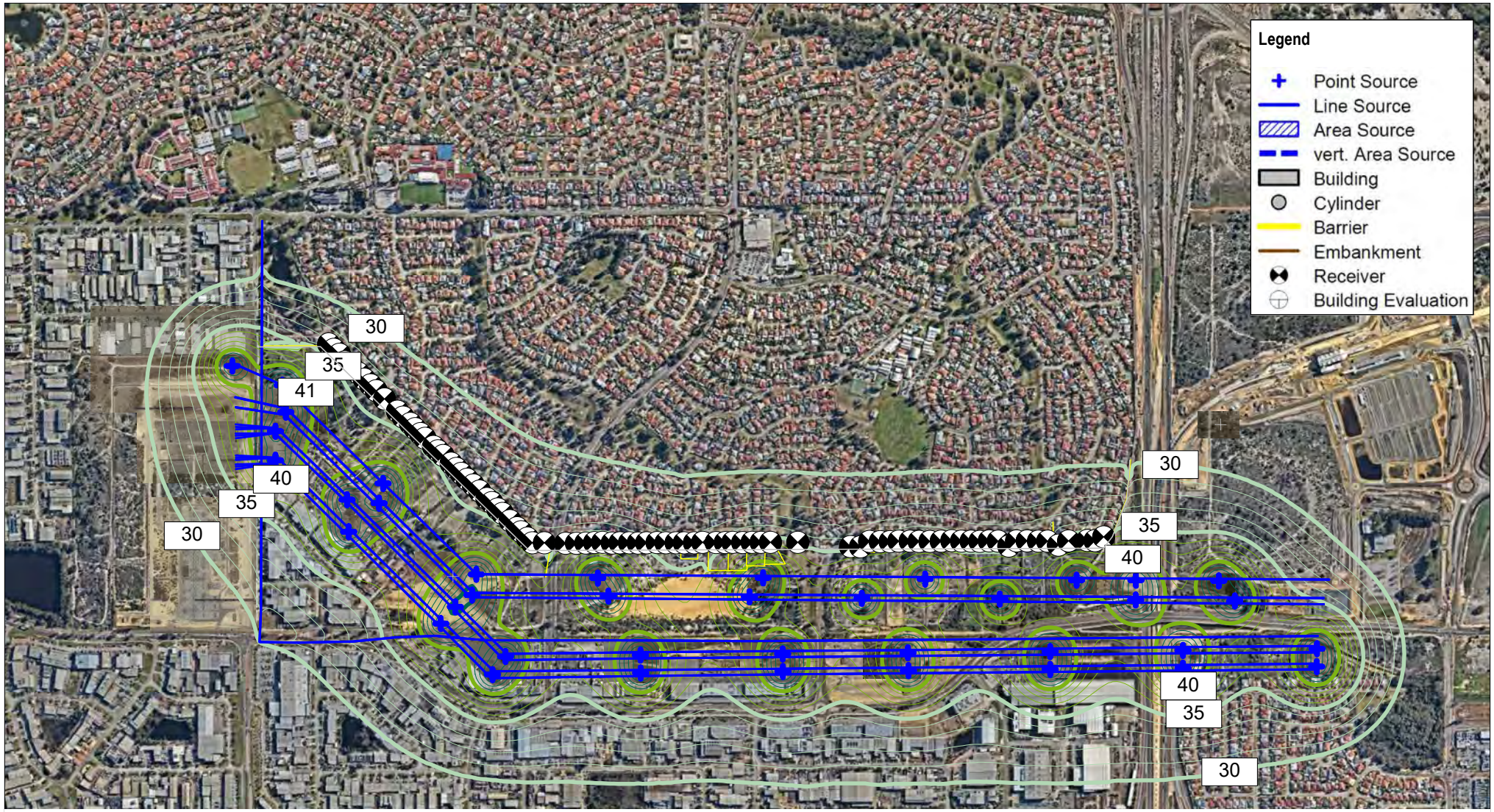


Paper Size ANSI B

0 100 200 300 400 500 m

N

GHD

EMF and Noise Monitoring
Western Power
Noise Assessment

Proposed Relocation - Rain Event

Project No. **12614906**
Revision No. **0**
Date **12.10.2023**

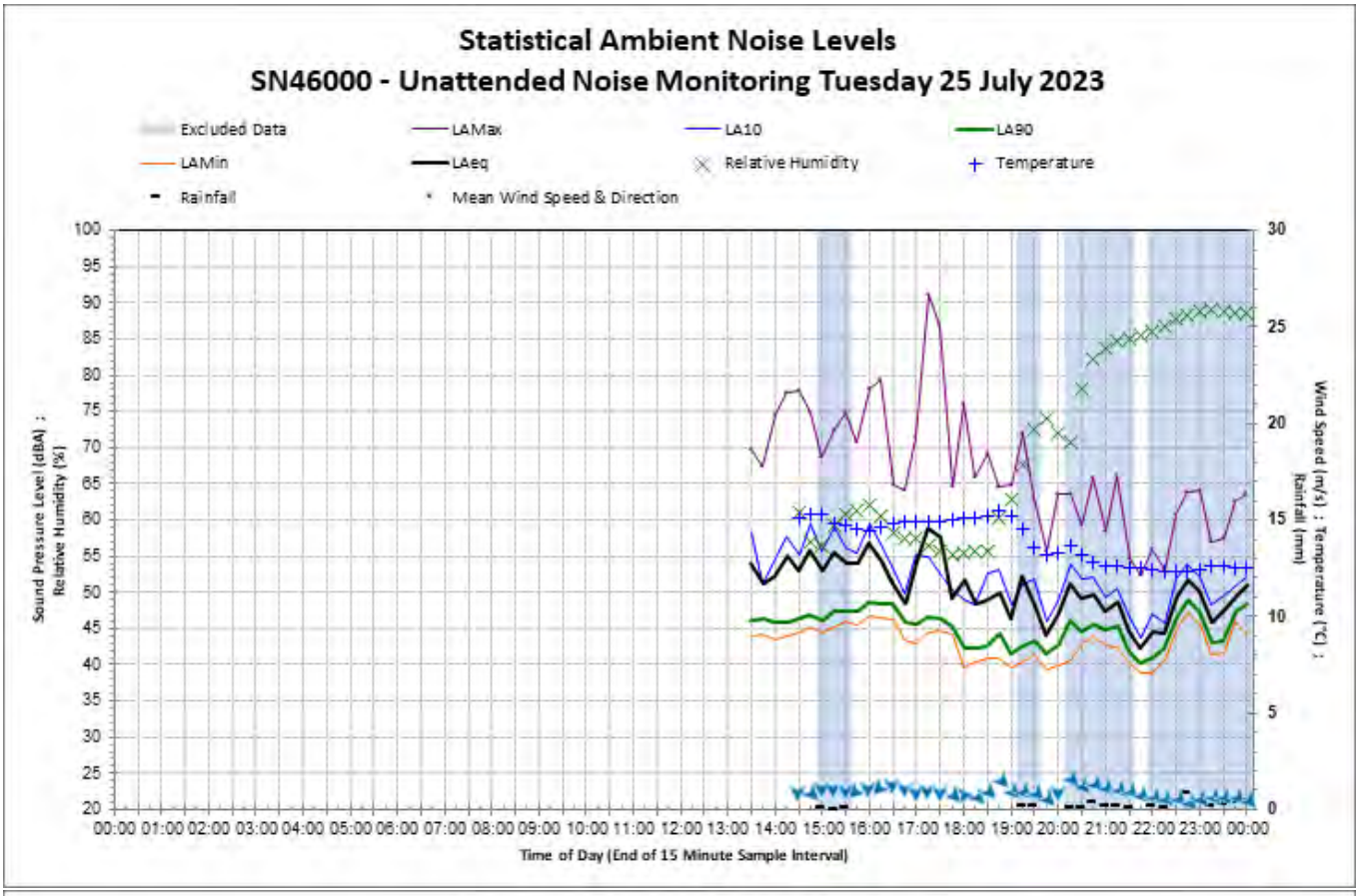
FIGURE C4

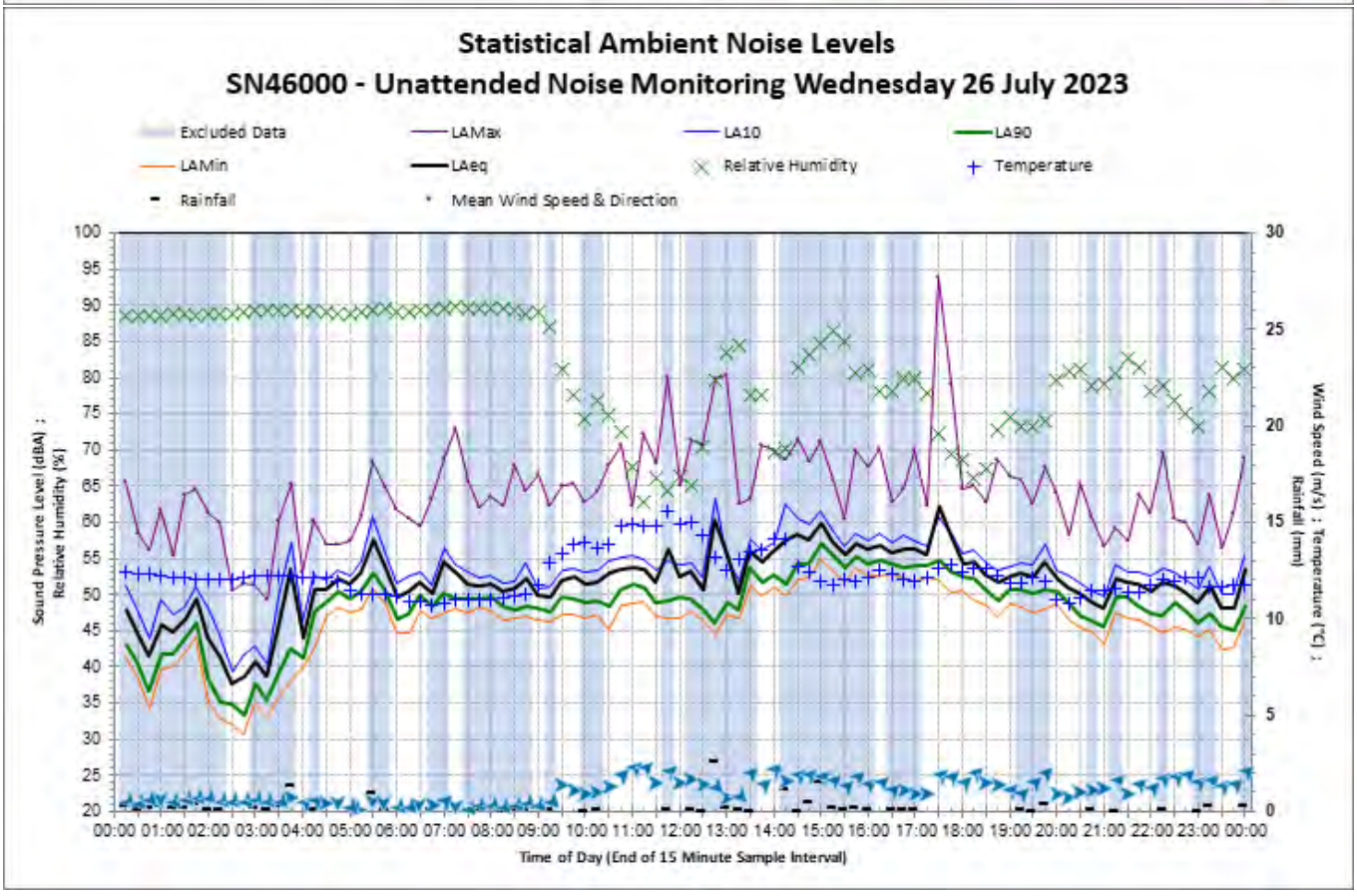
\\ghdnet\ghd\AU\Perth\Projects\61\12614906\Tech\Noise\05_Modelling\12614906_Proposed_Model_Rain_Event.cna
Imagery source:

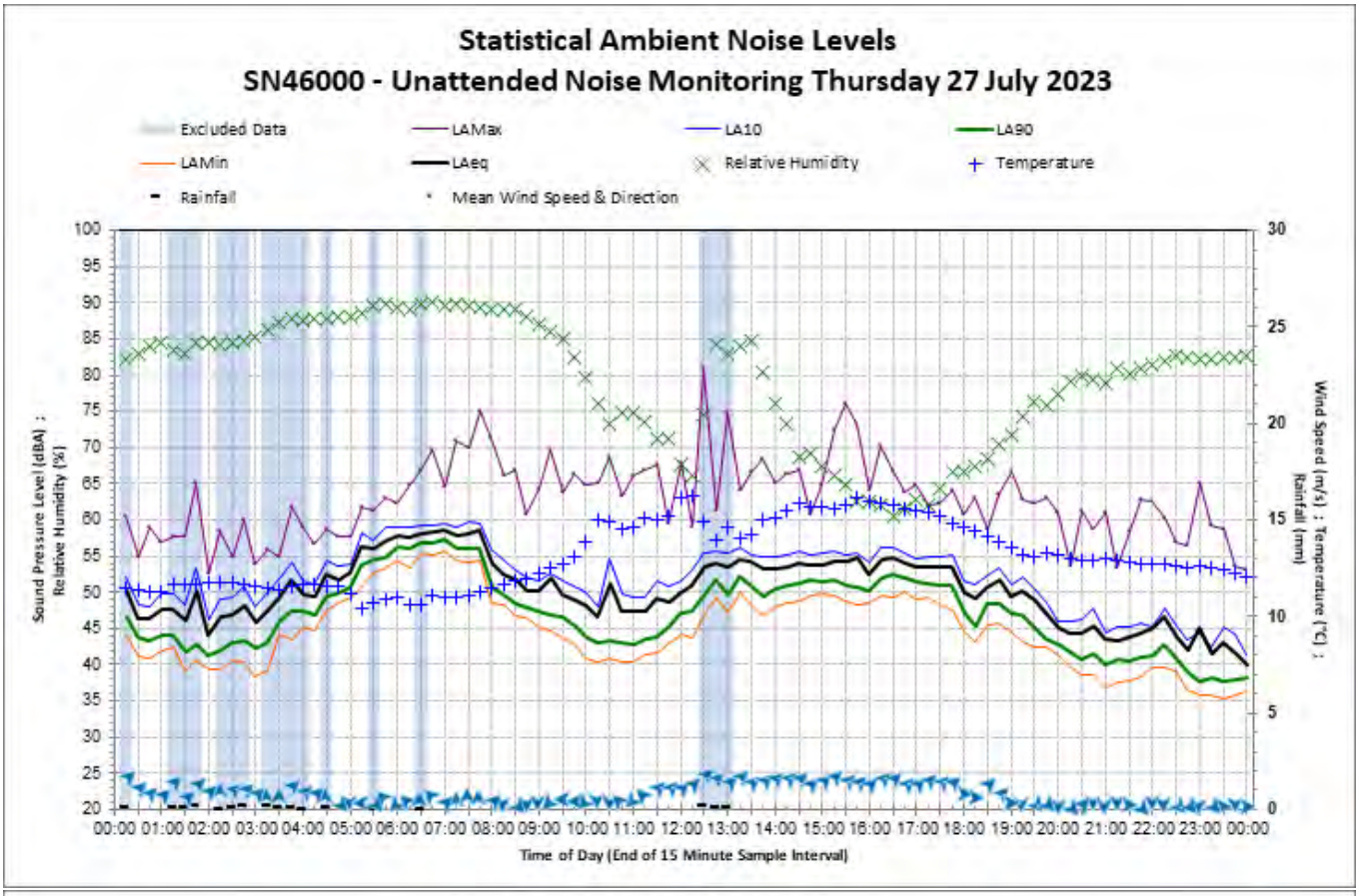
Appendix D

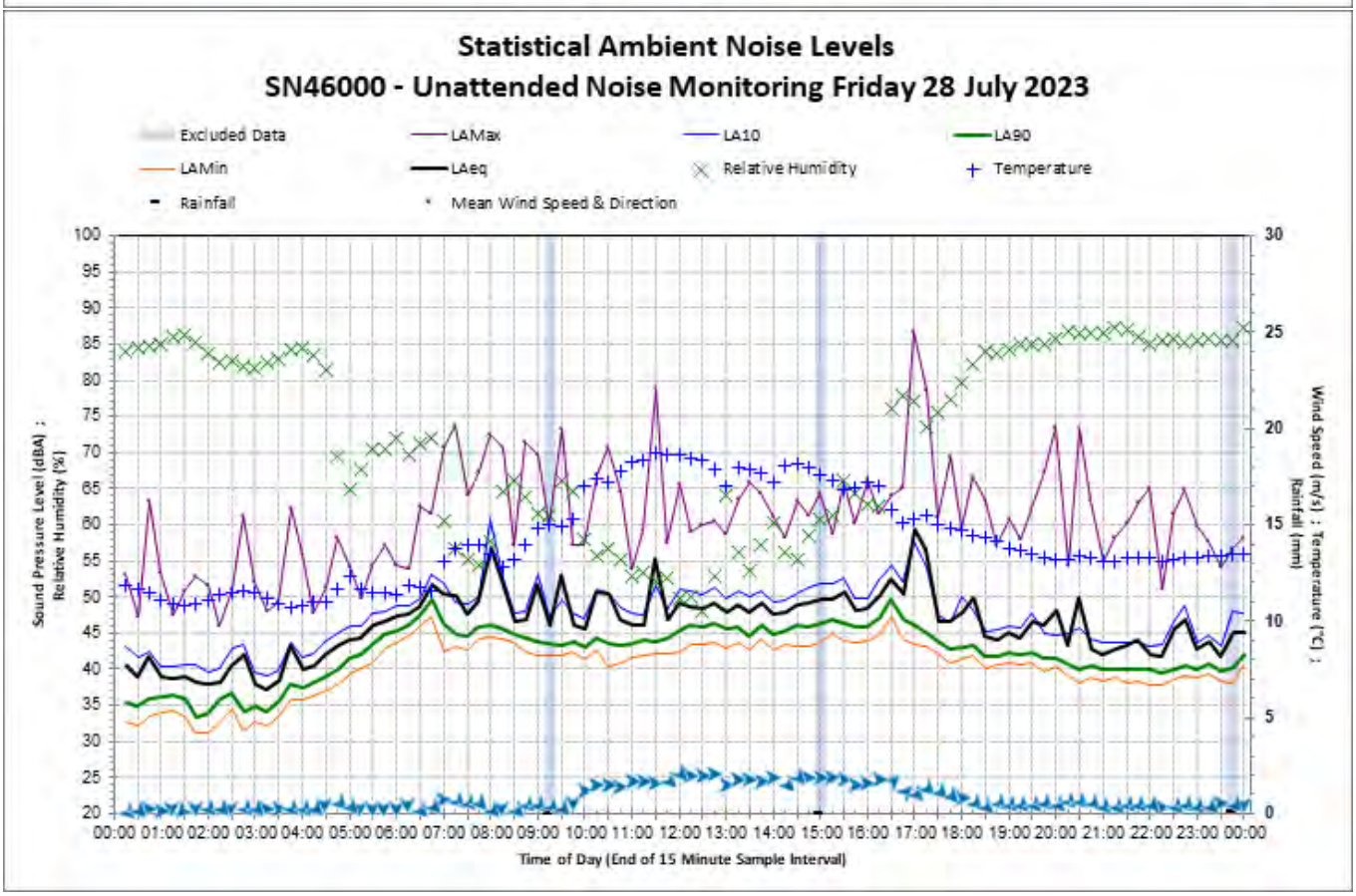
Noise logger charts

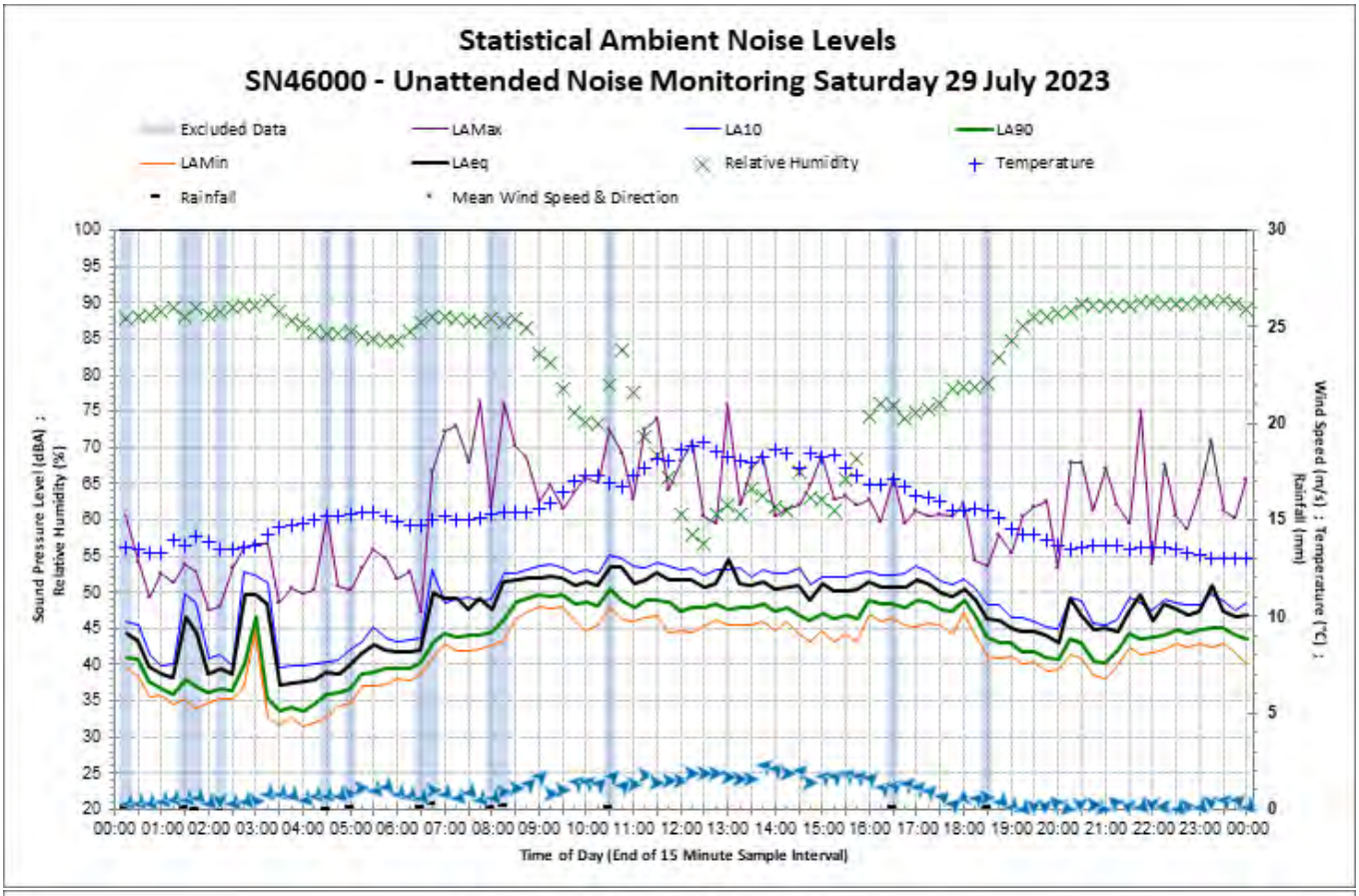
Logger 1 - SN46000 - 69 Guadalupe Drive - Noise Chart

