Operational Traffic Noise Assessment Report

Newell Highway Upgrade - Parkes Bypass

November 2020

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Executive Summary

Transport for NSW (TfNSW) proposes to build a new 10.5 kilometres bypass approximately 1.5 to 2.0 kilometres west of the existing Newell Highway in Parkes, NSW. Cardno has been engaged to prepare an Operational Traffic Noise Assessment Report as part of the detailed design for the Parkes Bypass project.

This report has been prepared to reflect the 100% detailed design for the project and provides updated predicted noise levels expected to impact nearby affected sensitive receivers from those previously contained in the project REF prepared by WSP in December 2019.

The new highway west of Parkes will be approximately 10.5 kilometres long and the key features will include:

- A two-lane road (one lane in each direction) with four key intersections including:
- North and south T-intersections with turn lanes between the existing Newell Highway and the Bypass
- A split T-intersection at London Road
- A split T-intersection at Brolgan Road
- A four-way roundabout at Condobolin Road
- Two bridges including:
- A bridge over the Broken Hill (Sydney to Perth) and Parkes-Narromine rail lines and Hartigan Avenue
- A local vehicle bridge with a shared path for cyclists and pedestrians over the bypass connecting Victoria Street and Back Trundle Road
- An extension of Hartigan Avenue to connect to Brolgan Road, Billy Mac Place and Condobolin Road
- Realignment, reconfiguration and modification to local roads including:
- Realignment of Moulden Street
- Maguire Road and Nock Road are converted to cul-de-sacs
- Construction of a new road between Brolgan Road and Hartigan Avenue
- Construction of a new road between Thomas Street and Mitchell Street
- New T-intersection at Thomas Street and Reedsdale Road (no access between Thomas Street and Moulden Street)
- New T-intersection at Brolgan Road (west) onto Hartigan Avenue extension (no access east/west along Brolgan Road across bypass)
- A new shared path for pedestrians and cyclists parallel to the eastern side of the bypass, which would connect Brolgan Road, Condobolin Road and Victoria Street

The project assessed for the REF stage of the project included the following elements:

- A new two-lane bypass (one lane in each direction) with four key intersections comprising:
- T-intersections where the new bypass connects to the existing highway near Barkers Road (south) and Maguire Road (north)
- A staggered T-intersection at London Road
- A four-way roundabout at Condobolin Road
- A bridge over the Broken Hill and Parkes to Narromine rail lines and Hartigan Avenue and a shared pedestrian/cycleway bridge over the Parkes Bypass connecting Victoria Street and Back Trundle Road
- An extension of Hartigan Avenue that would connect to Brolgan Road (west of the bypass) and Condobolin Road
- Changes to local roads to tie in with the new bypass.

The 100% Detailed Design reflects the following changes to the REF alignment:

- Changes to locations and sizes of cutting and embankments to the existing roads
- Changes to vertical road alignment
- Changes to horizontal alignments around the Henry Parkes Way (Condobolin Road) Intersection
- Speed and pavement surface changes (to include an additional section of low noise pavement).

The design alignment is shown in Figure 2-1.

This assessment considers the following policies and guidelines:

- *Road Noise Policy* (DECCW 2011) (RNP)
- *Noise Criteria Guideline* (RMS 2015) (NCG)
- *Noise Mitigation Guideline* (RMS 2015) (NMG)
- Noise Model Validation Guideline (RMS 2018) (NMVG)
- At-receiver Noise Treatment Guideline (Draft) (RMS 2017) (ARNTG)
- *Environmental Noise Management Manual* (RTA 2001) (ENMM)

The analysis used to inform this assessment has adopted revised traffic information and background noise levels from that used to generate the REF operational noise assessment and reflects the 100% DD stage of the project. The adopted traffic assumptions and measured noise levels have been outlined in the appropriate sections of this report.

In undertaking the assessment, the noise model initially provided by TfNSW and constructed for the REF assessment has been re-verified against additional noise monitoring data collected in August & September 2020 and updated to reflect the final 100% detailed design. 3D noise modelling software (SoundPLAN 8.2) was used to determine the noise model outputs for the design year (2033) and compare them to the appropriate assessment criteria in accordance with the RMS Noise Criteria Guideline. Where exceedances were predicted, the modelling was used to determine the most suitable mitigation measures in accordance with the RMS Noise Mitigation Guideline requirements.

On this basis, the assessment has identified the following conclusions:

Assessment Conclusions

- Operational road traffic noise, 10 years following completion of the project in the year 2033, is predicted to exceed the NSW NCG criteria at various residential receivers, one educational receiver and one place of worship located along the new bypass.
- Traffic noise levels for the Design Year of 2033, (10 years following completion) are predicted to exceed the NSW NCG daytime criteria at a number of properties with 110 residential receiver facades (includes all modelled facades of 57 separate residential properties along the new bypass) qualifying for mitigation. Exceedances of up to 11 dB(A) during the day and by up to 13 dB(A) at night are predicted.
- Predicted noise levels at 13 of these properties, were predicted to be impacted at levels above the cumulative noise limit. These properties are located in London Road, Painter Street, Newell Highway, Hideaway Lane, Hartigan Avenue, Brolgan Road, Rose Street, Thomas Street, and Endicott Street and Bogan Road.
- Exceedances of up to 8 and 11 dB(A) are predicted at two of the buildings located within the Parkes Christian School. However, this assessment conservatively allows for natural ventilation in all buildings and an outside to inside noise reduction of 10 dB(A). In practice, the outside to inside noise reduction may be greater than 10 dB(A) and therefore the predicted internal road traffic noise levels as a result of the new bypass may be lower in practice. In addition, the existing road traffic noise levels impacting the school are exceeding the criteria by up to 10dB(A) and the project is only predicted to increase the existing road traffic noise level incident on the school by 1 dB(A). This increase would not be subjectively noticeable. The receiver qualified for mitigation based on the existing exceedance of the cumulative criteria only. On this basis, an inspection of the two buildings indicated below is recommended during the construction phase to determine whether provision of additional mitigation is required to be considered for these receivers.

- A childcare centre is located approximately 380 metres east of the project. Road traffic noise levels from the project are not predicted to exceed the criteria at this location.
- Road traffic noise levels from the project were predicted to exceed the criteria at the most exposed façade by 7 dB(A at the Kingdom Hall of Jehovah's Witnesses. However, this is an increase of only 1 dB(A) above the existing road traffic noise level incident on the building. Subjectively an increase of 1 dB(A) is not likely to be noticeable. This assessment conservatively allows for natural ventilation in all buildings and an outside to inside noise reduction of 10 dB(A). In practice, the outside to inside noise reduction may be greater than 10 dB(A) for this building and therefore the predicted internal road traffic noise levels as a result of the new bypass may be lower in practice. A noise impact assessment is therefore recommended for this receiver at project completion, to determine the level of noise impact on the property, and whether it qualifies for “at property” mitigation in accordance with the ARNTG.
- No exceedances are predicted at the Scoble Place Park. Therefore no mitigation is recommended for the passive recreation area receivers within this park. Exceedances of the active recreational area noise criteria were not predicted at the Parkes Golf Club building (99 London Road) or on the fairways.
- When comparing the predicted levels with and without the project in the design year, the road traffic noise levels have been found to increase by up to 19 dB(A) at some locations during the day and night.
- In light of the predicted exceedances; investigation was conducted to analyse the feasibility of acoustic barriers, with the results discussed in Section 7.
- The feasibility of acoustic barriers was assessed in accordance with the NSW NMG and it was determined that provision of barriers is not likely to be a practical option given the height or barriers that would be required and the minimal improvement that would be provided. Hence property treatments (e.g. mechanical ventilation, upgraded glazing) are expected be the only suitable option in cases where a reduction in noise levels must be still achieved after application of the lower noise pavement as part of the 100% Design. In accordance with the ARNTG, the extent of mitigation should be selected on the basis of feasible measures, which are considered reasonable on the basis of social, economic, and environmental effects, including the cost of the abatement measures.

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Technical Terms

Term	Definition
Adverse Weather	Weather effects that enhance noise (that is, wind and rain) that occur at a site for a significant period of time (that is, wind exceeding 5 m/s and rain exceeding 0.5 mm per hour during any measurement period.)
A-weighted Level	As per dB(A) defined below.
Ambient Sound	Of an environment: the all-encompassing sound associated with that environment, being a composite of sounds from many sources, near and far.
ARNTG	At-receiver Treatment Noise Guideline (RMS 2017)
AV:ATG	New South Wales Office of Environment and Heritage Assessing Vibration: A Technical Guide (DEC 2006)
Background Sound Level	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted external ambient noise sources.
CoRTN	Calculation of Road Traffic Noise, HMSO 1988
Controlling Criterion	The greater exceedance of the “relative increase criterion” or the “road traffic noise assessment criteria (Table 3 and 4 in the RNP)”.
dB(A)	Unit of acoustic measurement electronically weighted to approximate the sensitivity of human hearing to sound frequency.
DEC	NSW Department of Environment and Conservation, now known as the NSW Office of Environment and Heritage
DECC	NSW Department of Environment and Climate Change, now known as the NSW Office of Environment and Heritage
DECCW	NSW Department of Environment and Climate Change and Water, now known as the NSW Office of Environment and Heritage
Decibel, dB	Unit of acoustic measurement. Measurements of power, pressure and intensity may be expressed in dB relative to standard reference levels.
ECRTN	New South Wales superseded Office of Environment and Heritage Environmental Criteria for Road Traffic Noise (EPA 1999).
ENMM	The New South Wales Department of Roads and Maritime Safety Environmental Noise Management Manual (RTA 2001).
EPA	New South Wales Environmental Protection Authority
ICNG	New South Wales Office of Environment and Heritage Interim Construction Noise Guideline (DECCW 1999).
INP	New South Wales Office of Environment and Heritage Industrial Noise Policy (EPA 2000).
L90, L10 etc.	A statistical measurement giving the sound pressure level which is exceeded for the given percentile of an observation period, i.e. L90 is the level which is exceeded for 90 percent of an observation period. L90 is commonly referred to as a basis for measuring the background sound level.
LAbg, T	The A-weighted background sound level measured over a time interval T.

Term	Definition
LAeq, T	Equivalent continuous A-weighted sound pressure level. This is the value of the A-weighted sound pressure level of a continuous steady sound that, within a measurement time interval T, has the same A-weighted sound energy as the actual time-varying sound.
NCG	Noise Criteria Guideline (RMS 2015)
NMG	Noise Mitigation Guideline (RMS 2015)
NSW	New South Wales
NMVG	Noise Model Validation Guideline (RMS 2018)
RBL	Rating Background Level
RMS	Roads & Maritime
RNP	New South Wales Office of Environment and Heritage Road Noise Policy (DECCW 2011).
RTA	NSW Roads and Traffic Authority, now known as the NSW Department of Transport, Roads and Maritime Services
Roads and Maritime	NSW Roads and Maritime Services
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound Pressure Level, Lp, dB, of a sound	A measurement obtained directly obtained using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the r.m.s. sound pressure to the reference sound pressure of 20 microPascals.
Sound Power Level, Lw, dB of a source	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power level is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picoWatt.
TfNSW	Transport for NSW (formerly Roads & Maritime)

1 Introduction

Transport for NSW (TfNSW) (formerly RMS) proposes to build a new 10.5 kilometres bypass approximately 1.5 to 2.0 kilometres west of the existing Newell Highway in Parkes, NSW. Cardno has been engaged to prepare an Operational Traffic Noise Assessment Report to inform the detailed design for the Parkes Bypass project.

This Operational Traffic Noise Assessment Report (OTNAR) has been prepared to reflect the 100% detailed design for the project and provides updated predicted noise levels expected to impact nearby affected sensitive receivers from those previously contained in the project REF prepared by WSP in December 2019.

The assessment has been based on the following statutory policies and guidelines:

- Road Noise Policy (EPA 2011) (RNP)
- *Noise Criteria Guideline* (RMS 2015) (NCG)
- *Noise Mitigation Guideline* (RMS 2015) (NMG)
- Noise Model Validation Guideline (RMS 2018) (NMVG)
- At-receiver Noise Treatment Guideline (Draft) (RMS 2017) (ARNTG)

With reference to:

- *Environmental Noise Management Manual* (RMS 2001) (ENMM)
- *Environmental Design & compliance Specification PS311* (Section 2.6 – Operational Noise)

In undertaking the assessment, the verified base noise model provided by TfNSW and constructed for the REF assessment, and the REF Noise & Vibration Assessment Report: "*Parkes Bypass - Operational road traffic noise and construction noise and vibration assessment report, October 2018" (File Ref: 07 NOISE – PS102430-NOI-REP-001 Rev C*)" (The REF) has been utilised for this assessment.

The REF noise model was re-verified using recently updated noise monitoring and traffic count data, and updated to reflect the final 100% detailed design alignment and design year traffic flows.

3D noise modelling software (SoundPLAN 8.2) was then used to determine the noise model outputs for the design year (2033) and compared to the relevant criteria s detailed in the NCG to determine whether noise mitigation measures will be required. Noise mitigation measures have been designed for all sensitive receivers that qualify for mitigation in accordance with the NMG.

1.1 Assessment Objectives

The assessment objectives are to determine the predicted levels of noise and vibration impact on sensitive receivers located near to the project, and determine the levels of mitigation that are likely to be required, if applicable, to enable compliance with the current NSW legislation.

2 Project Description

2.1 Existing Site Description

The areas surrounding the proposed bypass consist of freestanding residential dwellings, interspersed with other sensitive land uses including educational facilities, a child care centre, a place of worship, and outdoor recreational areas. A total of ten noise catchment areas (NCA) have been established to group together dwellings with similar representative land uses, ambient noise environments and potentially similar degree of impacts.

The assessment area surrounding the bypass includes the following land uses:

1. Freestanding residential dwellings
2. Educational facilities
3. Outdoor recreational areas.

Figure 2-1 shows the assessed 100% design alignment.

2.2 Proposed Project

TfNSW proposes to build a new 10.5 kilometres bypass approximately 1.5 to 2.0 kilometres west of the existing Newell Highway in Parkes, NSW.

The proposal includes:

- A two-lane road (one lane in each direction) with four key intersections including:
- North and south T-intersections with turn lanes between the existing Newell Highway and the Bypass
- A split T-intersection at London Road
- A split T-intersection at Brolgan Road
- A four-way roundabout at Condobolin Road
- Two bridges including:
- A bridge over the Broken Hill (Sydney to Perth) and Parkes-Narromine rail lines and Hartigan Avenue
- A local vehicle bridge with a shared path for cyclists and pedestrians over the bypass connecting Victoria Street and Back Trundle Road
- An extension of Hartigan Avenue to connect to Brolgan Road, Billy Mac Place and Condobolin Road
- Realignment, reconfiguration and modification to local roads including:
- Realignment of Moulden Street
- Maguire Road and Nock Road are converted to cul-de-sacs
- Construction of a new road between Brolgan Road and Hartigan Avenue
- Construction of a new road between Thomas Street and Mitchell Street
- New T-intersection at Thomas Street and Reedsdale Road (no access between Thomas Street and Moulden Street)
- New T-intersection at Brolgan Road (west) onto Hartigan Avenue extension (no access east/west along Brolgan Road across bypass)
- A new shared path for pedestrians and cyclists parallel to the eastern side of the bypass, which would connect Brolgan Road, Condobolin Road and Victoria Street.

The key features of the project are presented in Table 2-1.

Table 2-1: Key Features of the Project (100% Detailed Design)

Item	Proposed Works
Route	Provision of a new bypass 1-2 km west of the existing Newell Highway
Interchanges	A new two-lane bypass (one lane in each direction) with five key intersections at the following locations: > Southern Connection, (with the existing highway) > London Road, > Roundabout At Condobolin Road, > Bogan Road, > Northern Connection, (with the existing highway)
Noise Barriers	None proposed
Design Pavement Surface – *No Mitigation Scenario*	14 mm Spray Seal > Newell Highway Bypass (south of London Road) > Newell Highway Bypass (north of Henry Parkes Way (Condobolin Road)) Various ramps and connections range between 14 mm spray seal and 14 mm re-seal Dense Grade Asphalt > Newell Highway Bypass (London Rd to Henry Parkes Way)
Design Pavement Surface – *With Mitigation Scenario*	14 mm Spray Seal > Newell Highway Bypass (south of London Road) > Newell Highway Bypass (north of Painter Street) Various ramps and connections range between 14 mm spray seal and 14 mm re-seal Dense Grade Asphalt > Newell Highway Bypass (London Rd to Henry Parkes Way) > Newell Highway Bypass between Henry Parkes Way (Condobolin Street) and Painter Street (north of Parkes)

2.3 Noise Sensitive Receivers in Proximity to the Project

The sensitive receivers located near to the project can be grouped into residential and non-residential noise sensitive receivers as follows:

2.3.1 Residential Receivers

The existing acoustic environment varies throughout the project extent. Most of the residential properties are located east of the proposal footprint, west of Parkes town centre in medium density suburban developments. West of the proposal footprint, residential properties are typically isolated low-density rural residential dwellings across open farmland.

Most of the residential dwellings near the proposal are single storey with some isolated two storey dwellings. The minimum distance to the nearest residential property was identified as a dwelling on Hartigan Avenue, located about 20 metres from the nearest trafficked lane.

2.3.2 Non-Residential Noise Sensitive Properties

The following non-residential receivers were identified in proximity to the project:

Table 2-2: Non-Residential Sensitive Receivers

Land Use	Address	Approximate minimum distance from proposal boundary (metres)
Child care centre Outdoor passive recreational	97-105 Victoria Street	380
Outdoor active recreational	Scoble Place Park	330
Outdoor active recreational related facilities	99 London Road (Parkes Golf Course and Golf Club)	50
Educational	Back Trundle Road (Parkes Christian School)	550
Places of worship	182-184 Back Trundle Road (Kingdom Hall of Jehovah's Witnesses)	300

Figure 2-1: Detailed Design Alignment Project Extents (Cardno October 2020)

3 Existing Noise Environment

Noise monitoring was carried out by WSP for the REF assessment for the project. However, a review of the base model prepared for the REF determined that additional noise monitoring was required to provide a robust noise model to account for current traffic noise levels and to accommodate changes to the design. On this basis, additional noise monitoring was required to provide additional up to date data to verify the noise model for the existing scenario. Therefore noise monitoring was carried out in August & September 2020 to obtain the required additional noise monitoring and traffic count data.

3.1 Unattended Noise Monitoring Methodology

Unattended noise measurements were recorded between 31 July and 6 August 2020 and 1 and 5 September 2020 to determine the existing noise environment of the study area. The noise monitoring was carried out in general accordance with Australian Standard AS 1055 Acoustics, Description and Measurement of Environmental Noise (Standards Australia, 1997) and the RNP (EPA, 2011).

Table 3-1 presents the noise monitoring equipment used onsite, with the monitoring locations shown in Figure 3-1. The purpose of the noise monitoring was to establish existing road traffic noise levels at noise sensitive properties. The data was gathered over a period of typical traffic movement, outside of school holidays.

The noise monitors were configured with the following instrument settings;

- 'A' weighting
- 'Fast' response
- 15 minute statistical intervals
- Measurement descriptors LAMax, LAeq, LA1, LA10, LA90

Unattended noise monitoring was carried out using the following equipment:

Table 3-1: Noise Monitoring Equipment – Unattended Monitoring

Location	Equipment Type	Manufacturer and Model	Serial Number
1a	Logger	ARL NGARA	878002
1b	Logger	ARL NGARA	878007, 8780F0
2	Logger	ARL NGARA	8780FB
3	Logger	ARL NGARA	878042
4	Logger	ARL NGARA	87809E
5	Logger	ARL NGARA	87807B
6a	Logger	ARL NGARA	878079, 878083
6b	Logger	ARL NGARA	87812B

3.2 Equipment Calibration

All monitoring equipment, has current NATA calibration certificates and were fitted with windshields and were field calibrated before and after monitoring, with no significant drifts in calibration (± 0.3 dB) were noted.

3.3 Metrological Monitoring Conditions

The weather conditions at the time of monitoring were recorded at Parkes Airport automatic weather station (Bureau of Meteorology (BOM) station number 065068), which is located about eight kilometres east of the proposal. These have been included below for information.

3.3.1 Monitoring Period 1 - 31 July to 6 August 2020

Conditions: Fine. Wind speeds were typically below 5 m/s during the day and night periods.

Wind: 0 to 5 m/s from various directions

Humidity: 53 to 99%

Temperature: -4 to 16°C

3.3.2 Monitoring Period 2 - 1 to 5 September 2020

Conditions: Fine. Wind speeds were typically below 5 m/s during the day and night periods.

Wind: 0 - 10 m/s from various directions, predominantly, NW and NE.

Humidity: 56 - 83%

Temperature: - 1 to 23˚C

Monitoring data was excluded during periods of weather that adversely affected the monitoring data; where wind speeds were greater than five metres per second and during significant rainfall, as recorded at the nearest meteorological station. Excluded data is indicated on the noise monitoring charts included in Appendix A.

3.4 Monitoring Locations

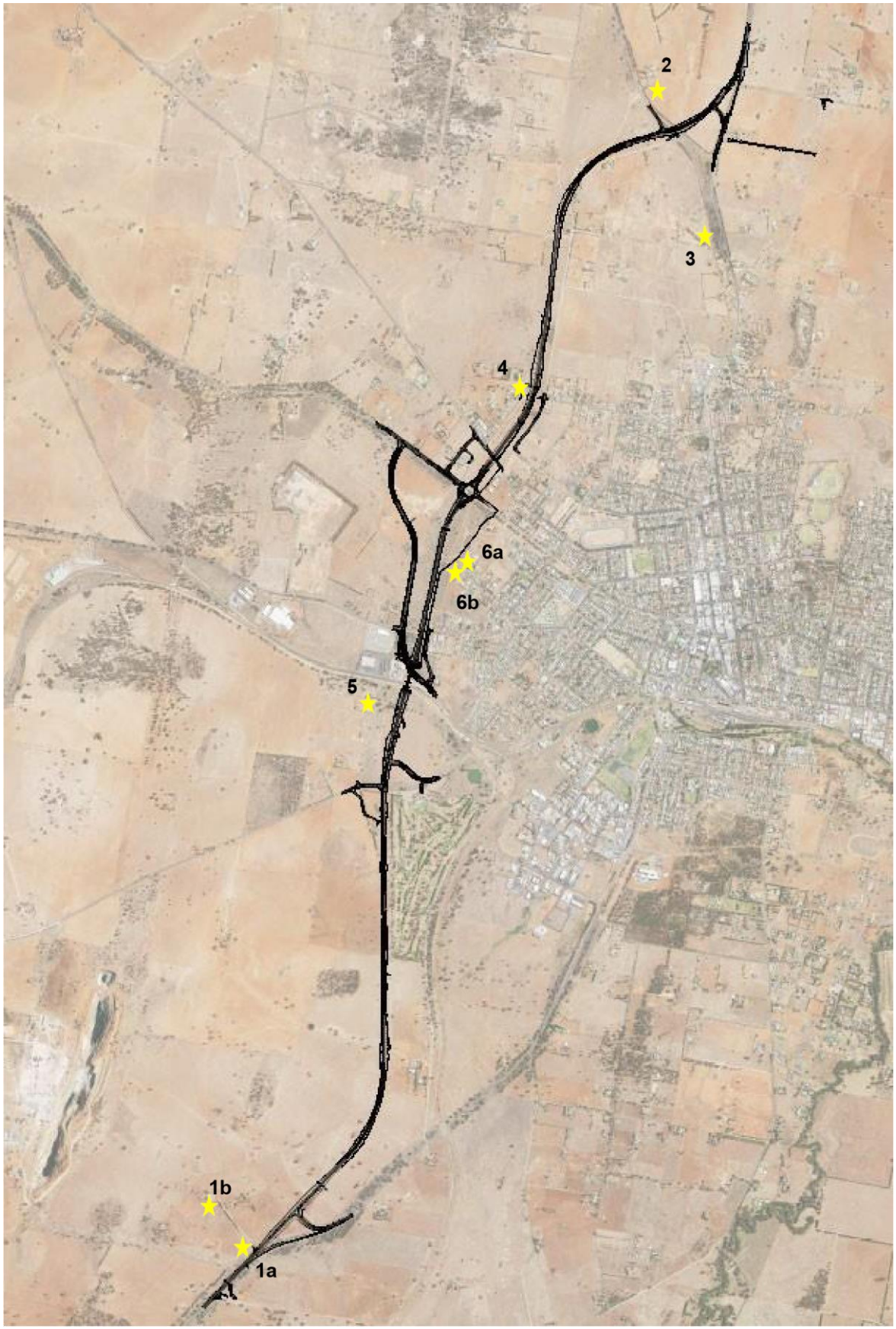
The loggers were deployed at the following locations:

Table 3-2: Noise Monitoring Locations

Monitoring Location	Monitoring Period	Address
1a	September	40 Barkers Road, Parkes (on the property 50 metres from the existing highway)
1b	August & September	40 Barkers Road, Parkes (at the dwelling)
2	August	98 Bogan Road, Parkes
3	August	285 Newell Hwy, Parkes
4	August	41 Moulden Street, Parkes
5	August	55 Ballerdee Lane, Parkes
6a	August & September	59 Coronation Avenue
6b	September	51 Coronation Avenue

Figure 3-1 shows the locations where unattended noise monitoring was conducted.

Figure 3-1: Noise Monitoring Locations



3.5 Measurement Parameters

As environmental noise varies with time, the use of statistical descriptors is necessary to understand and describe these variations. For road traffic noise these descriptors are further classified for day time (7am - 10pm) and night time (10pm - 7am).

For environmental noise, the assessment period for day time is further split into day (7am – 6pm) and evening (6pm – 10pm). A-weighted statistical levels are used to describe ambient noise levels. The common descriptors used to describe environmental noise are described as follows:

LAmax: the A-weighted maximum noise level measured during the measurement period.

LA1: the A-weighted noise level exceeded for 1% of the measurement period.

LA10: the noise A-weighted level exceeded for 10% of the measurement period, generally referred to as the average maximum sound pressure level.

LA90: the A-weighted noise level exceeded for 90% of the measurement period, generally referred to as the background noise level (refer AS 1055.1 – 1997).

LAeq: the equivalent continuous noise level over the measurement period, generally referred to as the energetical average sound pressure level over the measurement period.

3.6 Attended Noise Monitoring Methodology

Attended noise monitoring was carried out 1 August and 1 September 2020. Attended measurements were recorded during the daytime period, outside of peak hour, with the exception of NM03 and NA03 which were carried out during the afternoon and morning peak respectively.

Table 3-3 presents the noise monitoring equipment used onsite, for attended monitoring with the monitoring locations shown in Figure 3-1.

Table 3-3: Noise Monitoring Equipment – Attended Monitoring

Location	Equipment Type	Manufacturer and Model	Serial Number
1a, 1b, 3, 6a and 6b	Sound Level Meter	Rion NL-42	00184109

3.6.1 Observed Existing Noise Environment

The REF noted that the following existing noise environment was observed at each logger location:

Table 3-4: Operator Attended Noise Monitoring Results

Logger	Location	Observed Noise Environment
1a	40 Barkers Road (50 metres from Newell Highway), Parkes	Some noise of wind in the trees. The primary source of noise was traffic on the Newell Highway.
1b	40 Barkers Road (Dwelling), Parkes	Ambient noise environment dominated by distant trees rustling and birds chirping, with the distant traffic from the Newell Highway audible at times. Heavier vehicles such as B doubles produced a more noticeable pass-by event
3	285 Newell Hwy, Parkes	The ambient noise environment was generally dominated by light and heavy vehicles on Newell Highway.
5	55 Ballerdee Lane	The primary source of noise was an industrial premises to the north and rail noise on the nearby rail corridor. Traffic on Hartigan Avenue was inaudible.

Logger	Location	Observed Noise Environment
6a	59 Coronation Avenue	The ambient noise environment generally dominated by cars and heavy vehicle pass-bys on Westlime Road. Industrial noise from a nearby source was also audible. Some noise from birds, insects and wind in the trees was observed.
6b	51 Coronation Avenue	As above

3.7 Measured Noise Levels

Table 3-5 indicates the measured road traffic noise levels at the monitoring locations where traffic noise was identified to be a dominant noise source.

Table 3-5: Measured Road Traffic Noise Levels (Free Field)

Logger	Measurement Location	Measured Noise Level, dB(A) (Number in parenthesis includes noise during windy periods)	
		$L_{Aeq,\ 15\ hour}$ 07:00-22:00	$L_{Aeq,\ 9\ hour}$ 22:00-07:00
1a	40 Barkers Road, Parkes (on the property 50 metres from the existing highway)	62.0	59.2
1b	40 Barkers Road, Parkes (at the dwelling)	50.4	48.5
2	98 Bogan Road, Parkes	49.8	47.2
3	285 Newell Hwy, Parkes	66.0	62.3
4	41 Moulden Street, Parkes	43.6	39.5
5	55 Ballerdee Lane, Parkes	50.6	45.4
6a	59 Coronation Avenue	51.8	44.3
6b	51 Coronation Avenue	48.7	42.8

It should be noted that road traffic noise was inaudible at 55 Ballerdee Lane and has therefore been excluded from the model verification.

Noise monitoring charts for each location are provided in Appendix A

4 Statutory Assessment Criteria

4.1 Road Traffic Noise Criteria

4.1.1 NSW Road noise Policy 2011

The NSW *Road Noise Policy* (DECCW, July 2011) (NSW RNP) provides definitions of the functional class of the road under consideration. Table 4-1 outlines the roads under assessment and their functional class. For the purposes of adoption of assessment criteria from the NSW RNP, the NSW Noise Criteria Guideline (RMS 2014) states that collector roads are classed as sub-arterial roads.

Table 4-1: Assessed Roads - Functional Class

Road	Road Section	Functional Class
Newell Highway	Between Grey Dove Lane (approximately 6km south of Parkes) and Parkes Through Parkes town centre (existing Highway) Between Maguire Road and Goobang Road	Arterial
Westlime Road	Between Hartigan Avenue & Henry Parkes Way	Sub-arterial
Hartigan Avenue	South of Westlime Road	Arterial
Brolgan Road	West of Friendship Place	Collector
Condobolin Road	Between Westlime Road and Flinders Street	Sub-arterial
Henry Parkes Way	West of Westlime Road	Sub-arterial
Thomas Street	East of Reedsdale Road	Collector
Bogan Road	Between Deep Lead Road and the intersection with the exiting Newell Highway	Sub-arterial
Bleechmore Road	Between Maguire Road and the existing Newell Highway	Sub-arterial

4.1.2 Roads & Maritime Noise Criteria Guideline

Noise criteria are assigned to sensitive receivers using RMS' Noise Criteria Guideline (NCG). RMS' NCG provides guidance on how to apply the NSW Road Noise Policy.

The project assessment area extends to where noise levels are dominated by other roads that are not being assessed as part of this project as defined in NCG. This is generally up to a distance of 600 metres from the project works. However, under some circumstances, such as in rural areas, criteria may still be exceeded at 600 metres. Where it can be demonstrated that criteria may be exceeded beyond 600 metres then each residence will need to be assessed on a case by case basis. This has been done in consultation with Roads and Maritime noise specialists.

Residences may be assigned new, redeveloped, transition zone or relative increase criteria depending on how the project will influence noise levels. For each facade of the sensitive receiver, the most stringent applicable criteria will be used in the assessment.

Criteria are based on the road development type a sensitive receiver is affected by due to the road project. In some instances, residences may be exposed to noise from new and redeveloped roads or different functional classes. In this instance the proportion of noise from each road is used to establish transition zone criteria and provides a smooth change in noise criteria between adjacent residences. A further check is made to prevent large increases in noise level using the relative increase criteria.