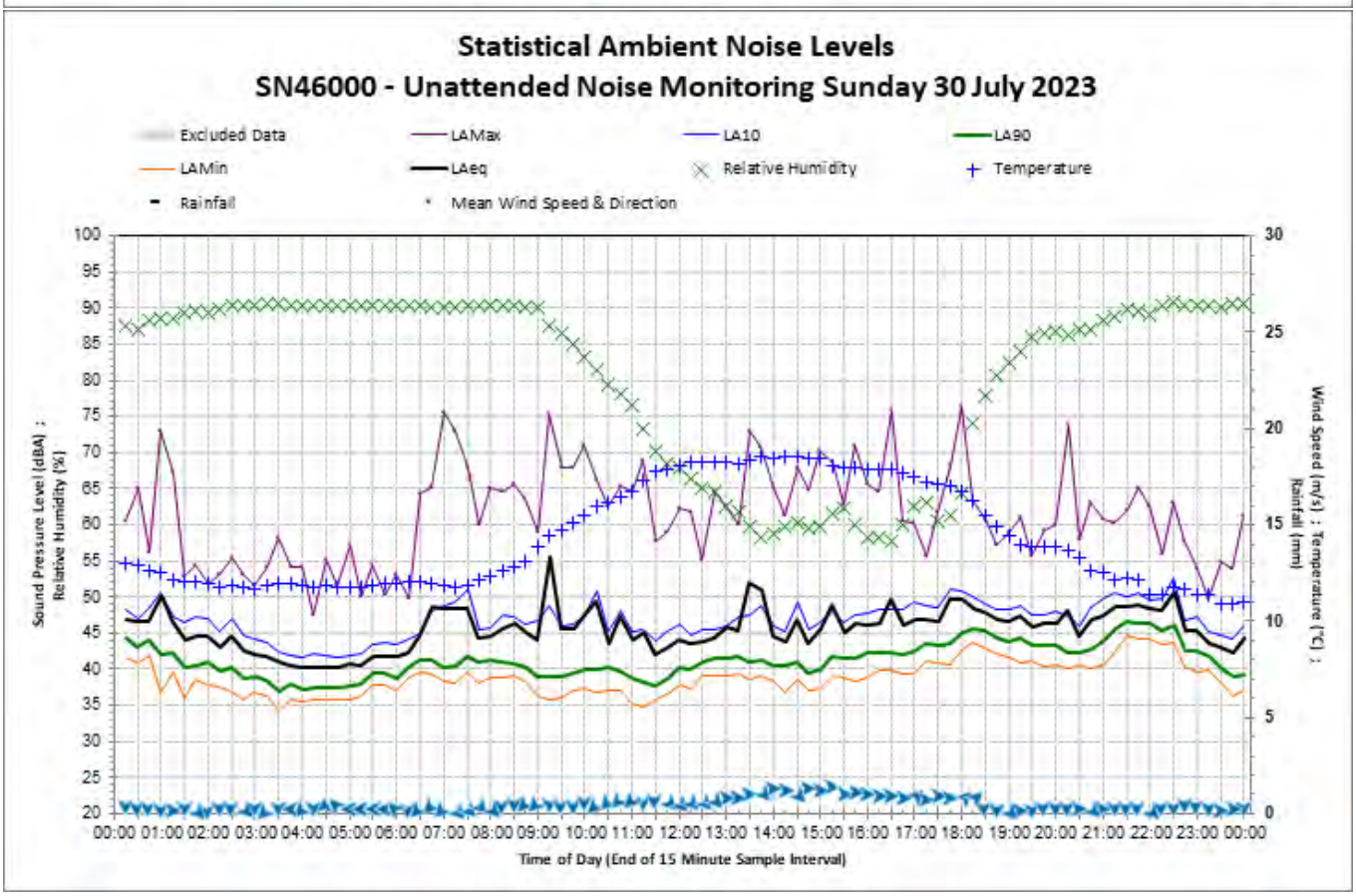




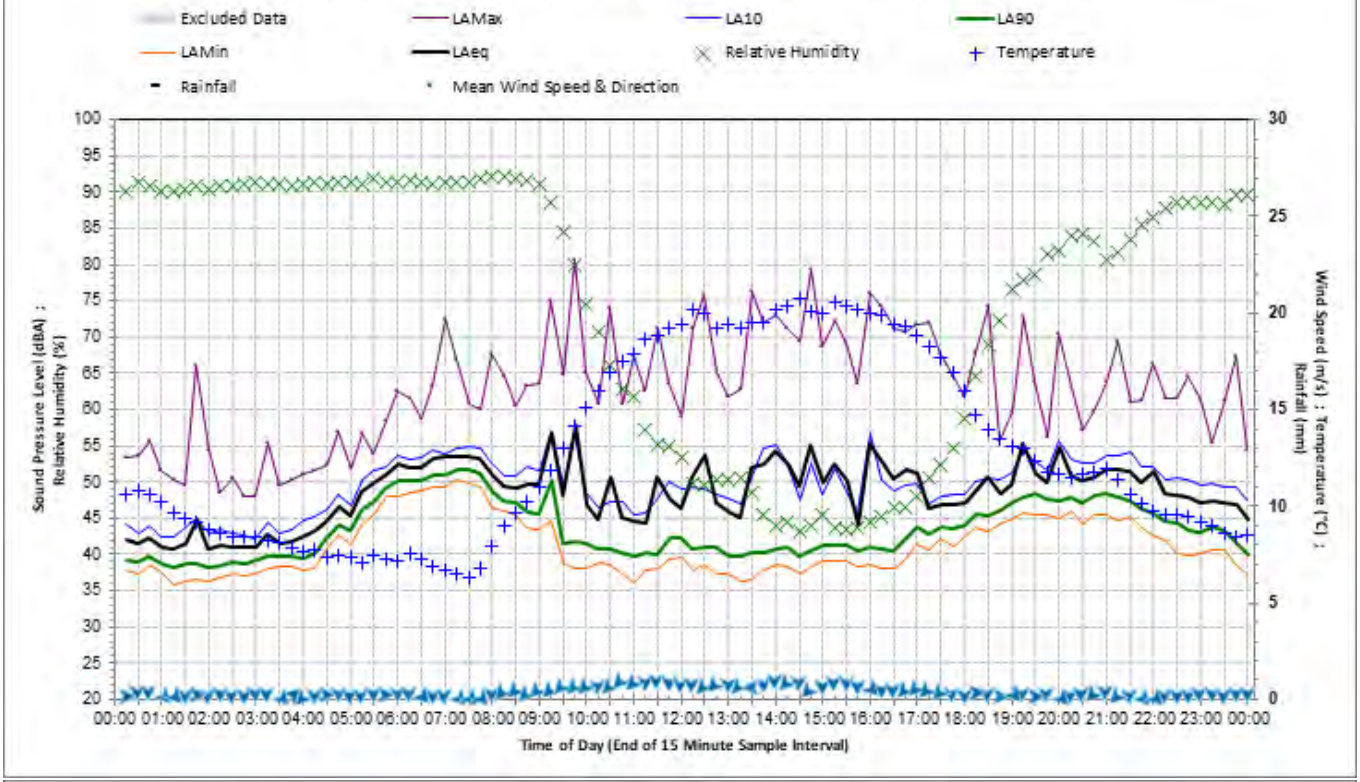

Statistical Ambient Noise Levels
SN46000 - Unattended Noise Monitoring Thursday 27 July 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
SN46000 - Unattended Noise Monitoring Friday 28 July 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

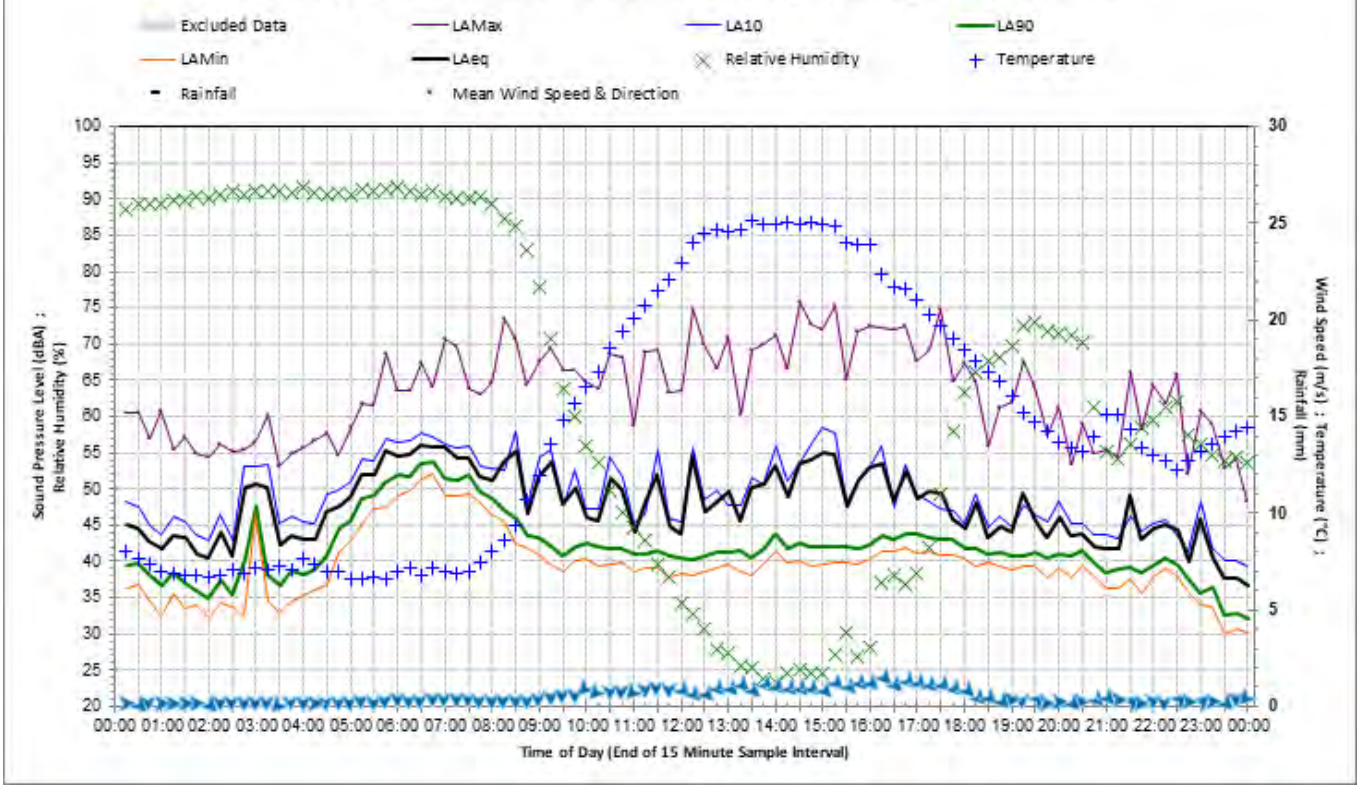

Statistical Ambient Noise Levels
SN46000 - Unattended Noise Monitoring Saturday 29 July 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

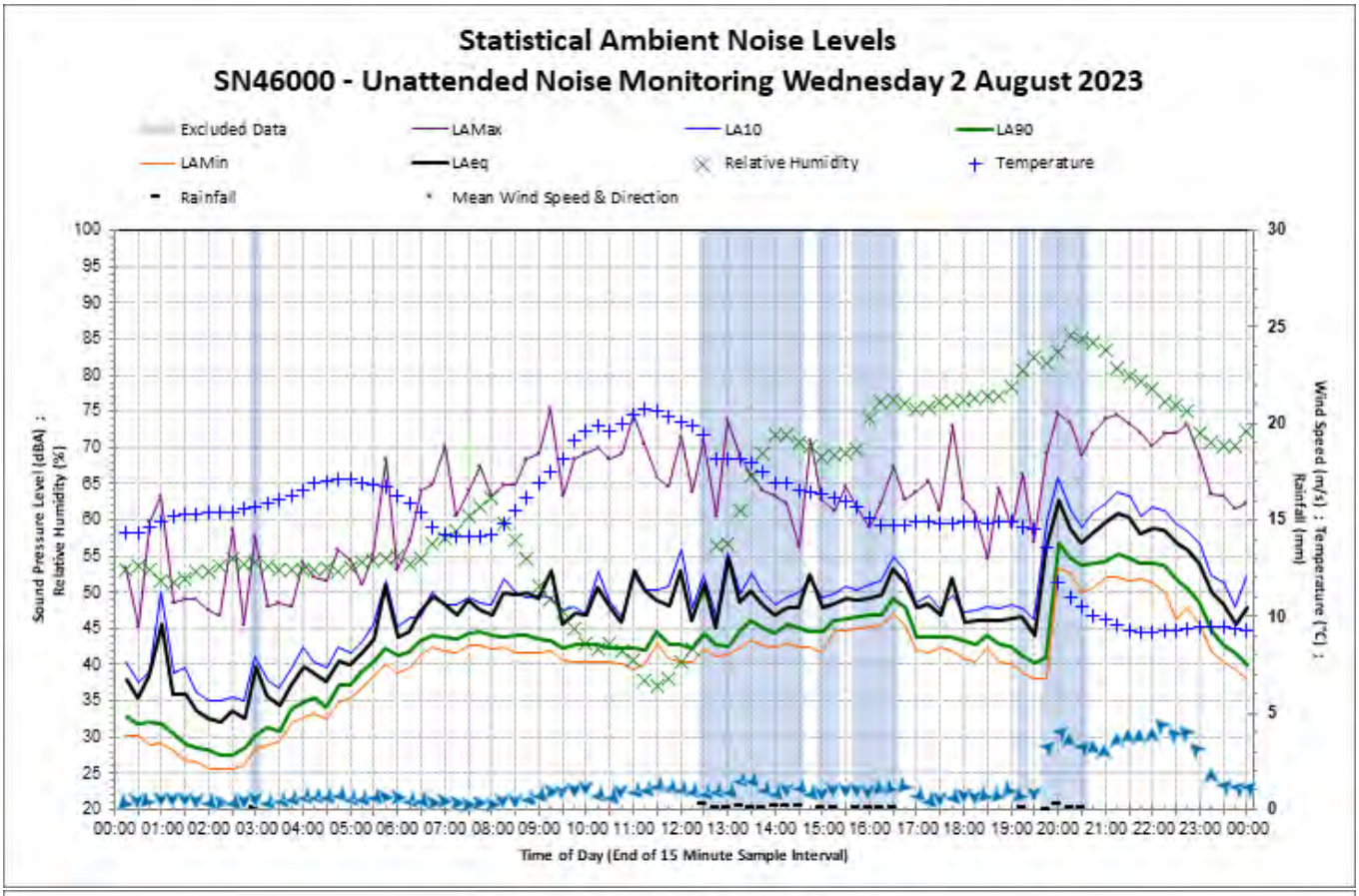

Statistical Ambient Noise Levels
SN46000 - Unattended Noise Monitoring Sunday 30 July 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

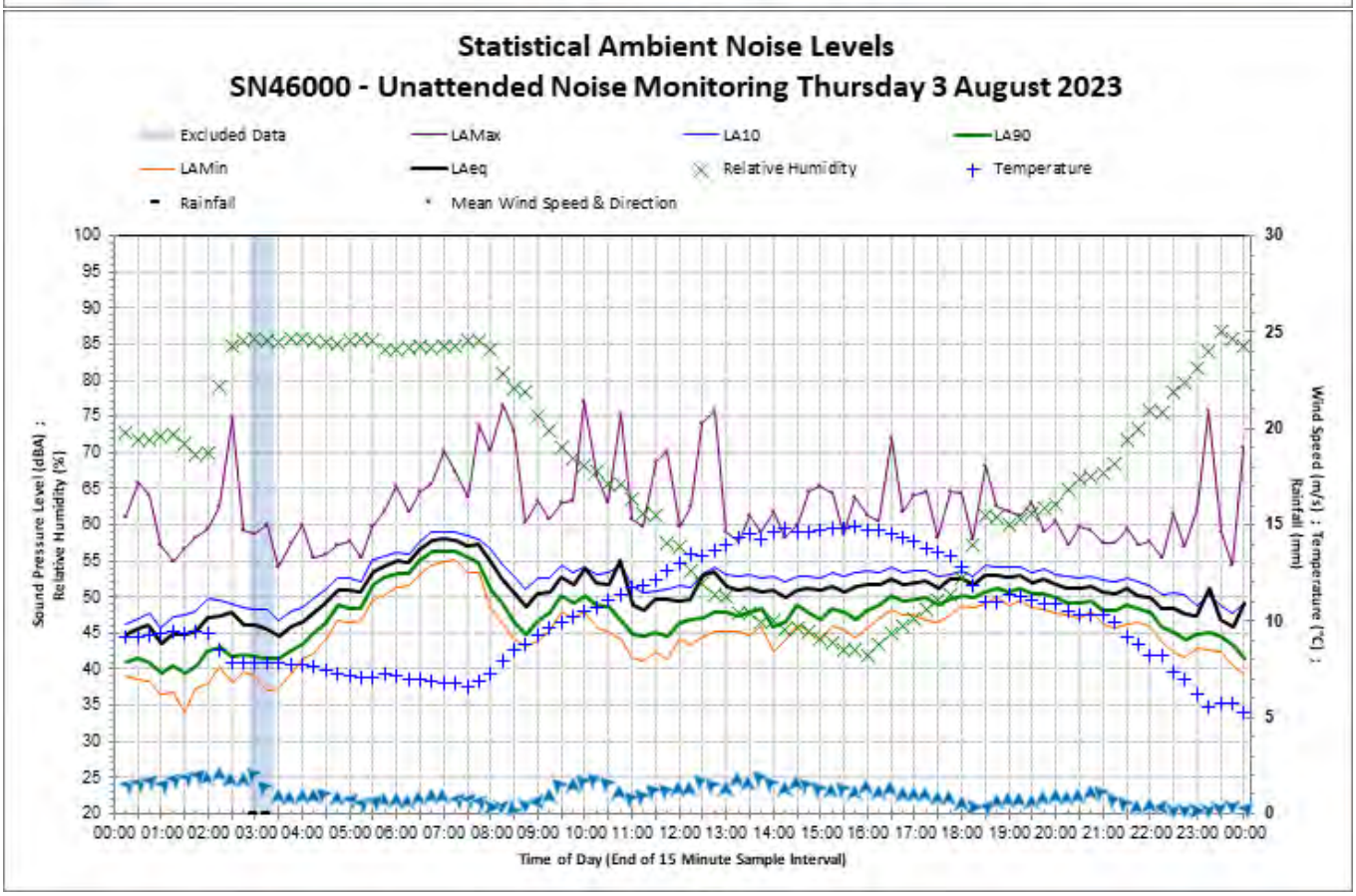
Statistical Ambient Noise Levels
SN46000 - Unattended Noise Monitoring Monday 31 July 2023

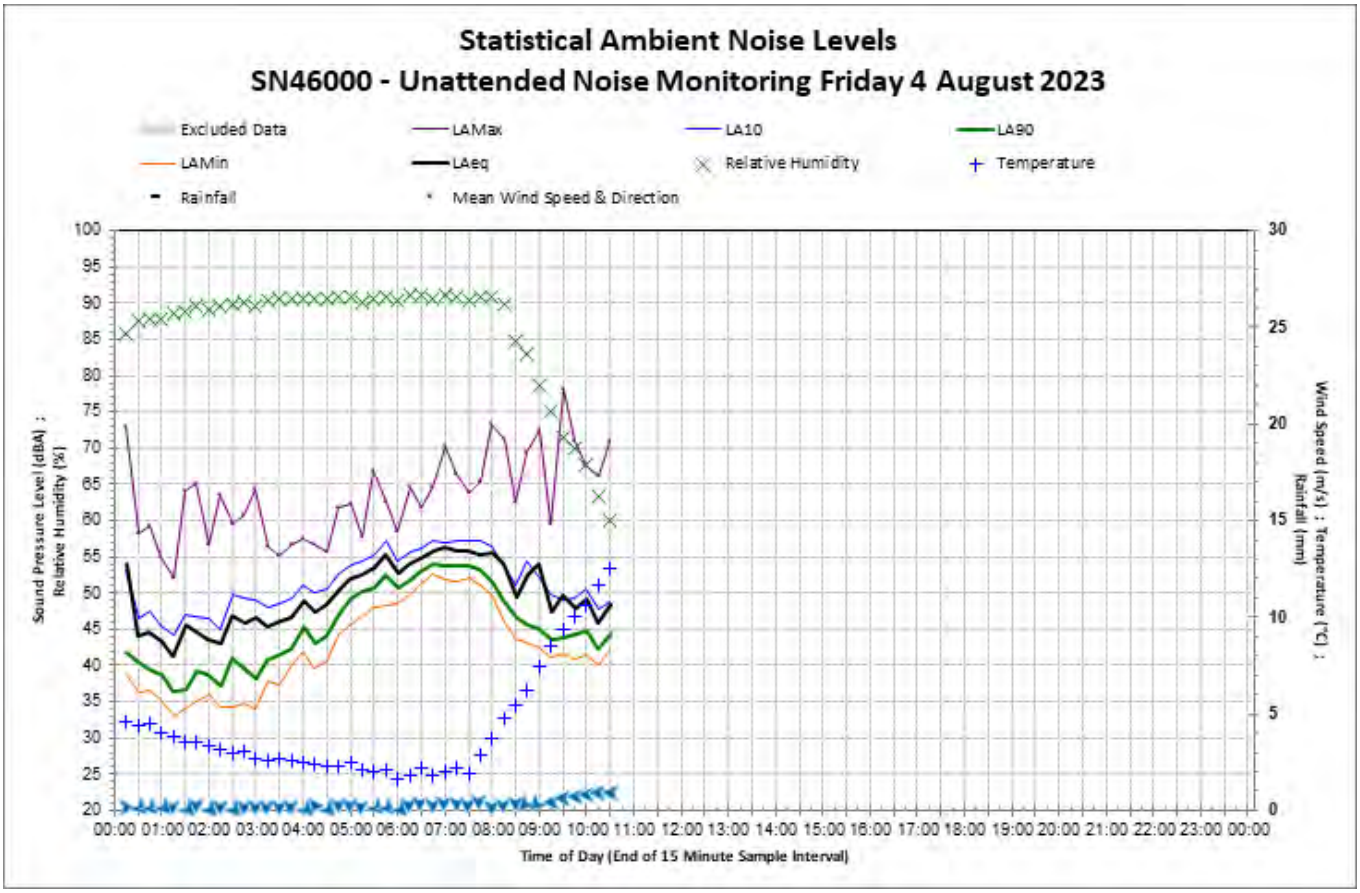


Statistical Ambient Noise Levels
SN46000 - Unattended Noise Monitoring Tuesday 1 August 2023