A road is defined as 'new' where the road is a bypass or has been substantially realigned (outside the NCG tolerance band and/or existing grade) However, consideration can be given to whether a road has been substantially realigned for distances less than six times the existing lane width using local context for guidance. This is consistent with the NCG.

To address the transition zone between new and redeveloped roads, traffic noise levels must be predicted for four scenarios, including:

1. New project roads only, daytime;
2. New project roads only, night time;
3. Redeveloped project roads only, day time;
4. Redeveloped project roads only, night-time;

Whether or not the noise limit for new or redeveloped roads applies to a receiver, depends upon the relative exposure of the receiver's façade to the new or the redeveloped road.

The redeveloped road criteria is 5 dB(A) higher than the new road criteria, however, a receiver location with relatively equal exposure to both new and redeveloped roads will have target noise level between the higher and lower of the two noise limits.

The project consists of arterial roads, new road and redeveloped road segments and contains a number of both new road and redeveloped road transition zones.

4.1.2.1 Target Criteria

4.1.2.1.1 RESIDENTIAL SENSITIVE RECEIVERS

The applicable NCG criteria for residential receivers located near to arterial and sub-arterial roads are shown in Table 4-2.

Table 4-2: NSW RNP Road Traffic Noise Assessment Criteria for Residential Land Uses

Road category	Type of project/land use	Assessment criteria — dB(A)	
		Day (7 AM–10 PM)	Night (10 PM–7 AM)
Freeway/ arterial/ sub-arterial roads	1. Existing residences* affected by noise from new freeway/arterial/sub-arterial road corridors	$L_{Aeq, (15\ hour)}$ 55 (external)	$L_{Aeq, (9\ hour)}$ 50 (external)
	2. Existing residences* affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads	$L_{Aeq, (15\ hour)}$ 60 (external)	$L_{Aeq, (9\ hour)}$ 55 (external)
	3. Existing residences affected by noise from a transition zone between new and redeveloped roads	$L_{Aeq, (15\ hour)}$ 55 - 60 (external)	$L_{Aeq, (9\ hour)}$ 50 - 55 (external)

4.1.2.1.2 NON-RESIDENTIAL SENSITIVE RECEIVERS

The applicable NCG criteria for educational receivers are shown in Table 4-3.

Table 4-3: NCG Road Traffic Noise Assessment Criteria for Other Sensitive Land Uses

Existing Sensitive Land Use	Location	Assessment Criteria — dB(A), LAeq, 1 hour	
		Day (7 AM–10 PM)	Night (10 PM–7 AM)
School Classrooms	External (when in use)	50	-
Playgrounds		55	-
Places of Worship		50	50
Open Space (Active Use)		60 ($L_{Aeq,15hr}$)	-
Childcare (sleeping rooms)		45	-
Childcare (indoor play areas)		50	-
Childcare (outdoor play areas)		55	-

It is generally accepted that most residential buildings provide a noise reduction of at least 10 dB(A) when windows are left 20% open. Therefore where the noise goals are specified as internal in the NCG, a 10 dB(A) reduction from external to internal noise levels has been adopted to allow an external assessment. For the above receivers, further investigation will be required to determine whether the internal noise levels at project completion exceed the above criteria.

4.1.2.2 Relative Increase Criteria

In addition to the assessment criteria outlined in Table 4-2, any increase in the total traffic noise level at a location due to a proposed project or traffic-generating development is required to be considered.

The NCG also states that residences experiencing increases in total traffic noise level above the relative increase criteria shown below in Table 4-4 should also be considered for mitigation. For road projects where the main subject road is a local road, the relative increase criterion does not apply.

Table 4-4: Relative Increase Criteria for Residential Land Uses

Road category	Type of project/land use	Total Traffic Noise Level Increase — dB(A)	
		Day (7 AM–10 PM)	Night (10 PM–7 AM)
Freeway/arterial/ sub-arterial roads and transitways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road	Existing $L_{Aeq,\ (15\ hour)}$ + 12 dB(A) (external)	Existing $L_{Aeq,\ (9\ hour)}$ + 12 dB(A) (external)

In Table 4-4 above, the 'existing' traffic noise level refers to the level from all road categories which would occur for the relevant 'no build' option. Where the existing $L_{Aeq,\ (period)}$ road traffic noise level is found to be less than 30 dB(A), it is deemed to be 30 dB(A).

4.1.3 RMS Noise Mitigation Guideline

The RMS Noise Mitigation Guideline (RMS 2014) (*NMG*) outlines the applicable methodology for the determination of mitigation. Noise mitigation options that should be considered are listed in order of preference below:

1. Quieter pavement surfaces
2. Noise mounds
3. Noise walls
4. At property treatments

The NMG provides three triggers where a receiver may qualify for consideration of noise mitigation (beyond the adoption of road design and traffic management measures), as follows:

Trigger 1: The predicted road traffic noise level with the project exceeds the NCG controlling criterion and the noise level increase due to the project (i.e. the noise predictions for the Build minus the No Build) is greater than 2 dB(A).

Trigger 2: The predicted road traffic noise level with the project is 5 dB(A) or more above the NCG criteria (exceeds the cumulative limit) and the receiver is significantly influenced by project road noise, regardless of the contribution from the project.

Trigger 3: The noise level contribution from the road project is acute (daytime $L_{Aeq,15hr}$ 65 dB or higher, or night-time $L_{Aeq,9hr}$ 60 dB or higher). It qualifies for consideration of noise mitigation even if noise levels are dominated by another road.

The eligibility of receivers for consideration of additional noise mitigation is determined before the benefit of additional noise mitigation (quieter pavement and noise barriers) is included. The requirement for the project is to provide reasonable and feasible additional mitigation for these eligible receivers to meet the NCG controlling criterion. If the NCG criterion cannot be satisfied with quieter pavement and noise barriers, then the receiver is eligible for consideration of at-property treatment.

4.1.4 Roads and Traffic Authority's Environmental Noise Measurement Manual (ENMM)

The maximum pass-by event criteria is provided within the Roads and Traffic Authority's Environmental Noise Measurement Manual (RTA 2001) (ENMM). Practice note iii in the ENMM states the following in relation to the assessment of maximum noise levels;

"*This maximum noise assessment should be used as a tool to help prioritise and rank mitigation strategies, but should not be applied as a decisive criterion in itself*."

In terms of the noise limits to be assessed, the ENMM provides the following;

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

At locations where road traffic is continuous rather than intermittent, the LAeq,9hr (night) target noise levels should sufficiently account for sleep disturbance impacts. However, where the emergence of LAmax over the ambient LAeq is equal to or greater than 15 dB(A), the LAeq,9hr criteria may not sufficiently account for sleep disturbance impacts.

A "maximum noise event" can therefore be defined as any pass-by for which

- LAmax – LAeq,1hr ≥ 15 dB(A).

4.1.5 Australian Standards

The following Australian Standards provide criteria and methodologies that have been adopted in this assessment.

- Australian Standard *AS1055: Acoustics – Description and measurement of environmental noise*
- Australian Standard AS 2702 – 1984, Methods for the Measurement of Road Traffic Noise.

5 Summary of Design Benchmarks

5.1 Road Traffic Noise

Based on a review of the above statutory road traffic noise criteria in Section 4.1, a summary of the design benchmarks applicable to this project is provided in Table 5-1 below.

Table 5-1: Summary of Assessment Criteria

Applicable Assessment Criteria	Assessment Criteria — dB(A)	
	Day (7 AM–10 PM)	Night (10 PM–7 AM)
Residential Receivers		
Target Noise Criteria – Redeveloped and Existing Roads	$L_{Aeq,\ (15\ hour)}$ 60 (external)	$L_{Aeq,\ (9\ hour)}$ 55 (external)
Target Noise Criteria – New Roads	$L_{Aeq,\ (15\ hour)}$ 55 (external)	$L_{Aeq,\ (9\ hour)}$ 50 (external)
Relative Increase Criteria	Design year “no build” (road traffic) noise level + 12.0 dB(A)	
[(1)]Significant Increase Criteria	Design year “no build” noise level + 2.0 dB(A)	
[(2)]Acute Criteria	$L_{Aeq,\ (15\ hour)}$ 65 (external)	$L_{Aeq,\ (9\ hour)}$ 60 (external)
[(3)]Cumulative Criteria	Target Criteria + 5 dB(A)	Target Criteria + 5 dB(A)
Non-Residential Receivers		
Schools (Classrooms)	$L_{Aeq,1hr}$ 40 (internal) [(4)]$L_{Aeq,1hr}$ 50 (external)	Not applicable
Schools (Outdoor Play Areas)	$L_{Aeq,1hr}$ 55 (external active)	Not applicable
Childcare (sleeping rooms)	$L_{Aeq,15hr}$ 45 (external)	Not applicable
Childcare (indoor play areas)	$L_{Aeq,1hr}$ 50 (external)	Not applicable
Childcare (outdoor play areas)	$L_{Aeq,1hr}$ 55 (external)	Not applicable
Places of Worship	$L_{Aeq,1hr}$ 50 (external)	$L_{Aeq,1hr}$ 50
Open Space (Active Use)	$L_{Aeq,15hr}$ 60 (external)	Not applicable

[(1)] This applies when the no build noise levels for that year are predicted to be exceeded.
[(2)] This applies to predicted impacts from project roads only for the year after year of opening.
[(3)] This applies where the predicted noise levels are 5 dB(A) or more above the adopted target criteria for each receiver after adjustments for transition zones).
[(3)] This assumes and outside to inside noise reduction of 10 dB(A).

6 Predicted Road Traffic Noise Impacts

6.1 General Noise Modelling Methodology

Noise modelling was undertaken using SoundPLAN 8.2. SoundPLAN calculates road traffic noise levels based on the Calculation of Road Traffic Noise (CoRTN, UK Department of Transport, Welsh Division 1988) assessment methodology algorithms.

The noise model was verified against measured noise levels using an amended NSW CoRTN methodology to account for the higher percentage of larger heavy vehicles on Australian Roads. The adopted methodology was based on the technical white paper: "*A six-category heavy vehicle noise emission model in free-flowing condition (Jeffrey Peng, Jeffrey Parnell & Nicole Kessissoglou 2018)*. The model essentially requires that the heavy vehicles on a road are split into 6 different classifications, and afforded appropriate weightings to represent the range of differently sized vehicles on Australian Roads.

The provided REF model was corrupted so a new version of this model was created and the predicted results from this new model were then compared to the measured levels detailed in Section 3.7 to confirm the verification of the existing scenario model and to generate new results for the 100% DD Alignment.

The model was used to produce noise prediction scenarios for the year of opening and design year (2033) scenarios with and without the project at all of the modelled receivers.

Noise prediction models were based upon the traffic volumes detailed in Sections 6.2.4 and 6.2.5 provided by Cardno.

6.2 Noise Model Inputs & Assumptions

6.2.1 General Modelling Assumptions

General noise modelling assumption adopted for the noise modelling are detailed below.

Table 6-1 details the sources of information used for the prediction of traffic noise levels.

Table 6-1: Road Traffic Noise Modelling Inputs and Assumptions

Input Parameter	Source Reference
Ground elevation geometry	SoundPLAN REF geofiles and DGMs provided by TfNSW.
Road Alignment	Existing: SoundPLAN REF geofiles and DGMs provided by TfNSW. Future: Proposed design alignment provided by the Cardno design team for the 100% DD.
Traffic volumes	Refer to Sections 6.2.4 and 6.2.5.
Percentage of Heavy Vehicles	Refer to Sections 6.2.4 and 6.2.5.
Source Heights & Corrections	The noise model assumes three sources heights: > Light vehicles at 0.5 metres with 0 dB correction > Heavy vehicles at 1.5 metres with a -0.6 dB correction and at 3.6 metres with a -8.6 dB correction.
Road traffic speeds	Existing – Existing average hourly speeds as provided in the REF. Design - Posted Speeds as described in Section 3.1 of the REF Assessment and advised by the Cardno traffic team.
Existing Pavement Surface	7 / 14 mm Spray Seal > Newell Highway South > Newell Highway North

Input Parameter	Source Reference
	> Westlime Road > Hartigan Avenue > Henry Parks Way > Thomas Street > Bleechmore Road > Condobolin Road (Henry Parkes Way) > Bogan Road
Design Pavement Surface	7 / 14 mm Spray Seal > Newell Highway Bypass (south of London Road) > Newell Highway Bypass (north of Painter Street) Various ramps and connections range between 14 mm spray seal and 14 mm re-seal Dense Grade Asphalt > Newell Highway Bypass (London Rd to Henry Parkes Way) > Newell Highway Bypass between Henry Parkes Way (Condobolin Road) and Painter Street (north of Parkes)
Pavement Surface Corrections	> No correction factor was added for DGA > +2 dB correction was added for cold overlay and 7 mm chip seal, > +4 dB correction was added for 14 mm chip seal. (applied correction factors representative of acoustic performance relative to DGA).
Ground Absorption	As per the REF Assessment as follows: > 75% soft ground for grass, wooded areas and park land > 50% soft ground for residential/suburban land use > 25% soft ground for commercial and industrial land uses
Façade correction	+ 2.5 dB(A)
Receiver Height	> Ground Floors - 1.5 metres above ground level > First Floors – 4.5 metres above ground level It was noted that no properties of more than two floors are identified in the study area.

6.2.2 Definition of Project Study Area

The project assessment footprint or study area was determined by including all receivers within 600 metres of the project and any additional receivers up to 800 metres from the project alignment where criteria was predicted to be exceeded. Detailed maps of modelled receiver locations are detailed in Appendix B.

6.2.3 Transition Zones

The NSW NCG provides the process for establishing noise limits in accordance with NSW RNP requirements, with particular detail to the transition zones between redeveloped, and existing roads.

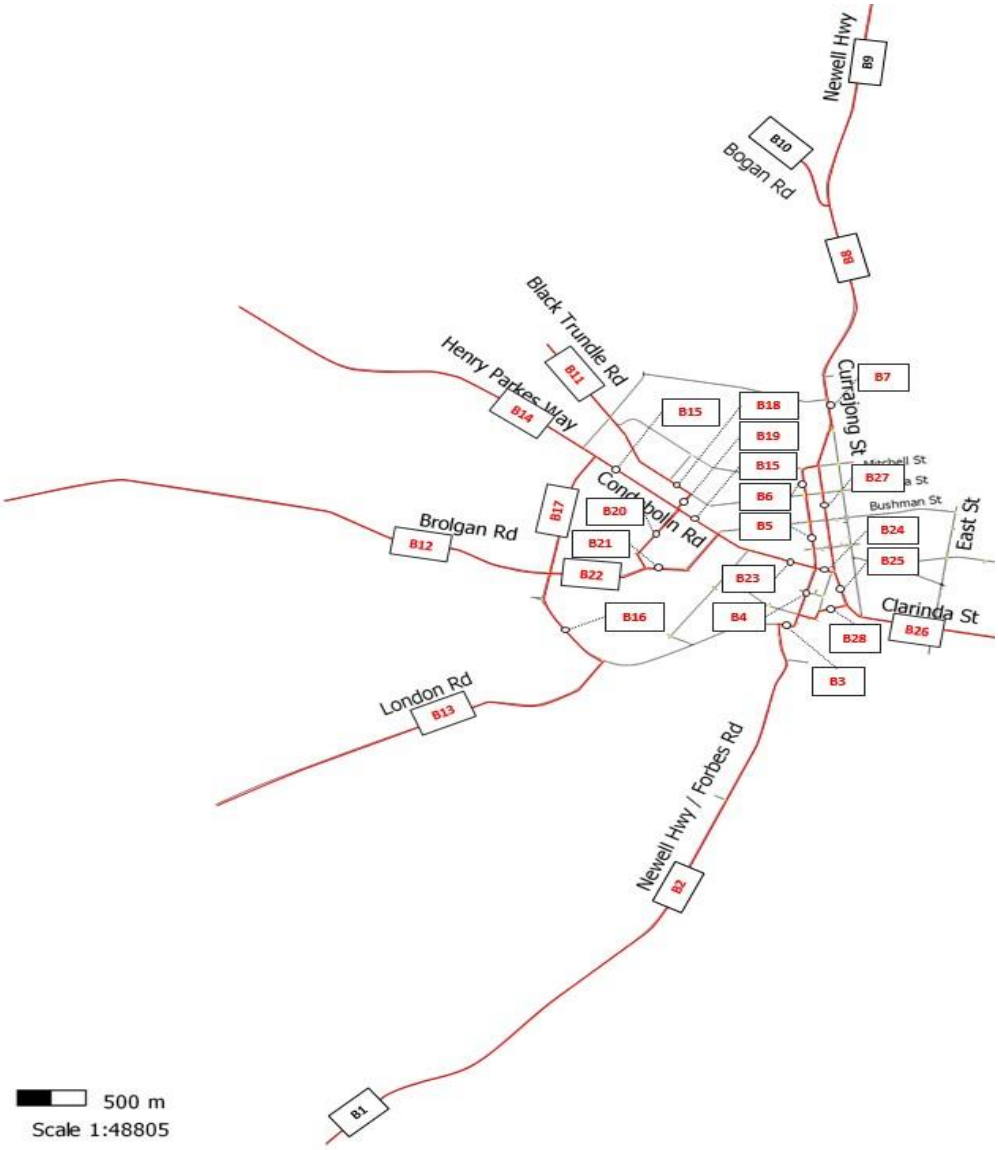
To establish the noise limits within transition zones, predicted levels were calculated for all new road segments, and all existing & redeveloped road segments for the detailed design scenario. Based upon a receiver locations' relative exposure to these segments, the applicable criteria was determined.

Predicted traffic noise levels for project roads were based on the predicted traffic volumes for the year of opening (2023). A map showing the location of the adopted transition zones is detailed in Appendix C.

6.2.4 Existing Traffic Volumes

Existing traffic volumes for the study area were provided by Cardno Traffic for the road segments indicated below in Figure 6-1. Traffic volumes from the REF were adopted and supplemented with traffic volume counts carried out by Cardno in 2019 and adjusted to represent 2016 accordingly.

Figure 6-1: Location of Road Segments – Existing & No Build Scenarios.



Modelled traffic volumes for each relevant road segment were adopted as follows:

Table 6-2: Modelled Traffic Volumes – Existing Year (2016)

Label	Road	Direction	Existing Traffic Volumes 2016					
			Vehicles Per 15 hour (day)			Vehicles Per 9 hour (night)		
			Total Volume	Heavy Vehicle	Mean Speed (km/h)	Total Volume	Heavy Vehicle	Mean Speed (km/h)
B1	Newell Highway Sth of Parkes	NB	1807	316	99	248	107	99
		SB	1786	368	103	190	75	105
B2	Newell Highway Sth of Parkes	NB	1807	316	99	248	107	99
		SB	1786	368	103	190	75	105
B8	Newell Highway Nth of Parkes	NB	2172	460	67	289	38	71
		SB	1904	334	61	500	94	68
B9	Newell Highway Nth of Parkes	NB	2172	460	84	289	38	85
		SB	1904	334	94	500	94	92
B10	Bogan Road	NB	566	228	84	45	20	85
		SB	400	47	94	209	10	92
B11	Victoria Street (Black Trundle Road)	NB	405	35	80	347	30	80
		SB	405	35	80	347	30	80
B12	Brolgan Road	EB	572	37	46	52	7	46
		WB	615	107	48	49	49	48
B13	London Road	EB	170	63	60	13	0	60
		WB	632	107	60	72	20	60
B14	Henry Parkes Way	EB	738	69	68	61	5	68
		WB	717	69	62	40	2	62
B15	Condobolin Road	EB	738	69	68	61	5	63
		WB	717	69	62	40	2	66
B16	Hartigan Avenue	EB	406	126	60	50	22	60
		WB	412	106	60	64	29	60
B17	Westlime Road	NB	380	74	77	64	29	77
		SB	404	110	79	50	22	79
B18	Victoria Street	EB	622	16	60	55	1	60
		WB	248	18	60	16	1	60
B19	McGlynn Street	NB	245	0	60	18	0	60
		SB	171	22	60	20	3	60
B20	Flinders Street	NB	245	51	50	15	0	50
		SB	263	22	50	31	3	50
B21	Middleton Street	NB	488	13	50	37	0	50
		SB	755	22	50	87	3	50
B22	Brolgan Road	EB	202	50	47	17	1	47
		WB	278	27	45	32	4	45
-	Moulden Street	NB	180	15	40	18	2	40
		SB	165	45	40	15	3	40
-	Thomas Street	EB	250	39	54	225	35	54
		WB	250	39	57	225	35	57

6.2.5 Future 'No Build' Traffic Volumes

Future traffic volumes for the "No Build" Scenario for 2023 for the study area were provided by Cardno Traffic for the road segments indicated below in Table 6-3:

Table 6-3: Predicted Future Traffic Volumes – No Build – Year of Opening 2023

Label	Road	Direction	Year of Opening Traffic Volumes 2023					
			Vehicles Per 15 hour (day)			Vehicles Per 9 hour (night)		
			Total Volume	Heavy Vehicle	Mean Speed (km/h)	Total Volume	Heavy Vehicle	Mean Speed (km/h)
B1	Newell Highway Sth of Parkes	NB	2986	511	99	311	105	99
		SB	2901	647	103	419	209	105
B2	Newell Highway Sth of Parkes	NB	2985	2748	99	310	104	99
		SB	2228	505	103	414	205	105
B8	Newell Highway Nth of Parkes	NB	3104	715	67	517	183	71
		SB	2776	675	61	183	57	68
B9	Newell Highway Nth of Parkes	NB	2553	610	84	270	153	85
		SB	2062	592	94	132	54	92
B10	Bogan Road	NB	552	105	84	247	30	85
		SB	715	83	94	50	3	92
B11	Victoria Street (Black Trundle Road)	NB	790	68	80	70	5	80
		SB	617	97	80	50	3	80
B12	Brolgan Road	EB	451	140	46	64	25	46
		WB	514	167	48	26	0	48
B13	London Road	EB	249	63	60	78	23	60
		WB	636	153	60	15	0	60
B14	Henry Parkes Way	EB	1169	150	68	102	12	68
		WB	891	140	62	54	4	62
B15	Condobolin Road	EB	1046	124	63	91	10	63
		WB	744	159	66	44	5	66
B16	Hartigan Avenue	EB	1767	137	60	133	12	60
		WB	611	67	60	277	17	60
B17	Westlime Road	NB	393	76	77	39	4	77
		SB	417	114	79	30	11	79
B18	Victoria Street	EB	536	36	60	23	1	60
		WB	358	24	60	47	3	60
B19	McGlynn Street	NB	311	6	60	22	0	60
		SB	202	29	60	24	4	60
B20	Flinders Street	NB	233	44	50	14	0	50
		SB	193	7	50	22	1	50
B21	Middleton Street	NB	312	13	50	25	0	50
		SB	913	7	50	104	1	50
B22	Brolgan Road	EB	280	57	47	36	5	47
		WB	309	37	45	17	0	45
B23	Condobolin Road	EB	1876	62	68	89	1	68
		WB	1336	24	62	166	5	62
B29	Victoria Street	EB	462	18	60	30	1	60
		WB	781	16	60	70	1	60
B30	Hartigan Avenue	EB	955	123	60	207	22	60
		WB	655	96	60	86	12	60
-	Moulden Street	NB	188	16	40	19	2	40
		SB	177	48	40	16	3	40
-	Thomas Street	EB	237	27	54	351	36	54
		WB	237	27	57	351	36	57

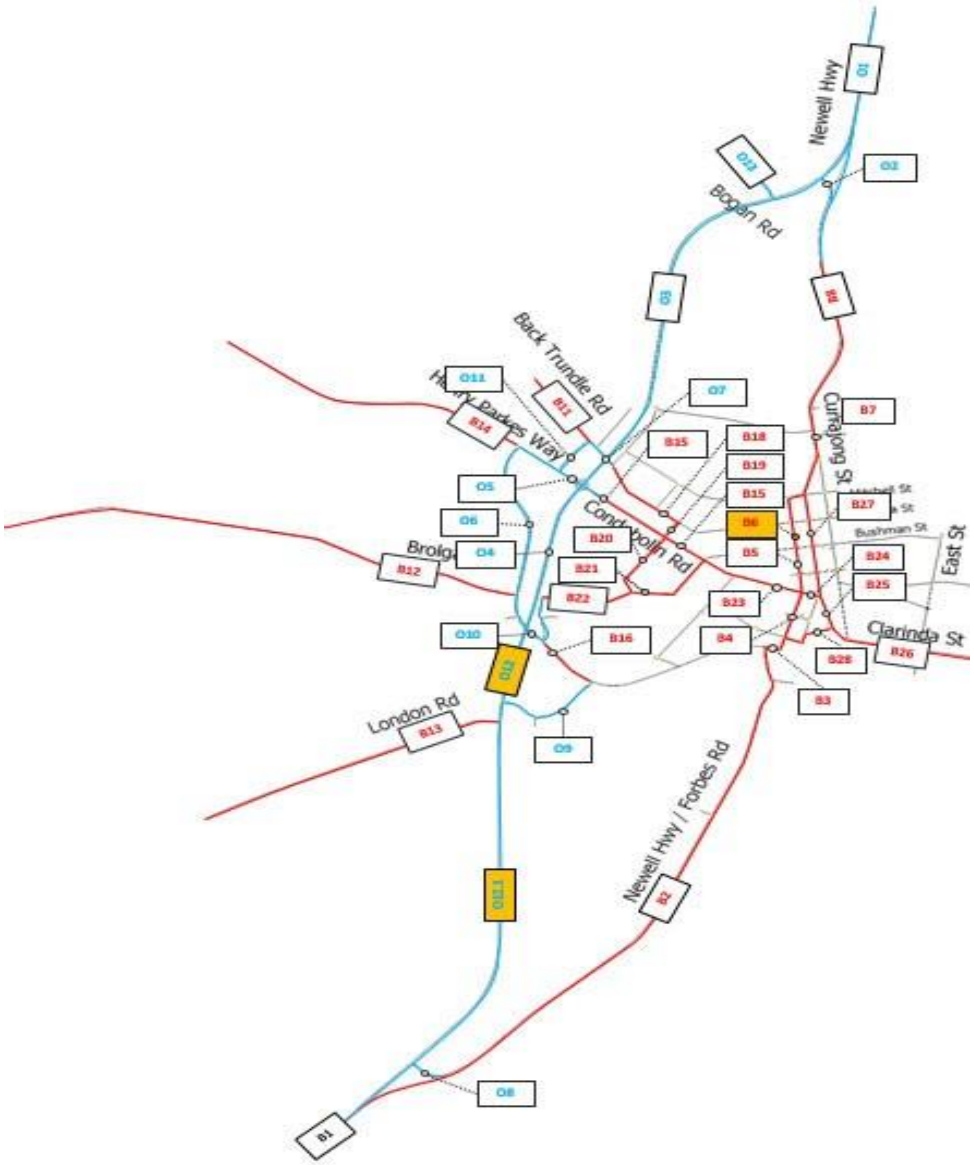
Table 6-4: Predicted Future Traffic Volumes – No Build – Design Year 2033

Label	Road	Direction	Design Year Traffic Volumes 2033					
			Vehicles Per 15 hour (day)			Vehicles Per 9 hour (night)		
			Total Volume	Heavy Vehicle	Mean Speed (km/h)	Total Volume	Heavy Vehicle	Mean Speed (km/h)
B1	Newell Highway Sth of Parkes	NB	3073	554	99	324	114	99
		SB	3108	758	103	464	245	105
B2	Newell Highway Sth of Parkes	NB	3048	156	99	321	113	99
		SB	2889	548	103	466	248	105
B8	Newell Highway Nth of Parkes	NB	3731	792	67	613	203	71
		SB	3105	792	61	205	67	68
B9	Newell Highway Nth of Parkes	NB	3004	668	84	282	168	85
		SB	2293	701	94	148	63	92
B10	Bogan Road	NB	727	123	84	431	78	85
		SB	812	91	94	331	35	92
B11	Victoria Street (Black Trundle Road)	NB	878	78	80	78	6	80
		SB	641	125	80	38	4	80
B12	Brolgan Road	EB	515	203	46	26	0	46
		WB	528	175	48	66	26.2	48
B13	London Road	EB	286	76	60	17	0	60
		WB	783	182	60	95	27	60
B14	Henry Parkes Way	EB	1185	170	68	103	13	68
		WB	931	171	62	56	5	62
B15	Condobolin Road	EB	1186	192	63	103	15	63
		WB	851	217	66	49	7	66
B16	Hartigan Avenue	EB	1825	185	60	284	23	60
		WB	645	59	60	141	11	60
B17	Westlime Road	NB	438	0	77	44	0	77
		SB	466	0	79	33	0	79
B18	Victoria Street	EB	650	5	60	58	0	60
		WB	327	19	60	21	1	60
B19	McGlynn Street	NB	271	0	60	21	0	60
		SB	111	0	60	13	0	60
B20	Flinders Street	NB	329	57	50	21	0	50
		SB	173	0	50	20	0	50
B21	Middleton Street	NB	412	13	50	31	0	50
		SB	938	0	50	106	0	50
B22	Brolgan Road	EB	265	70	47	15	0	47
		WB	352	30	45	41	4.4	45
B23	Condobolin Road	EB	2018	10	68	180	1	68
		WB	1267	7	62	85	0	62
B29	Victoria Street	EB	912	5	60	70	1	60
		WB	405	12	60	30	1	60
B30	Hartigan Avenue	EB	898	130	60	207	22	60
		WB	1121	154	60	86	12	60
-	Moulden Street	NB	240	21	40	19	2	40
		SB	226	62	40	16	3	40
-	Thomas Street	EB	237	27	54	351	36	54
		WB	237	27	57	351	36	57

6.2.6 Design Traffic Volumes

Design traffic volumes for the study area were provided by Cardno Traffic for the road segments indicated below in Figure 6-2.