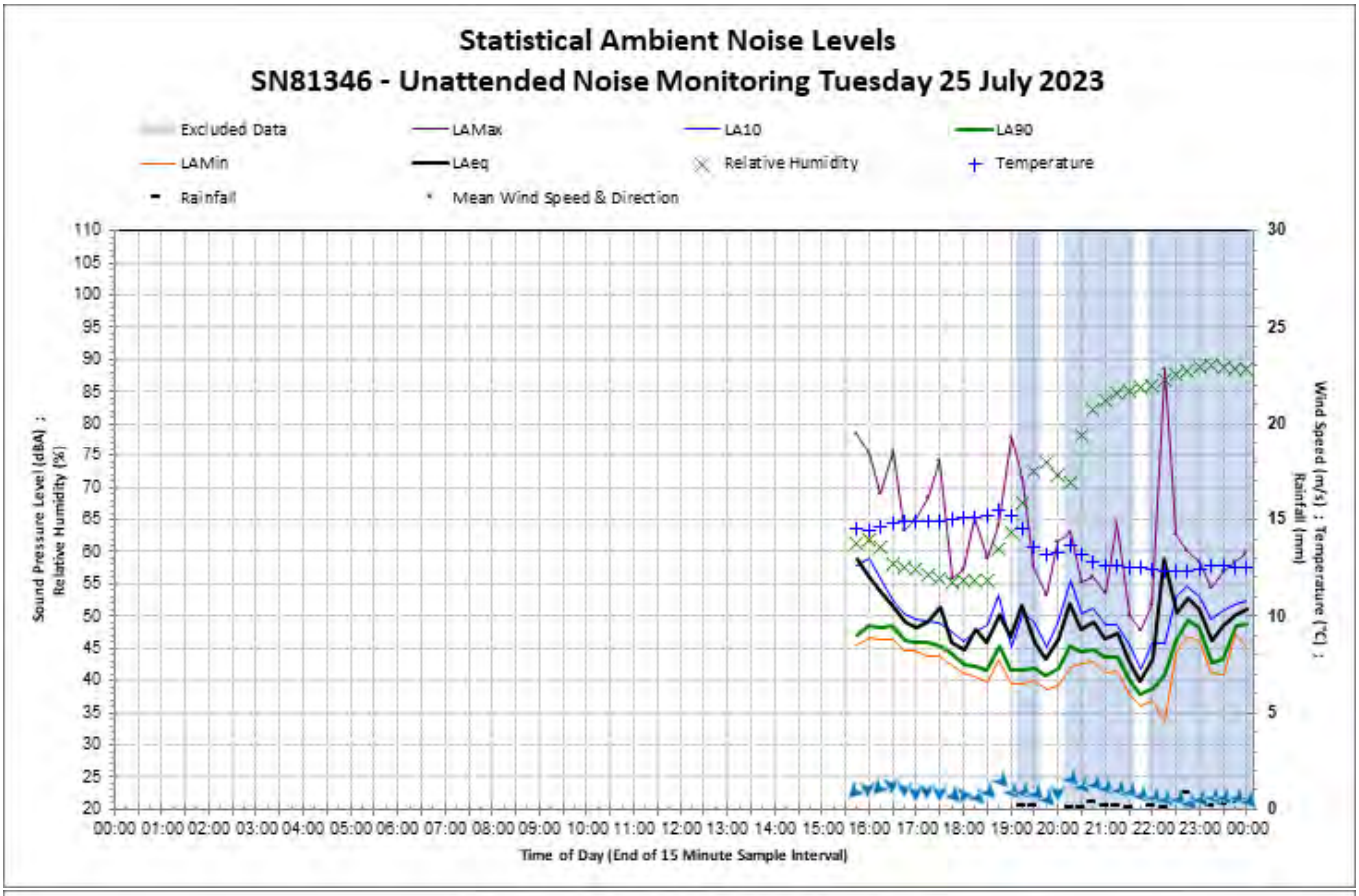


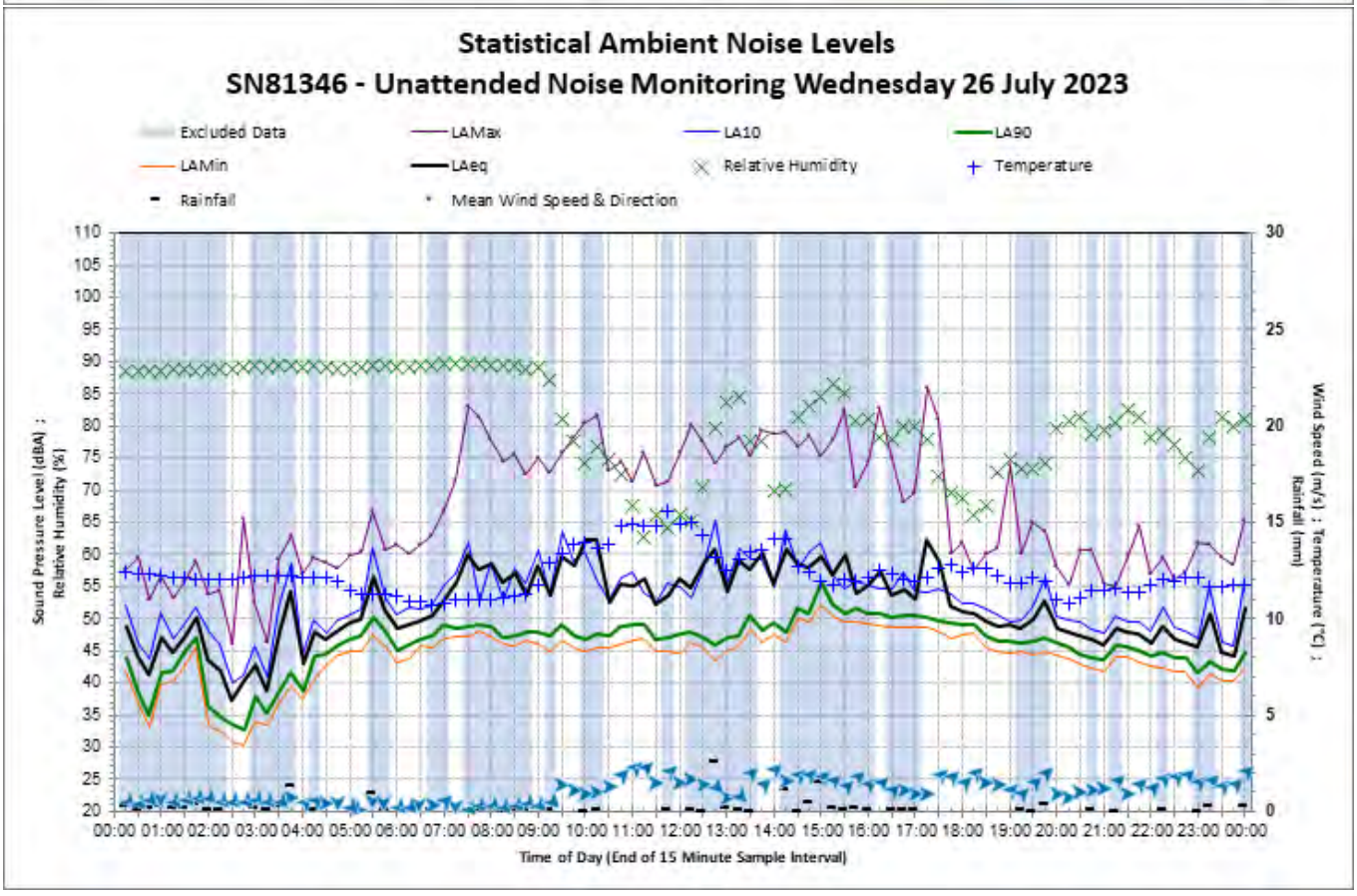

Statistical Ambient Noise Levels
SN46000 - Unattended Noise Monitoring Wednesday 2 August 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

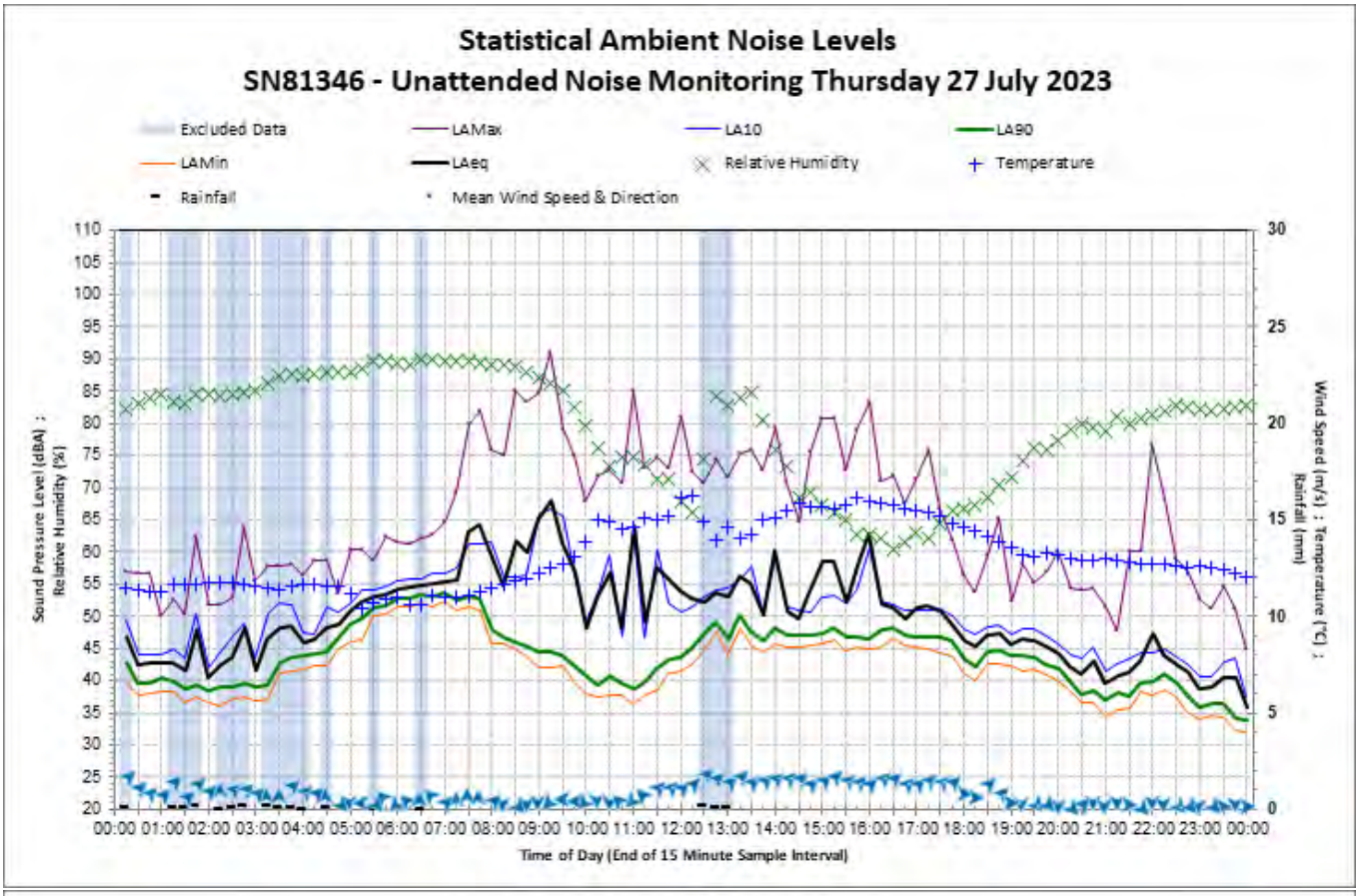

Statistical Ambient Noise Levels
SN46000 - Unattended Noise Monitoring Thursday 3 August 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

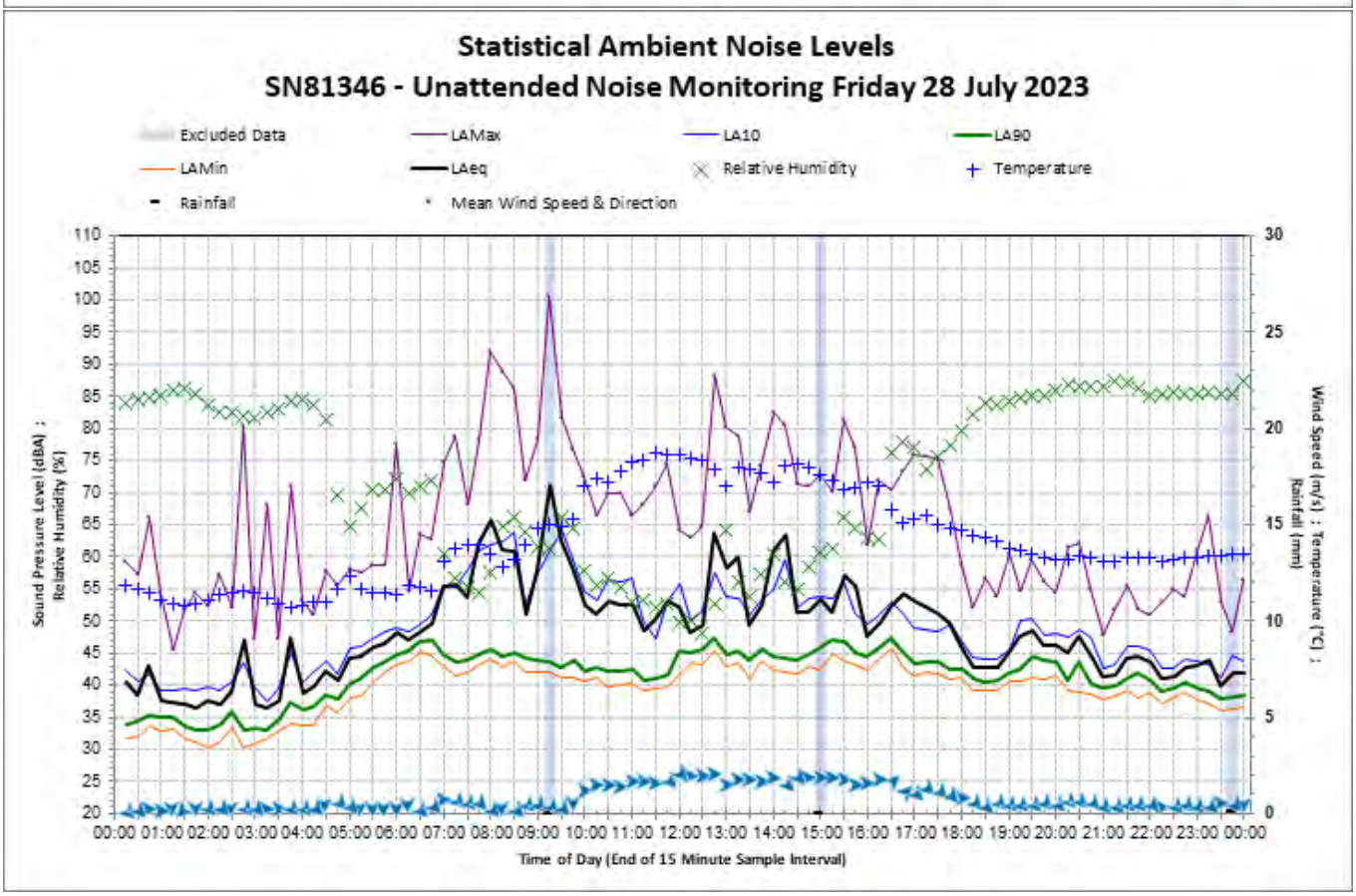

Statistical Ambient Noise Levels
SN46000 - Unattended Noise Monitoring Friday 4 August 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

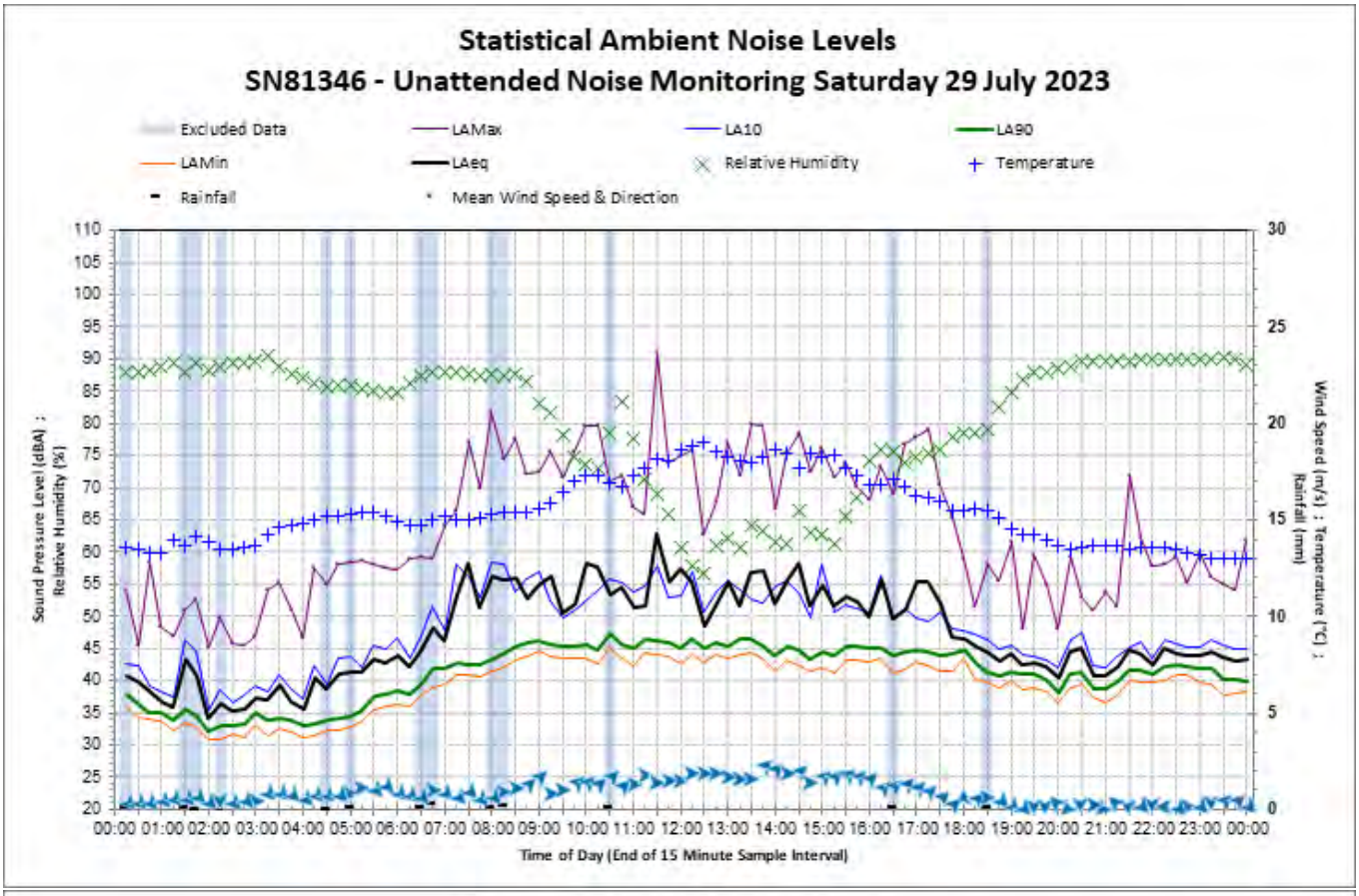
Logger 2 - SN81346 - 107 Guadalupe Drive - Noise Chart

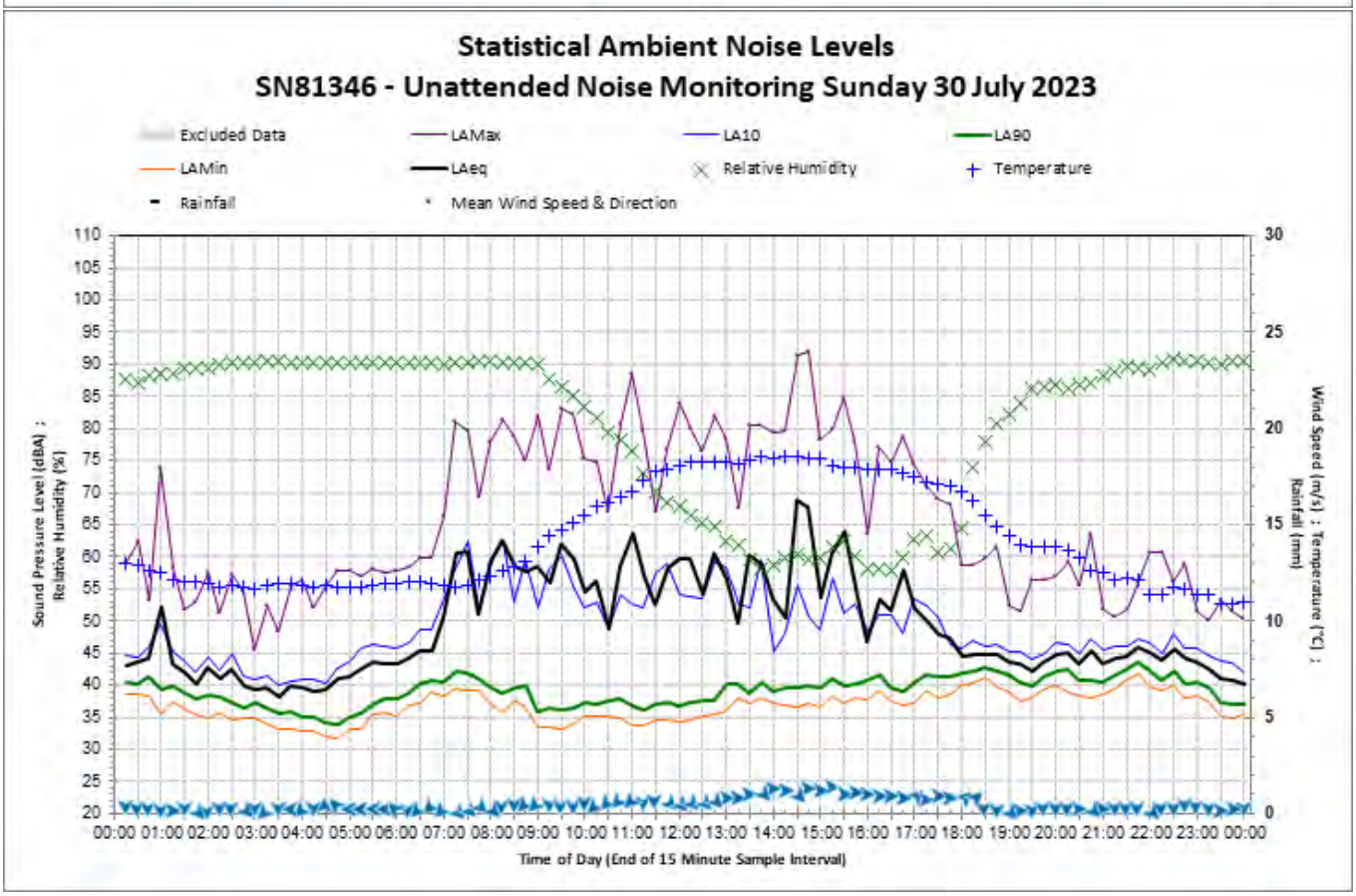




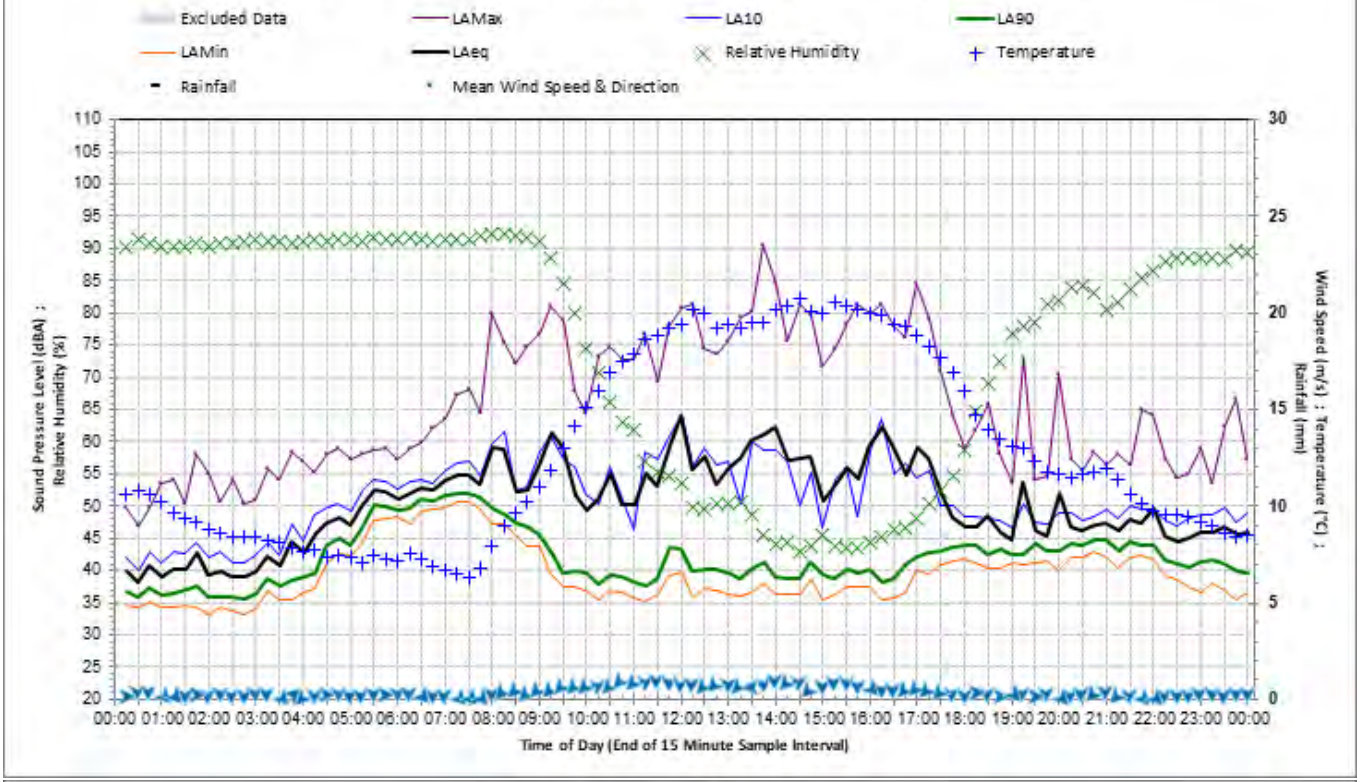

Statistical Ambient Noise Levels
SN81346 - Unattended Noise Monitoring Thursday 27 July 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
SN81346 - Unattended Noise Monitoring Friday 28 July 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