Figure 6-2: Location of Road Segments – Build Scenarios



Future traffic volumes for the “Build” Scenario for 2023 for the study area were provided by Cardno Traffic for the road segments indicated below in Table 6-5:

Table 6-5: Predicted Future Traffic Volumes – Build 2023

Label	Road	Direction	Design Traffic Volumes 2023					
			Vehicles Per 15 hour (day)			Vehicles Per 9 hour (night)		
			Total Volume	Heavy Vehicle	Mean Speed (km/h)	Total Volume	Heavy Vehicle	Mean Speed (km/h)
B1	Newell Highway Sth of Parkes	NB	2948	473	100	303	97	100
		SB	2801	553	100	388	179	100
B2	Newell Highway Sth of Parkes	NB	1693	217	100	167	45	100
		SB	1295	213	100	170	69	100
B3	Newell Highway In Parkes	EB	6131	385	50	464	75	50
		WB	4650	212	50	368	75	50
B4	Newell Highway In Parkes	NB	4016	321	50	325	62	50
		SB	4242	116	50	332	14	50
B5	Bogan Street	NB	2922	185	50	231	36	50
		SB	4502	86	50	351	10	50
B6	Bogan Street	NB	1806	185	50	152	36	50
		SB	1667	54	50	131	6	50
B7	Curajong Street	NB	2579	193	50	207	37	50
		SB	2691	113	50	212	13	50
B8	Newell Highway Nth of Parkes	NB	1736	230	80	272	59	80
		SB	754	114	80	48	10	80
B11	Victoria Street (Black Trundle Road)	NB	810	88	50	72	7	50
		SB	617	92	50	38	3	50
B12	Brolgan Road	EB	490	178	50	26	0	50
		WB	512	182	50	67	27	50
B13	London Road	EB	242	57	100	15	0	100
		WB	655	139	100	80	21	100
B14	Henry Parkes Way	EB	1259	197	70	110	15	70
		WB	918	168	70	55	5	70
B15	Condobolin Road	EB	1532	203	100	134	16	100
		WB	1115	189	100	68	6	100
B16	Hartigan Avenue	EB	183	80	80	23	10	80
		WB	407	45	80	89	8	80
B18	Victoria Street	EB	502	36	50	45	3	50
		WB	343	12	50	23	0	50
B19	McGlynn Street	NB	221	0	50	16	0	50
		SB	130	0	50	15	0	50
B20	Flinders Street	NB	312	108	50	16	0	50
		SB	272	0	50	31	0	50
B21	Middleton Street	EB	236	13	50	18	0	50
		WB	770	0	50	87	0	50
B22	Brolgan Road	EB	289	22	50	15	0	50
		WB	291	96	50	34	3	50
B23	Dalton Street	NB	2121	114	50	188	9	50
		SB	1493	141	50	95	4	50
B28	Short Street	EB	2319	156	50	248	32	50
		WB	3200	164	50	185	18	50
O1	Redeveloped Bypass North of Parkes	NB	2658	745	110	454	191	110
		SB	2327	585	110	153	49	110
O2	Link Between New BP + Newell	NB	1767	240	80	278	62	80
		SB	537	103	80	35	9	80

Label	Road	Direction	Design Traffic Volumes 2023					
			Vehicles Per 15 hour (day)			Vehicles Per 9 hour (night)		
			Total Volume	Heavy Vehicle	Mean Speed (km/h)	Total Volume	Heavy Vehicle	Mean Speed (km/h)
	Highway Nth Parkes							
O3	New Bypass North of Parkes	NB	1519	516	110	272	132	110
		SB	1920	477	110	127	40	110
O4	New Bypass in Parkes	NB	1095	282	110	126	58	110
		SB	1676	342	110	235	111	110
O5	Condobolin Road	NB	1412	150	50	124	12	50
		SB	1043	186	50	63	6	50
O6	Hartigan Avenue Extension (Henry Parkes Way)	NB	112	58	80	8	6	80
		SB	174	50	80	9	2	80
O7	New Bypass in Parkes	NB	588	16	50	52	1	50
		SB	389	31	50	25	1	50
O8	Link Between New BP + Newell Highway Sth Parkes	NB	1683	217	80	167	45	80
		SB	0	0	80	0	0	80
O9	London Road East	NB	157	17	80	15	3	80
		SB	285	137	80	58	44	80
O10	Link New Bypass to Hartigan Avenue	NB	548	32	50	79	4	50
		SB	278	170	50	55	31	50
O11	Relocated Moulden Street South	NB	278	94	50	35	19	50
		SB	243	50	50	34	16	50
O12	New Bypass south Parkes	NB	1226	273	110	139	56	110
		SB	1541	340	110	222	110	110
O12.1	New Bypass south Parkes	NB	1091	282	110	125	58	110
		SB	1644	319	110	227	103	110
O13	Bogan Road	NB	552	105	110	247	30	110
		SB	715	83	110	50	3	110

Note: Road traffic has not been modelled on Thomas Street and the northern section of Moulden Street in the “Build” scenarios, as both streets become cul-de sacs with minimal road traffic, as a result of the project.

Future traffic volumes for the “Build” Scenario for 2033 for the study area were provided by Cardno Traffic for the road segments indicated below in Table 6-6:

Table 6-6: Predicted Future Traffic Volumes – Build 2033 (TBC)

Label	Road	Direction	Design Traffic Volumes 2033					
			Vehicles Per 15 hour (day)			Vehicles Per 9 hour (night)		
			Total Volume	Heavy Vehicle	Mean Speed (km/h)	Total Volume	Heavy Vehicle	Mean Speed (km/h)
B1	Newell Highway Sth of Parkes	NB	3047	528	100	318	109	100
		SB	3182	800	100	480	259	100
B2	Newell Highway Sth of Parkes	NB	1849	284	100	189	58	100
		SB	1364	237	100	182	77	100
B3	Newell Highway In Parkes	EB	6391	478	50	514	93	50
		WB	4983	195	50	393	23	50
B4	Newell Highway In Parkes	NB	4283	357	50	349	69	50
		SB	4532	142	50	356	17	50
B5	Bogan Street	NB	3373	221	50	268	43	50
		SB	4926	102	50	385	12	50
B6	Bogan Street	NB	2102	228	50	178	44	50
		SB	1840	81	50	145	9	50
B7	Curajong Street	NB	3029	264	50	247	51	50
		SB	3019	104	50	237	12	50
B8	Newell Highway Nth of Parkes	NB	2027	264	80	316	68	80
		SB	853	101	80	53	9	80
B11	Victoria Street (Black Trundle Road)	NB	883	83	50	78	7	50
		SB	618	106	50	37	3	50
B12	Brolgan Road	EB	483	172	50	26	0	50
		WB	513	161	50	64	24	50
B13	London Road	EB	286	76	100	17	0	100
		WB	771	145	100	93	22	100
B14	Henry Parkes Way	EB	1166	171	70	101	13	70
		WB	955	200	70	57	6	70
B15	Condobolin Road	EB	1609	202	100	141	16	100
		WB	1248	254	100	74	8	100
B16	Hartigan Avenue	EB	254	116	80	32	14	80
		WB	459	25	80	101	5	80
B18	Victoria Street	EB	759	36	50	67	21	50
		WB	325	12	50	21	0	50
B19	McGlynn Street	NB	274	17	50	20	0	50
		SB	132	8	50	14	0	50
B20	Flinders Street	NB	317	20	50	22	0	50
		SB	277	17	50	30	0	50
B21	Middleton Street	EB	424	64	50	28	0	50
		WB	838	0	50	95	0	50
B22	Brolgan Road	EB	304	102	50	16	0	50
		WB	301	22	50	35	3	50
B23	Dalton Street	NB	2138	124	50	199	10	50
		SB	1459	129	50	93	4	50
B24	Clarinda Street	EB	931	0	50	83	0	50
		WB	599	40	50	38	1	50
B25	Clarinda Street	NB	2731	0	50	224	0	50
		SB	2850	56	50	269	8	50
B26	Clarinda Street	EB	3963	150	50	337	27	50
		WB	4298	311	50	417	45	50
B27	Clarinda Street	NB	1936	19	50	160	3	50

Label	Road	Direction	Design Traffic Volumes 2033					
			Vehicles Per 15 hour (day)			Vehicles Per 9 hour (night)		
			Total Volume	Heavy Vehicle	Mean Speed (km/h)	Total Volume	Heavy Vehicle	Mean Speed (km/h)
		SB	1761	15	50	165	2	50
B28	Short Street	EB	3603	285	50	291	55	50
		WB	2303	130	50	183	15	50
O1	Redeveloped Bypass North of Parkes	NB	2982	778	110	502	199	110
		SB	2580	716	110	171	60	110
O2	Link Between New BP + Newell Highway Nth Parkes	NB	2022	279	80	317	71	80
		SB	635	84	80	40	7	80
O3	New Bypass North of Parkes	NB	1737	562	110	305	144	110
		SB	2204	671	110	149	57	110
O4	New Bypass in Parkes	NB	1157	279	110	130	57	110
		SB	1906	537	110	301	174	110
O5	Condobolin Road	NB	1510	171	50	132	13	50
		SB	1045	224	50	62	7	50
O6	Hartigan Avenue Extension (Henry Parkes Way)	NB	138	59	80	8	4	80
		SB	127	42	80	10	1	80
O7	New Bypass in Parkes	NB	573	16	50	51	1	50
		SB	542	31	50	35	1	50
O8	Link Between New BP + Newell Highway Sth Parkes	NB	1854	275	80	187	57	80
		SB	6	0	80	1	0	80
O9	London Road East	NB	167	23	80	17	5	80
		SB	386	151	80	71	49	80
O10	Link New Bypass to Hartigan Avenue	NB	623	22	50	89	3	50
		SB	379	228	50	75	41	50
O11	Relocated Moulden Street South	NB	283	114	50	37	23	50
		SB	142	45	50	23	14	50
O12	New Bypass Sth Parkes	NB	1390	268	110	149	55	110
		SB	1834	567	110	301	183	110
O12.1	New Bypass Sth Parkes	NB	1168	279	110	129	57	110
		SB	1889	528	110	298	171	110
O13	Bogan Road	NB	727	123	110	331	35	110
		SB	812	91	110	57	4	110

Note: Road traffic has not been modelled on Thomas Street and the northern section of Moulden Street in the “Build” scenarios, as both streets become cul-de sacs with minimal road traffic, as a result of the project.

6.3 Modelled Scenarios

Modelled traffic noise scenarios are provided in accordance with the NSW NCG requirements. This includes construction of noise model scenarios to establish the study area, and evaluate compliance. The modelled scenarios provided in this assessment are therefore as follows:

Table 6-7: Modelled Scenarios

Scenario	Year	Name	Description
1	**2020**	Verification Scenario	Existing road traffic noise model based on the modelling inputs detailed in Section 6.2 with predicted levels at the verification locations detailed in the REF.
2	**2020**	Existing Situation	Existing road traffic noise model for all modelled receivers based on the modelling inputs detailed in Section 6.2 for 2020.
3a	**2023**	Build - Year of opening	Predicted Build 2023 scenario was run based on 100% design alignment and revised traffic volumes.
3b	**2023**	No Build - Year of opening	Predicted No Build 2023 traffic volumes and alignment were rerun based on no build traffic volumes provided by Cardno Traffic.
4a	**2033**	Build – 10 Years After Opening	Predicted Build 2033 scenario was run based on 100% design alignment and revised traffic volumes.
4b	**2033**	No Build - 10 Years After Opening	Predicted No Build 2033 traffic volumes and alignment were rerun based on no build traffic volumes provided by Cardno Traffic.

Notes:

1. All modelled traffic scenarios included iterations for both the day period ($L_{Aeq,\ 15\ hr}$) and the night period ($L_{Aeq,\ 9\ hr}$).
2. The traffic volumes adopted for the 100% Design assessment were provided by Cardno Traffic, based on traffic modelling carried out in November 2019.

6.4 Model Verification

The verified noise model was used as a base model to determine the predicted results for this assessment. A summary of the modelled noise levels versus the measured levels are detailed below for information.

Table 6-8: Modelled versus Measured Levels – Noise Monitoring Locations

Measurement Location	Descriptor	Predicted Noise Level, dB(A)	Measured Noise Level, dB(A)	Difference, dB(A)
40 Barkers Road (50m from Newell Highway)	$L_{Aeq,\ 15\ hour}$	62.4	62.0	+0.4
	$L_{Aeq,\ 9\ hour}$	59.6	59.2	+0.4
40 Barkers Road (Dwelling)	$L_{Aeq,\ 15\ hour}$	50.0	50.4	-0.4
	$L_{Aeq,\ 9\ hour}$	47.0	48.5	-1.5
98 Bogan Road	$L_{Aeq,\ 15\ hour}$	51.5	49.8	+1.7
	$L_{Aeq,\ 9\ hour}$	47.3	47.2	+0.1
	$L_{Aeq,\ 15\ hour}$	67.5	66.0	+1.5

Measurement Location	Descriptor	Predicted Noise Level, dB(A)	Measured Noise Level, dB(A)	Difference, dB(A)
285 Newell Highway	$L_{Aeq, 9 hour}$	62.4	62.3	+0.1
41 Moulden Street	$L_{Aeq, 15 hour}$	44.5	43.6	+0.9
	$L_{Aeq, 9 hour}$	39.3	39.5	-0.2
59 Coronation Avenue	$L_{Aeq, 15 hour}$	52.2	51.8	+0.4
	$L_{Aeq, 9 hour}$	45.0	44.3	+0.7
51 Coronation Avenue	$L_{Aeq, 15 hour}$	49.5	48.7	+0.8
	$L_{Aeq, 9 hour}$	42.3	42.8	-0.5
			Average Day	**+0.9**
			Average Night	**-0.2**

6.5 Predicted Road Traffic Noise Levels

Modelled traffic noise levels for the day period ($L_{Aeq, 15hr}$) are presented in Appendix D. Noise predictions in the form of noise contour maps presented in Appendix E.

6.6 Results Overview

6.6.1 Residential Receivers

Assessment of the 80% Design previously indicated that traffic noise levels for the Design Year (year 2033, 10 years following completion) were predicted to exceed the NSW NCG criteria at 174 facades of 88 receivers by up to 11 dB(A) during the day and by up to 13 dB(A) at night. Predicted noise levels at 15 of these properties, were predicted to be impacted at levels above the cumulative noise limit. These properties are located in London Road, Painter Street, Newell Highway, Hideaway Lane, Hartigan Avenue, Brolgan Road, Rose Street, Thomas Street, Endicott Street, and Moulden Street and Parkes Christian School.

When comparing the predicted levels with and without the project in the design year, along the new alignment, the road traffic noise levels were found to increase by up to 21 dB(A) during the day and night. This is generally due to provision of the new road in proximity to sensitive receivers in a rural area with low levels of existing traffic noise.

In light of the predicted exceedances; investigation was conducted during the 80% Design Stage to analyse the feasibility of acoustic barriers, and further investigation was carried out to determine the effectiveness of provision of DGA pavement surface along the new bypass between Condobolin Road and Painter Road.

Barriers were not found to be a feasible or reasonable mitigation measure in accordance with the requirements of the NMG. A summary of the reasoning for this is provided Section 7.2 of this report.

For the 100% Design, additional DGA pavement surface along the new bypass between Condobolin Road and Painter Road was adopted as a noise mitigation measure.

Assessment of the 100% Design indicates that traffic noise levels for the Design Year (year 2033, 10 years following completion) were predicted to exceed the NSW NCG criteria at a number of residential properties with 110 facades of 57 residential receivers qualifying for mitigation. Exceedances of up to 11 dB(A) during the day and by up to 13 dB(A) at night were predicted. Predicted noise levels at 13 of these properties, were predicted to be impacted at levels above the cumulative noise limit. These properties are located in London Road, Painter Street, Newell Highway, Hideaway Lane, Hartigan Avenue, Brolgan Road, Rose Street, Thomas Street, and Endicott Street and Bogan Road.

When comparing the predicted levels with and without the project in the design year, along the new alignment, the road traffic noise levels were found to increase by up to 21 dB(A) during the day and night.

This is generally due to provision of the new road in proximity to sensitive receivers in a rural area with low levels of existing traffic noise.

6.6.2 Non-Residential Receivers

6.6.2.1 Parkes Christian School

With the 100% Design, exceedances of up to 8 and 11 dB(A) are predicted at two of the buildings located within the Parkes Christian School. However, this assessment conservatively allows for natural ventilation in all buildings and an outside to inside noise reduction of 10 dB(A).

In practice, the outside to inside noise reduction may be greater than 10 dB(A) and therefore the predicted internal road traffic noise levels as a result of the new bypass may be lower in practice.

In addition, the existing road traffic noise level impacting the school are exceeding the criteria by up to 10dB(A) as the project is only predicted to increase the existing road traffic noise level incident on the school by 1 dB(A) which would not be subjectively noticeable. The receiver qualified for mitigation based on the existing exceedance of the cumulative criteria only. On this basis, an inspection of the two buildings indicated below is recommended during the construction phase to determine whether provision of additional mitigation is required to be considered for these receivers.

Figure 6-3: Location of Exceedances – Parkes Christian College.

Image Referenced from Google Earth 2020.

6.6.2.2 Childcare Centre (97-105 Victoria Street)

The childcare centre is located approximately 380 metres east of the project. Road traffic noise levels from the project are not predicted to exceed the criteria at this location.

6.6.2.3 Place of Worship (182-184 Back Trundle Road)

Road traffic noise levels from the project were predicted to exceed the criteria at the most exposed façade by 7 dB(A at the Kingdom Hall of Jehovah's Witnesses. However, this is an increase of only 1 dB(A) above the existing road traffic noise level incident on the building. Subjectively an increase of 1 dB(A) is not likely to be noticeable.

This assessment conservatively allows for natural ventilation in all buildings and an outside to inside noise reduction of 10 dB(A). In practice, the outside to inside noise reduction may be greater than 10 dB(A) for this building and therefore the predicted internal road traffic noise levels as a result of the new bypass may be lower in practice.

For this reason it is recommended that an inspection and internal noise measurements are conducted during the construction stage of the project, to confirm the predicted exceedance, and confirm whether noise mitigation is required.

6.6.2.4 Passive & Active Recreation Areas

No exceedances are predicted at the Scoble Place Park. Therefore no mitigation is recommended for the passive recreation area receivers within this park. Exceedances of the active recreational area noise criteria were not predicted at the Parkes Golf Club building (99 London Road)) or on the fairways.

7 Adopted Mitigation Measures

The NSW *Noise Mitigation Guideline* (RMS 2015) (NSW NMG) provides a methodology in relation to determining and recommending acoustic treatments for road projects as follows:

For receivers that qualify for consideration of additional noise mitigation measures, identify potential noise mitigation measures from the list below. Options for noise mitigation measures are listed below in the order of preference for application given in the RNP:

1. *Quieter pavement surfaces*
2. *Noise mounds*
3. *Noise walls*
4. *At-property treatments.*

On this basis, and after review of the 80% Design, lower noise asphalt surfaces were incorporated into the 100% design for the section of the alignment where the majority of exceedances were identified, located between the Condobolin Street roundabout and Painter Street, north of Parkes. The rationale for this was based on the following extract from the NSW ENMM which notes that:

> *"For traffic as a whole, road tyre noise appears to dominate at speeds around 70 km/h. This means that in areas with posted speeds of 70 km/h or more, the reduction of road tyre noise can be a useful noise reduction treatment.*

The results of the noise modelling based on the 100% Design alignment and incorporating lower noise pavement are detailed below, compared to the previously predicted REF results.

Table 7-1: Summary of Predicted Exceedances Compared to those Predicted in the REF

The above results reflect the worst case predicted LAeq road traffic noise levels for day and night for the most affected facade.

Note that road traffic noise at 31 of the identified exceedances with the pavement mitigation included for the 100% Design (i.e. DGA north of the roundabout) are predicted to exceed the criteria by only 1-2 dB(A) during either the day or the night period.

The 100% detailed designs result vary significantly from the REF assessment. We believe that this may be because the REF noise model did not correctly capture the high percentage of HV2 heavy vehicles (Austroads Vehicle Classifications 6 to 12) due to a lack of existing traffic data on local roads, and the REF night-time noise model may have been under-predicting the traffic noise levels as a result.

7.1 Noise Barrier Feasibility

After pavement treatments, acoustic barriers are the next preferred form of mitigation. The NSW NMG states the following key points in relation to acoustic barriers:

Section 7

"For it to be considered reasonable to provide noise mounds and noise walls there needs to be four or more closely spaced receivers that benefit. Where there are four or more closely spaced receivers, the specific combination of noise mitigation measures is subject to further evaluation."

AND

Section 8.2

"Barrier heights above 8 metres will not be considered"

AND

Section 8.9

"As a guide noise walls or mounds are considered to be a reasonable noise mitigation option where they are capable of providing an insertion loss of:

- *5dBA at representative receivers for heights up to 5 metres high*
- *10dBA at representative receivers for heights above 5 metres and up to 8 metres high."*

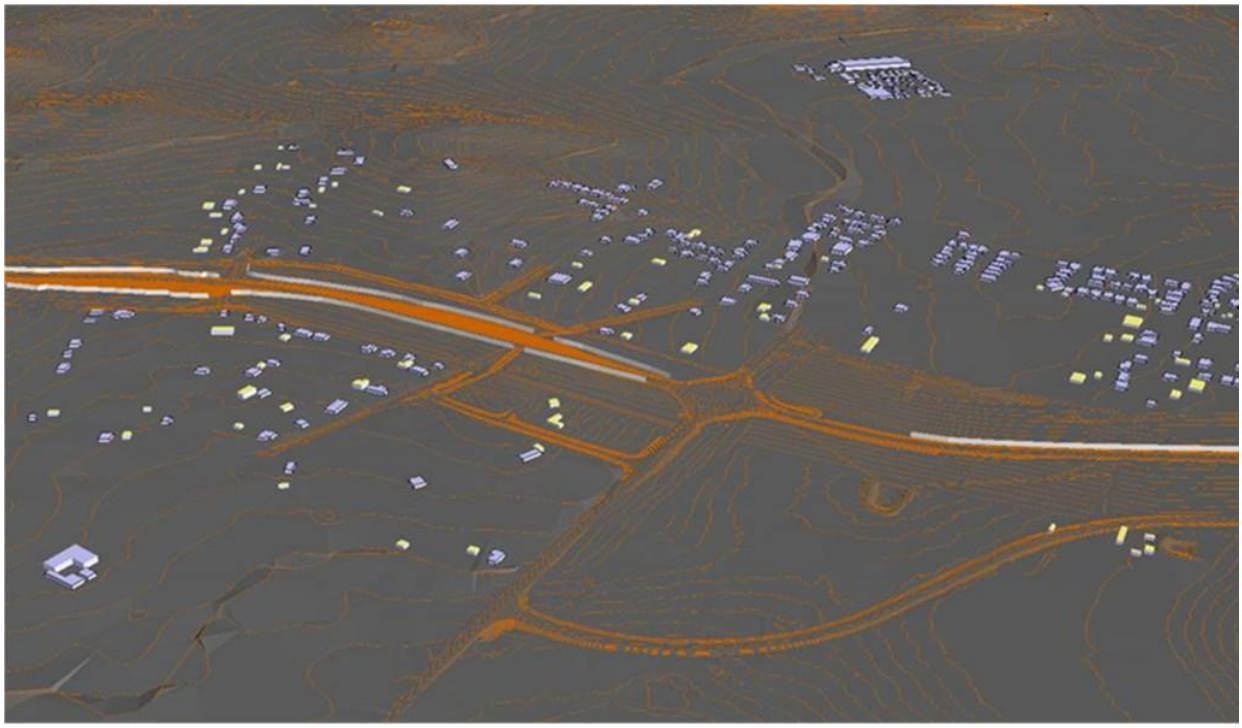
When considering the above statements, a review of the exceedances with no barriers, indicated that noise barriers would be feasible where 4 or more closely grouped receivers can be screened. On this basis, the following can be grouped (based upon having a shared street frontage) as follows:

- Moulden Street, 8 receivers over a 350 metre length
- Thomas Street, 5 receivers

Preliminary modelling of barriers as shown below in Figure 7-2 was carried out to determine whether provision of barriers and design in accordance with the NMG was feasible.

Figure 7-1: Modelled Noise Barrier Locations

Figure 7-2: Modelled Noise Barrier Locations 3D Perspective



During assessment of the 80% Design, modelling indicated that an 8 metre high acoustic barrier (refer to Figure 7-1 & Figure 7-2 for details of modelled barrier locations) would not achieve a minimum reduction of 10 dB(A), and a 5 metre high barrier would not achieve a minimum recommended noise reduction of 5 dB(A). Therefore, provision of barriers was not considered a reasonable noise mitigation option in accordance with Section 8.9 of the requirements of the NMG. For this reason formal detailed noise barrier analysis in accordance with Section 8.4 of the NMG was not carried out for this assessment.

In addition construction of noise barriers at these locations, was also considered to be problematic and impractical when considering the constructability implications and space constraints.

Provision of noise barriers were therefore considered not to be a feasible mitigation option.

Given that acoustic barriers would be impractical on the basis of the above reasoning, it is recommended that dwellings requiring mitigation after application of the proposed additional section of DGA pavement, as part of the 100% Design are considered for 'at property' treatments. A summary of dwellings requiring at 'property' treatments is shown in Section 7.3.

7.2 Property Treatments

The traffic noise levels due to implementation of the project are currently predicted to exceed the assessment criteria at the sensitive receivers identified in Table 7-1 based on the 100% Design.

The required attenuation for the remaining receivers ranges from 1 to 13 dB(A) at residential receivers. Options for attenuating traffic noise to the required levels are limited due to the following reason:

- As discussed in Section 7.2 acoustic barriers would not constitute a feasible or reasonable mitigation measure in addition to the provision of a lower noise pavement surface.

Hence, property treatments (e.g. mechanical ventilation, upgraded glazing) may be the only suitable option in cases where an additional reduction in noise levels is required. In cases where building treatments are required, specific attenuation measures should be designed in accordance with the ARNTG.

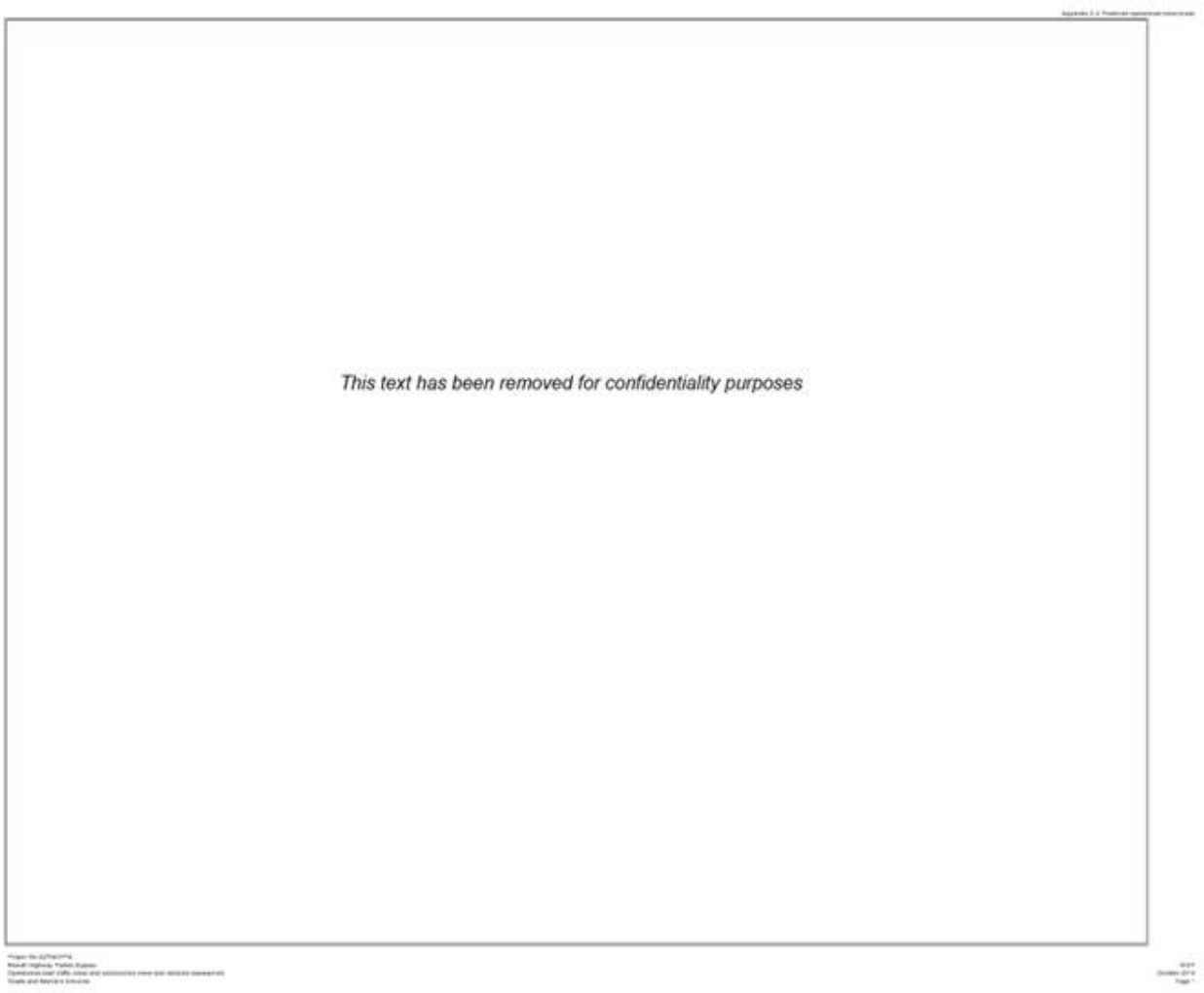
In accordance with the ARNTG, the following principles apply at sensitive receivers:

1. *Communities should receive reasonable and equitable internal traffic noise level outcomes regardless of whether external noise criteria have been met.*
2. *The internal traffic noise level at sensitive receivers with at-receiver treatment should be similar to the internal traffic noise levels at a sensitive receiver where the external criterion has been met. Note: It should be assumed the windows are closed in both instances.*
3. *Courtyard fences and screens should be considered where it is not feasible and reasonable to upgrade the acoustic rating of the building or to provide noise barriers or quieter pavements.*
4. *Noise mitigation shall be evaluated and installed where feasible and reasonable.*
5. *Where practicable feasible and reasonable noise mitigation shall be installed before construction works begin near affected residences*

In addition, the extent of mitigation should be selected on the basis of feasible measures, which are considered reasonable on the basis of social, economic, and environmental effects, including the cost of the abatement measures.

Table 7-2 also provides information as to which properties are expected to experience exceedances of the criteria in the year of opening as well as the design year, to assist RMS with prioritising the implementation of treatments.

Table 7-2: Summary of Proposed Properties Requiring Treatment



TfNSW generally considers the following property treatments where the criteria is not reasonably or feasibly achievable with pavement treatments or barriers located within the road reserve:

- Ventilation systems that meet Building Code of Australia requirements with the windows and doors shut
- Upgraded windows and glazing and solid core doors on the exposed façades of substantial structures only (e.g. masonry or insulated board cladding each with sealed underfloor)
  - Upgrading window and door seals
  - The sealing of wall vents,
  - The sealing of the underfloor below the bearers and appropriately treating sub-floors ventilation;
  - Roof insulation; and
  - The sealing of eaves.
  - The installation of external screen walls.

The above treatments are recommended for the properties listed in Table 7-2 in accordance with RMS requirements. It should be noted that each property will require inspection to determine the appropriate reasonable and feasible property mitigation, as the existing construction of some of the affected properties may preclude the above recommended treatments.

In general property treatments should be selected so that an internal noise level within the property of approximately 20 dB(A) below the external criterion can be achieved with the windows closed.

The specific mitigation measures should be determined with an operational noise impact assessment once the project is complete. The operational noise impact assessment should include additional traffic noise monitoring to verify the results of this assessment, and specify acoustic treatment to affected dwellings, if required.

8 Conclusion

A noise impact assessment was carried out to identify the predicted road traffic noise levels as a result of the 100% detailed design alignment. For the 100% Design, it was determined that provision low noise asphalt surfaces was considered a suitable mitigation measure for the section of the alignment where the majority of exceedances were identified. Therefore noise levels were predicted based on the application of DGA pavement to the new bypass to replace the originally designed chip seal surface, between Condobolin Road and Painter Street.