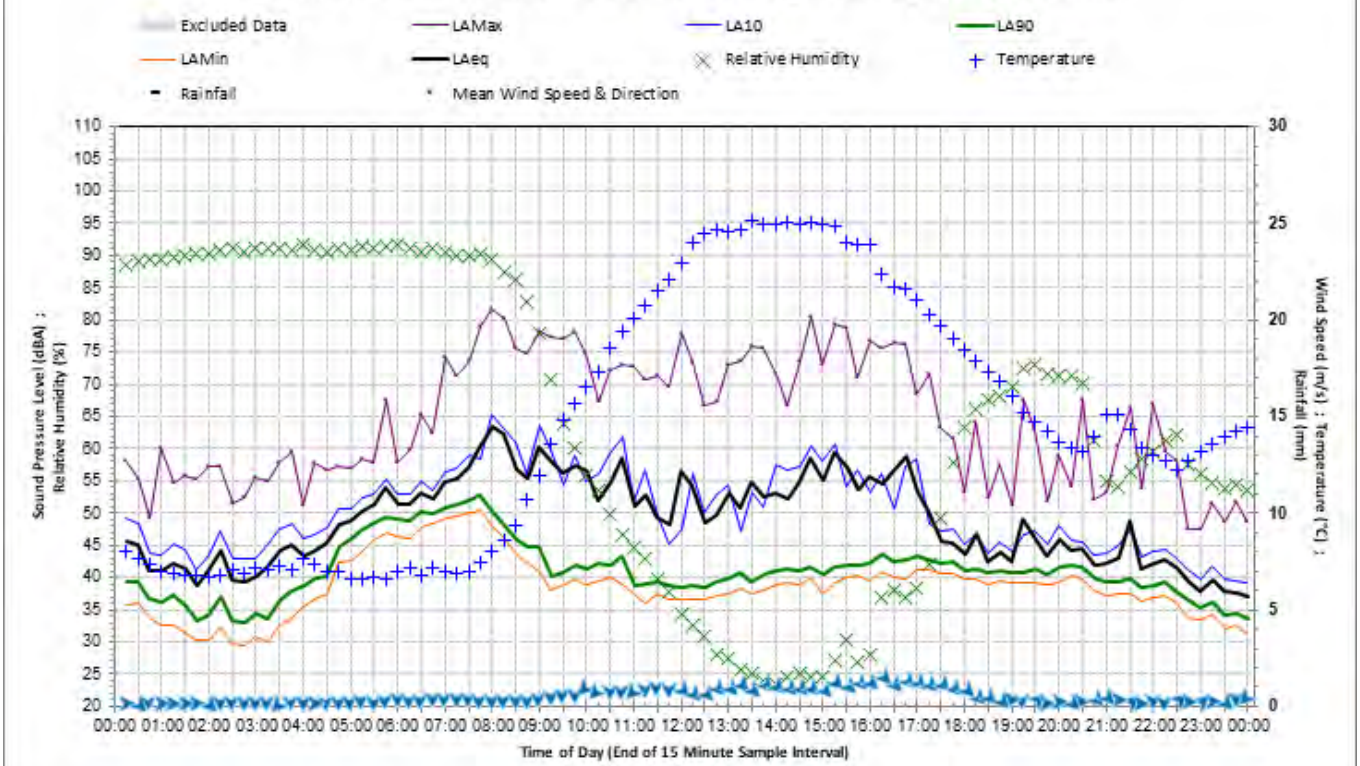

Statistical Ambient Noise Levels
SN81346 - Unattended Noise Monitoring Saturday 29 July 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
SN81346 - Unattended Noise Monitoring Sunday 30 July 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

Statistical Ambient Noise Levels
SN81346 - Unattended Noise Monitoring Monday 31 July 2023

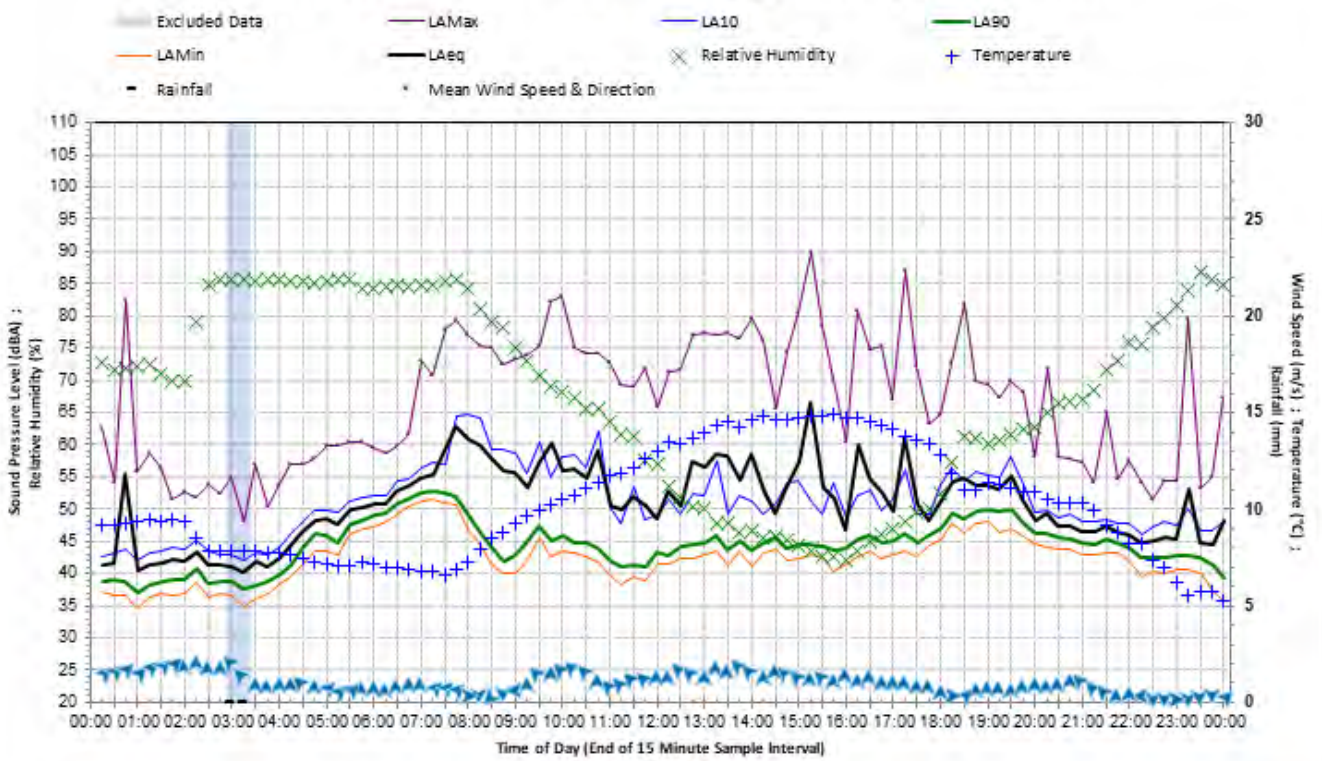


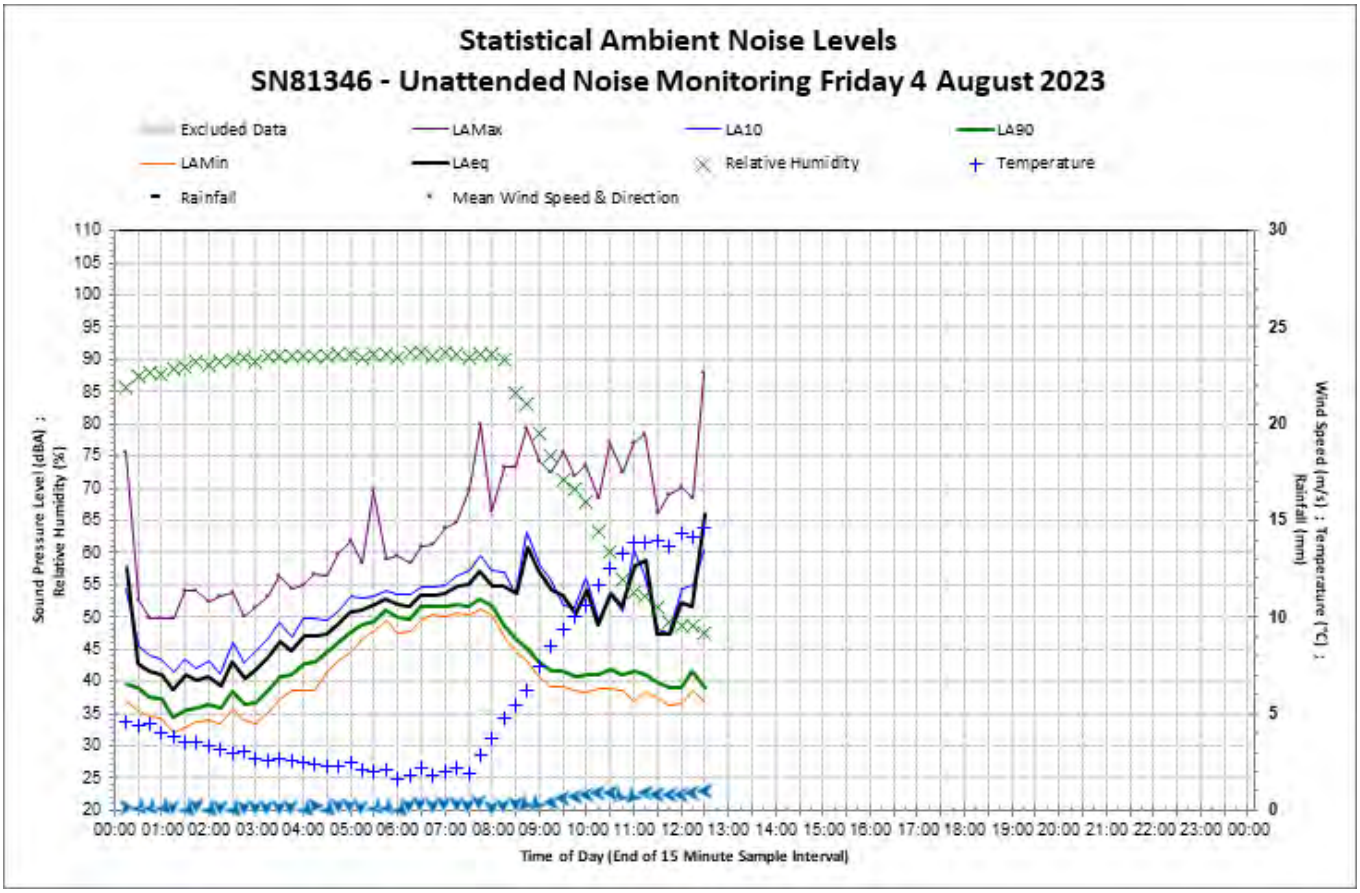
Statistical Ambient Noise Levels
SN81346 - Unattended Noise Monitoring Tuesday 1 August 2023



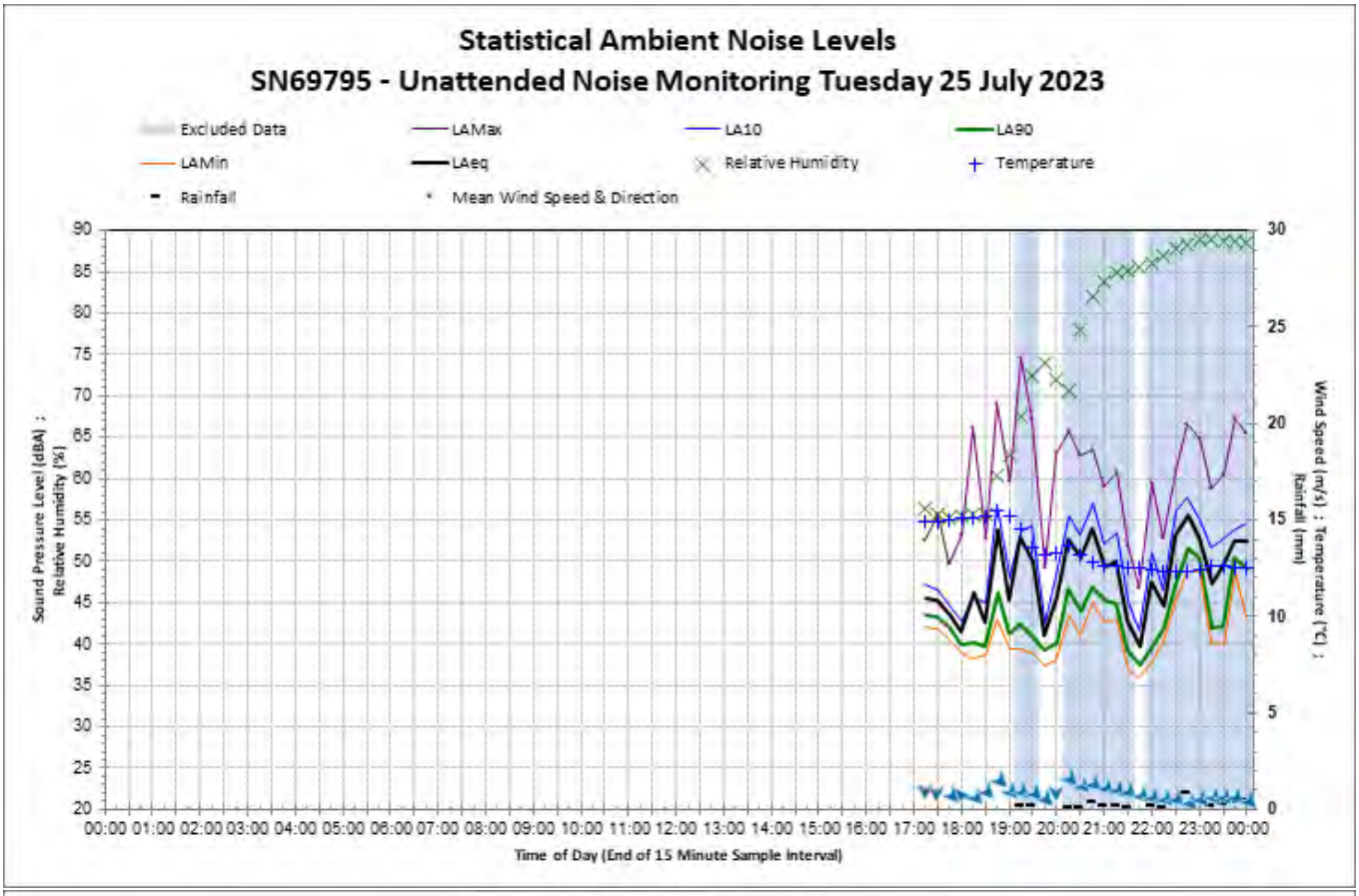
Statistical Ambient Noise Levels
SN81346 - Unattended Noise Monitoring Wednesday 2 August 2023

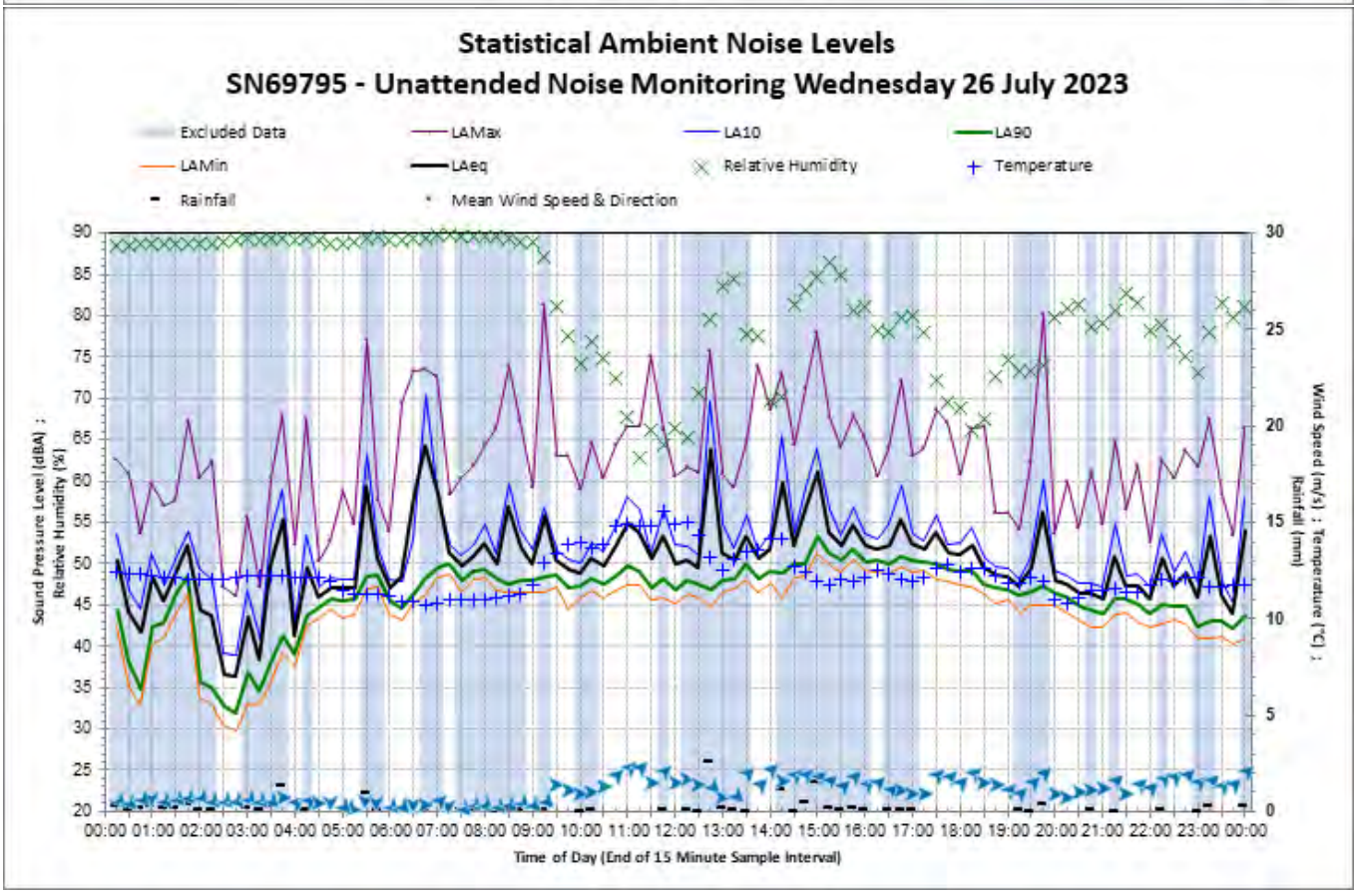
Statistical Ambient Noise Levels
SN81346 - Unattended Noise Monitoring Thursday 3 August 2023



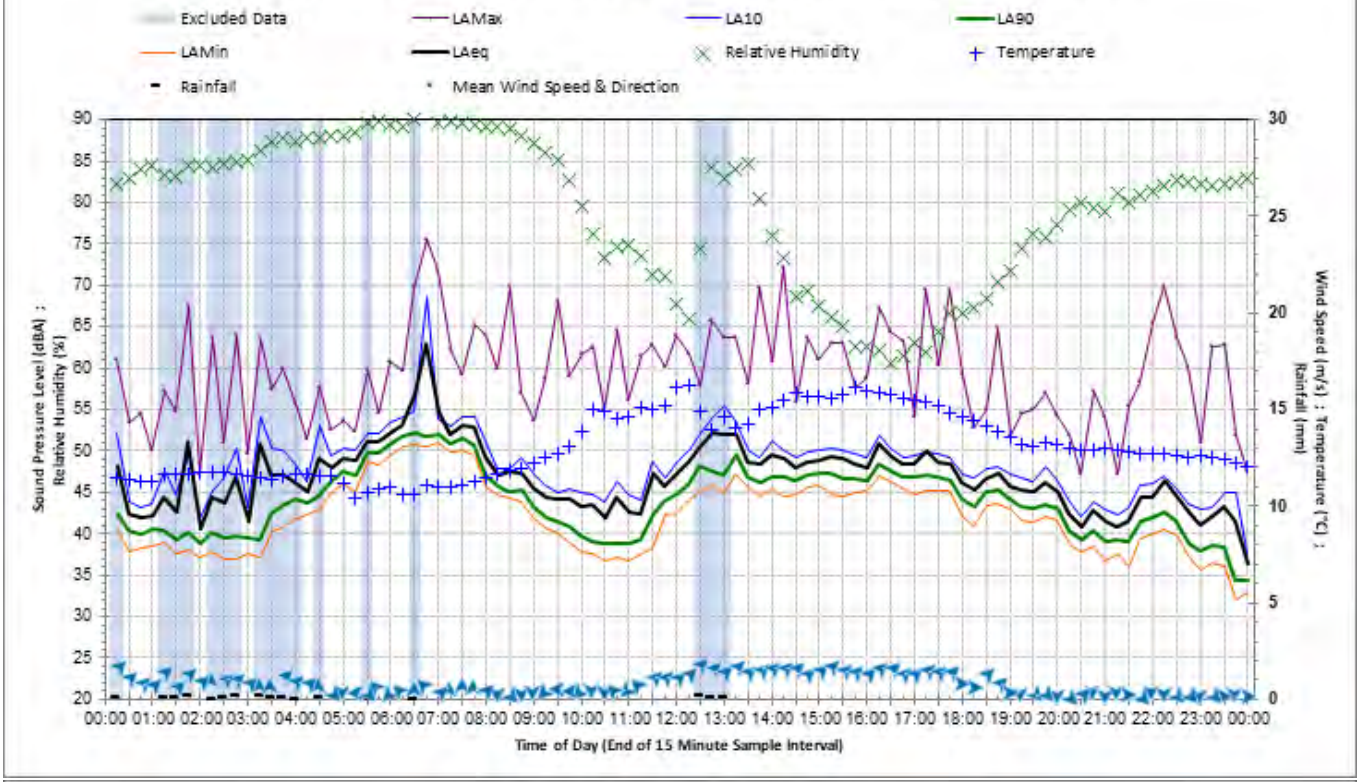

Statistical Ambient Noise Levels
SN81346 - Unattended Noise Monitoring Friday 4 August 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