The assessment has identified the following conclusions:

- Operational road traffic noise, 10 years following completion of the project in the year 2033, is predicted to exceed the NSW NCG criteria at various residential receivers, one educational receiver and one place of worship located along the new bypass.
- Traffic noise levels for the Design Year of 2033, (10 years following completion) are predicted to exceed the NSW NCG daytime criteria at a number of properties with 110 residential receiver facades (includes all modelled facades of 57 separate residential properties along the new bypass qualifying for mitigation. Exceedances of up to 11 dB(A) during the day and by up to 13 dB(A) at night are predicted.
- Predicted noise levels at 13 of these properties, were predicted to be impacted at levels above the cumulative noise limit. These properties are located in London Road, Painter Street, Newell Highway, Hideaway Lane, Hartigan Avenue, Brolgan Road, Rose Street, Thomas Street, and Endicott Street and Bogan Road.
- Exceedances of up to 8 and 11 dB(A) are predicted at two of the buildings located within the Parkes Christian School. However, this assessment conservatively allows for natural ventilation in all buildings and an outside to inside noise reduction of 10 dB(A). In practice, the outside to inside noise reduction may be greater than 10 dB(A) and therefore the predicted internal road traffic noise levels as a result of the new bypass may be lower in practice. In addition, the existing road traffic noise levels impacting the school are exceeding the criteria by up to 10dB(A) and the project is only predicted to increase the existing road traffic noise level incident on the school by 1 dB(A). This increase would not be subjectively noticeable. The receiver qualified for mitigation based on the existing exceedance of the cumulative criteria only. On this basis, an inspection of the two buildings indicated below is recommended during the construction phase to determine whether provision of additional mitigation is required to be considered for these receivers.
- A childcare centre is located approximately 380 metres east of the project. Road traffic noise levels from the project are not predicted to exceed the criteria at this location.
- Road traffic noise levels from the project were predicted to exceed the criteria at the most exposed façade by 7 dB(A at the Kingdom Hall of Jehovah's Witnesses. However, this is an increase of only 1 dB(A) above the existing road traffic noise level incident on the building. Subjectively an increase of 1 dB(A) is not likely to be noticeable. This assessment conservatively allows for natural ventilation in all buildings and an outside to inside noise reduction of 10 dB(A). In practice, the outside to inside noise reduction may be greater than 10 dB(A) for this building and therefore the predicted internal road traffic noise levels as a result of the new bypass may be lower in practice. A noise impact assessment is therefore recommended for this receiver at project completion, to determine the level of noise impact on the property, and whether it qualifies for “at property” mitigation in accordance with the ARNTG.
- No exceedances are predicted at the Scoble Place Park. Therefore no mitigation is recommended for the passive recreation area receivers within this park. Exceedances of the active recreational area noise criteria were not predicted at the Parkes Golf Club building (99 London Road) or on the fairways.
- When comparing the predicted levels with and without the project in the design year, the road traffic noise levels have been found to increase by up to 19 dB(A) at some locations during the day and night.
- In light of the predicted exceedances; investigation was conducted to analyse the feasibility of acoustic barriers, with the results discussed in Section 7.

- The feasibility of acoustic barriers was assessed in accordance with the NSW NMG and it was determined that provision of barriers is not likely to be a practical option given the height or barriers that would be required and the minimal improvement that would be provided. Hence property treatments (e.g. mechanical ventilation, upgraded glazing) are expected be the only suitable option in cases where a reduction in noise levels must be still achieved after application of the lower noise pavement as part of the 100% Design. In accordance with the ARNTG, the extent of mitigation should be selected on the basis of feasible measures, which are considered reasonable on the basis of social, economic, and environmental effects, including the cost of the abatement measures.

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APPENDIX A

NOISE MONITORING CHARTS

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Figure A1: Noise Monitoring Chart – Location 1A

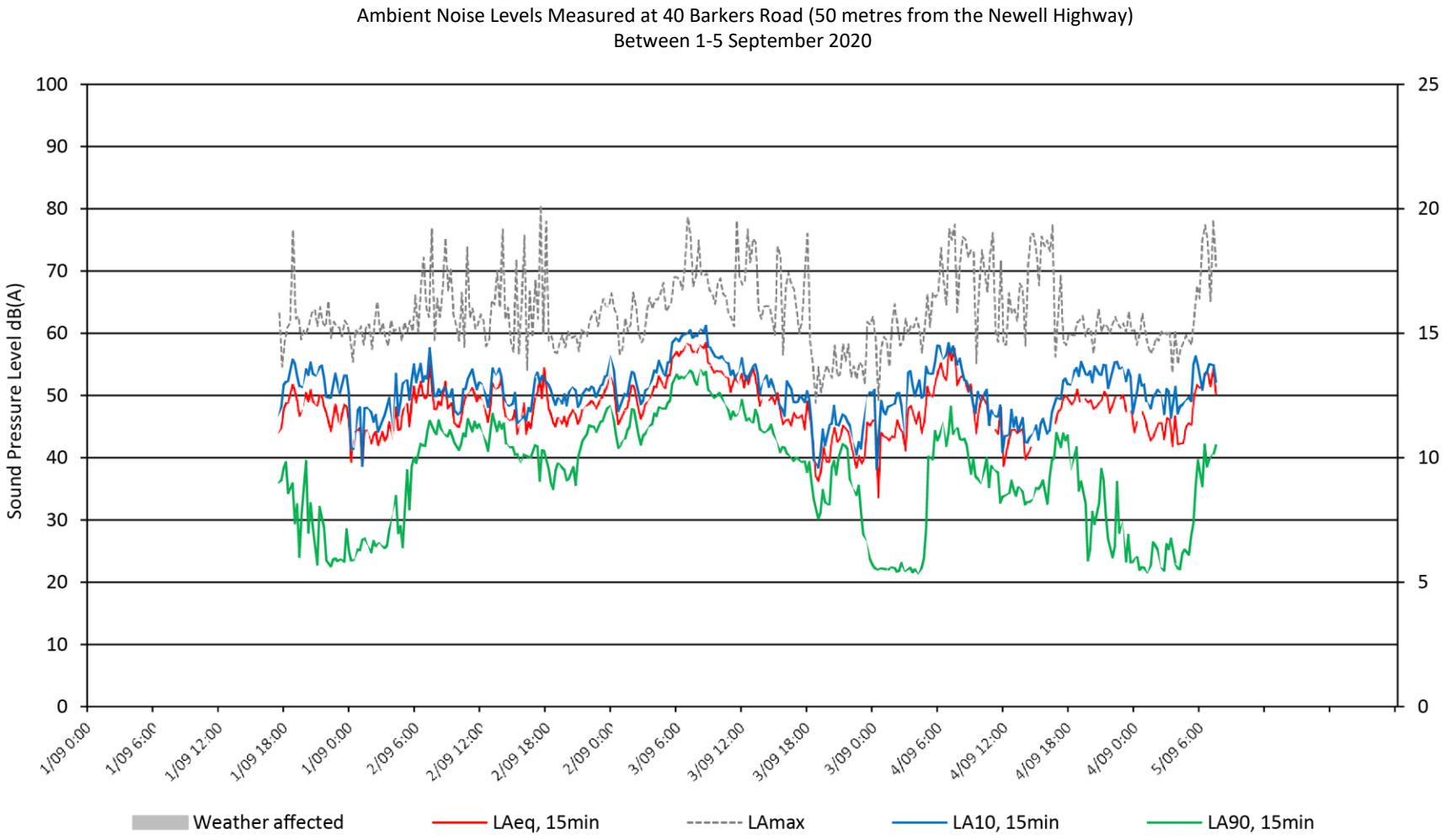


Figure A2: Noise Monitoring Chart – Location 1B

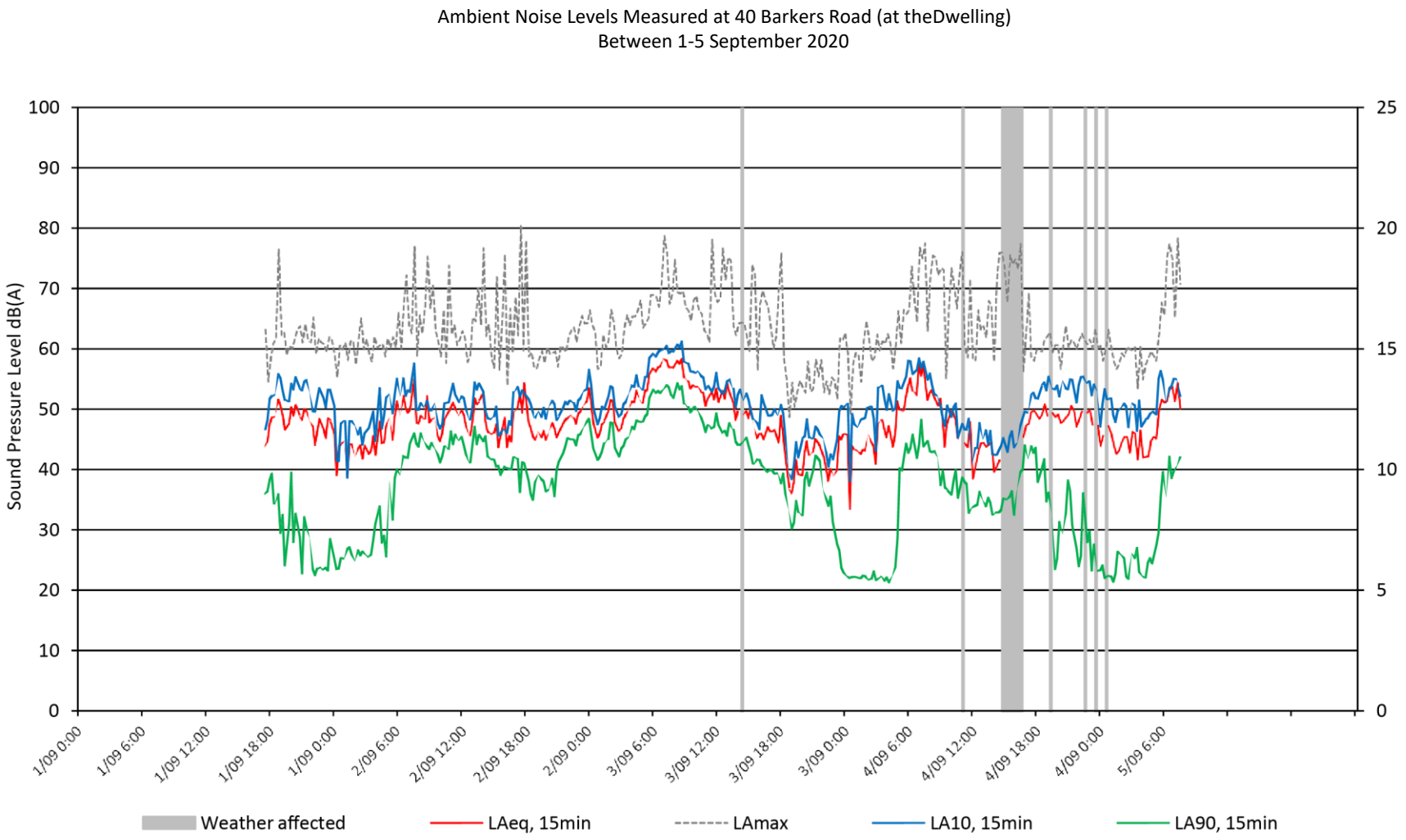


Figure A3: Noise Monitoring Chart – Location 2

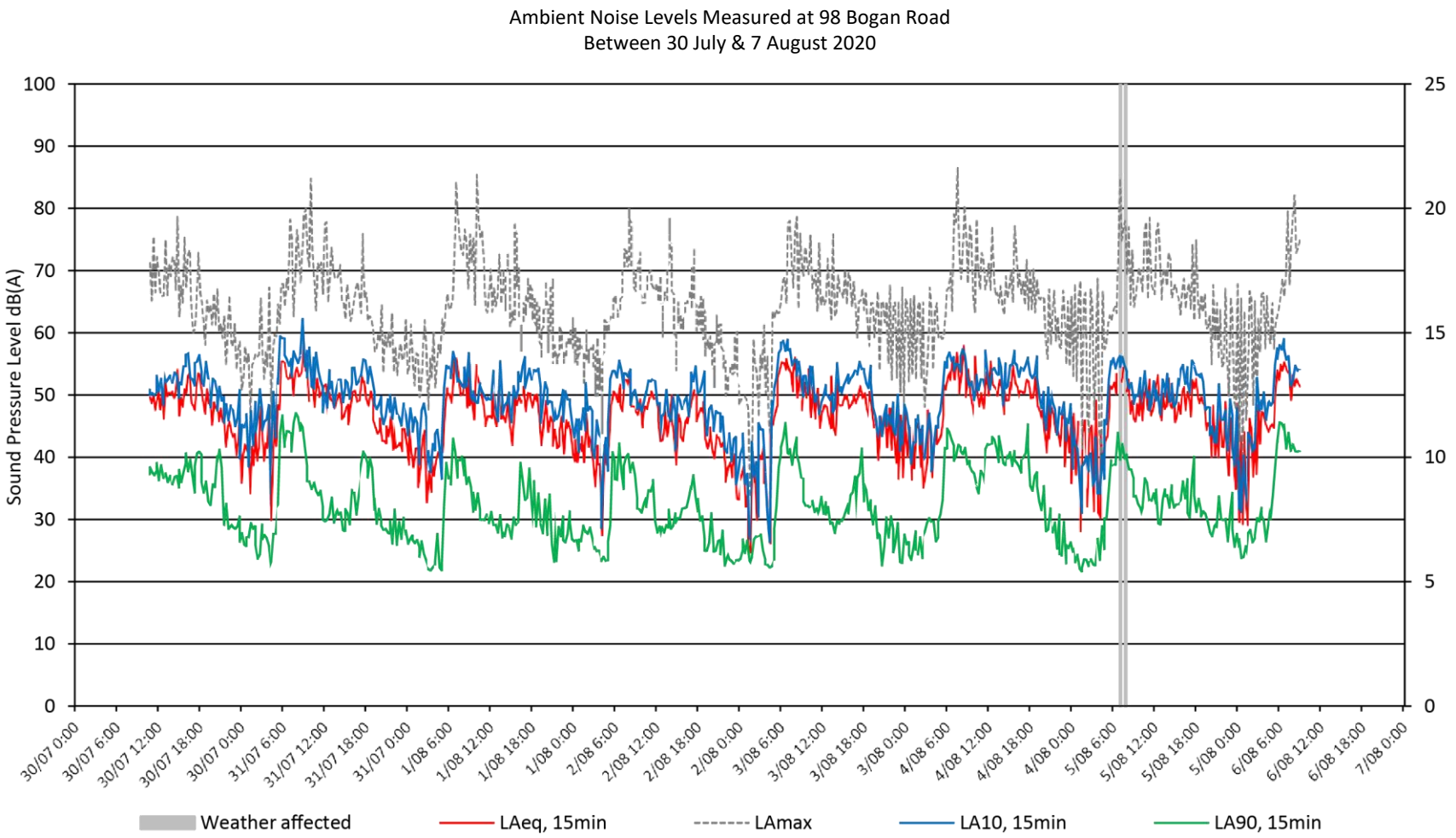


Figure A4: Noise Monitoring Chart – Location 3

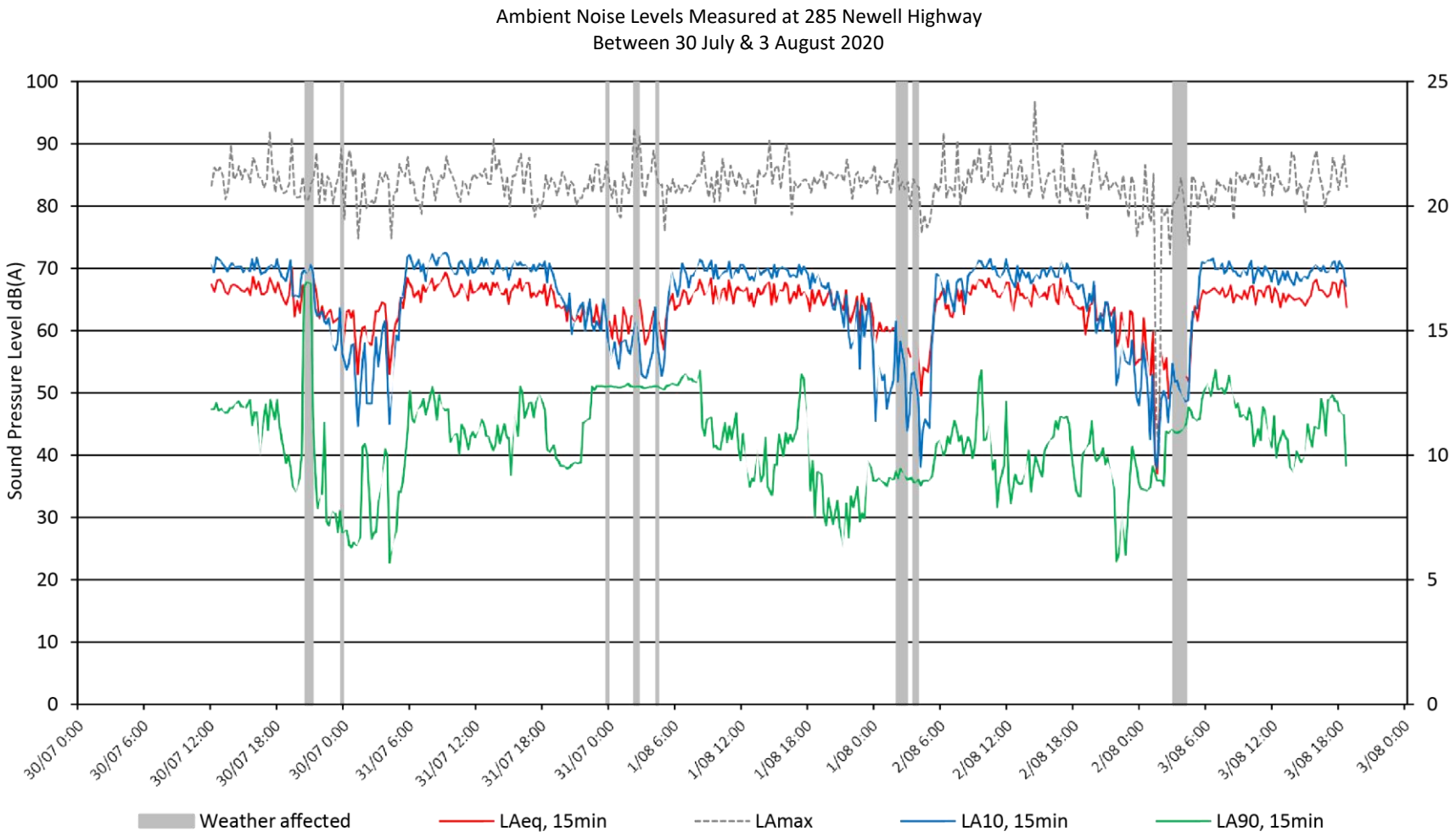


Figure A5: Noise Monitoring Chart – Location 4

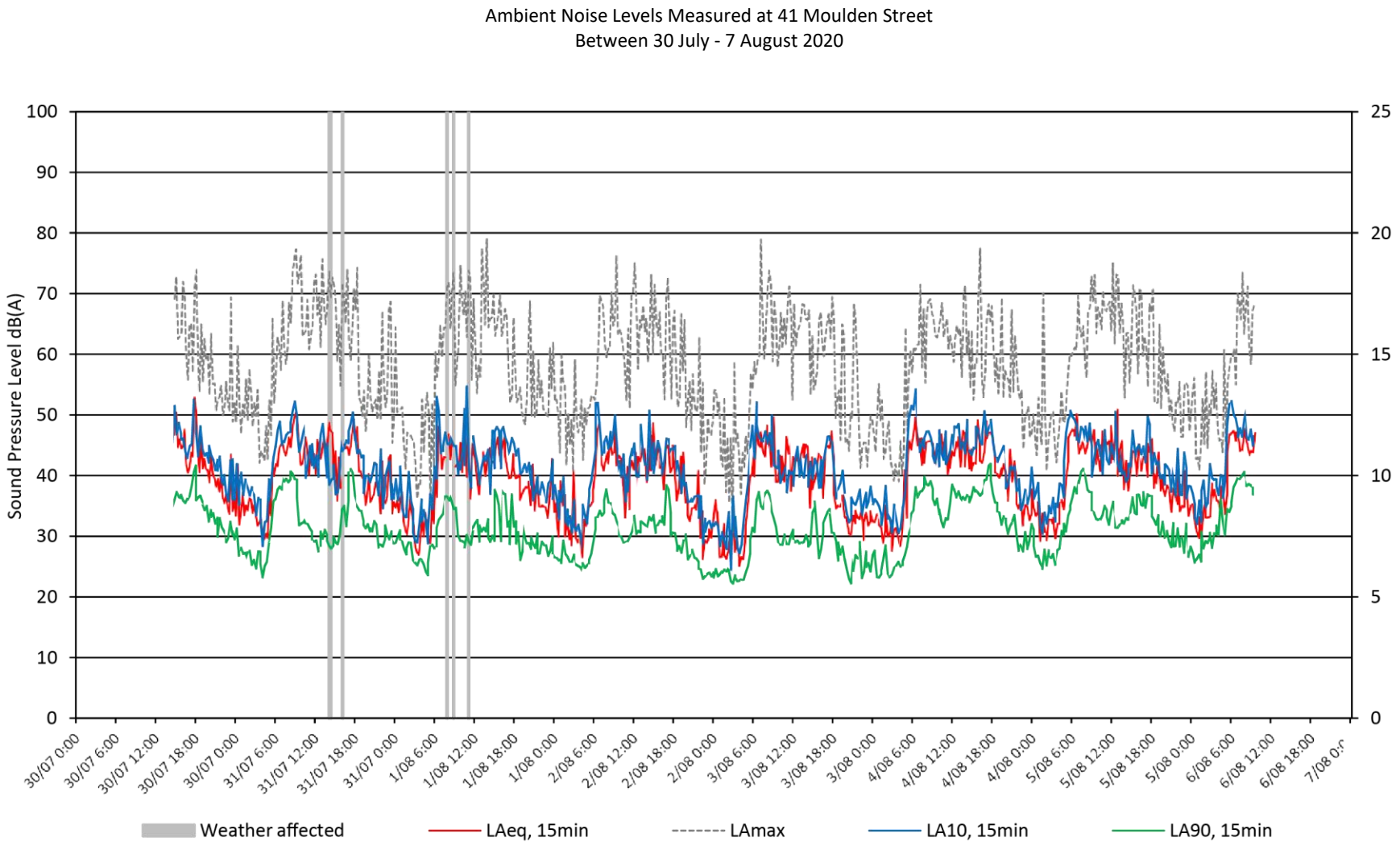


Figure A6: Noise Monitoring Chart – Location 5

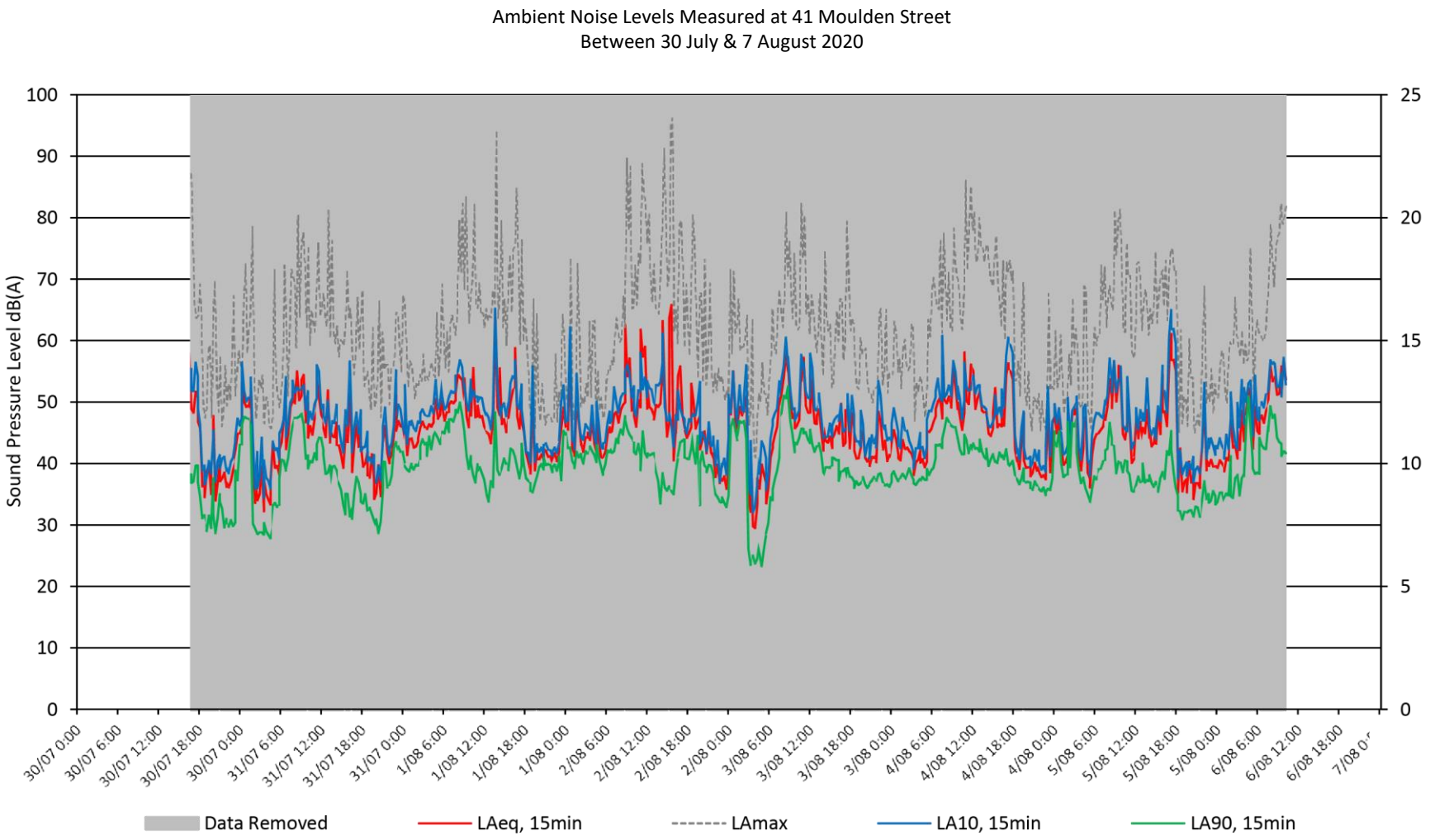


Figure A7: Noise Monitoring Chart – Location 6A

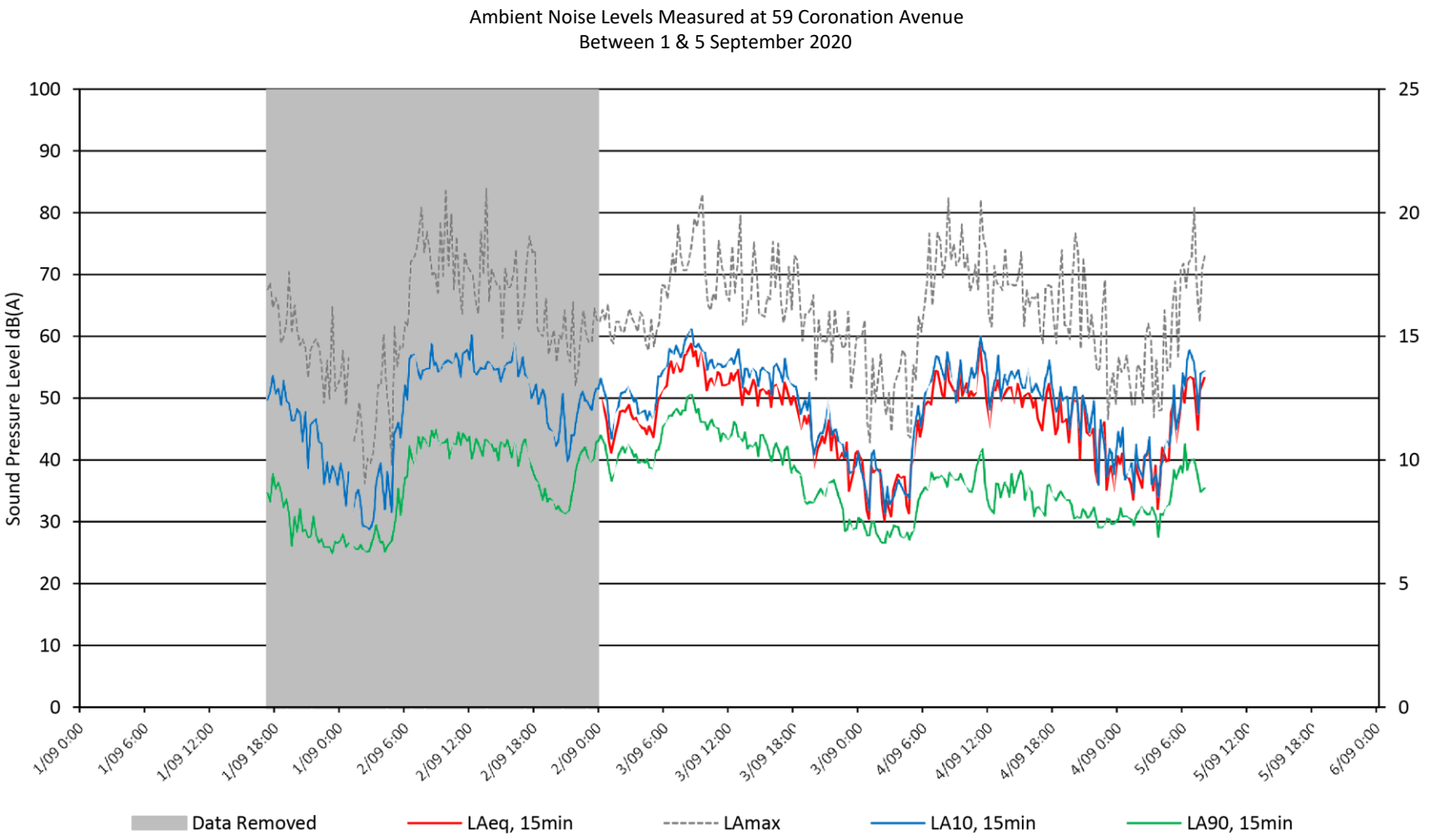
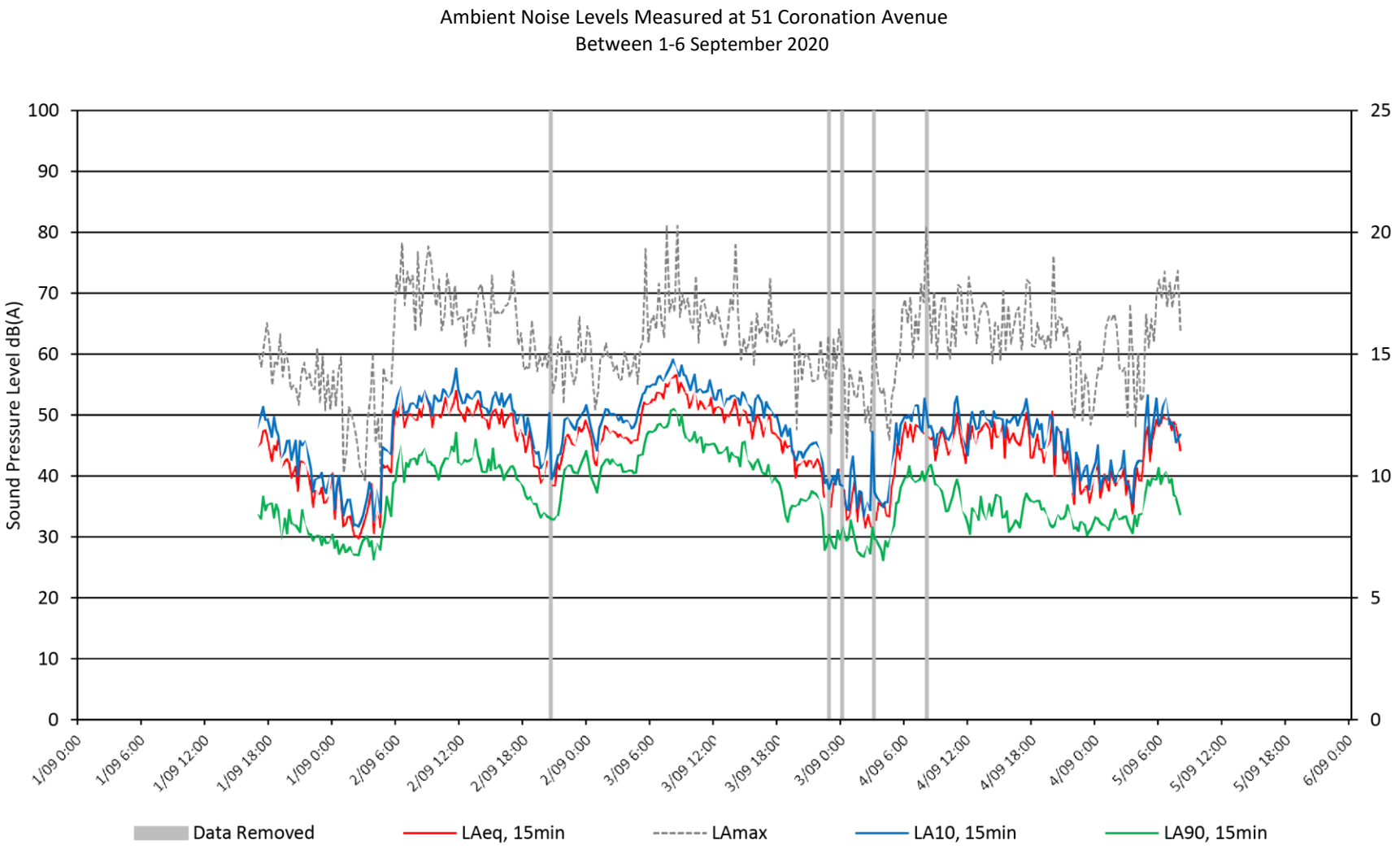


Figure A8: Noise Monitoring Chart – Location 6B



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APPENDIX B

MODELLED RECEIVER LOCATIONS

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Figure B1: Modelled Receiver Locations – Legend

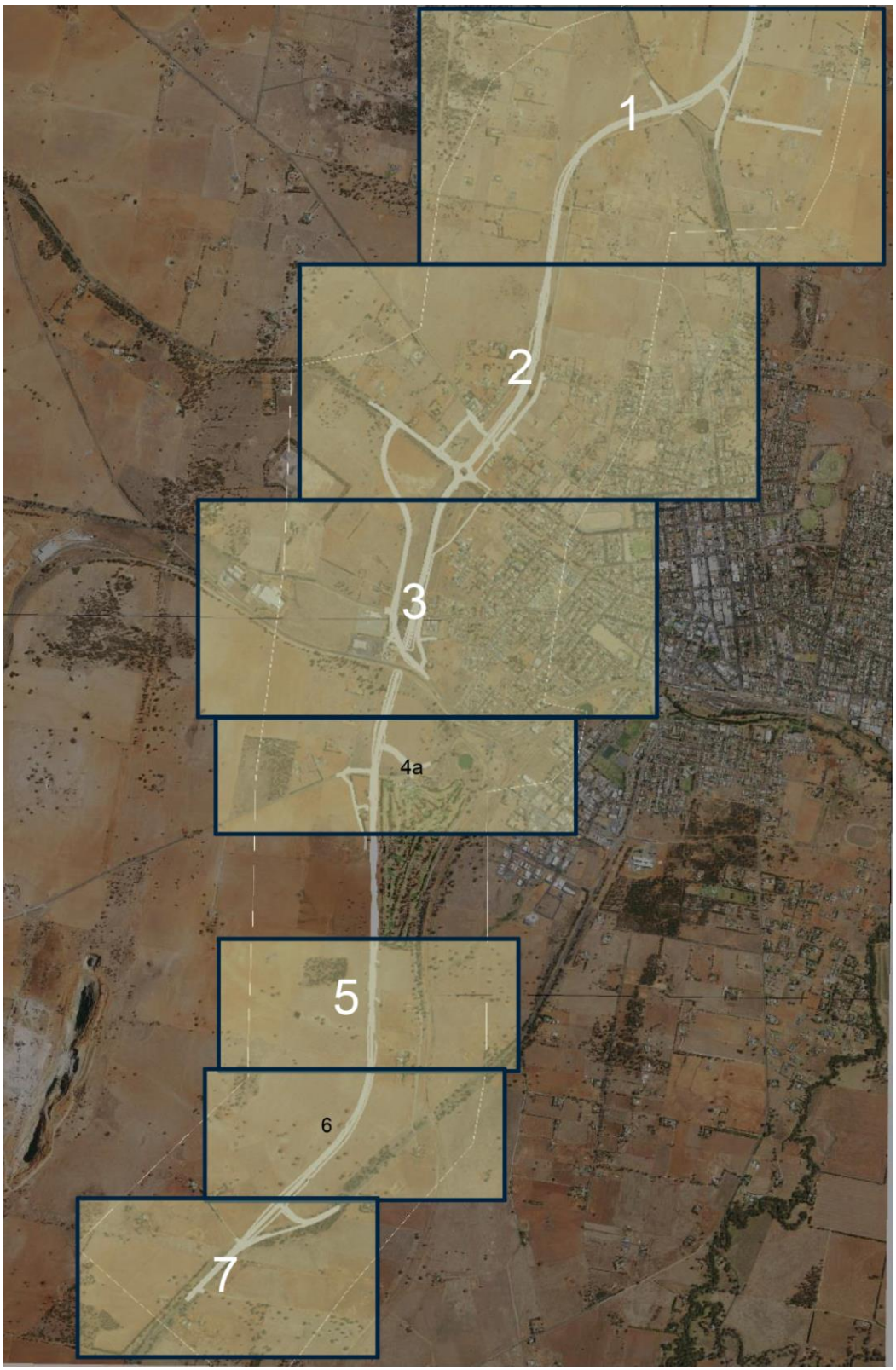

Figure B2: Modelled Receiver Locations – Area 1

Figure B3: Modelled Receiver Locations –Area 2

Figure B4: Modelled Receiver Locations – Area 3

Figure B5: Modelled Receiver Locations – Area 4

Figure B6: Modelled Receiver Locations – Area 5

Figure B7: Modelled Receiver Locations – Area 6

Figure B8: Modelled Receiver Locations – Area 7

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APPENDIX C

TRANSITION ZONE LOCATIONS

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Figure C1: Transition Zones & Assessment Criteria – Day Period

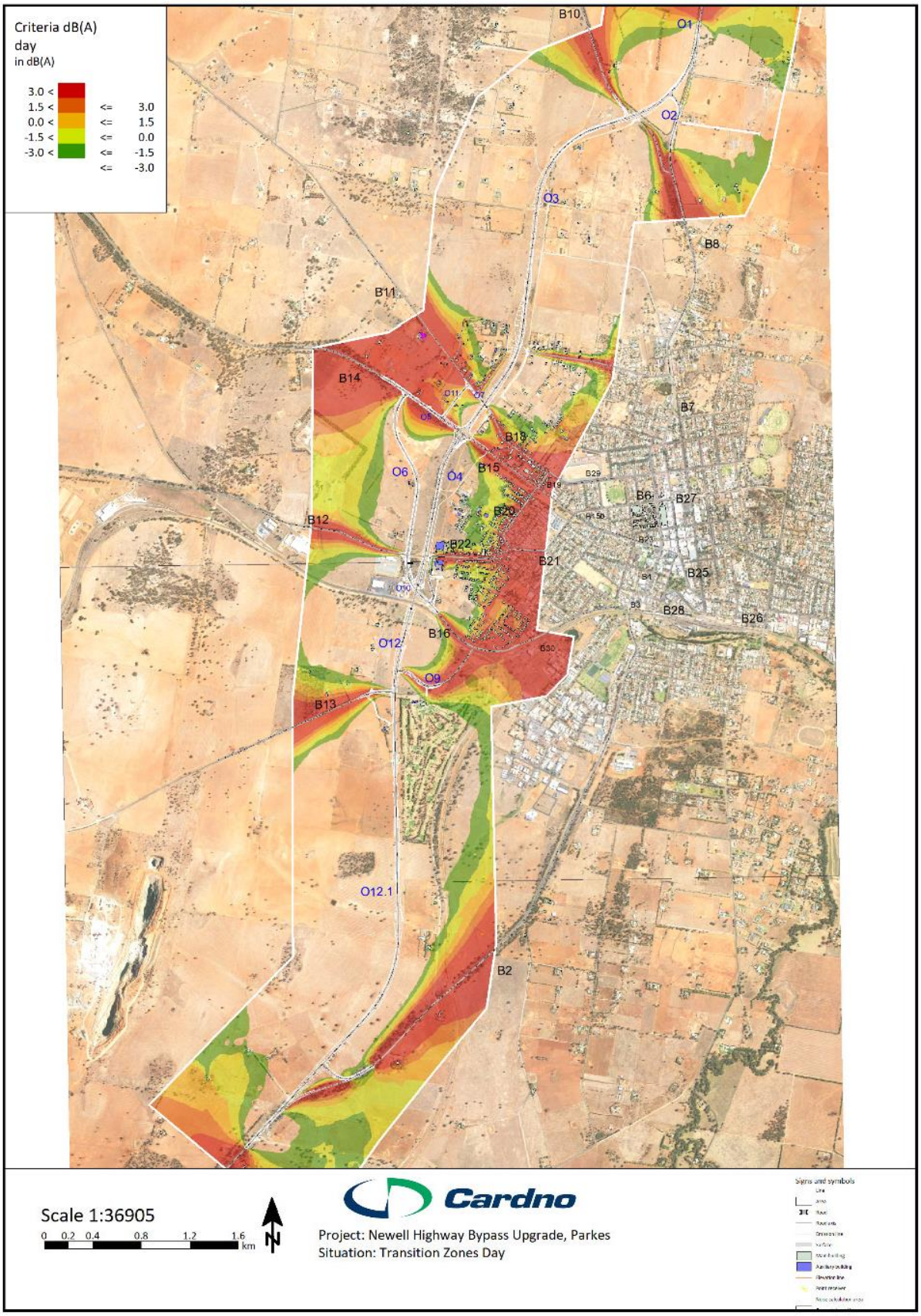
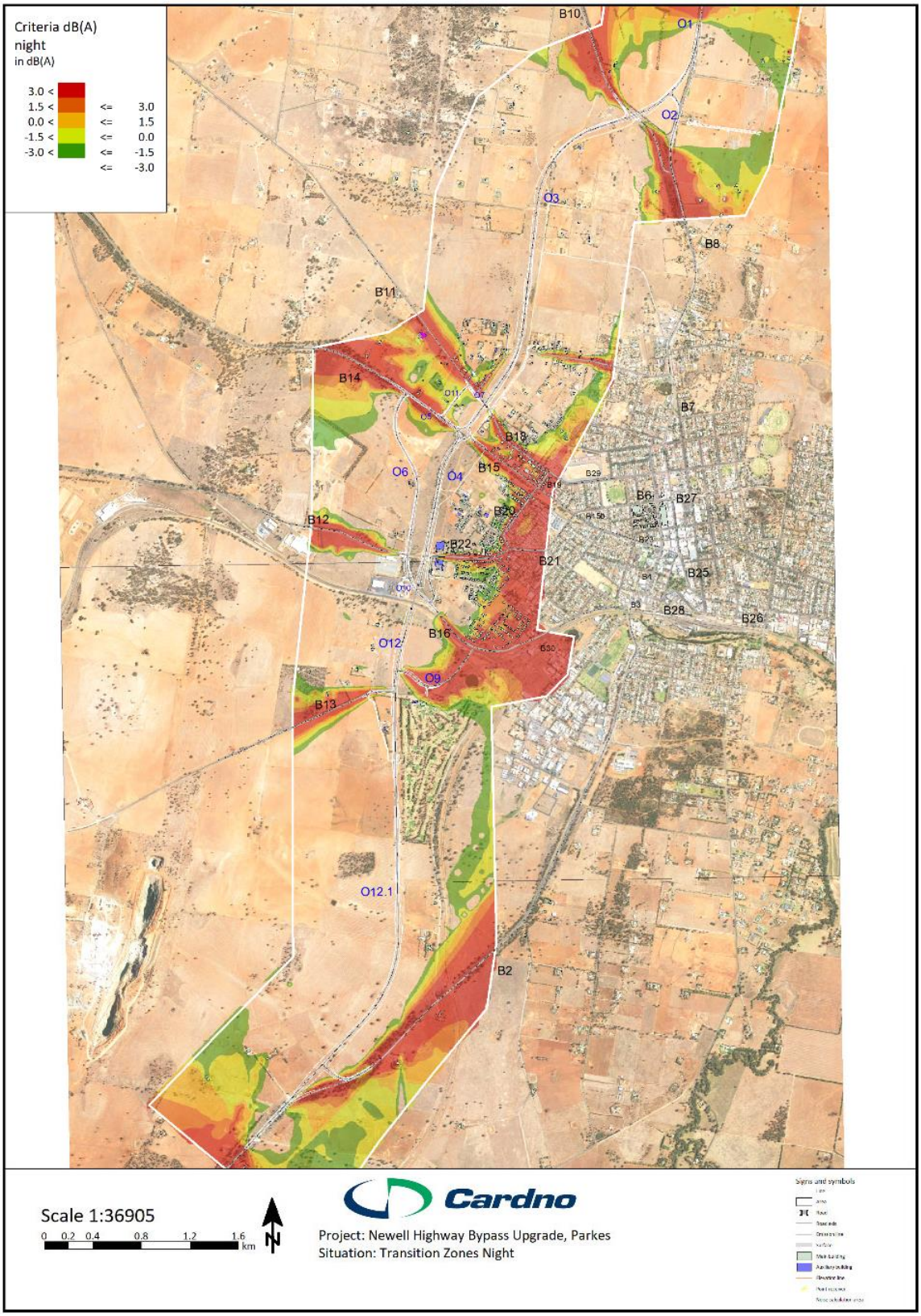


Figure C2: Transition Zones & Assessment Criteria –Night Period



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APPENDIX D

PREDICTED ROAD TRAFFIC NOISE LEVELS

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Table D1: Predicted Daytime Traffic Noise Levels - Residential Receivers

This text has been removed for confidentiality purposes

Table D2: Predicted Daytime Traffic Noise Levels - Non-Residential Receivers

This text has been removed for confidentiality purposes

Table D3: Predicted Night-time LAeq,9hr Traffic Noise Levels – Residential Receiver

This text has been removed for confidentiality purposes

An overview of the above results is provided in Section 6.6.

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APPENDIX E

PREDICTED TRAFFIC NOISE LEVELS – NOISE CONTOUR MAPS

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Figure E1: Year 2020 - Existing Traffic Noise Levels – Daytime (South)

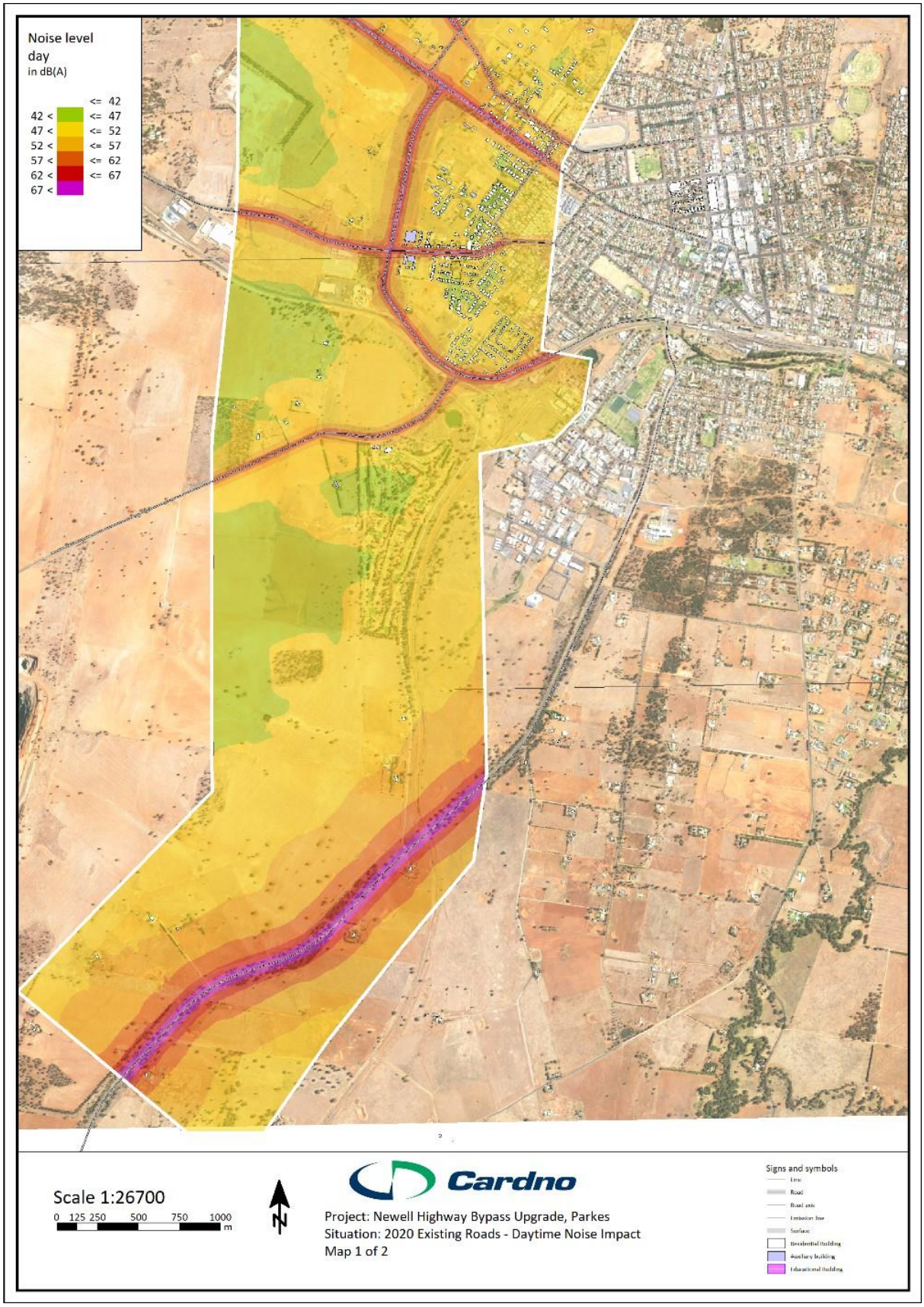

Figure E2: Year 2020 - Existing Traffic Noise Levels – Daytime (North)

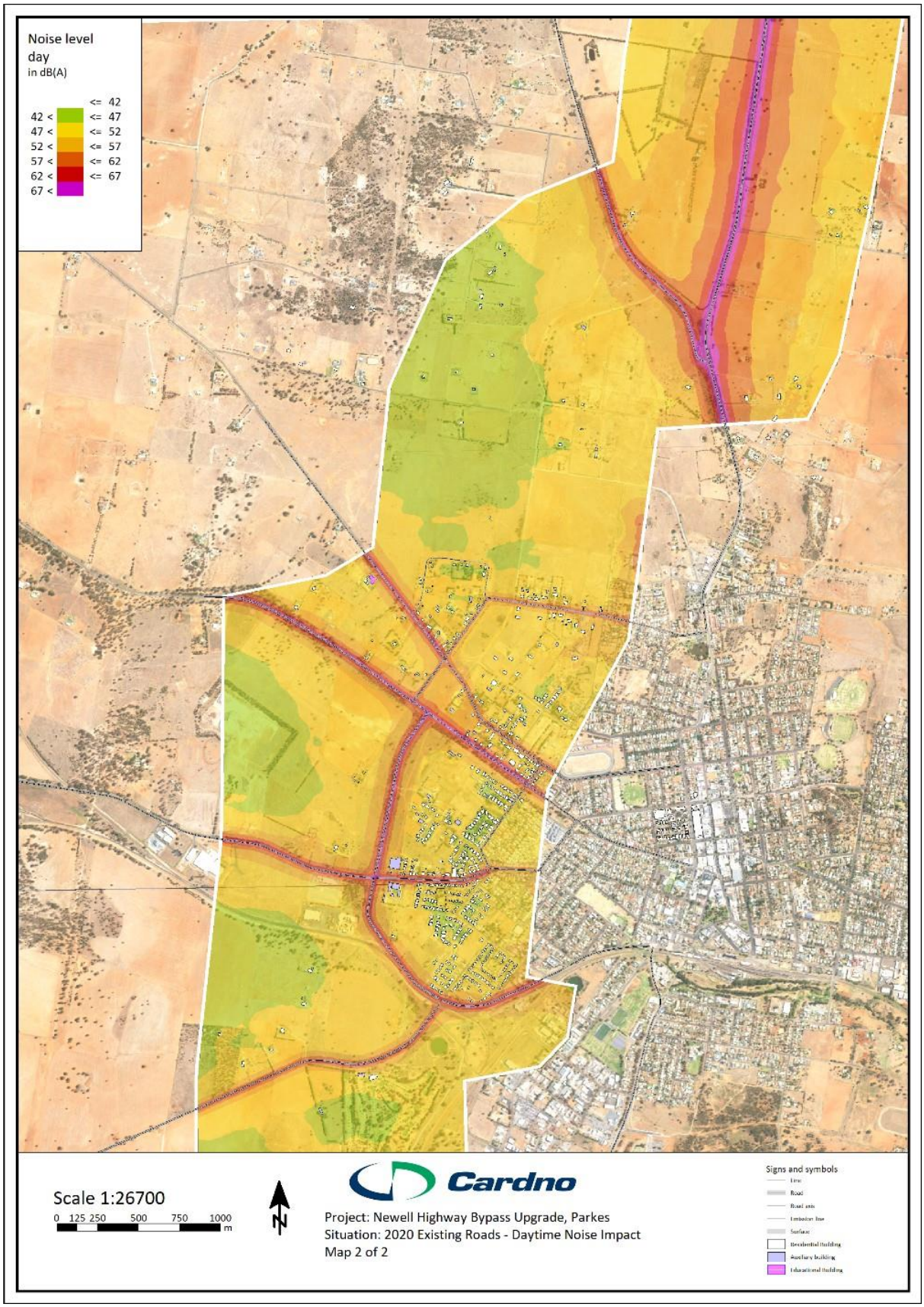

Figure E3: Year 2020 - Existing Traffic Noise Levels – Night-time (South)

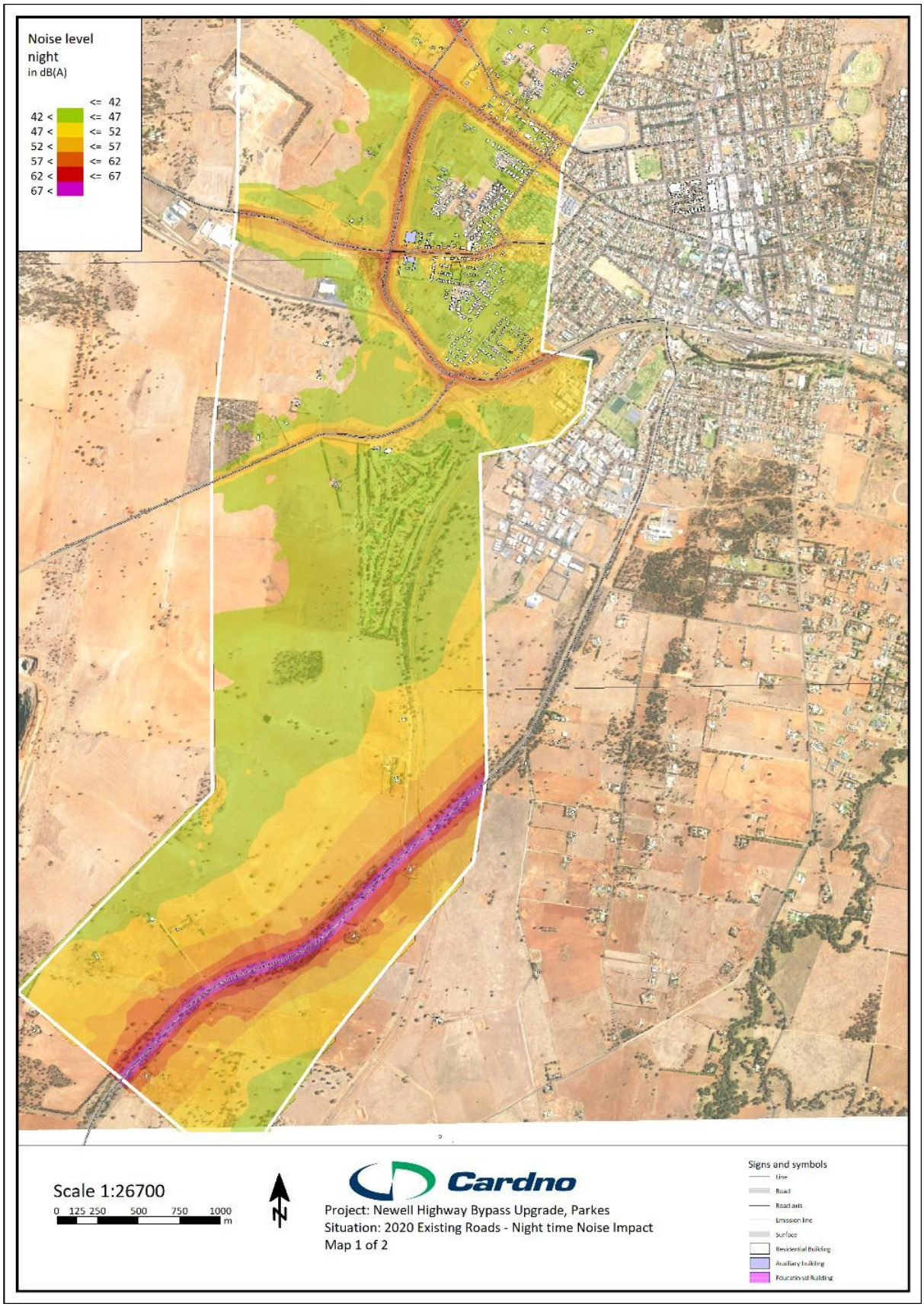

Figure E4: Year 2020 - Existing Traffic Noise Levels – Night-time (North)

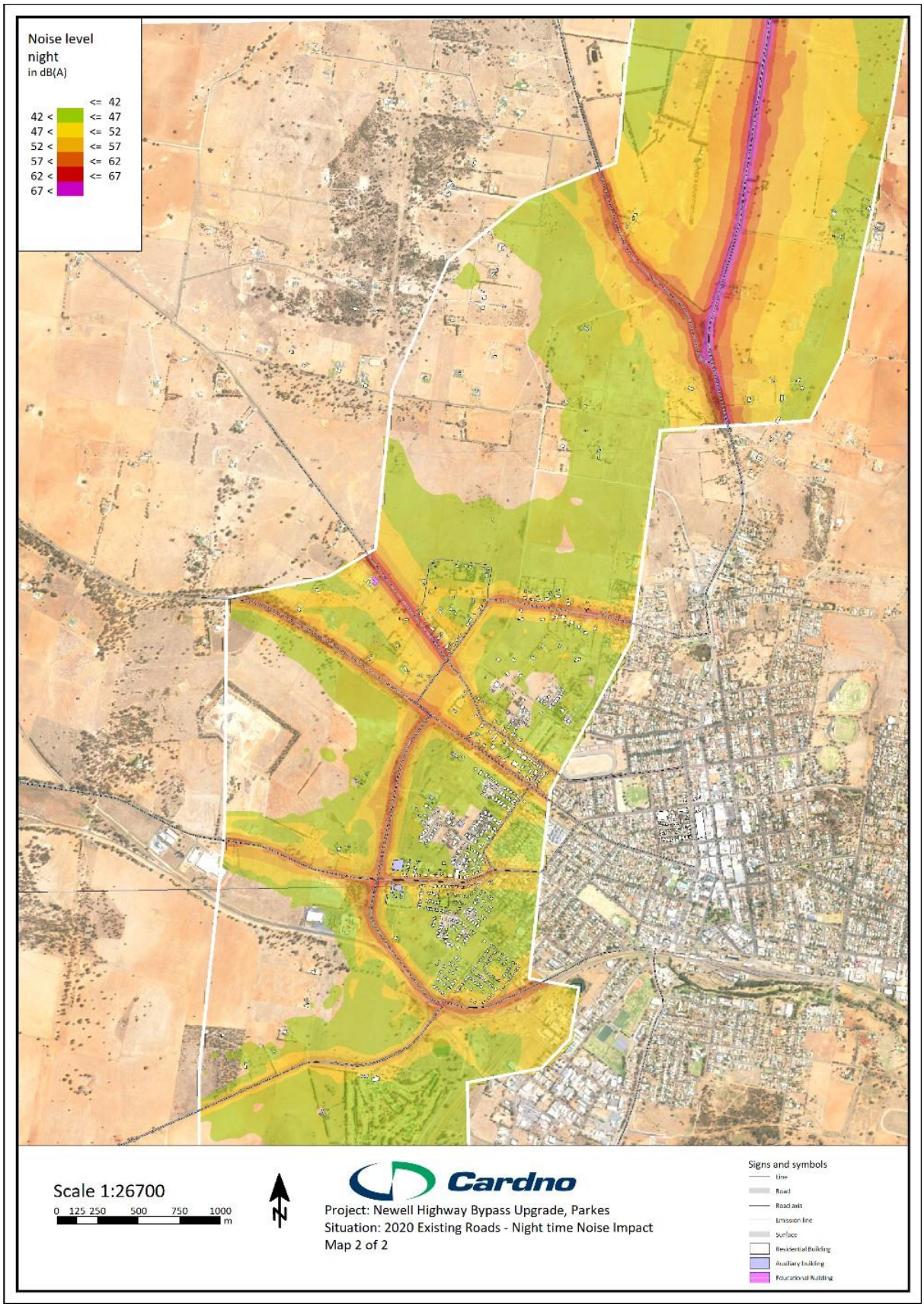

Figure E5: Year 2023 - Predicted Road Traffic Noise Levels (No Mitigation) – Daytime (South)