Logger 3 - SN69795 - 8 Lassen Gardens - Noise Chart

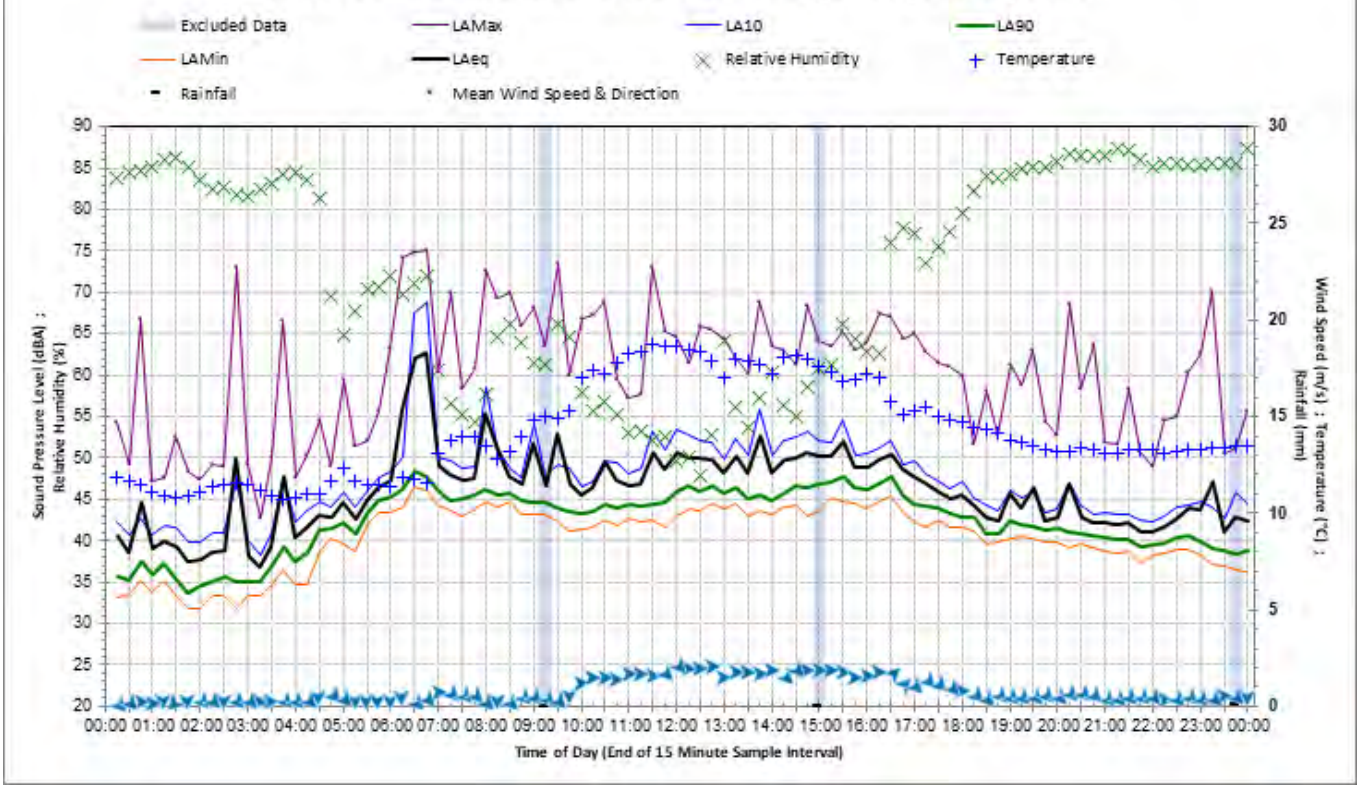




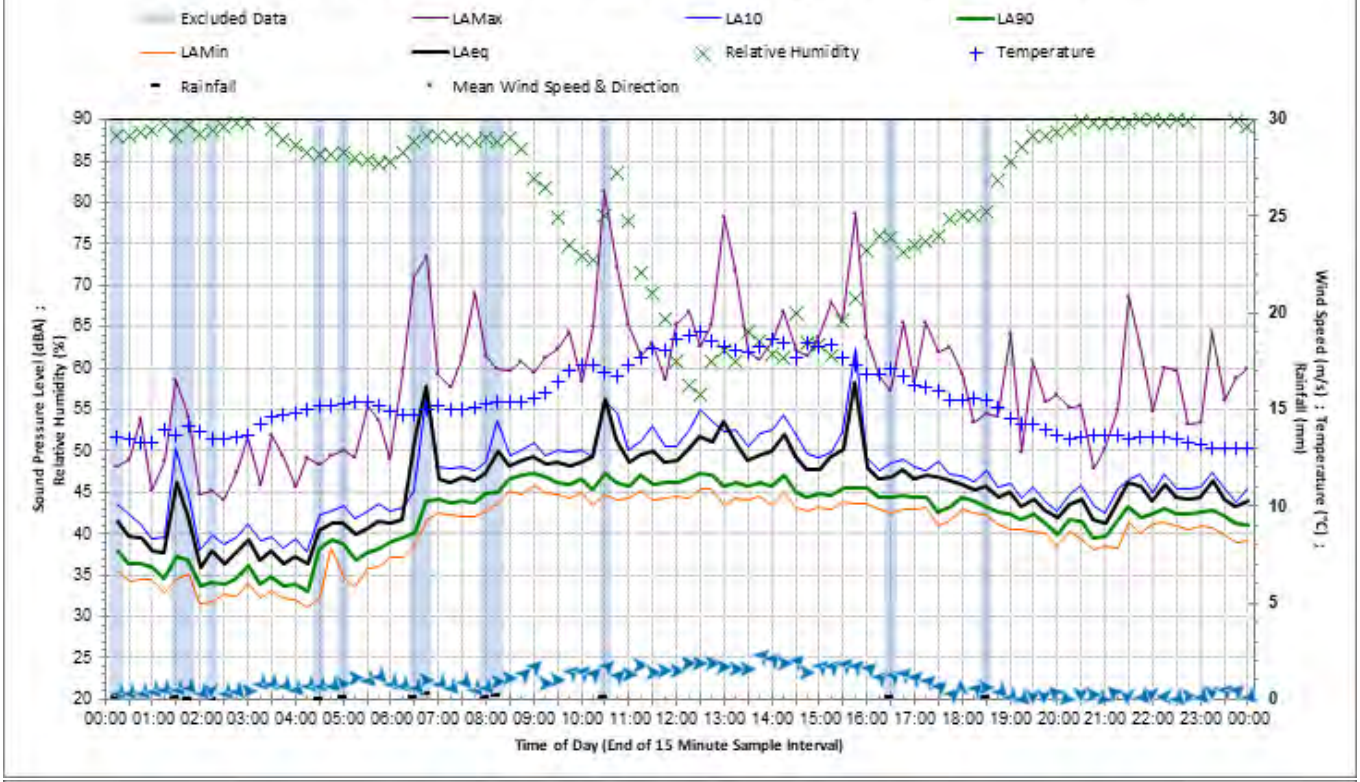
Statistical Ambient Noise Levels
SN69795 - Unattended Noise Monitoring Thursday 27 July 2023



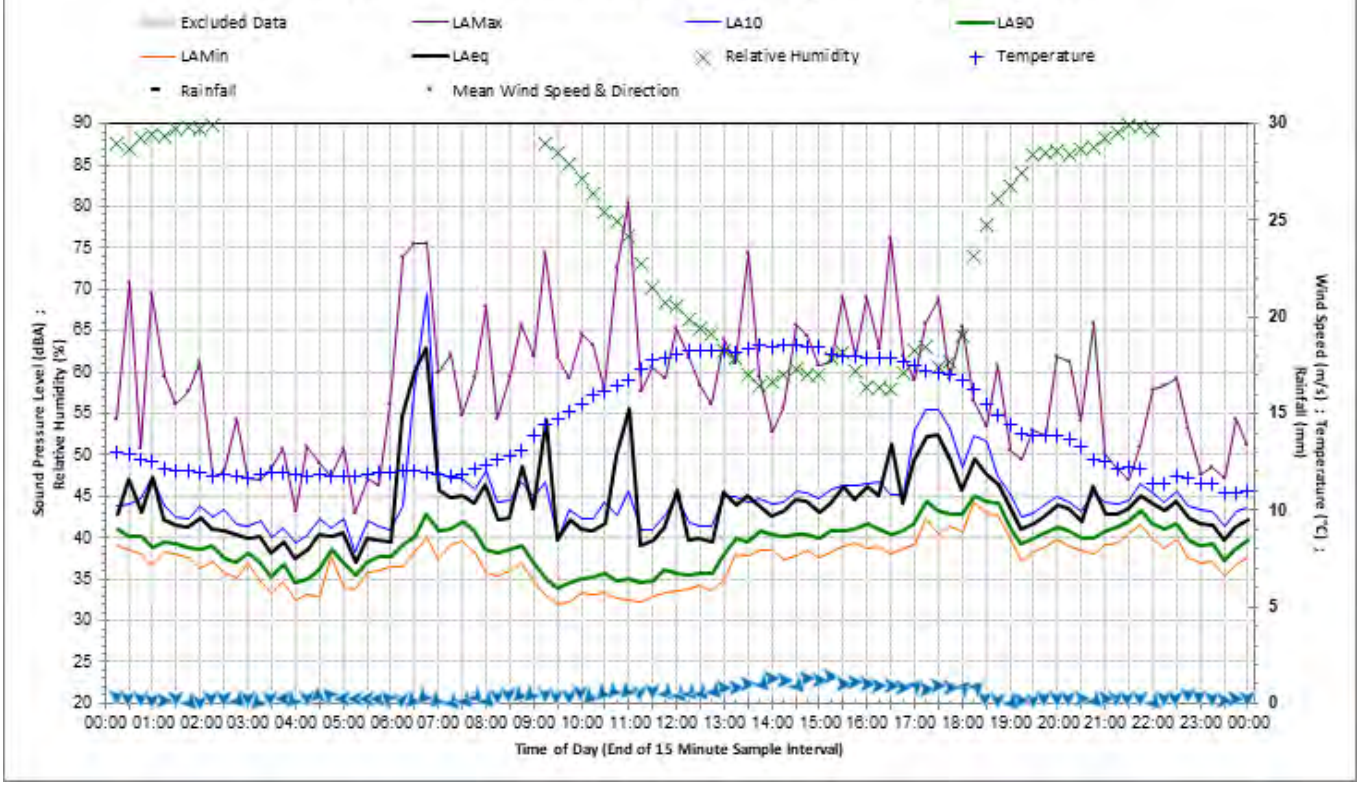
Statistical Ambient Noise Levels
SN69795 - Unattended Noise Monitoring Friday 28 July 2023



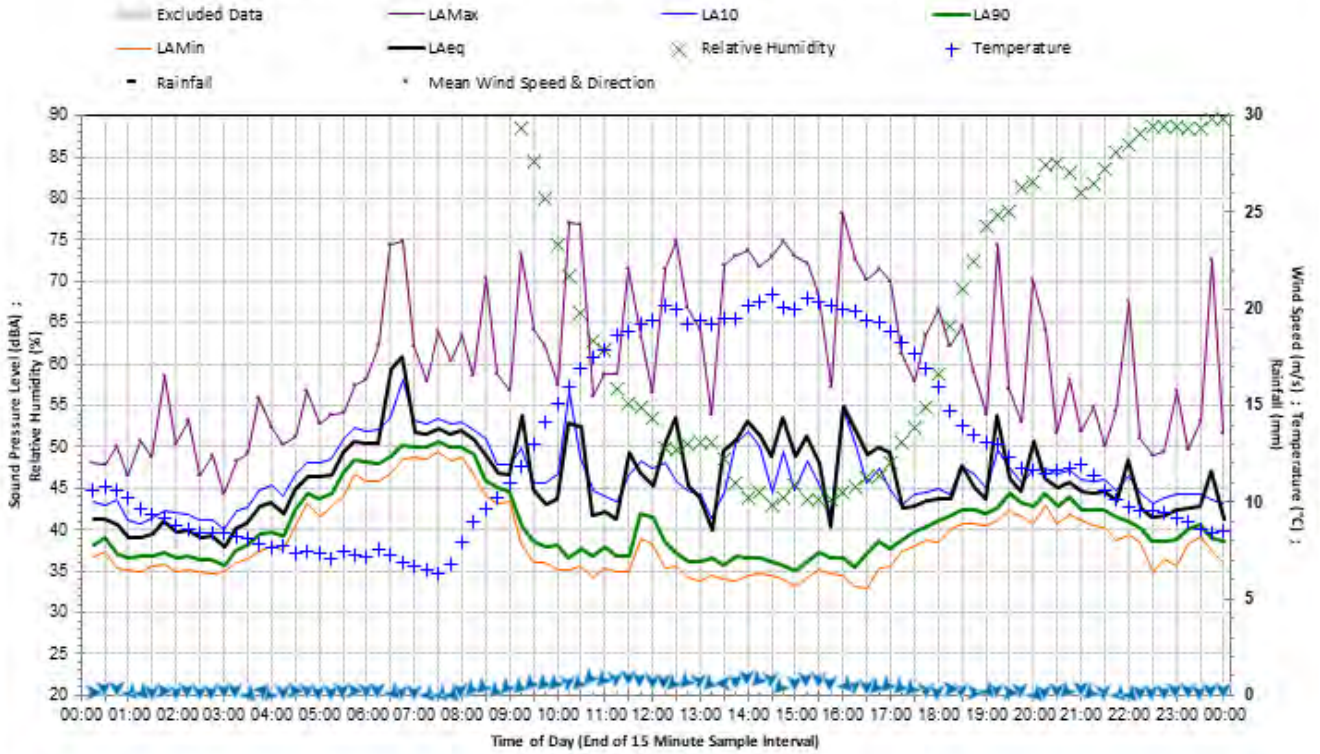
Statistical Ambient Noise Levels
SN69795 - Unattended Noise Monitoring Saturday 29 July 2023



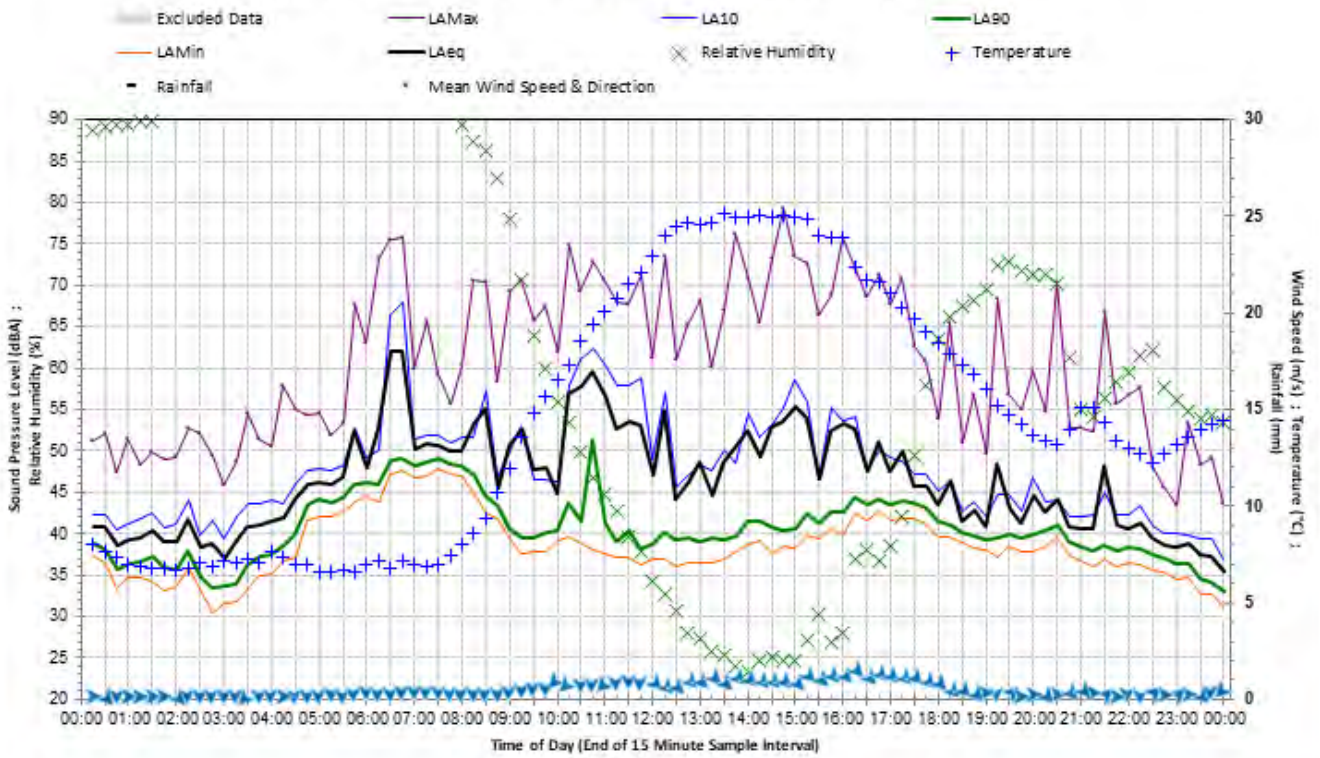
Statistical Ambient Noise Levels
SN69795 - Unattended Noise Monitoring Sunday 30 July 2023



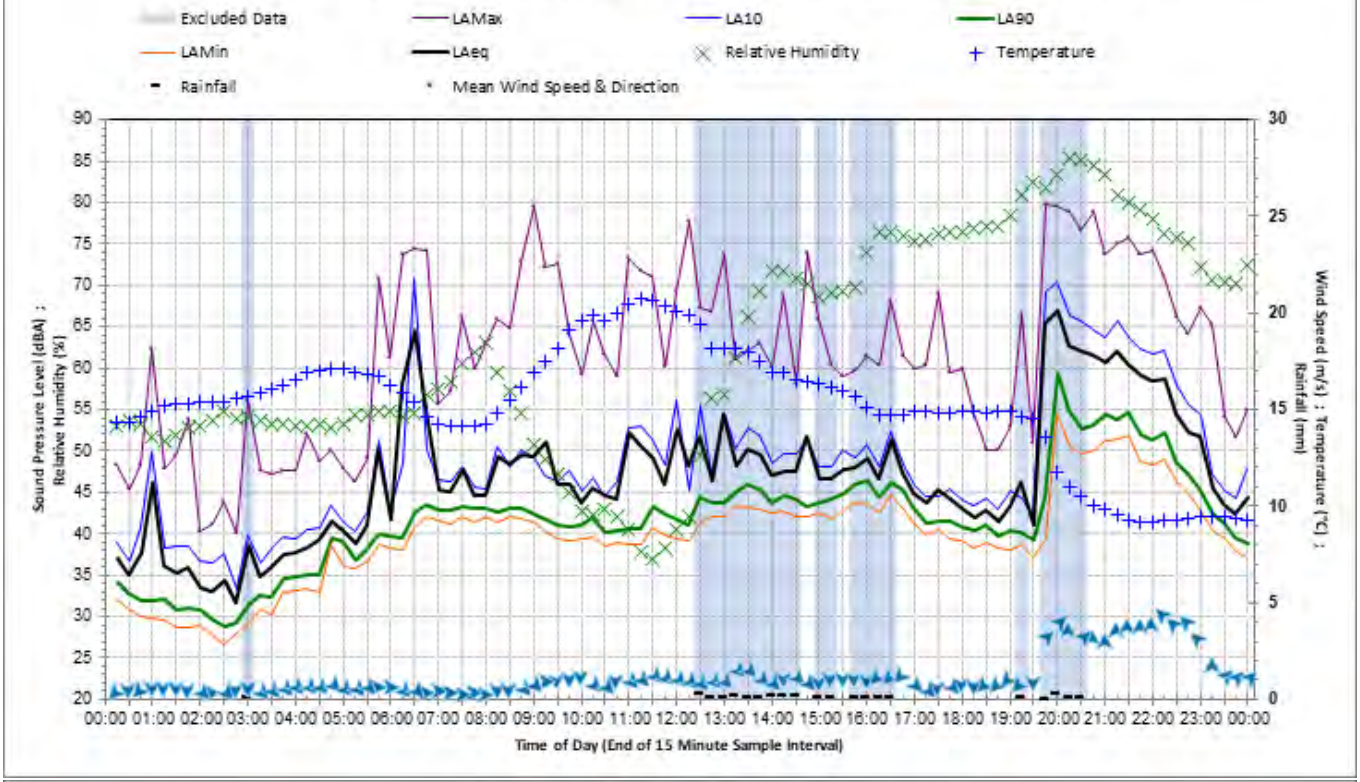
Statistical Ambient Noise Levels
SN69795 - Unattended Noise Monitoring Monday 31 July 2023



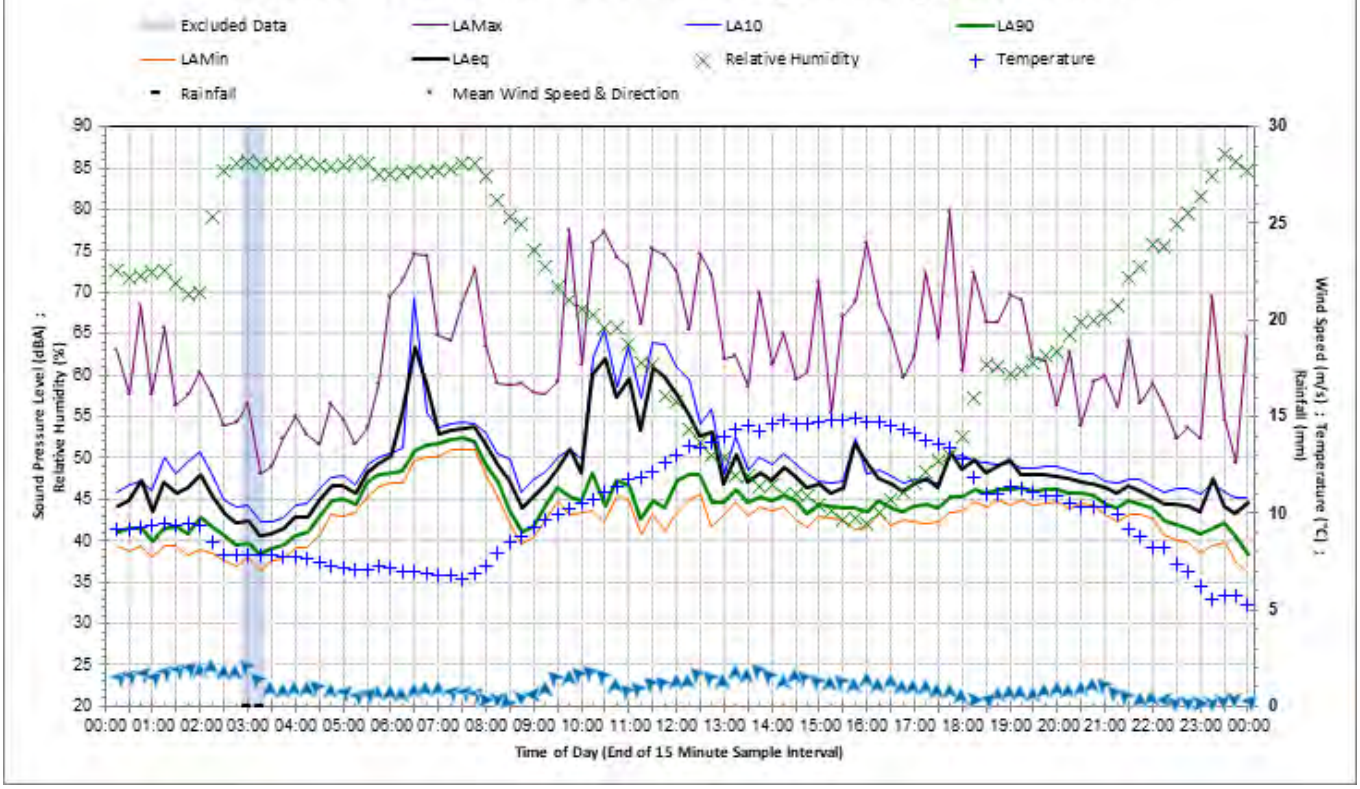
Statistical Ambient Noise Levels
SN69795 - Unattended Noise Monitoring Tuesday 1 August 2023

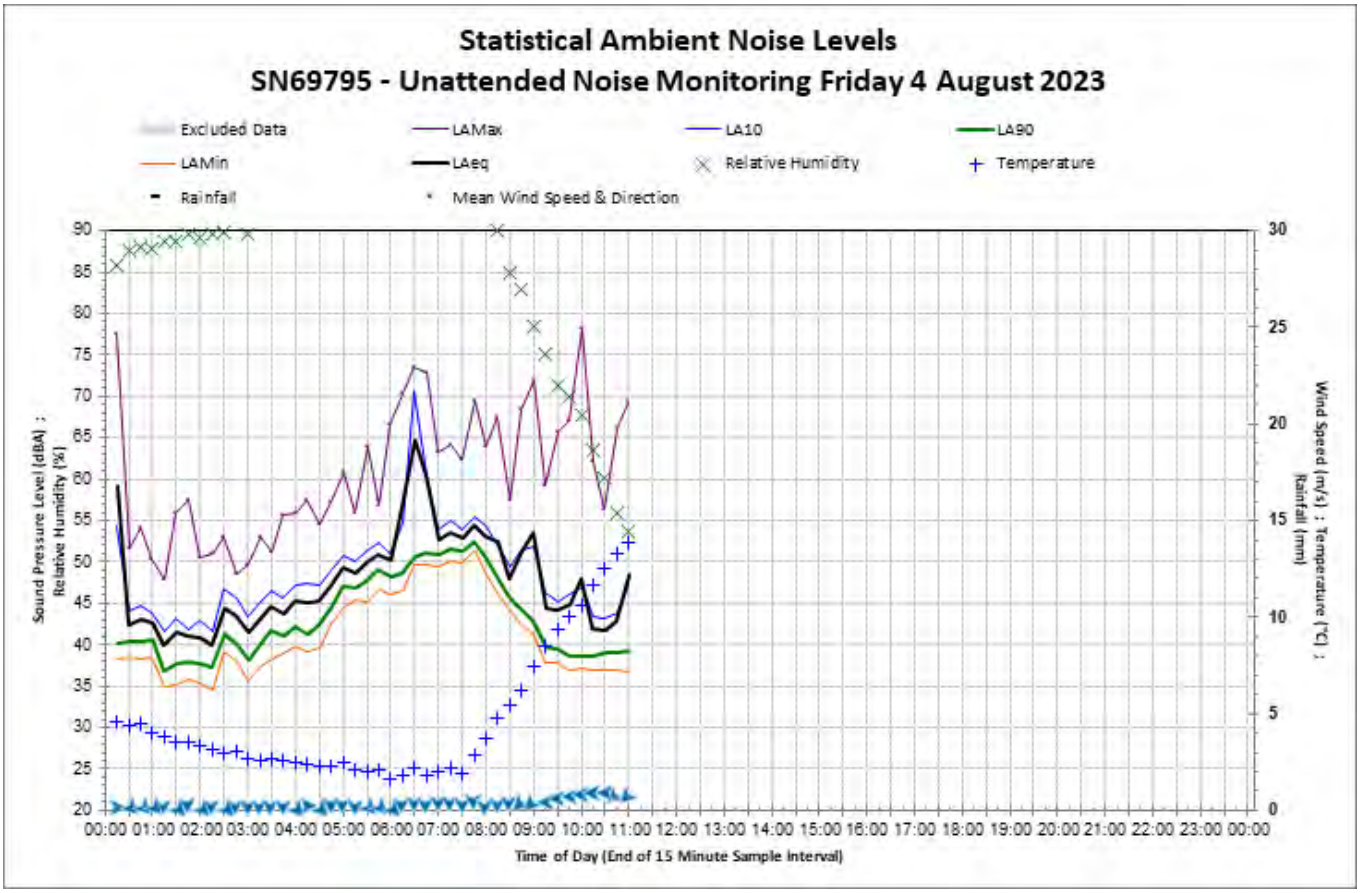


Statistical Ambient Noise Levels
SN69795 - Unattended Noise Monitoring Wednesday 2 August 2023