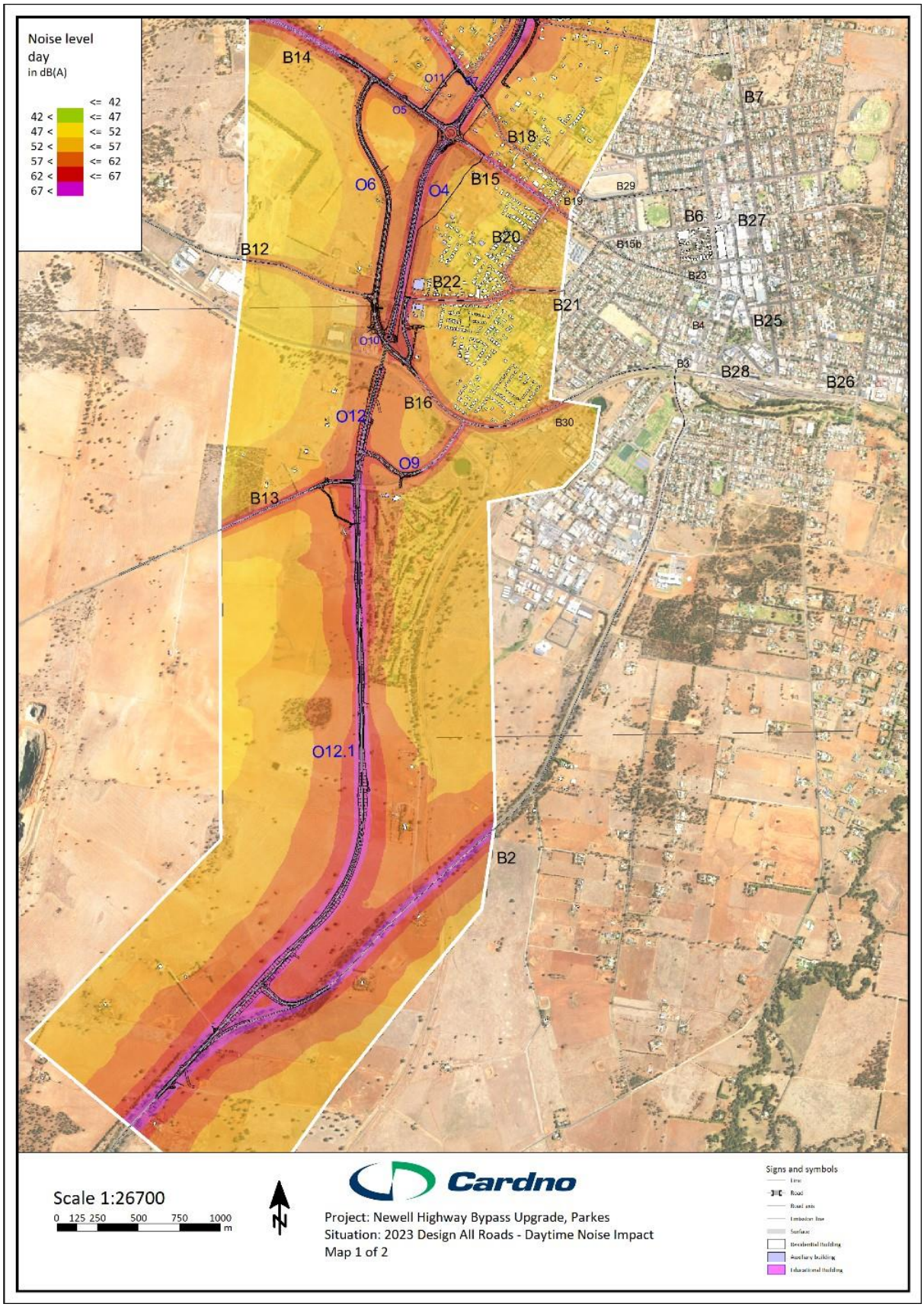

Figure E6: Year 2023 - Predicted Road Traffic Noise Levels (No Mitigation) – Daytime (North)

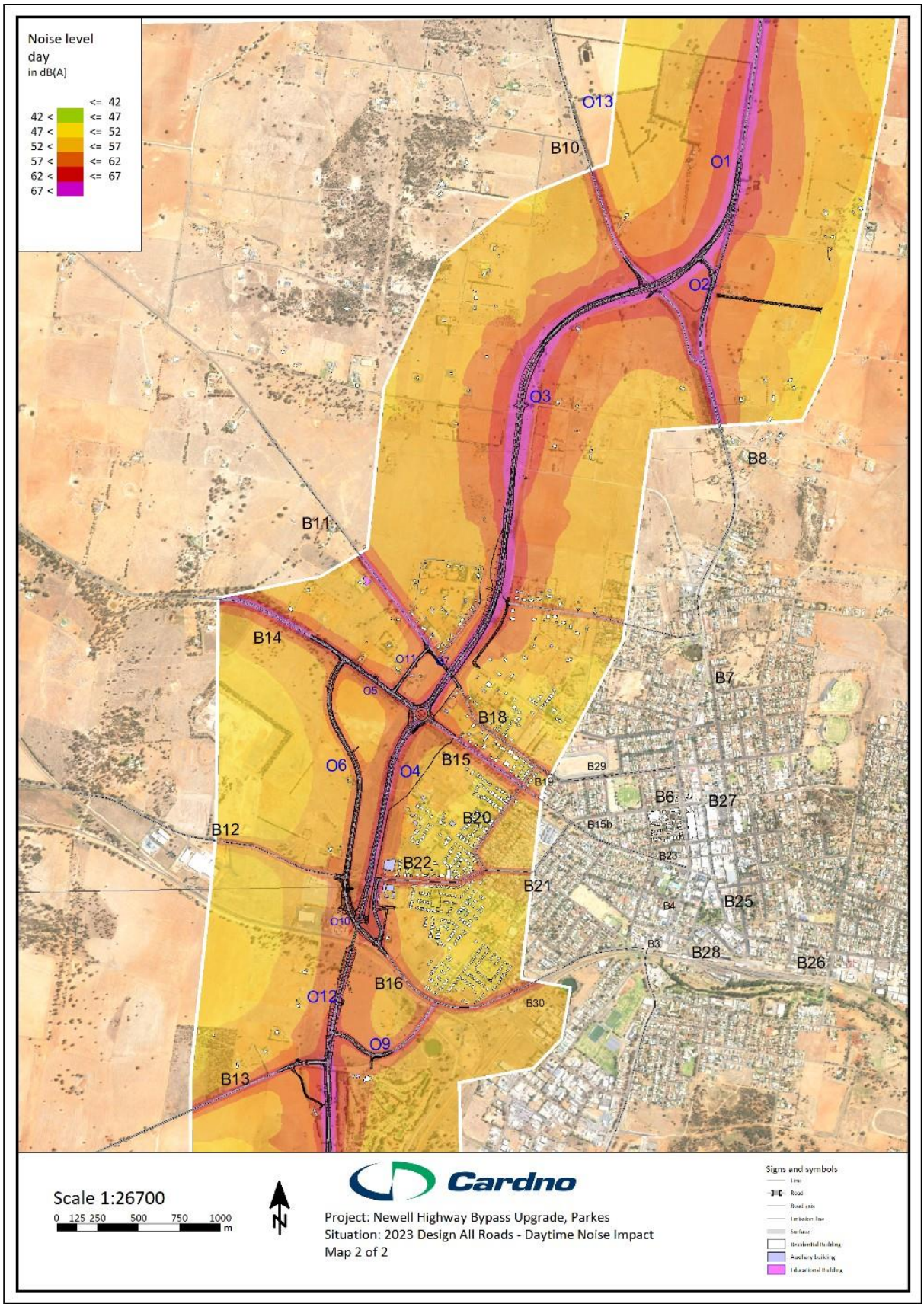

Figure E7: Year 2023 - Predicted Road Traffic Noise Levels (No Mitigation) – Night-time (South)

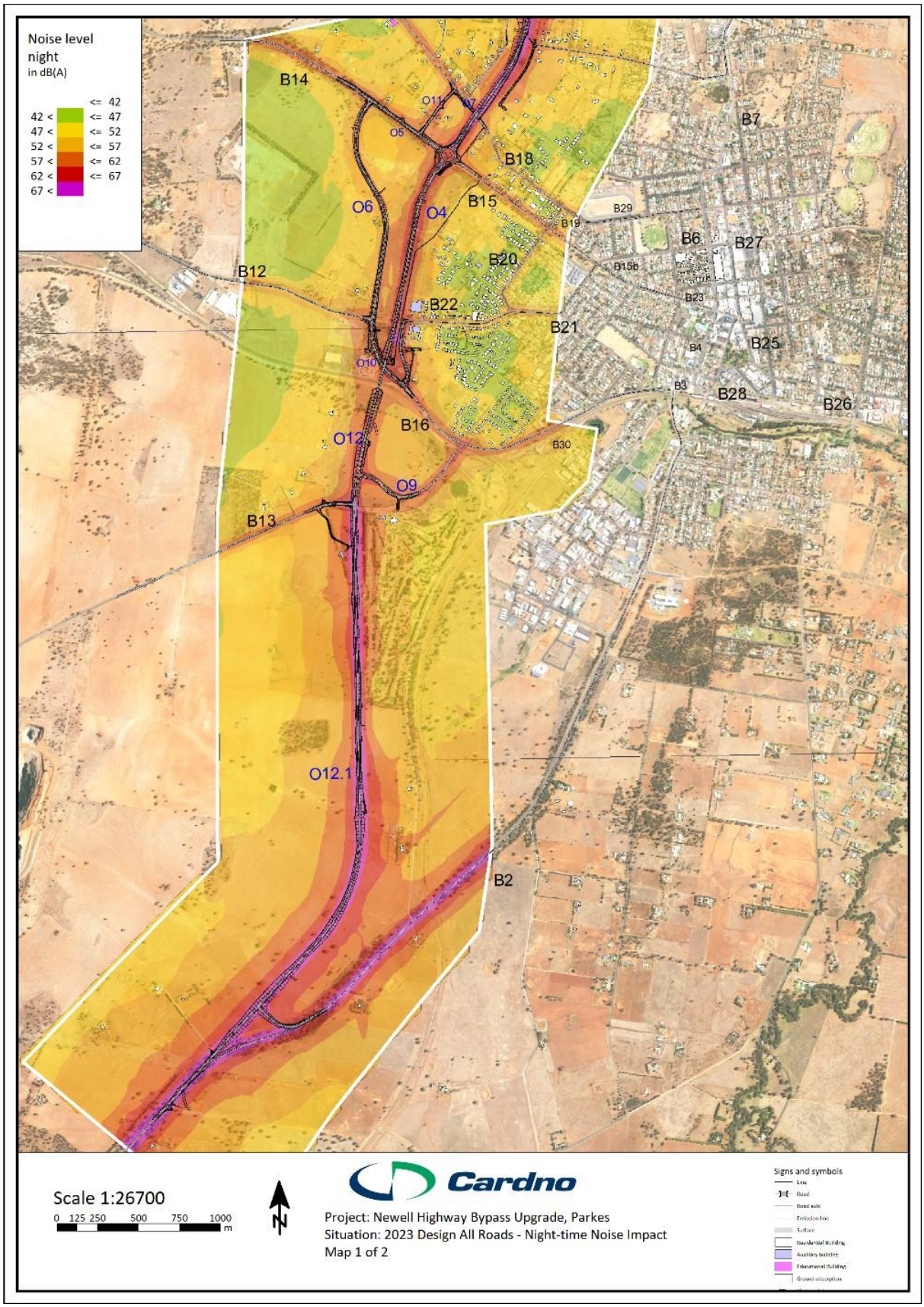

Figure E8: Year 2023 - Predicted Road Traffic Noise Levels (No Mitigation) – Night-time (North)

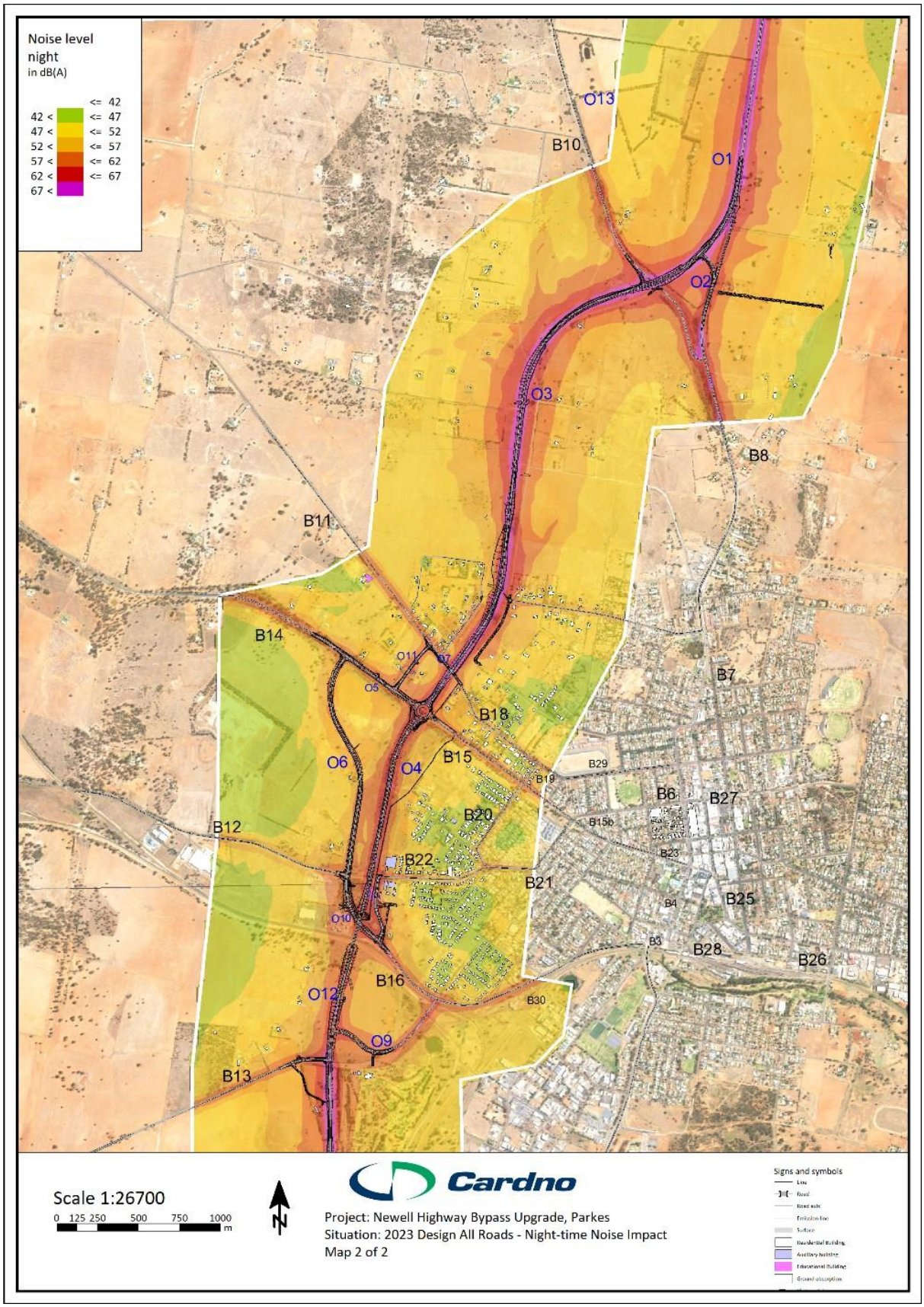

Figure E9: Year 2023 – No Build Traffic Noise Levels – Daytime (South)

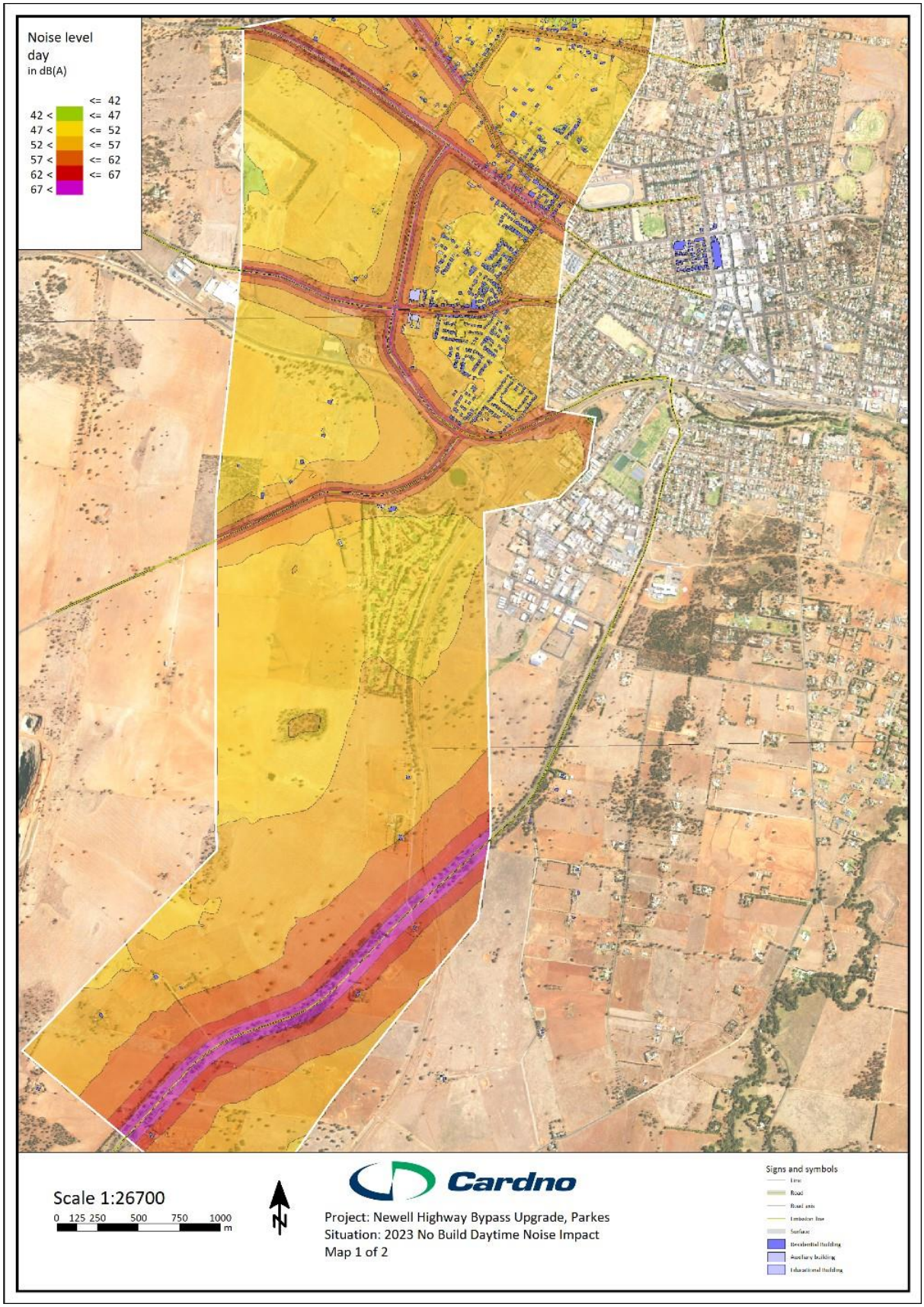

Figure E10: Year 2023 – No Build Traffic Noise Levels – Daytime (North)

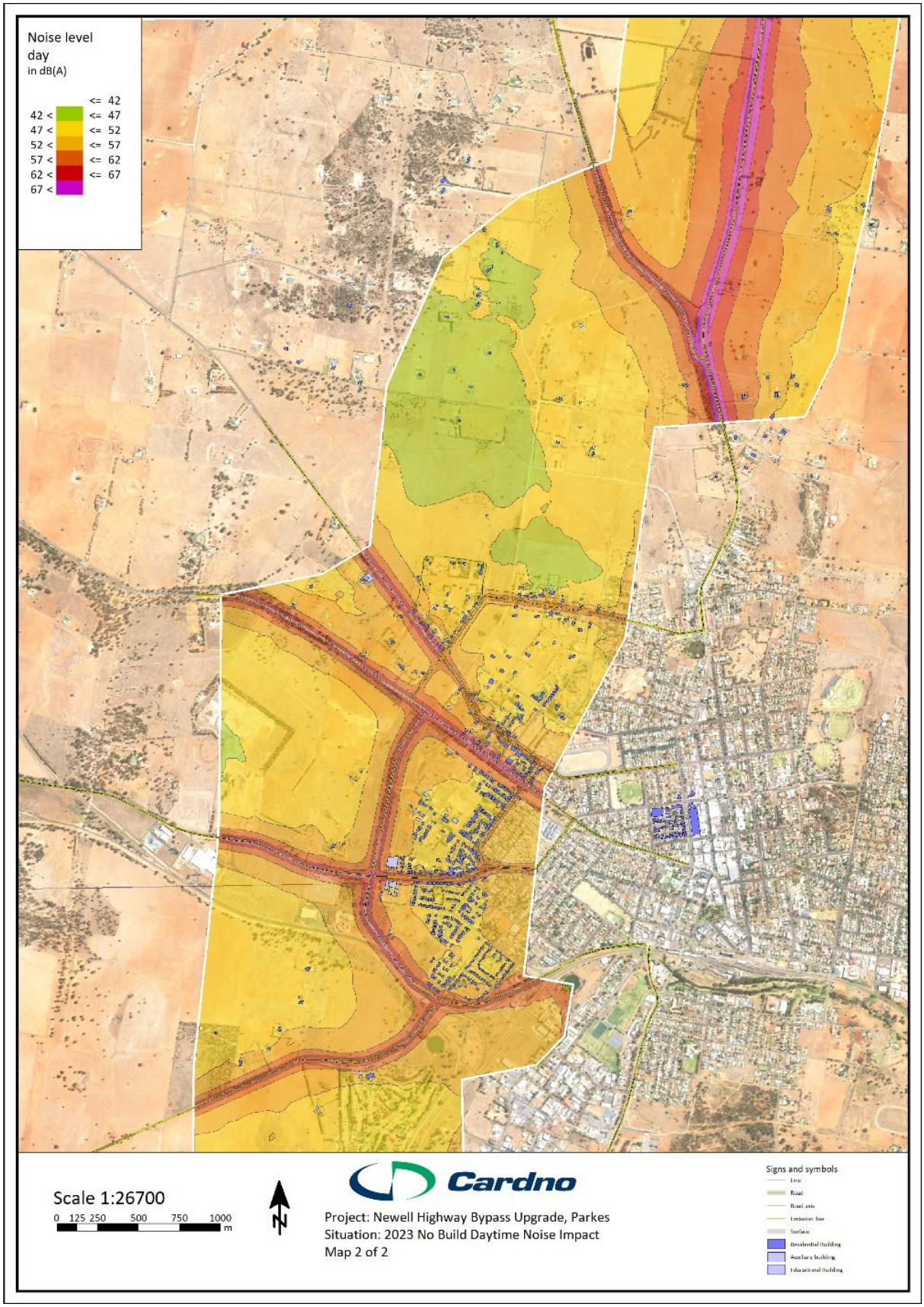

Figure E11: Year 2023 – No Build Traffic Noise Levels – Night-time (South)

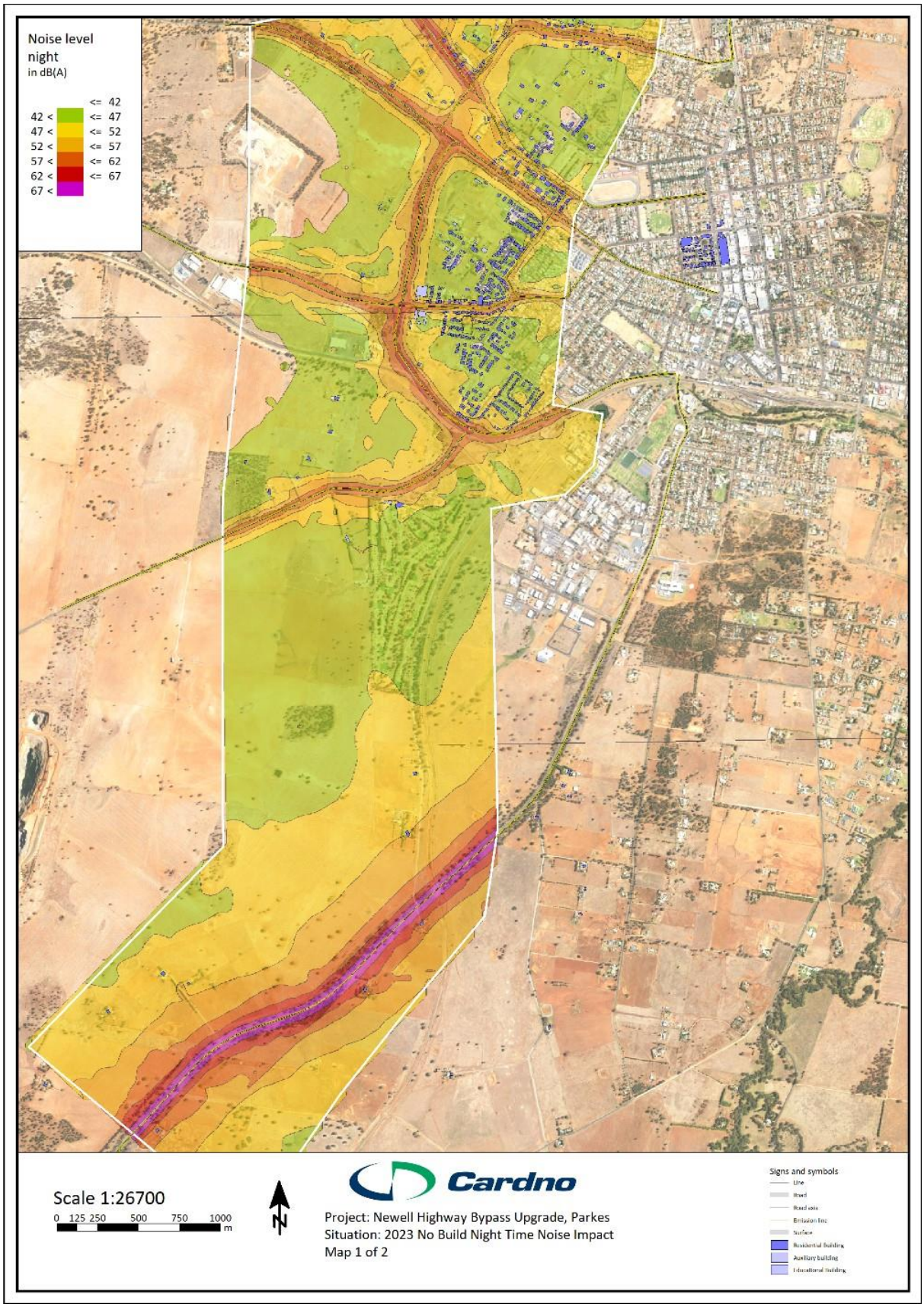

Figure E12: Year 2023 – No Build Traffic Noise Levels – Night-time (North)

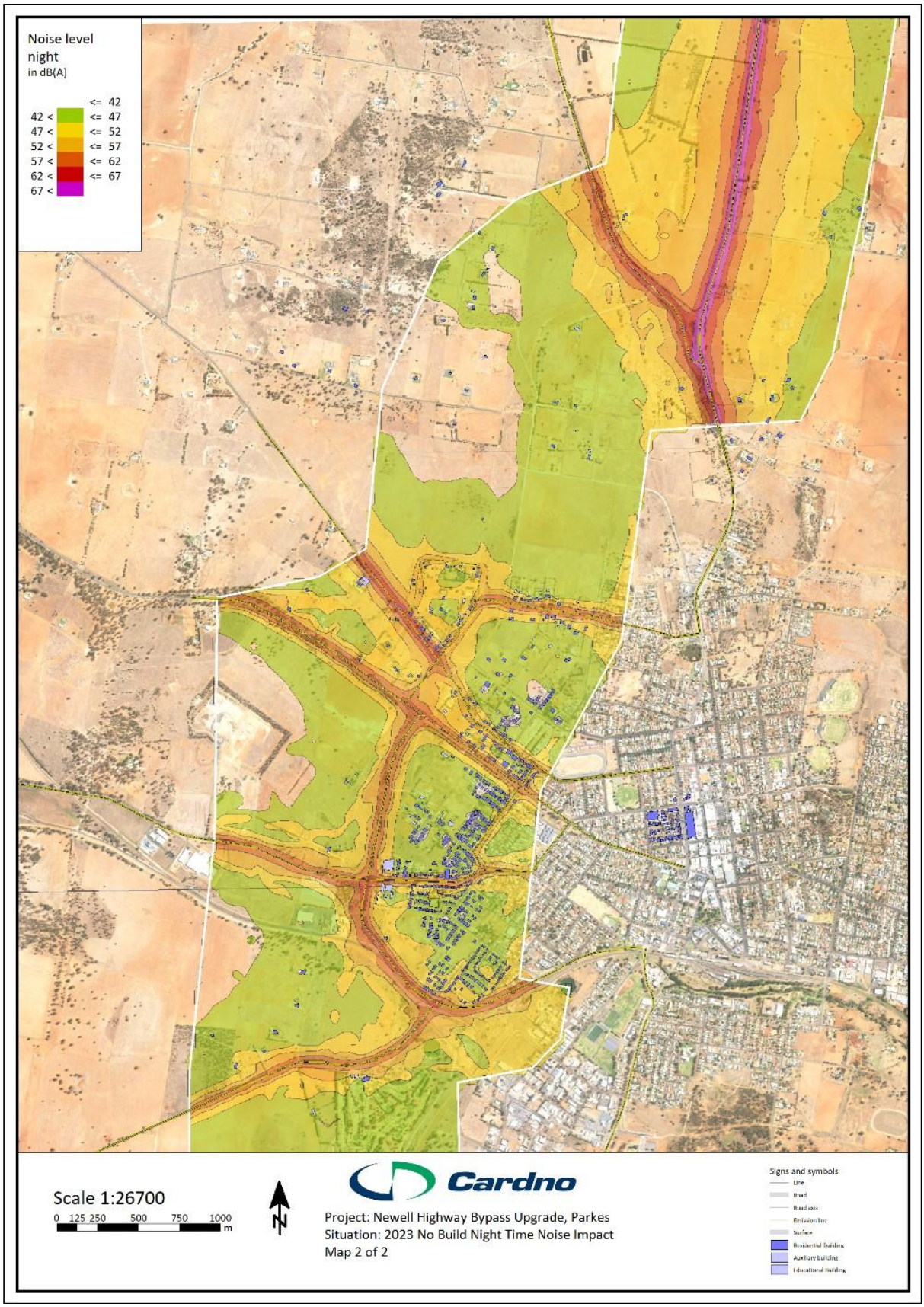

Figure E13: Year 2033 - Predicted Road Traffic Noise Levels (No Mitigation) – Daytime (South)

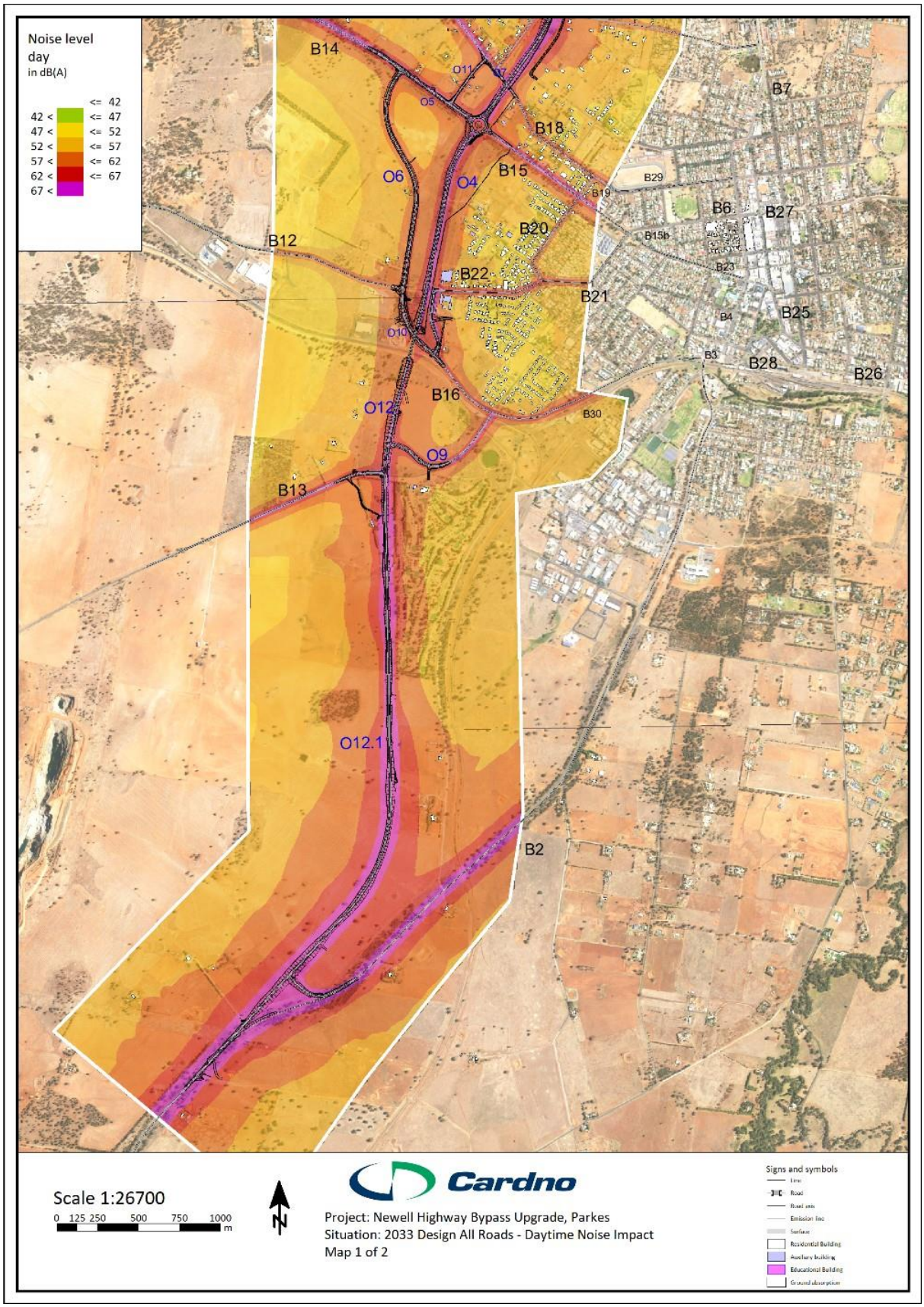

Figure E14: Year 2033 - Predicted Road Traffic Noise Levels (No Mitigation) – Daytime (North)

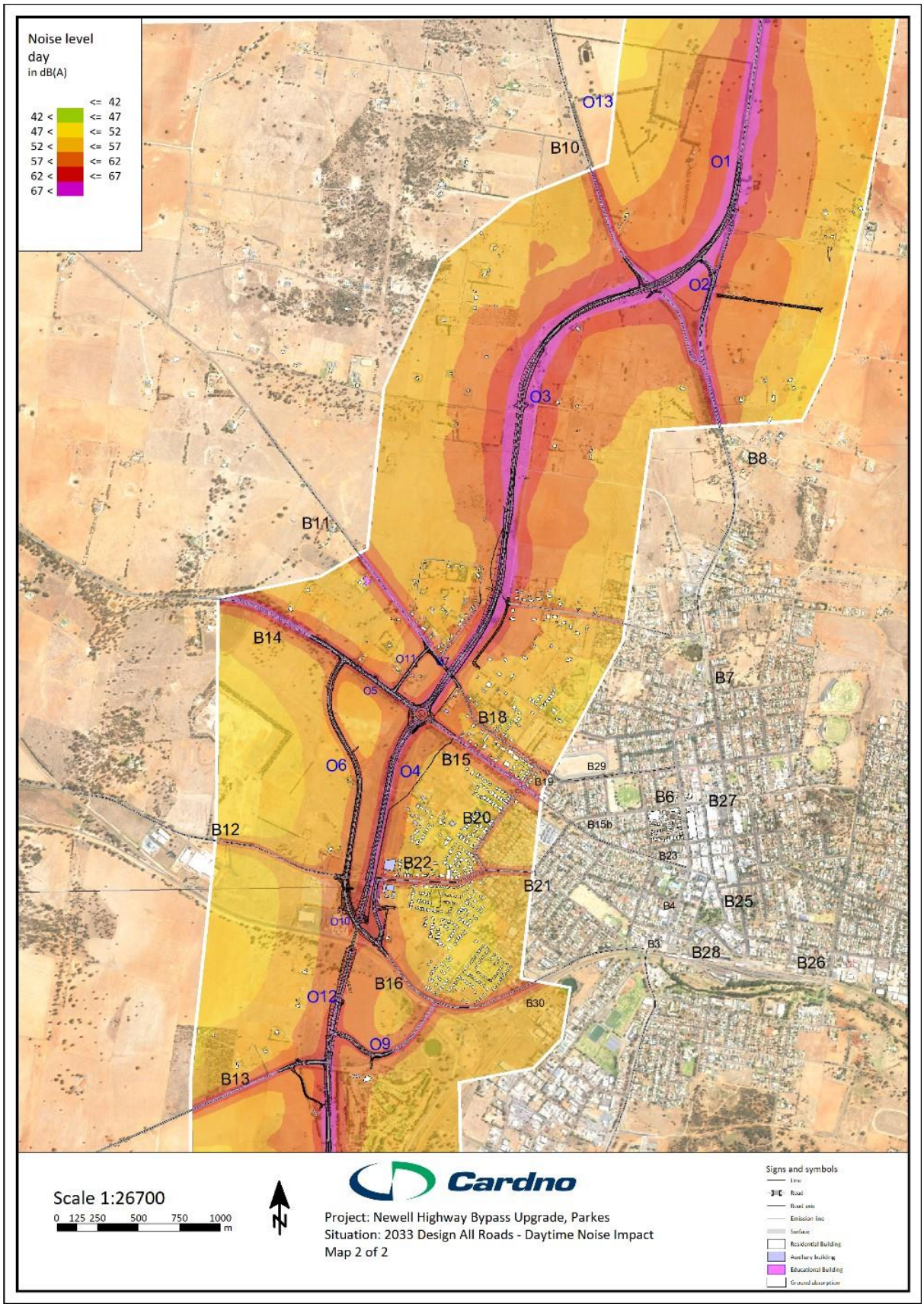

Figure E15: Year 2033 - Predicted Road Traffic Noise Levels (No Mitigation) – Night-time (South)

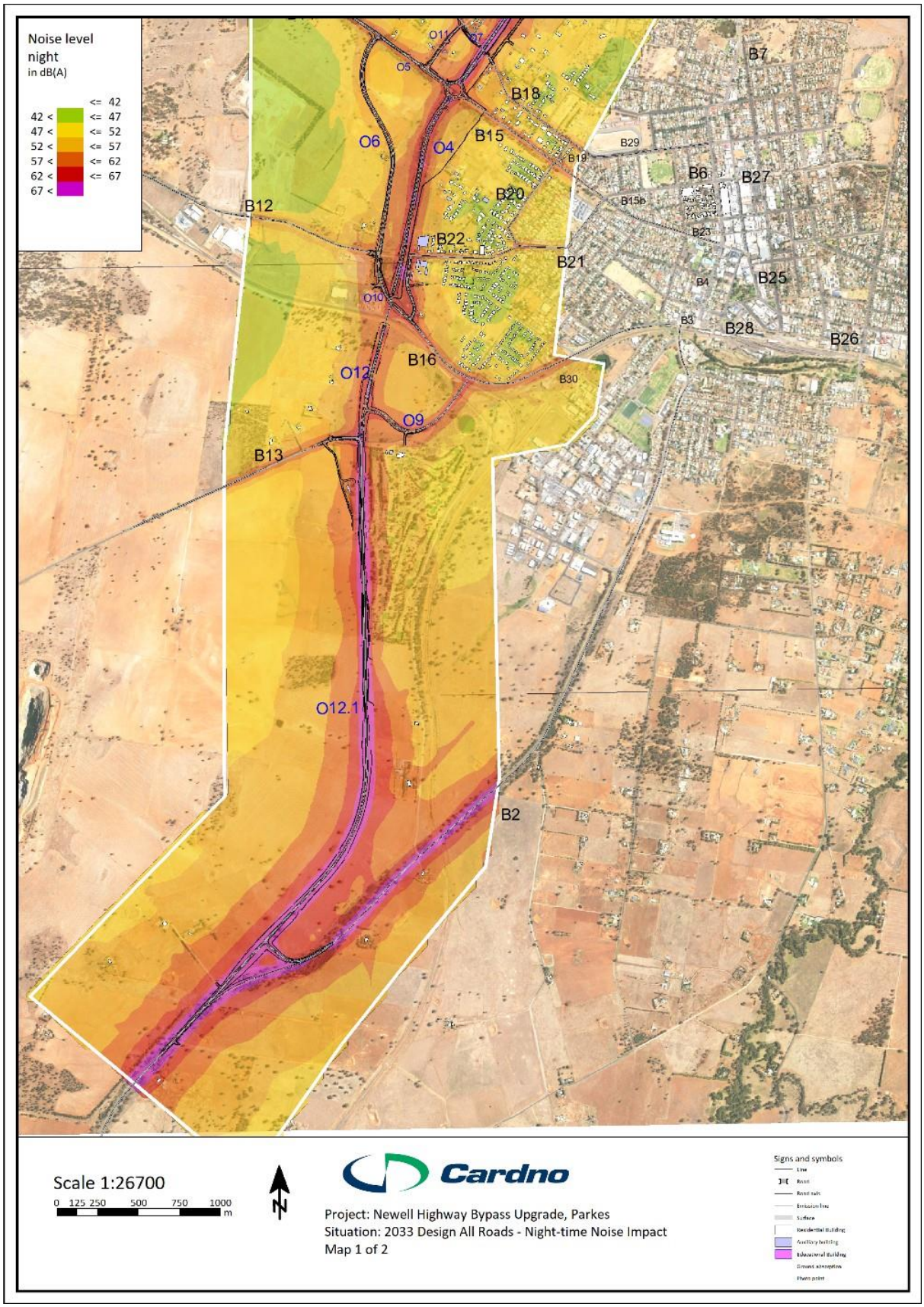

Figure E16: Year 2033 - Predicted Road Traffic Noise Levels (No Mitigation) – Night-time (North)

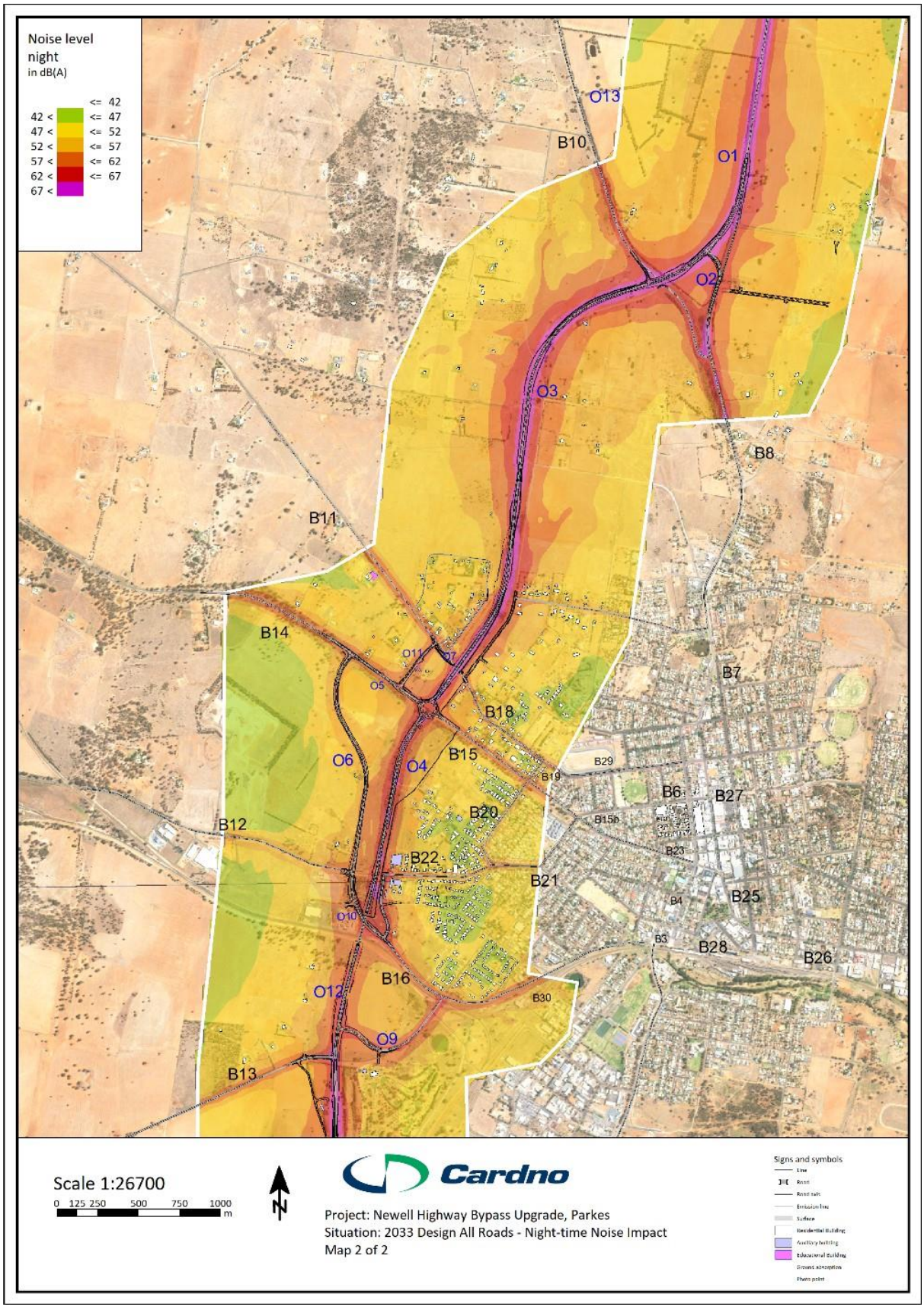

Figure E17: Year 2023 - Predicted Road Traffic Noise Levels (DGA) – Day-time (South)

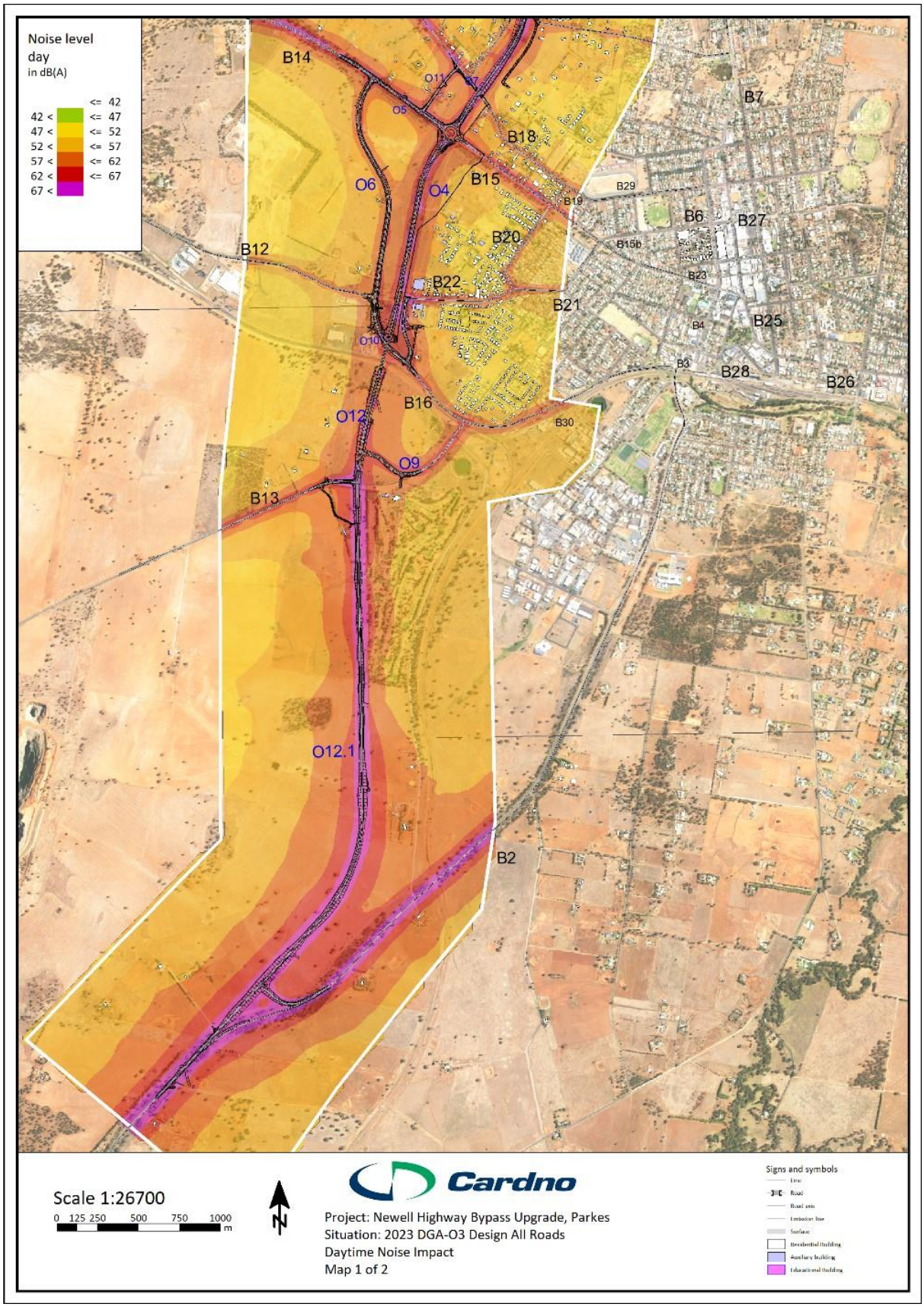

Figure E18: Year 2023 - Predicted Road Traffic Noise Levels (DGA) – Day-time (North)

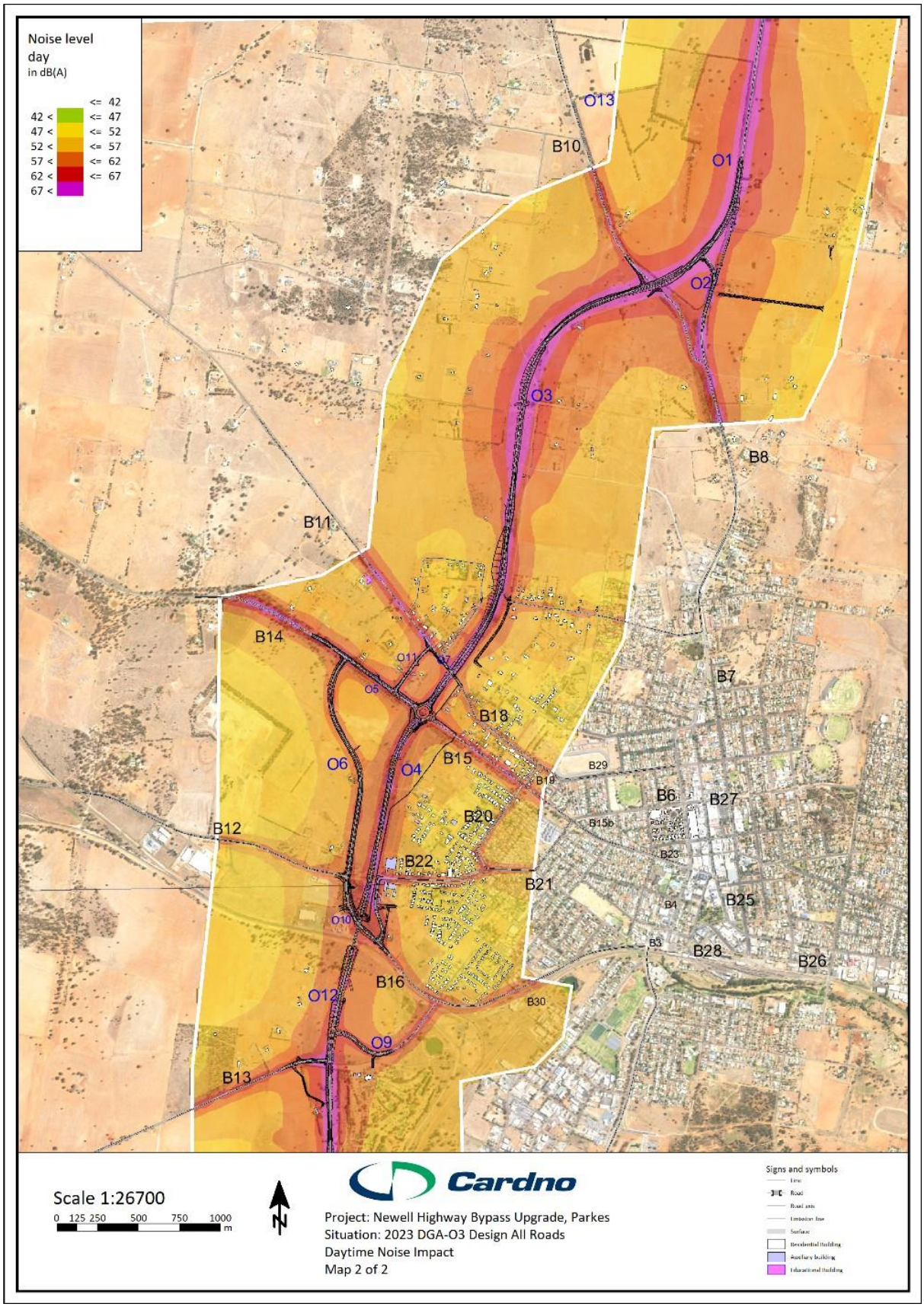

Figure E19: Year 2023 - Predicted Road Traffic Noise Levels (DGA) – Night-time (South)

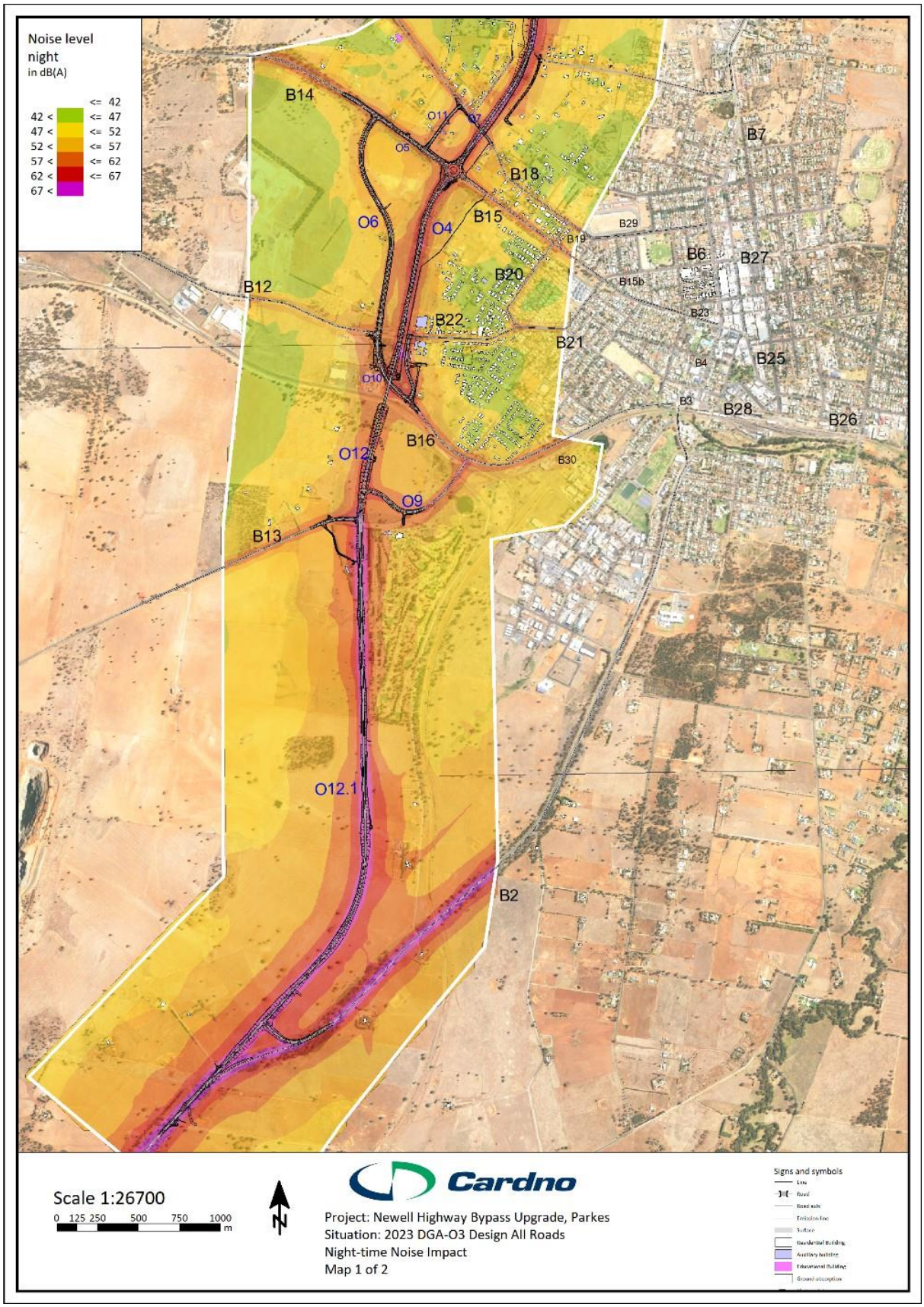

Figure E20: Year 2023 - Predicted Road Traffic Noise Levels (DGA) – Night-time (North)

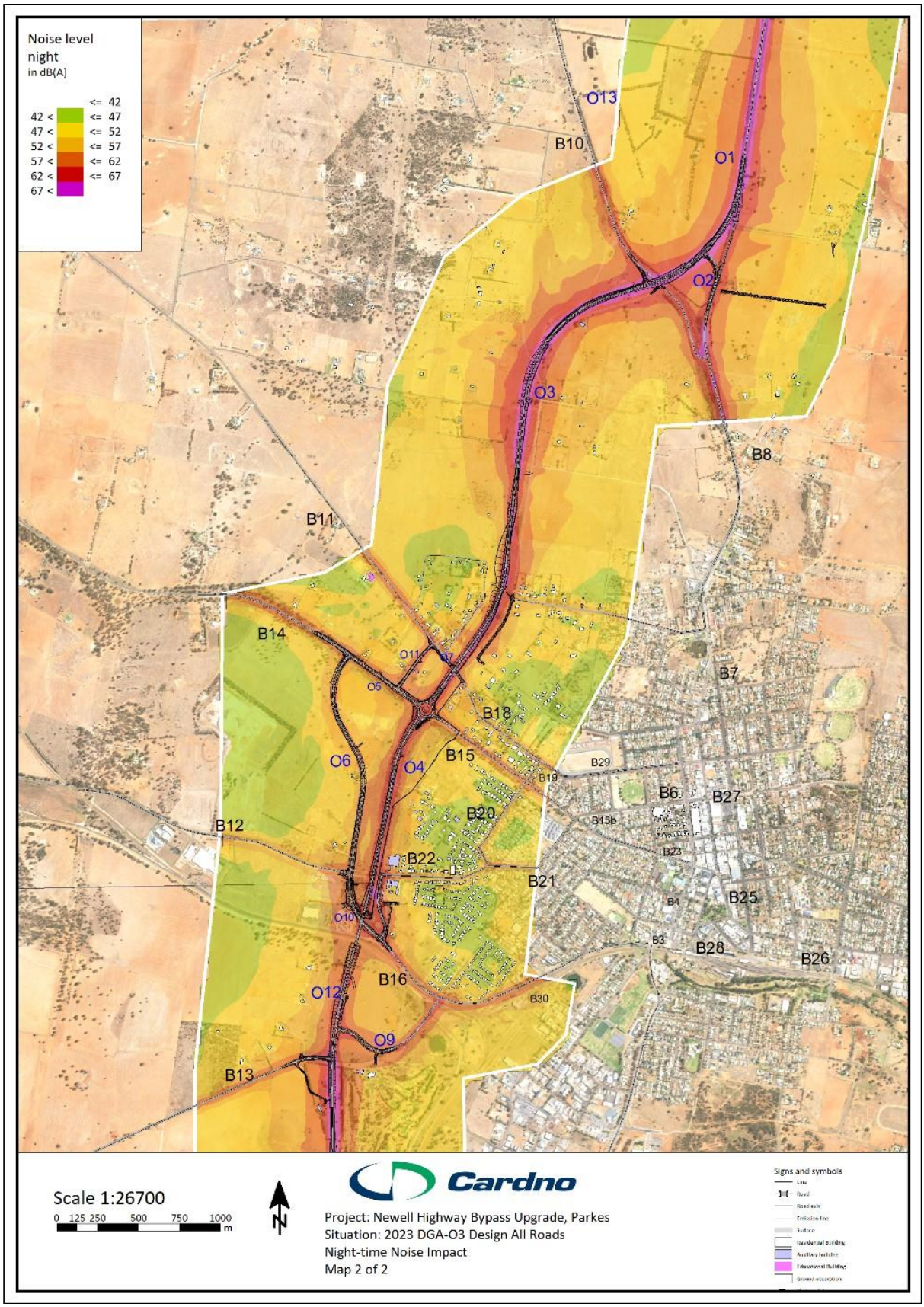

Figure E21: Year 2033 - Predicted Road Traffic Noise Levels (DGA) – Day-time (South)

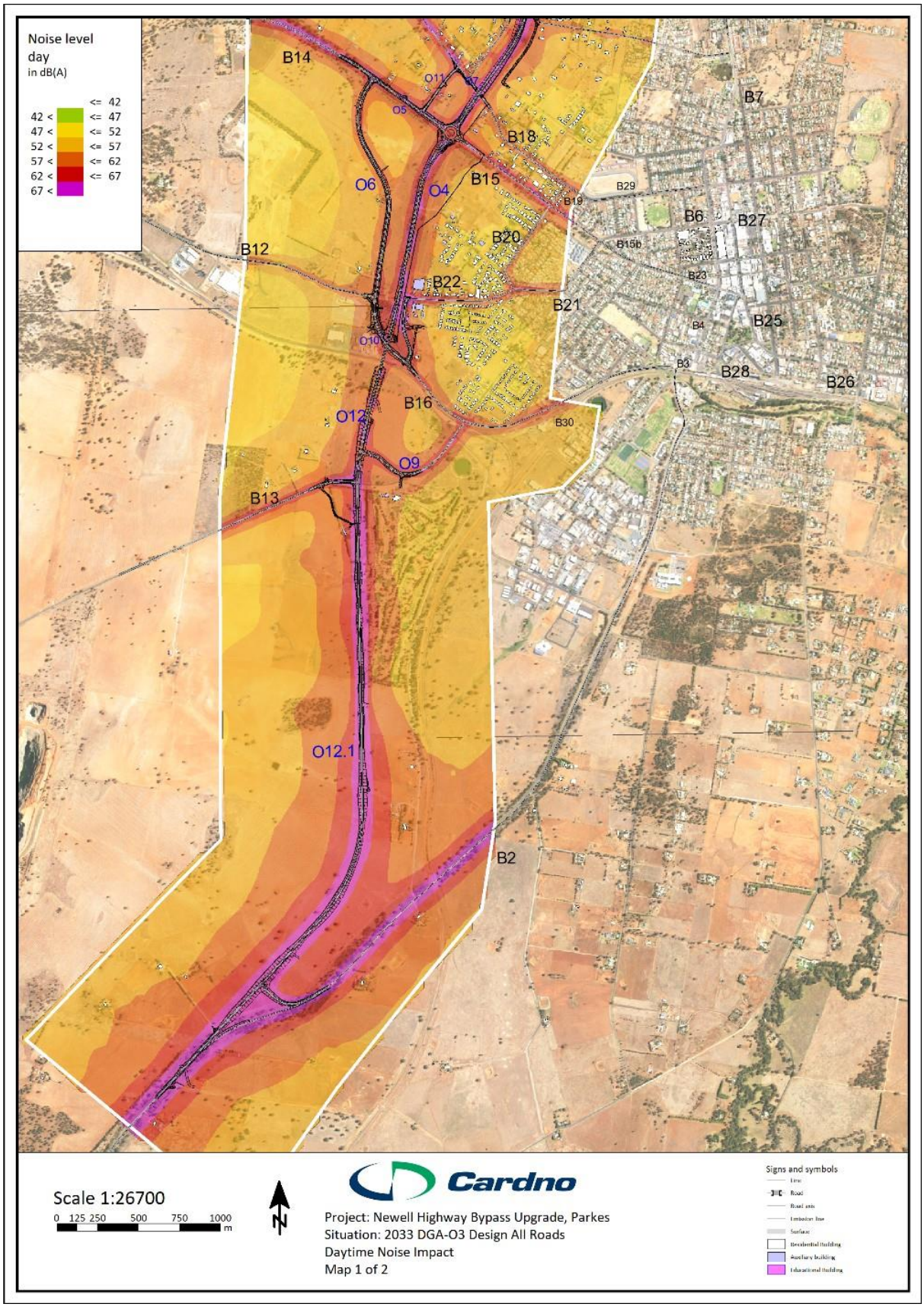

Figure E22: Year 2033 - Predicted Road Traffic Noise Levels (DGA) – Day-time (North)