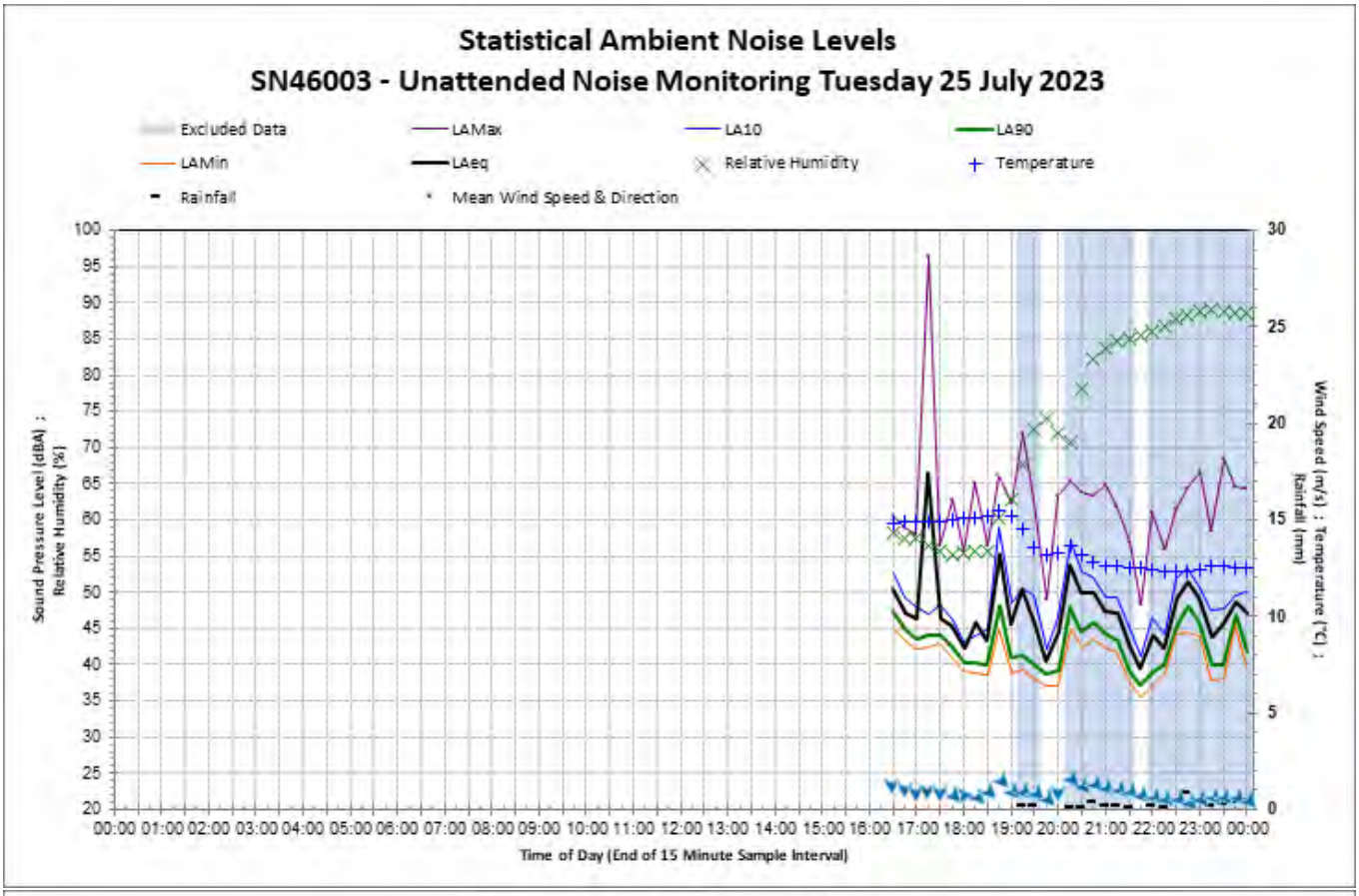


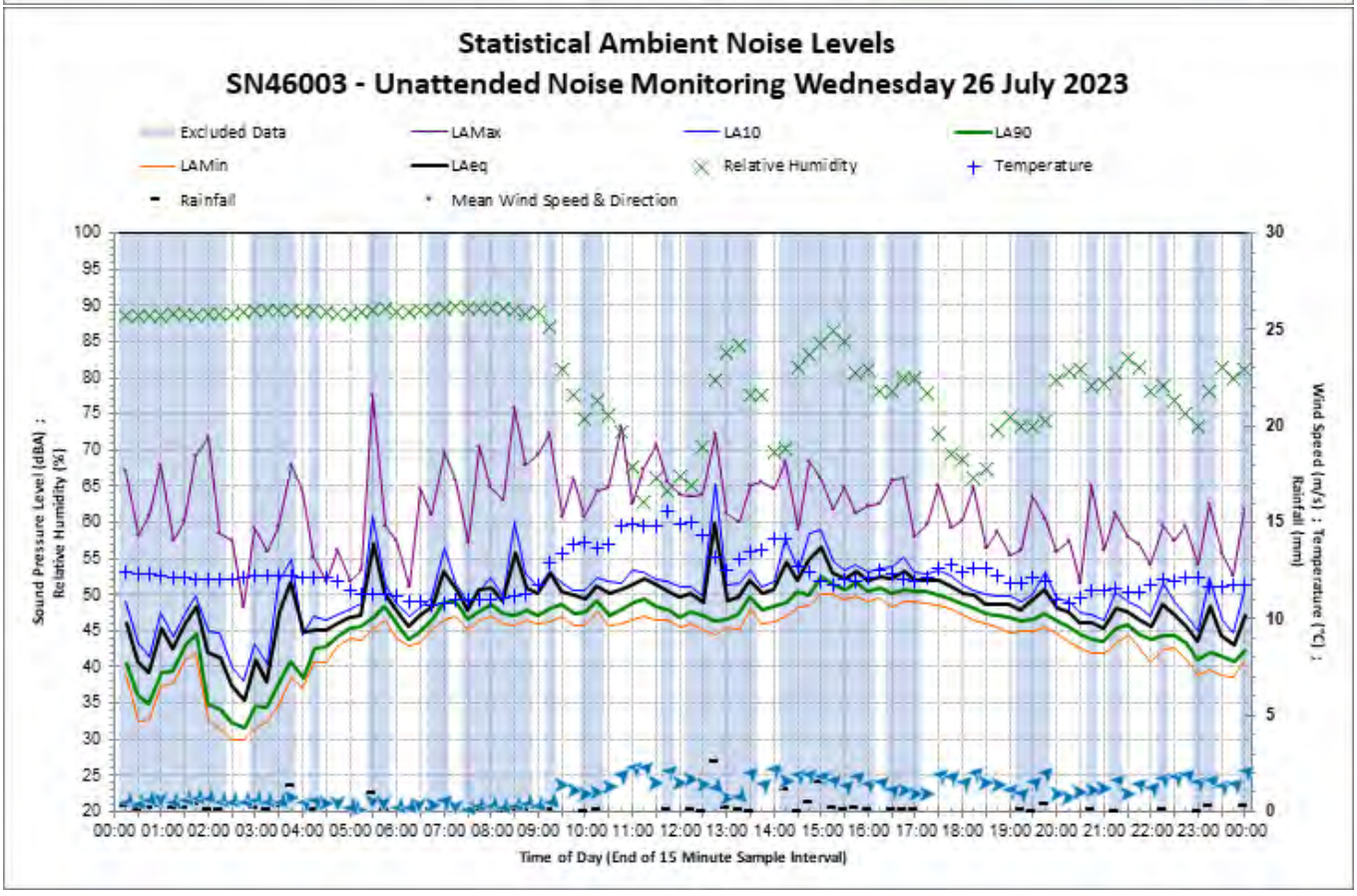
Statistical Ambient Noise Levels
SN69795 - Unattended Noise Monitoring Thursday 3 August 2023

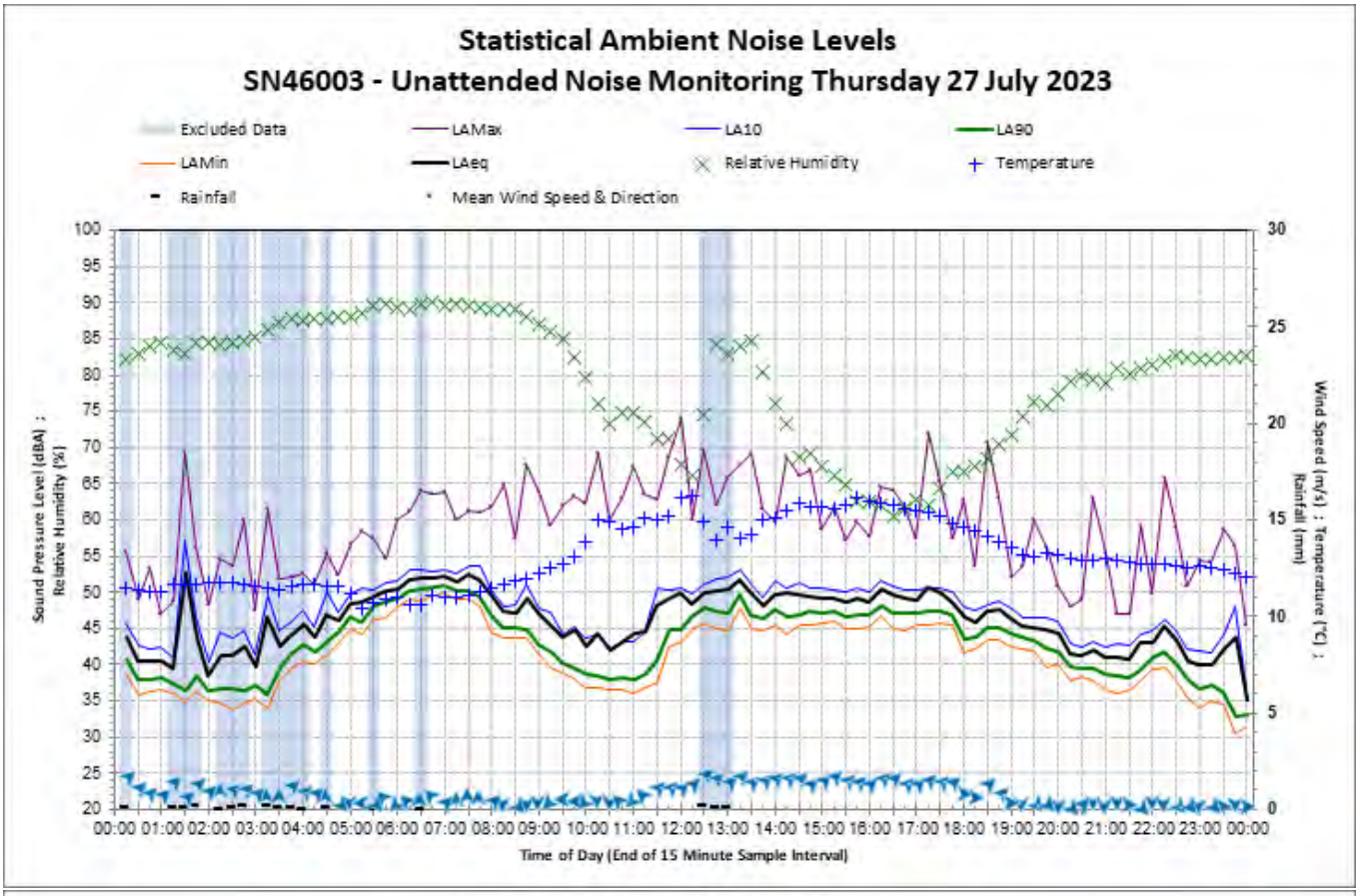


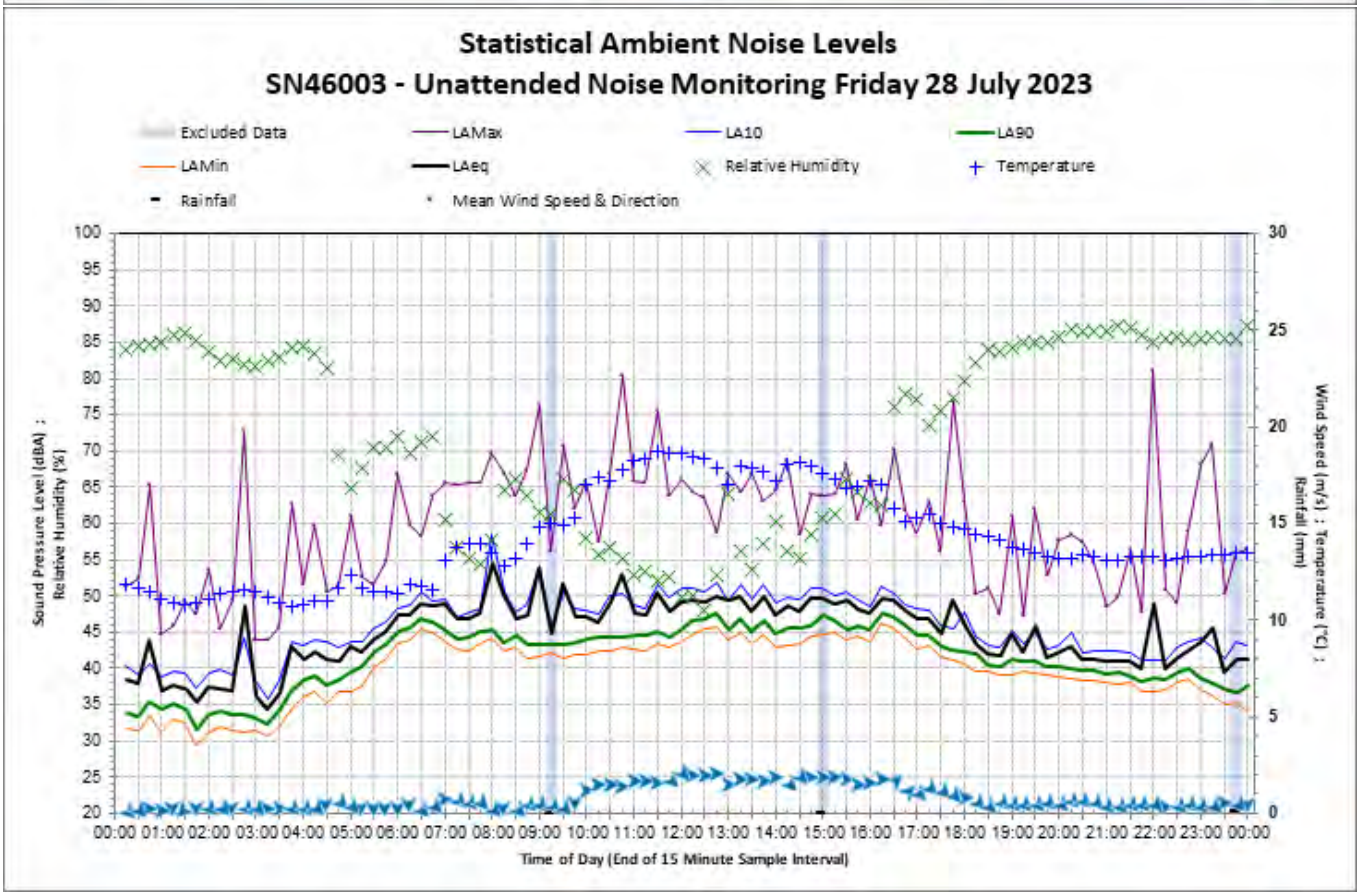

Statistical Ambient Noise Levels
SN69795 - Unattended Noise Monitoring Friday 4 August 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

Logger 4 - SN46003 - 7 Tekapo Lane - Noise Chart

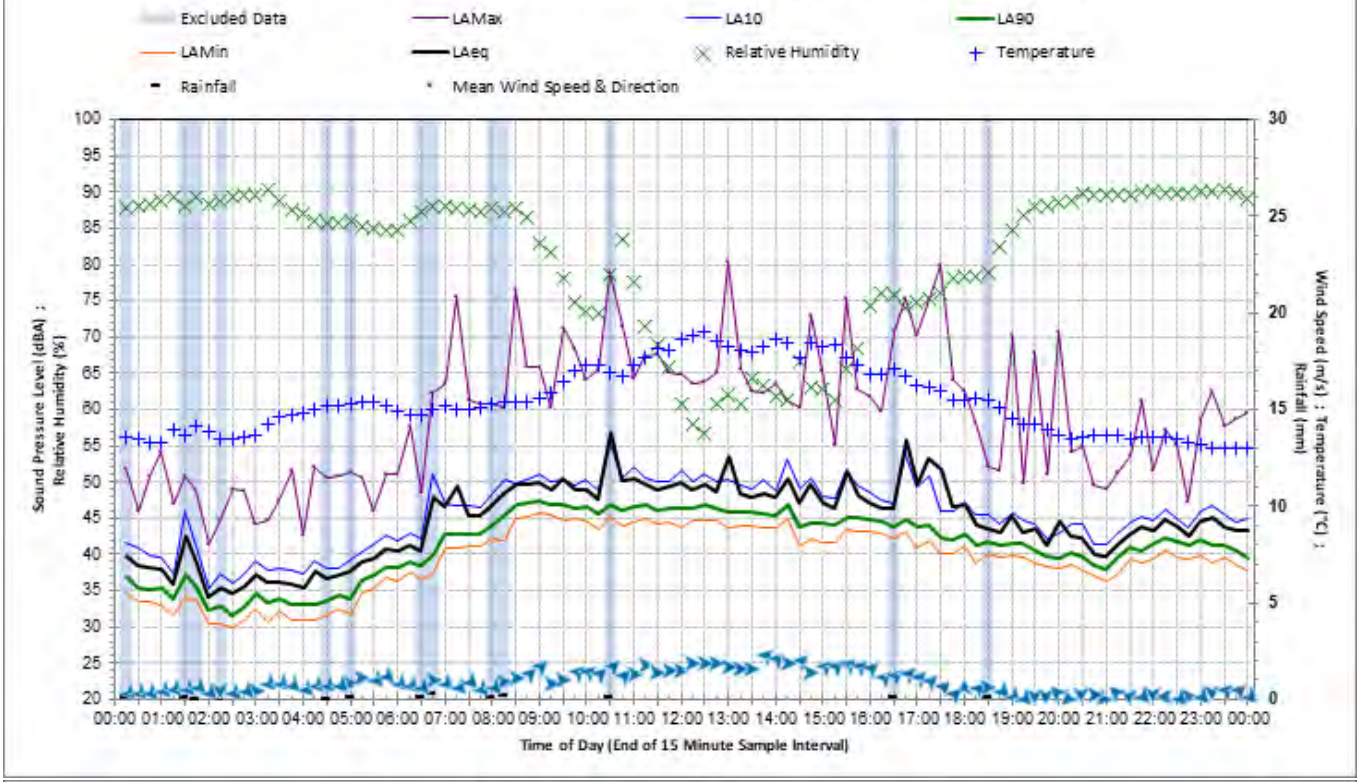




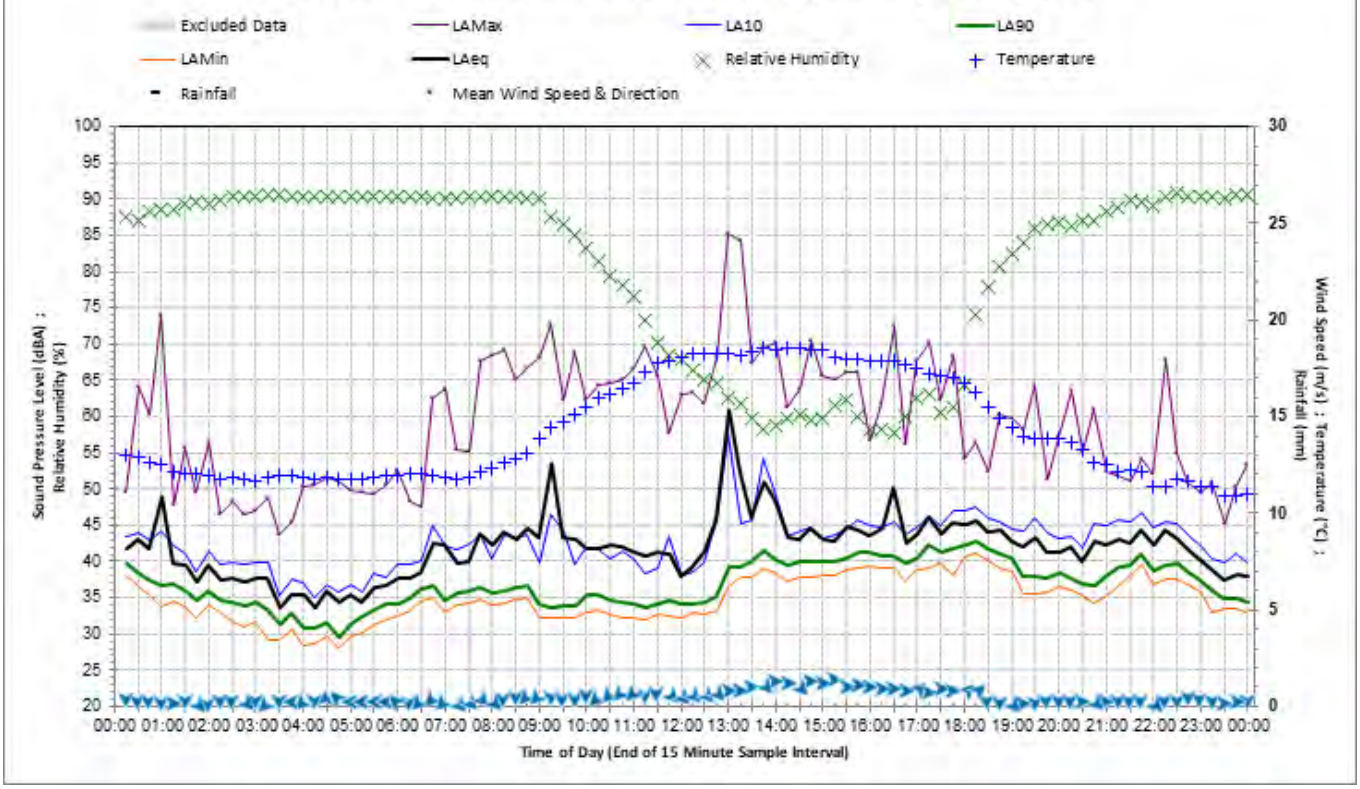

Statistical Ambient Noise Levels
SN46003 - Unattended Noise Monitoring Thursday 27 July 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
SN46003 - Unattended Noise Monitoring Friday 28 July 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

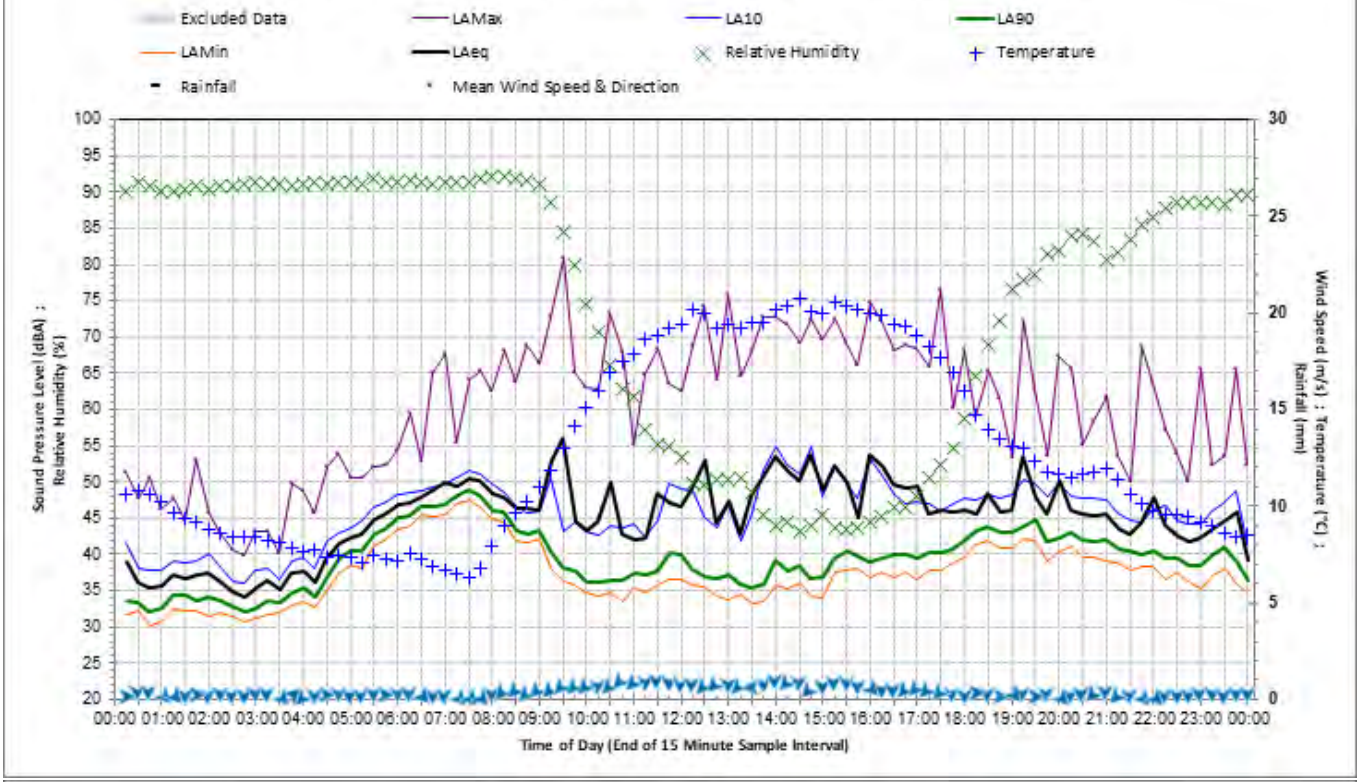
Statistical Ambient Noise Levels
SN46003 - Unattended Noise Monitoring Saturday 29 July 2023



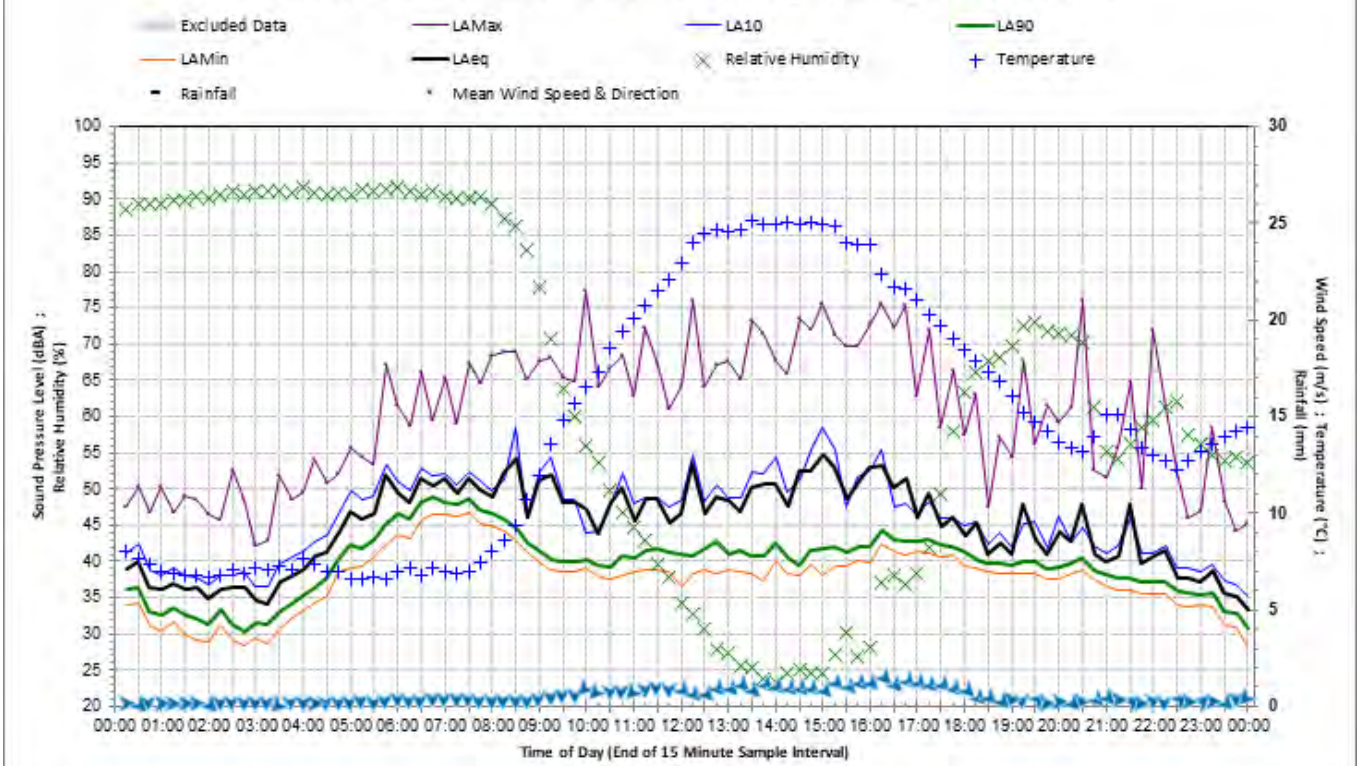
Statistical Ambient Noise Levels
SN46003 - Unattended Noise Monitoring Sunday 30 July 2023



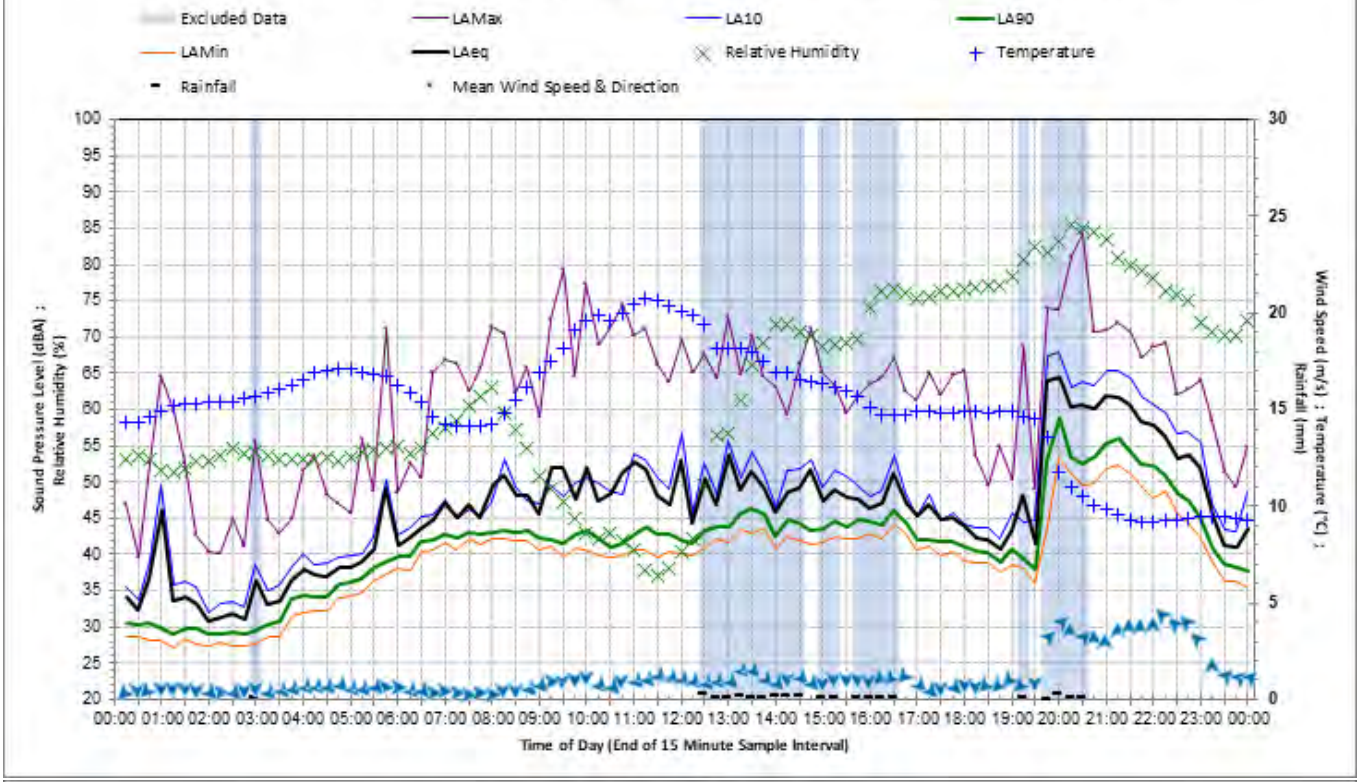
Statistical Ambient Noise Levels
SN46003 - Unattended Noise Monitoring Monday 31 July 2023



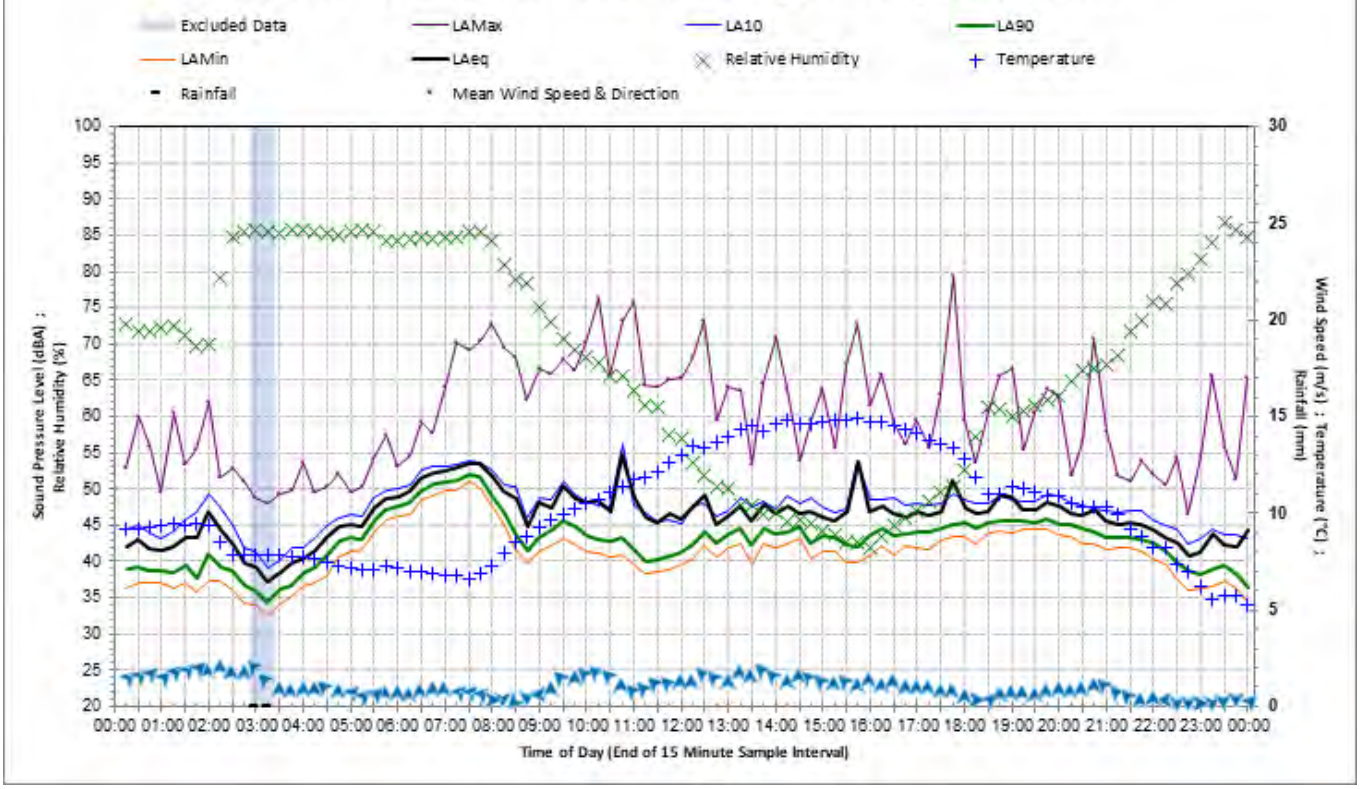
Statistical Ambient Noise Levels
SN46003 - Unattended Noise Monitoring Tuesday 1 August 2023

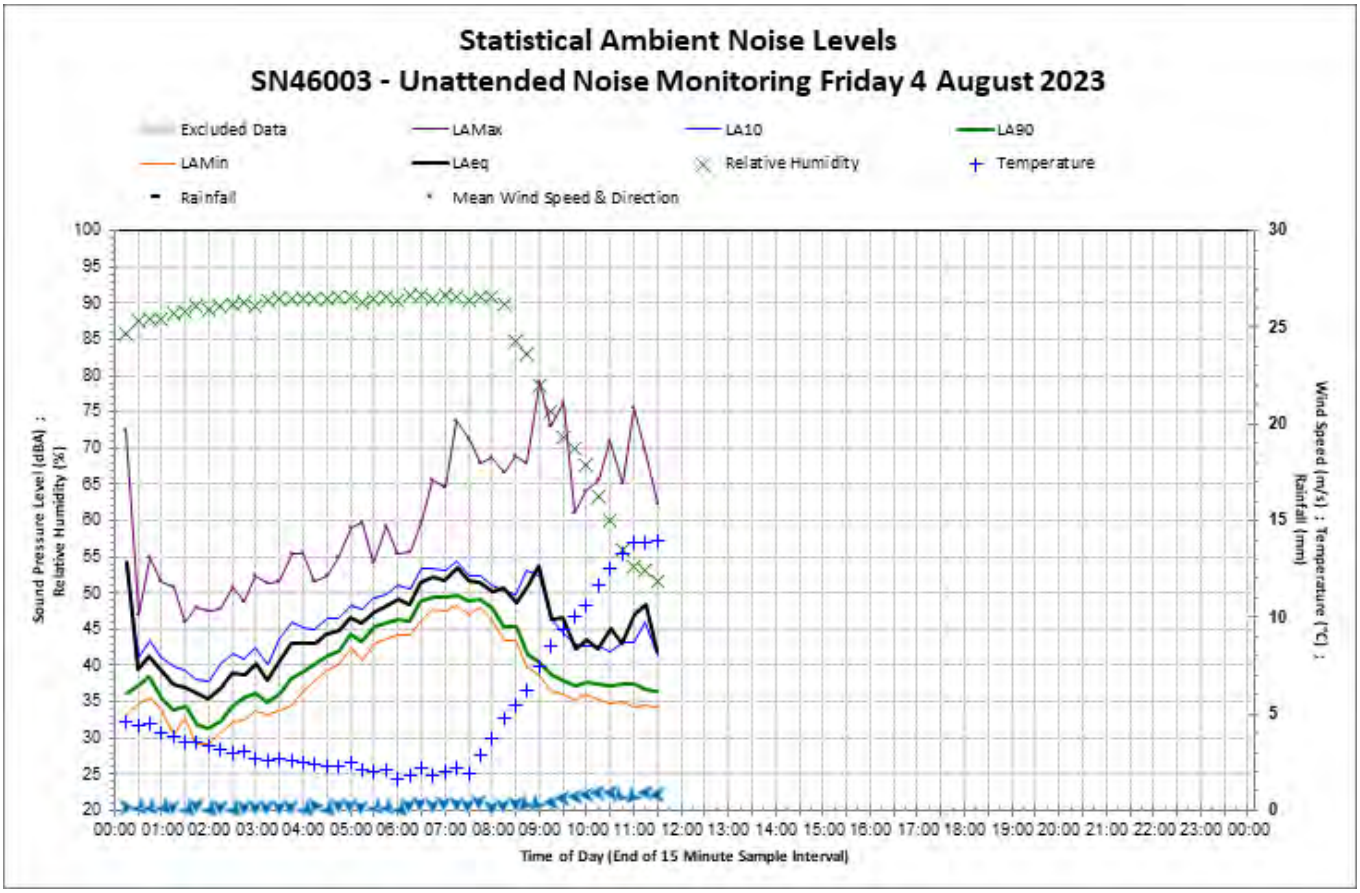


Statistical Ambient Noise Levels
SN46003 - Unattended Noise Monitoring Wednesday 2 August 2023

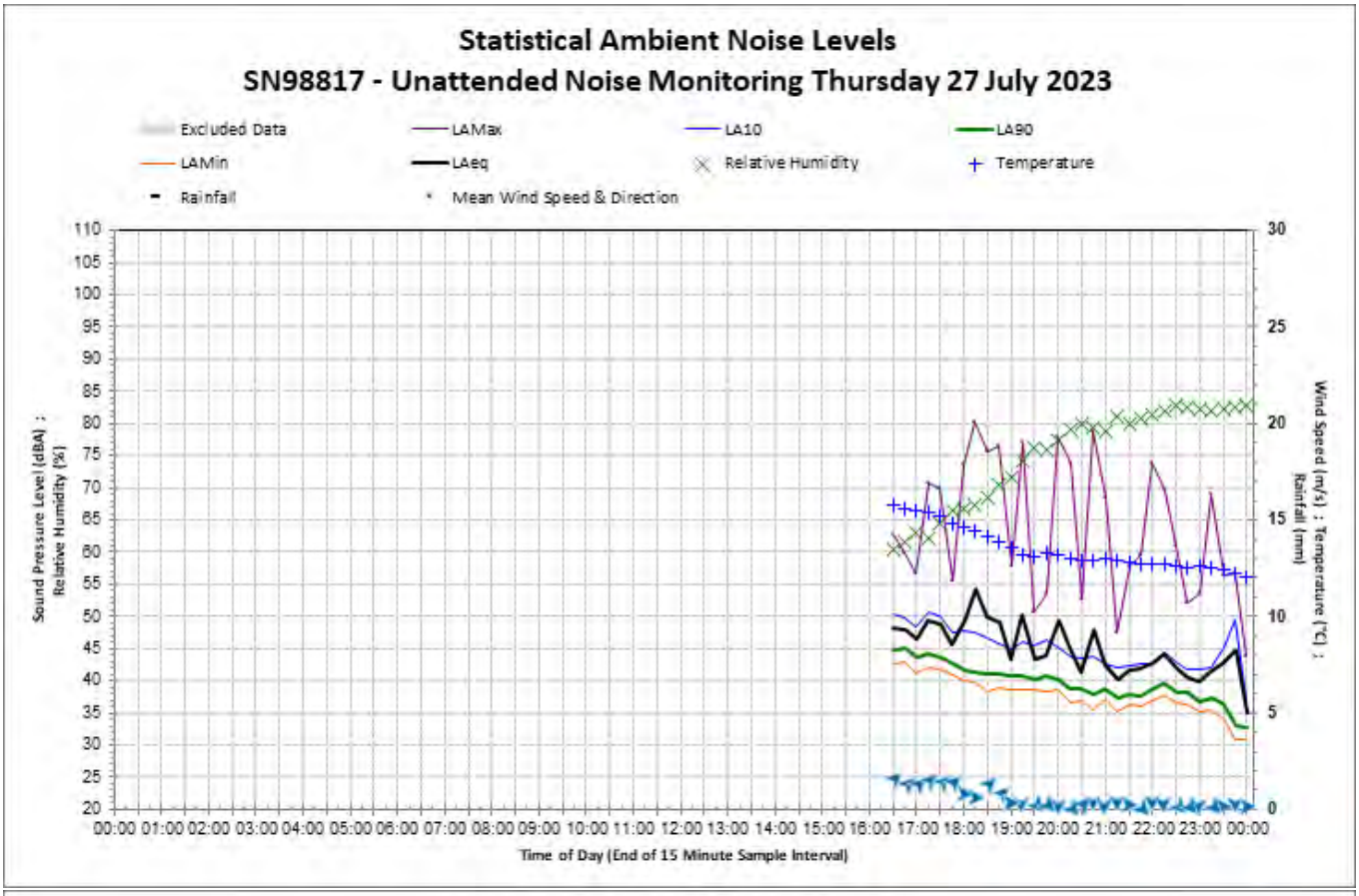


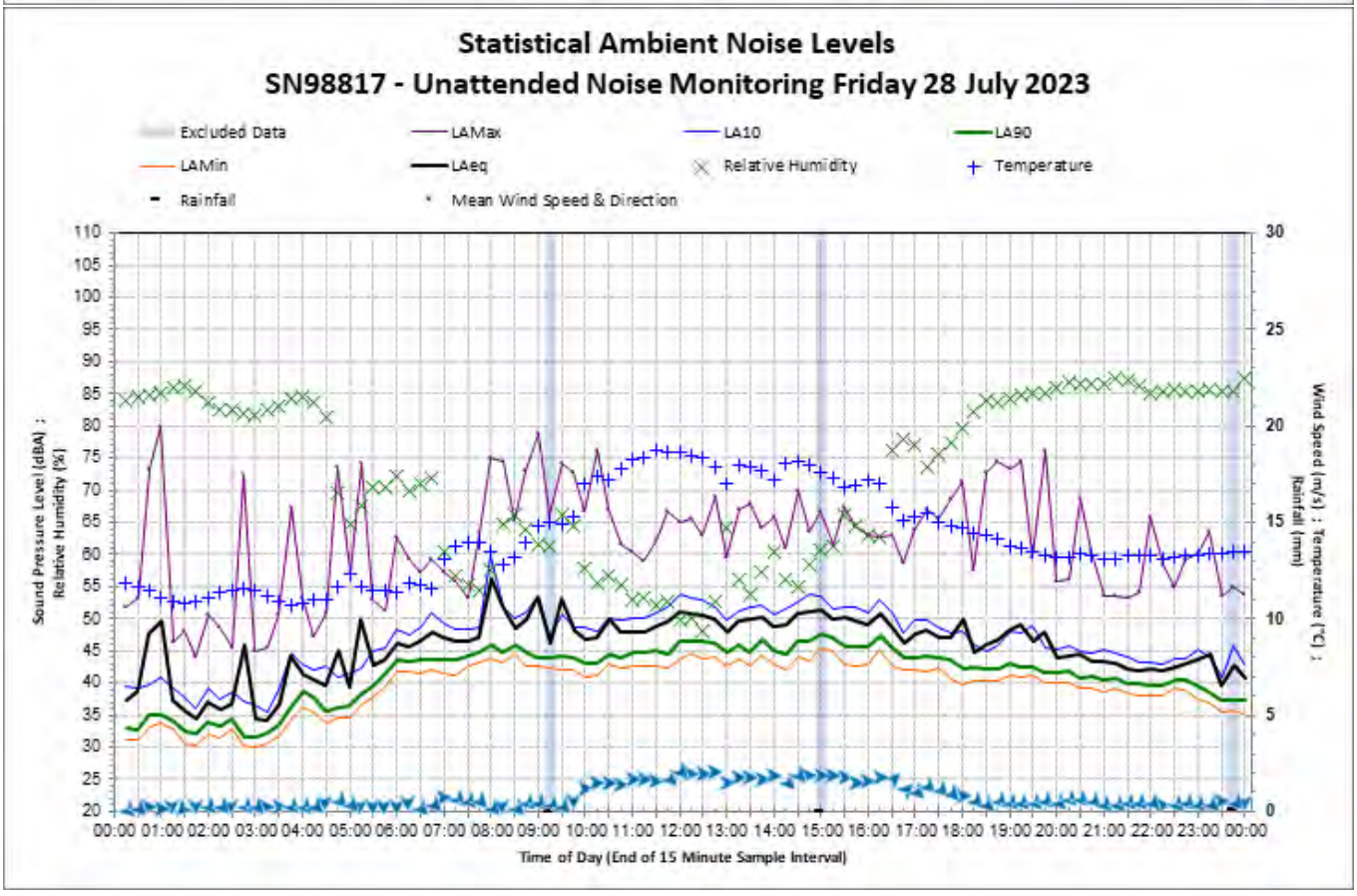
Statistical Ambient Noise Levels
SN46003 - Unattended Noise Monitoring Thursday 3 August 2023



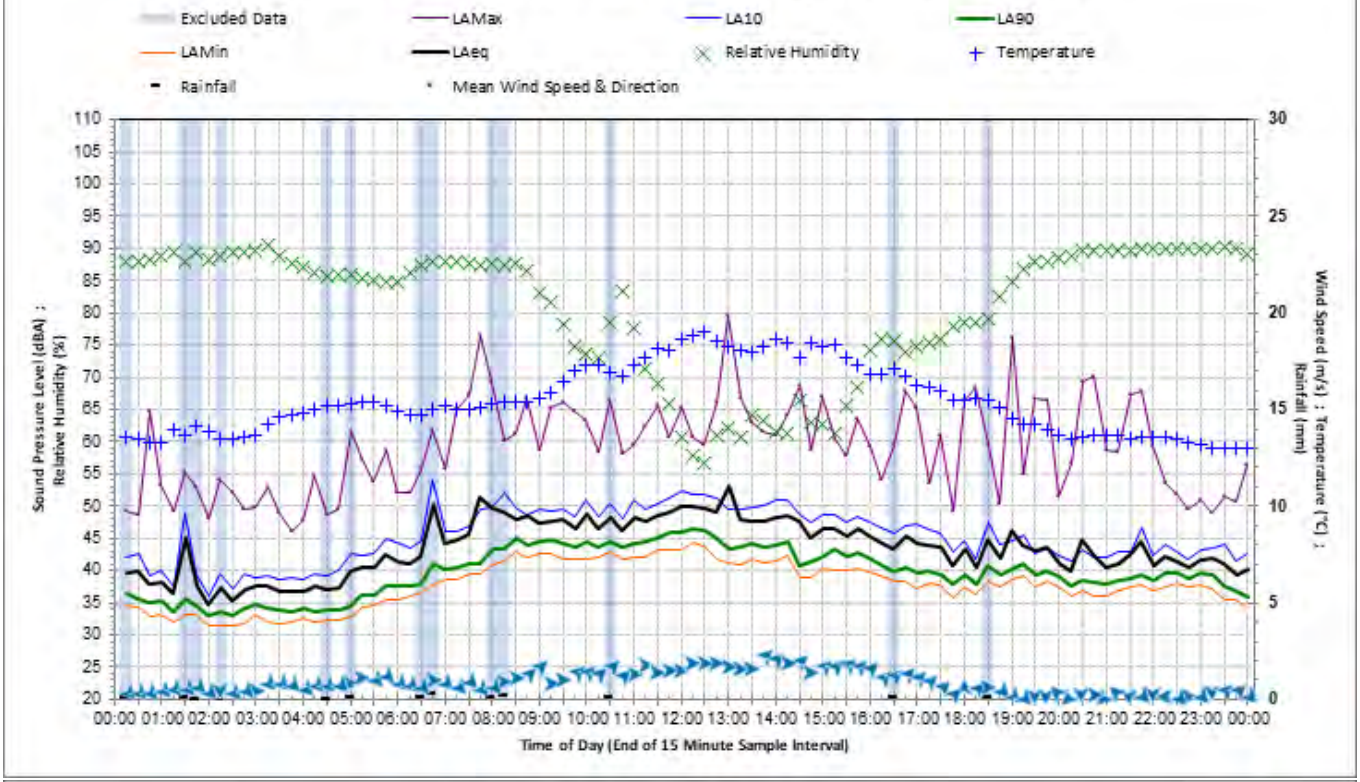

Statistical Ambient Noise Levels
SN46003 - Unattended Noise Monitoring Friday 4 August 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

Logger 5 - SN98817 - 38 Winchester Place - Noise Chart

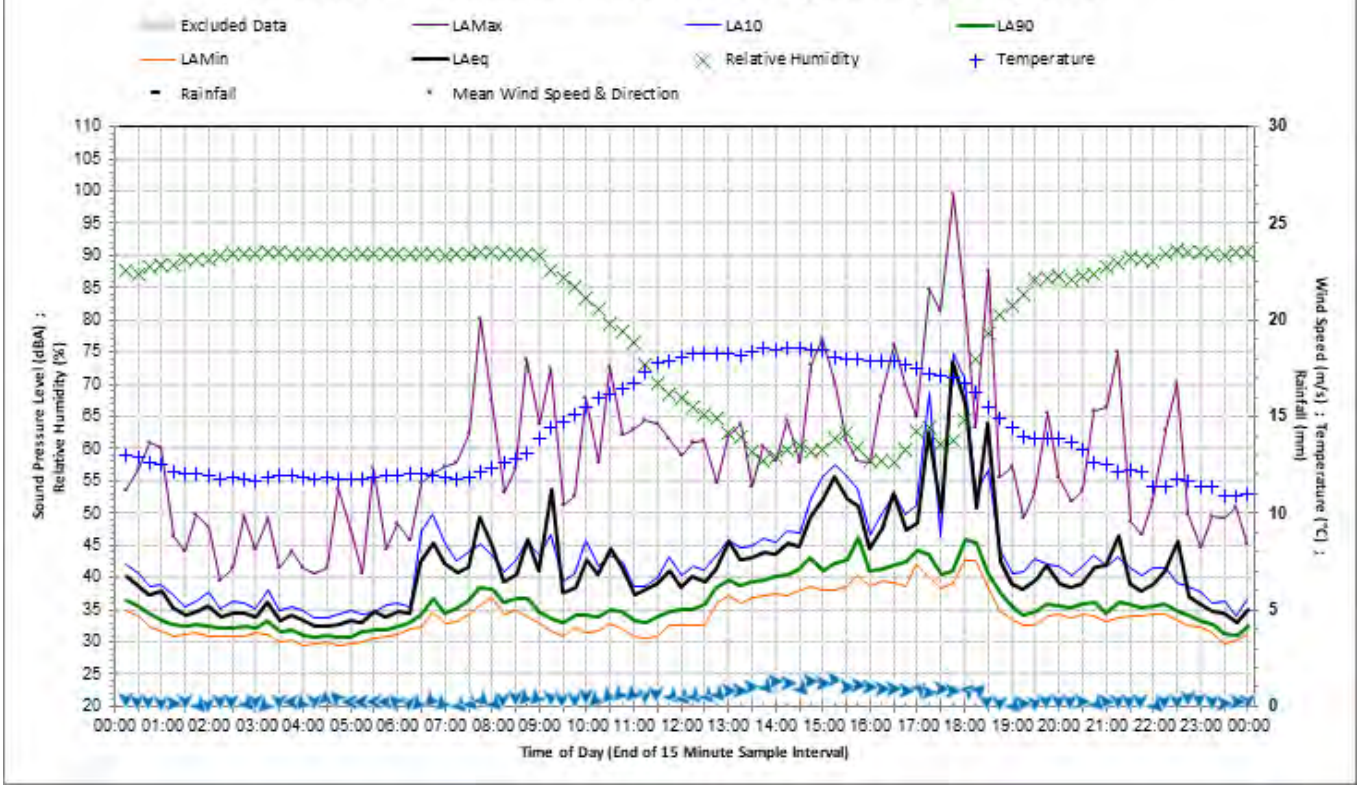




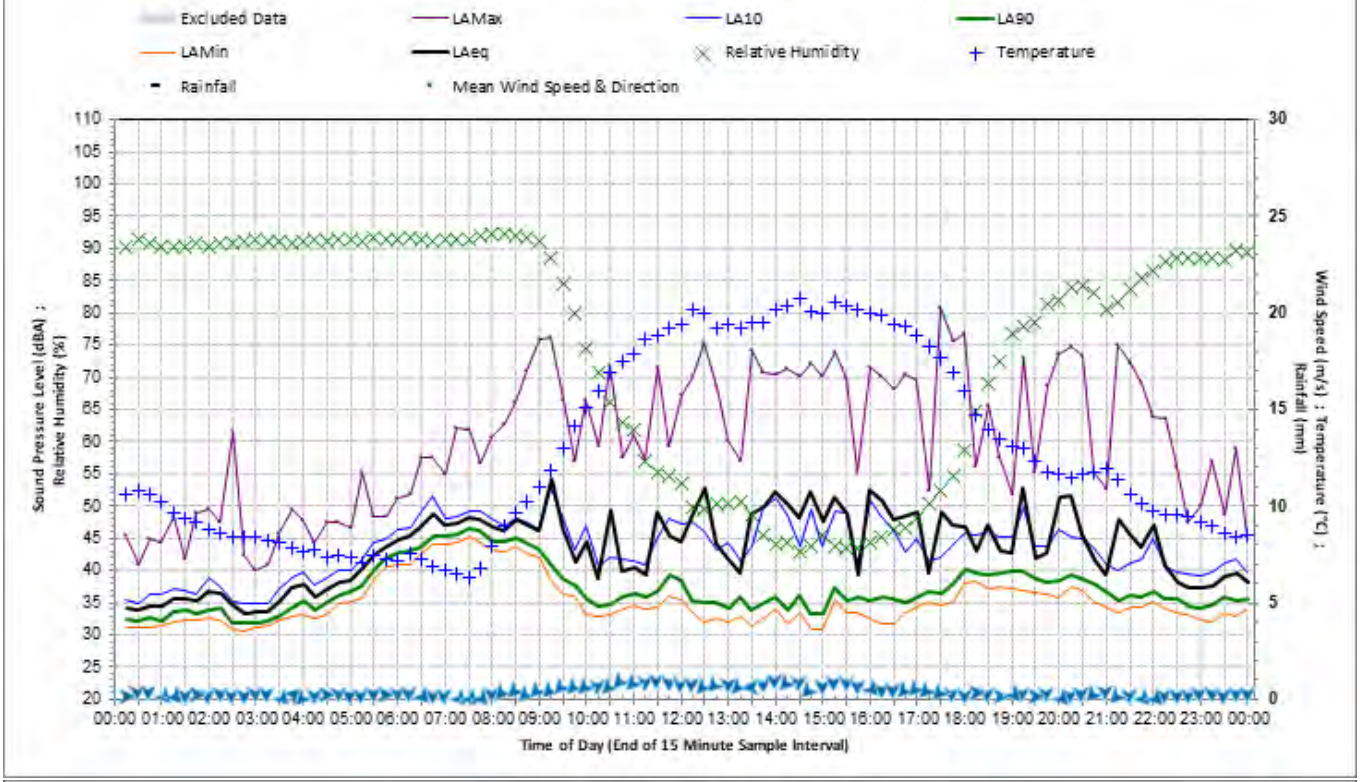
Statistical Ambient Noise Levels
SN98817 - Unattended Noise Monitoring Saturday 29 July 2023



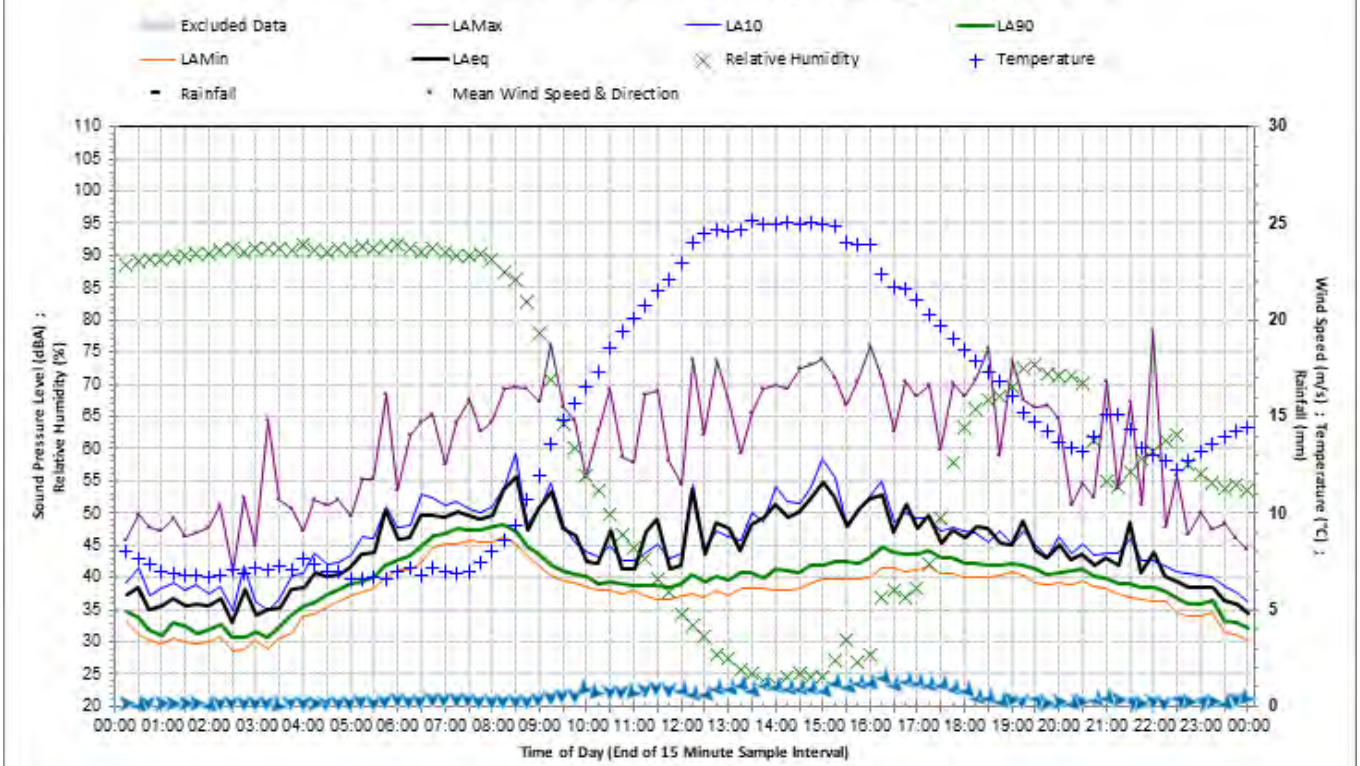
Statistical Ambient Noise Levels
SN98817 - Unattended Noise Monitoring Sunday 30 July 2023



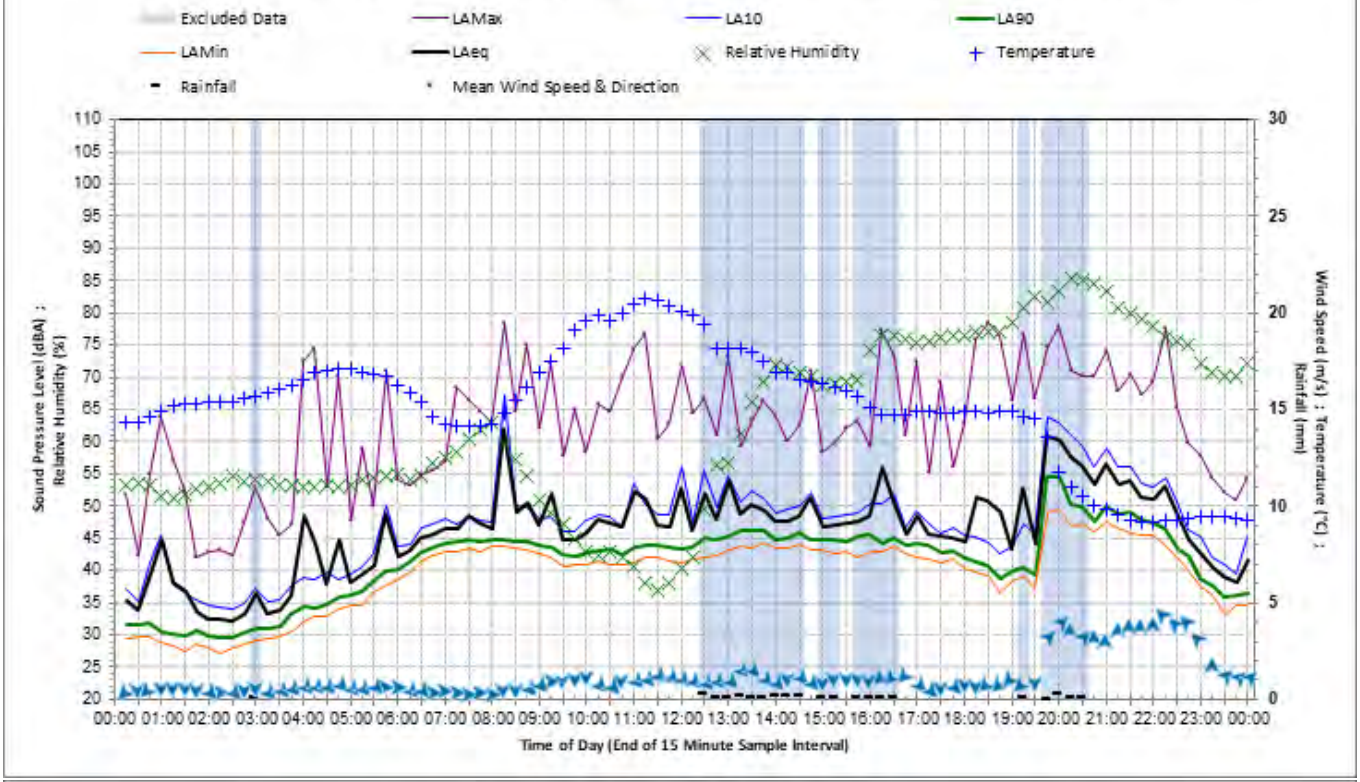
Statistical Ambient Noise Levels
SN98817 - Unattended Noise Monitoring Monday 31 July 2023



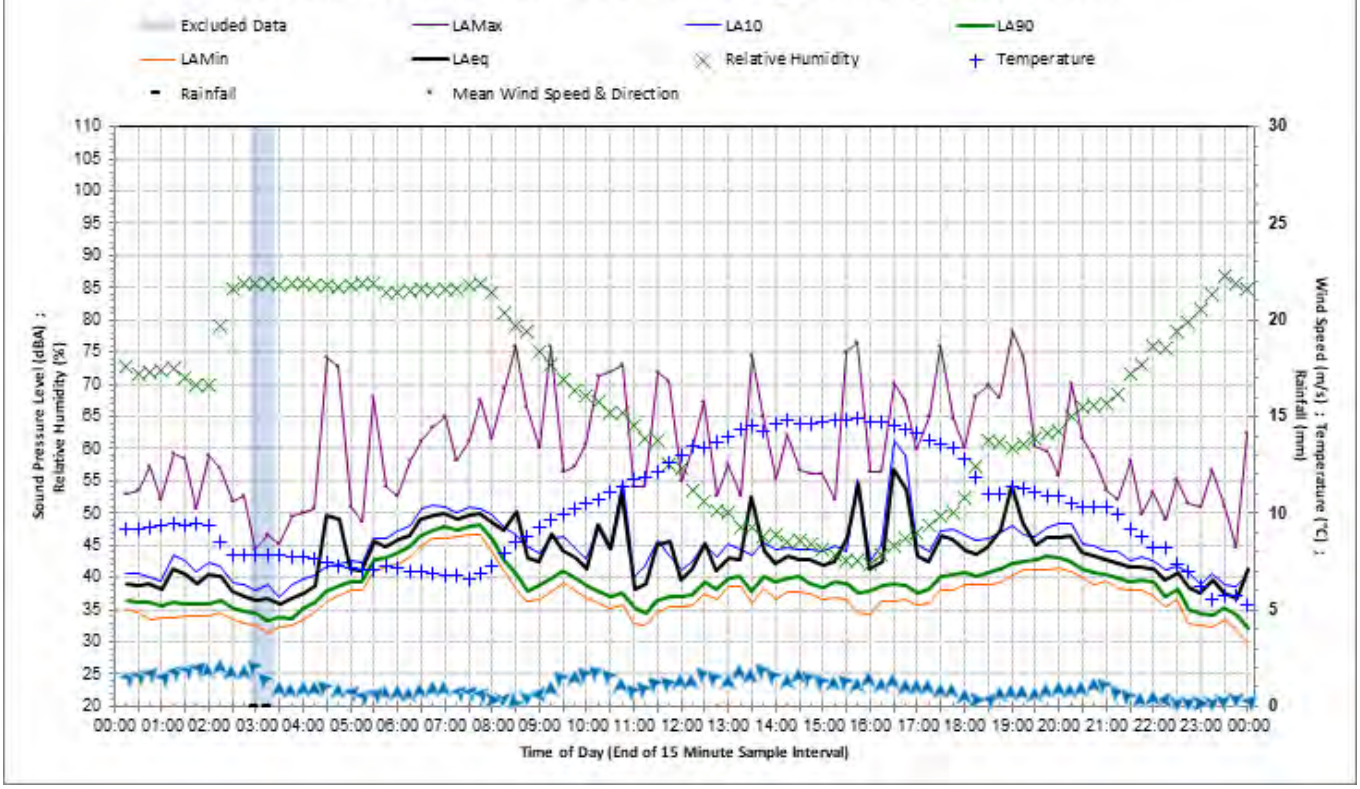
Statistical Ambient Noise Levels
SN98817 - Unattended Noise Monitoring Tuesday 1 August 2023

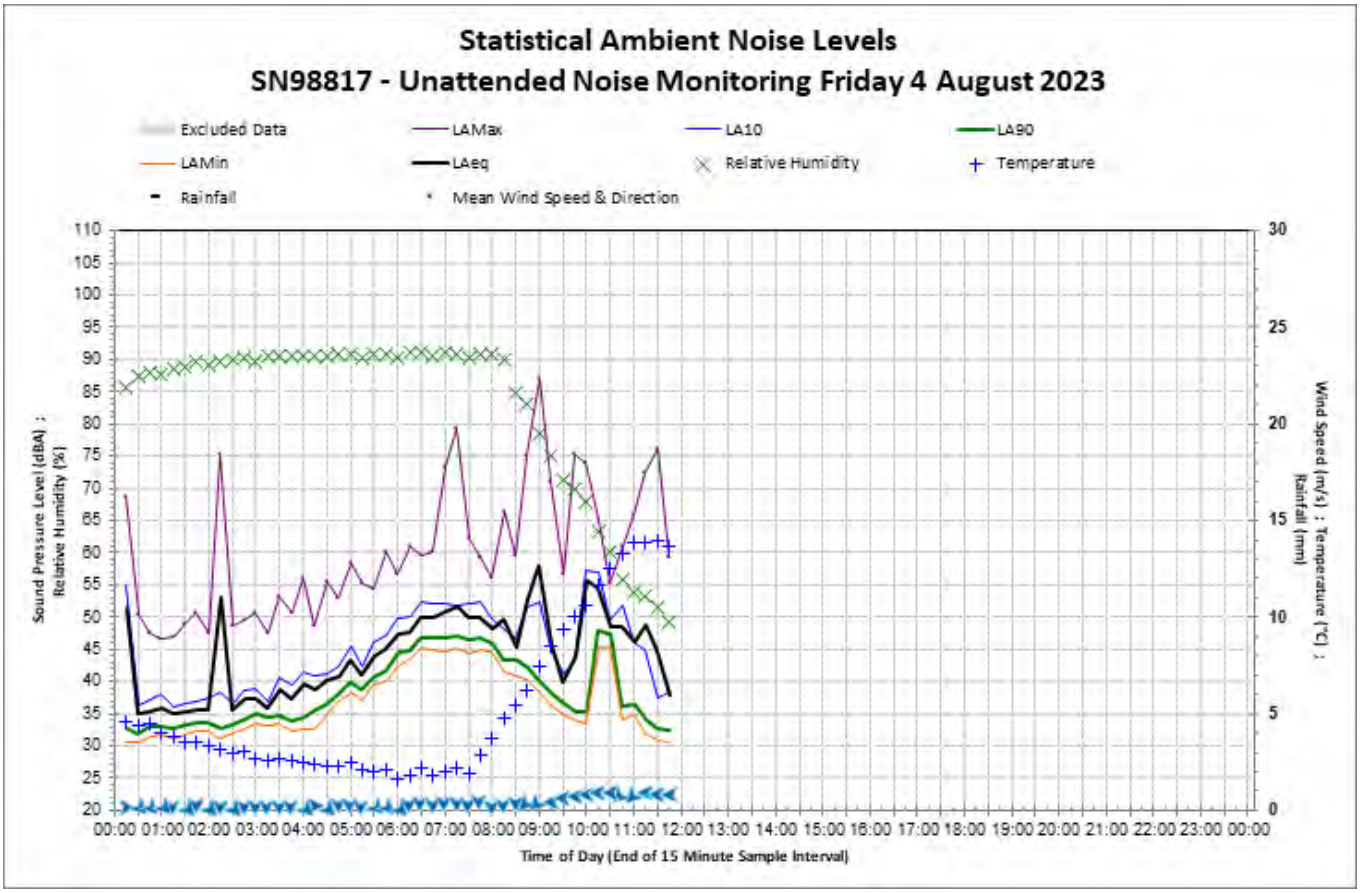


Statistical Ambient Noise Levels
SN98817 - Unattended Noise Monitoring Wednesday 2 August 2023



Statistical Ambient Noise Levels
SN98817 - Unattended Noise Monitoring Thursday 3 August 2023




Statistical Ambient Noise Levels
SN98817 - Unattended Noise Monitoring Friday 4 August 2023
Excluded Data
LAMax
LA10
LA90
LAMin
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

Appendix E

Conductor operating currents

ghd.com

→ The Power of Commitment