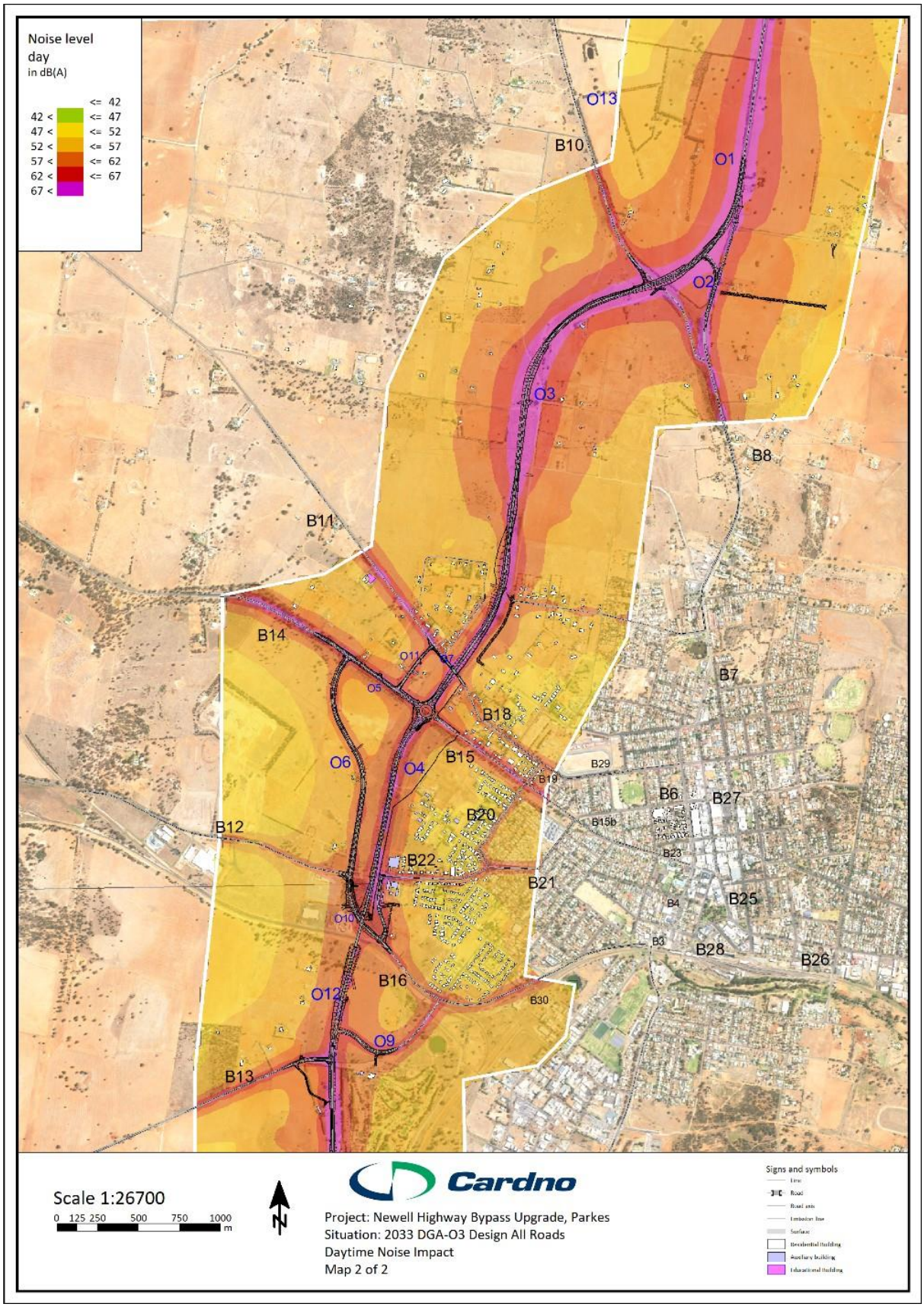

Figure E23: Year 2033 - Predicted Road Traffic Noise Levels (DGA) – Night-time (South)

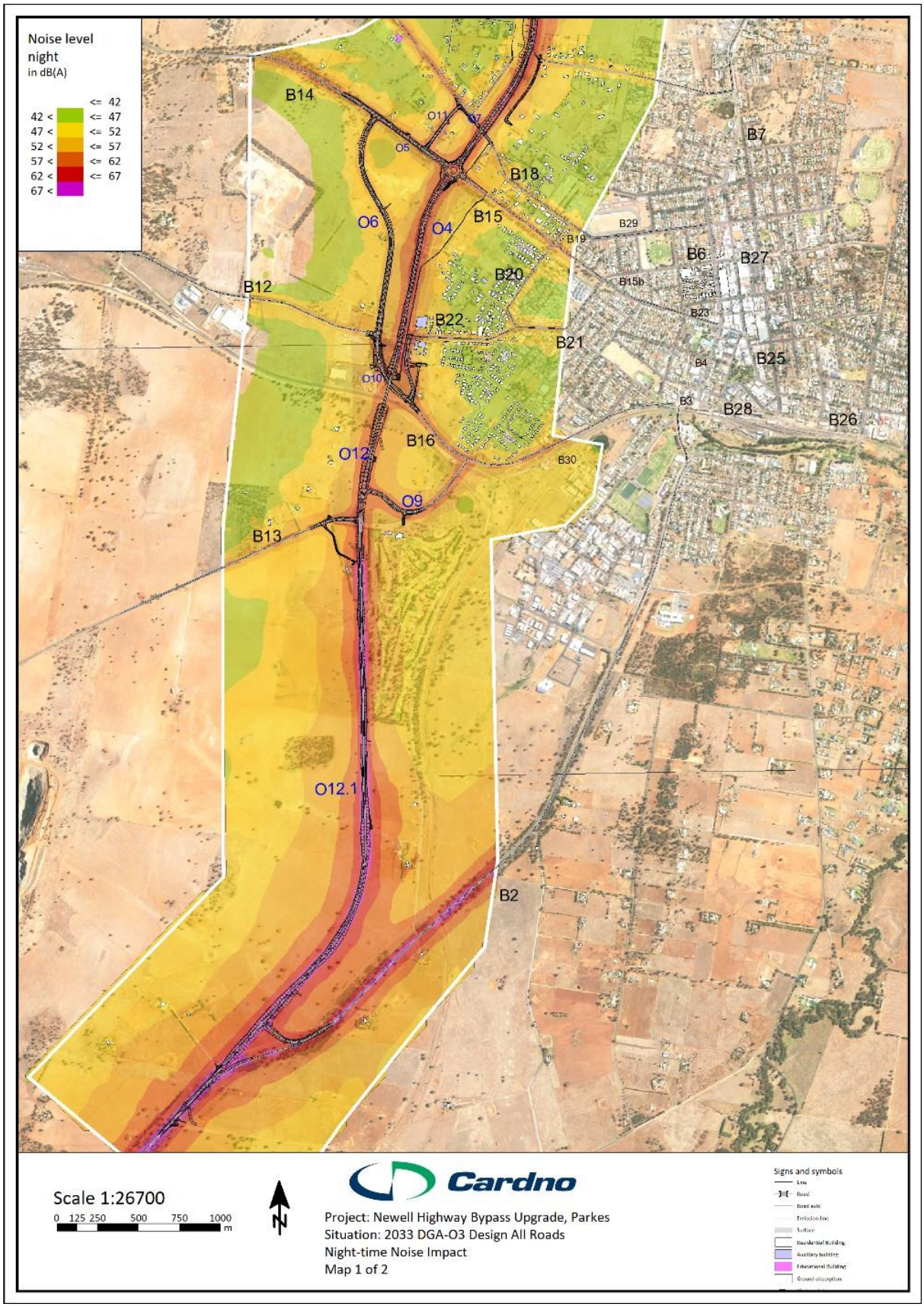

Figure E24: Year 2033 - Predicted Road Traffic Noise Levels (DGA) – Night-time (North)

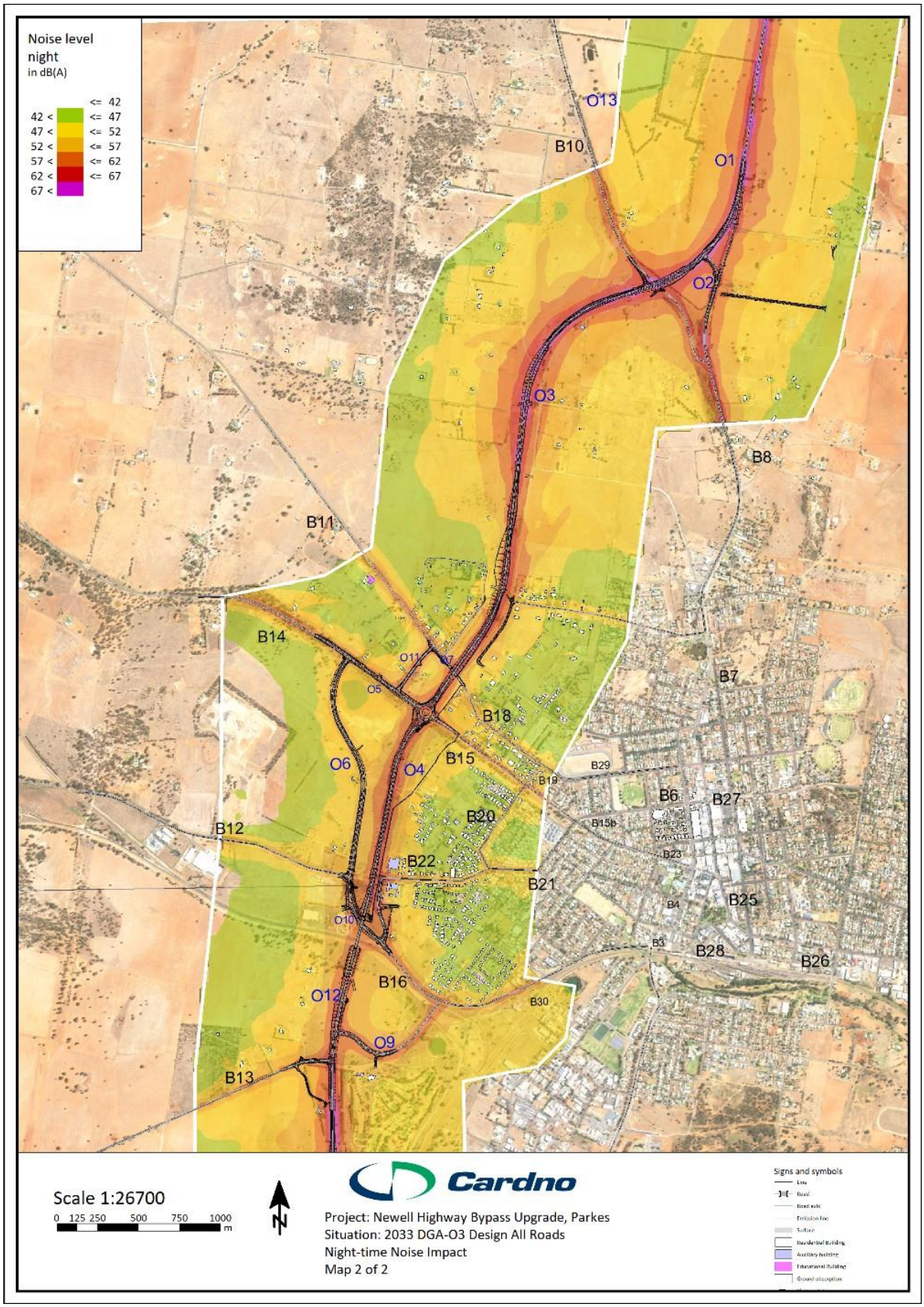

Figure E25: Year 2033 – No Build Traffic Noise Levels – Daytime (South)

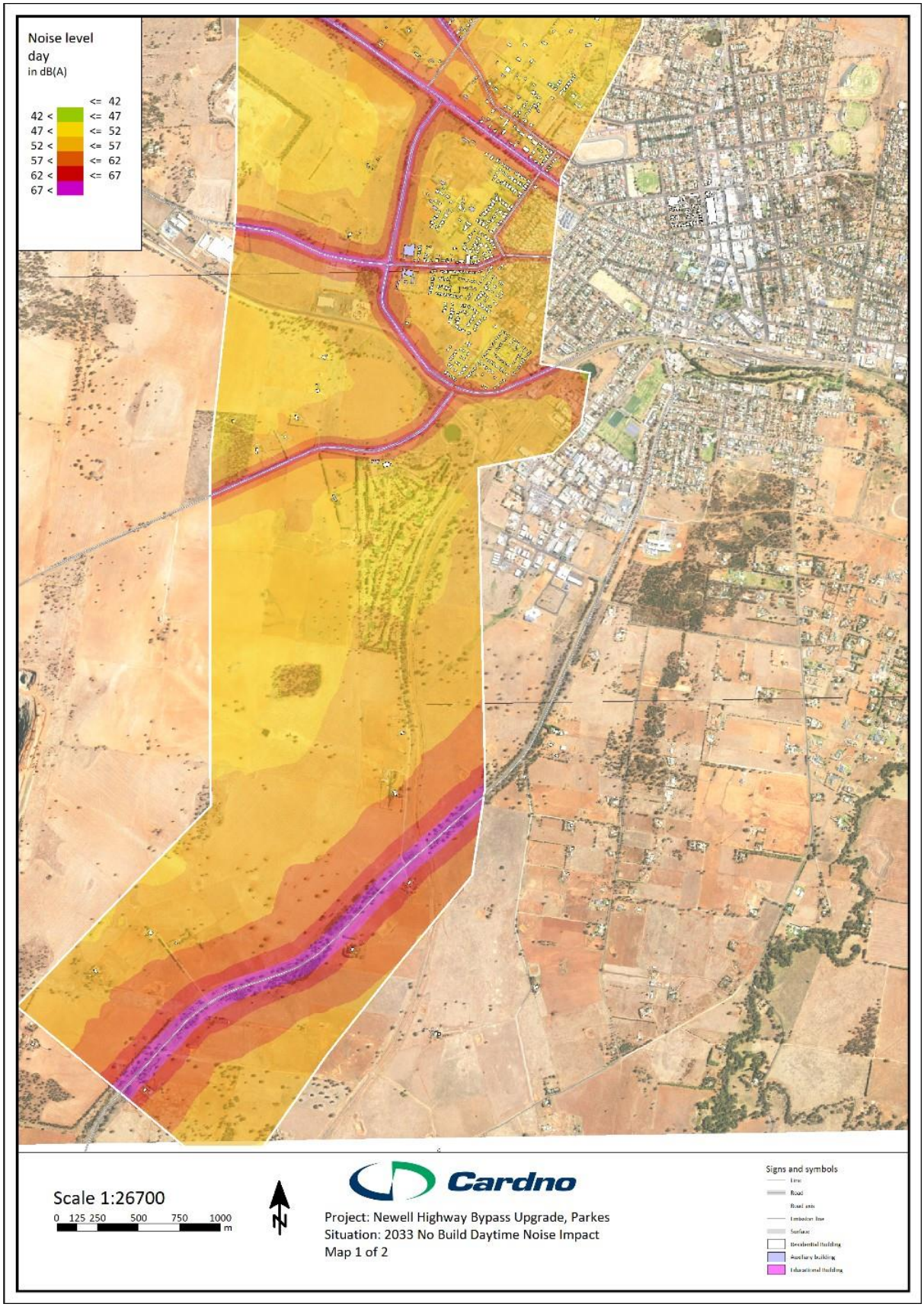

Figure E26: Year 2033 – No Build Traffic Noise Levels – Daytime (North)

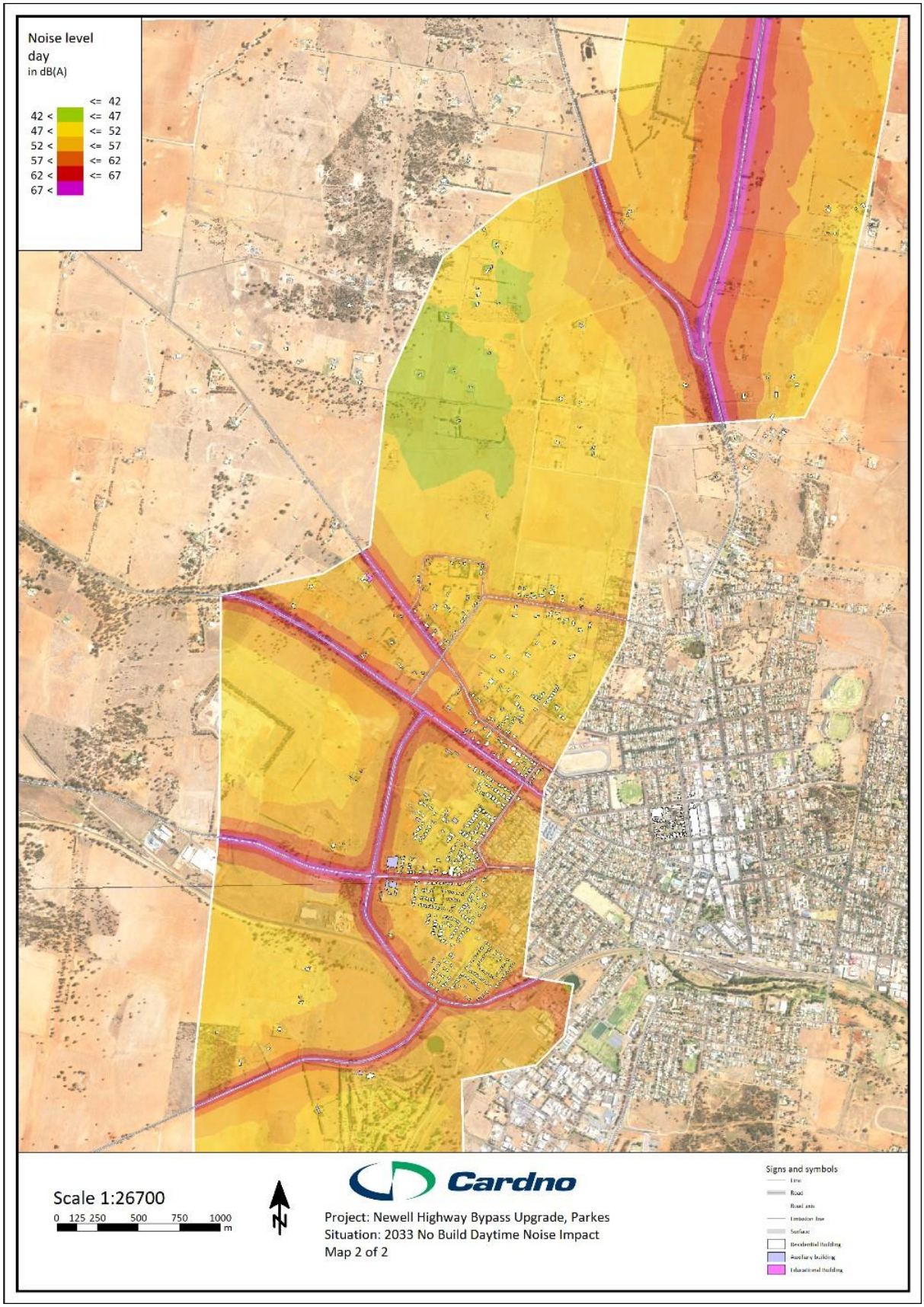

Figure E27: Year 2033 – No Build Traffic Noise Levels – Night-time (South)

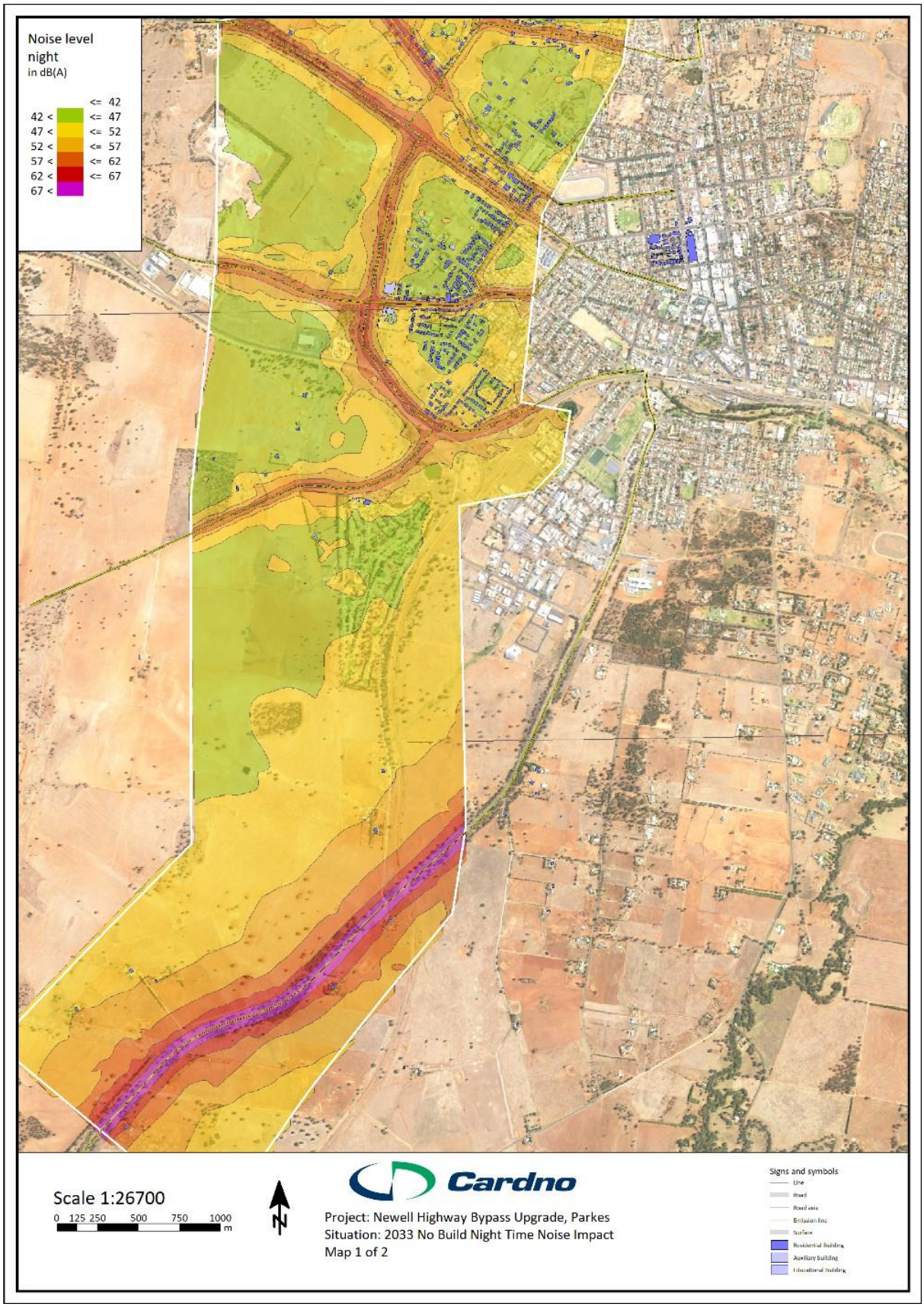

Figure E28: Year 2033 – No Build Traffic Noise Levels – Night-time (North)

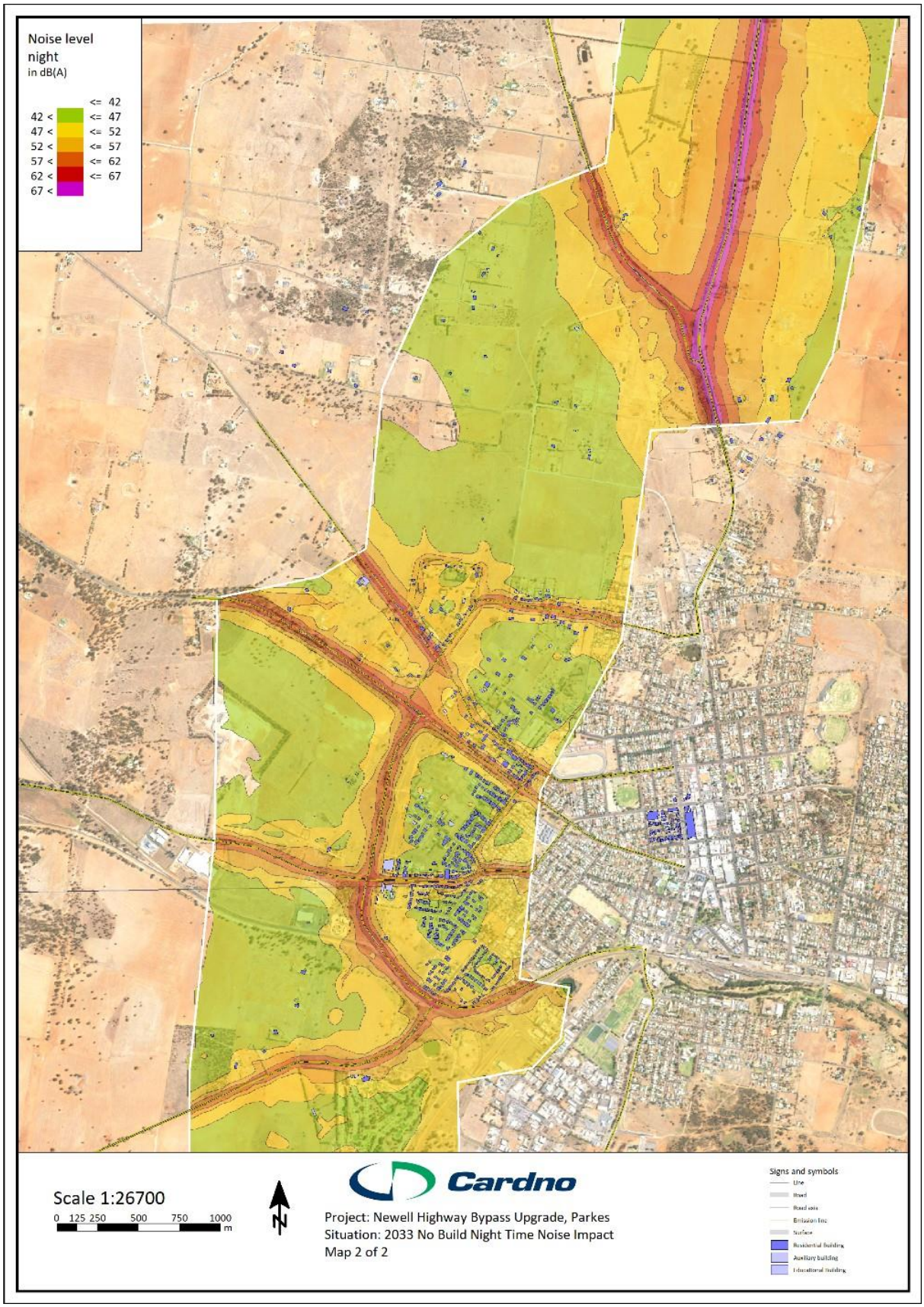

Figure E29: Year 2033 – Noise Increase above No Build– Daytime (South)

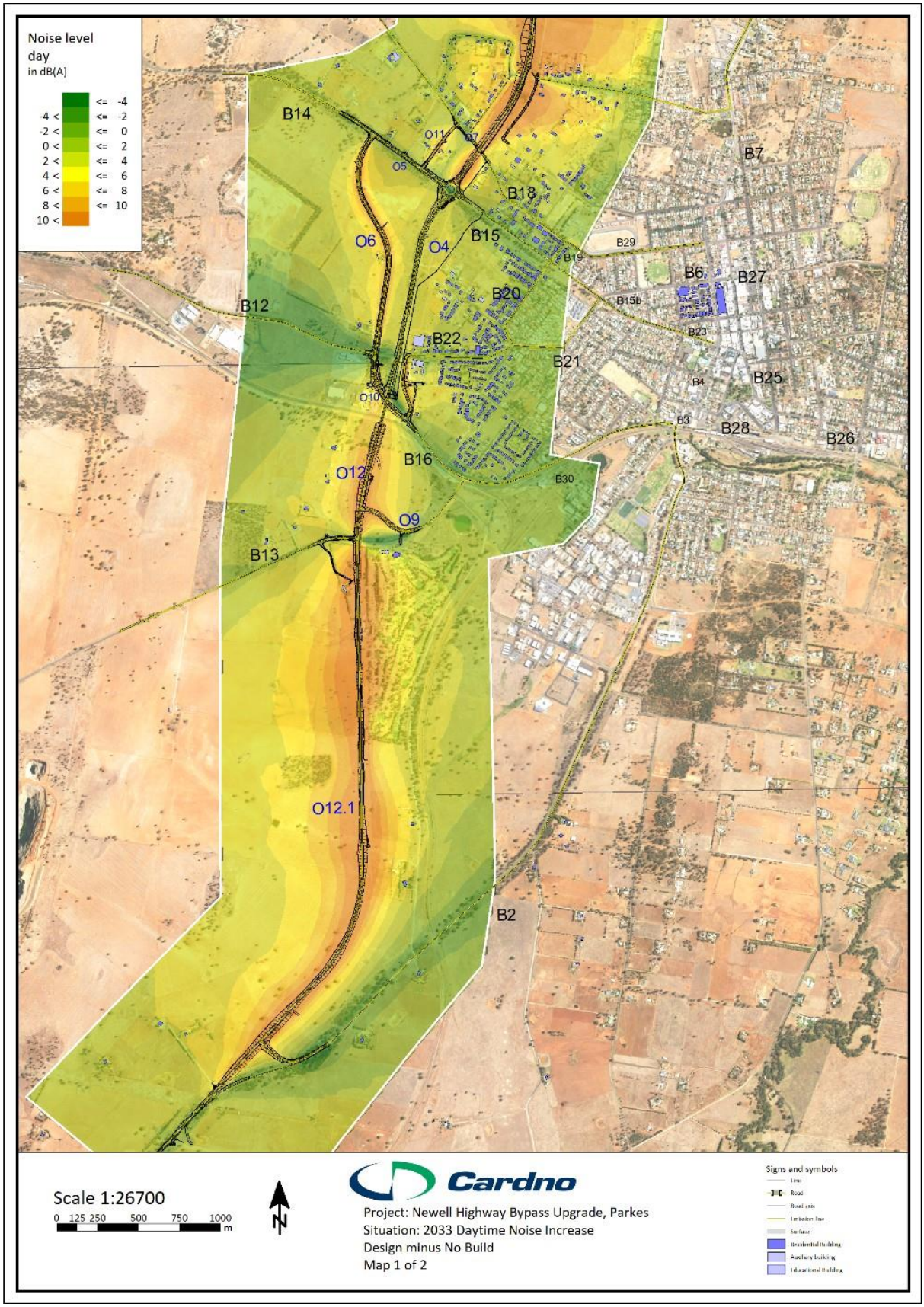

Figure E30: Year 2033 – Noise Increase above No Build – Daytime (North)

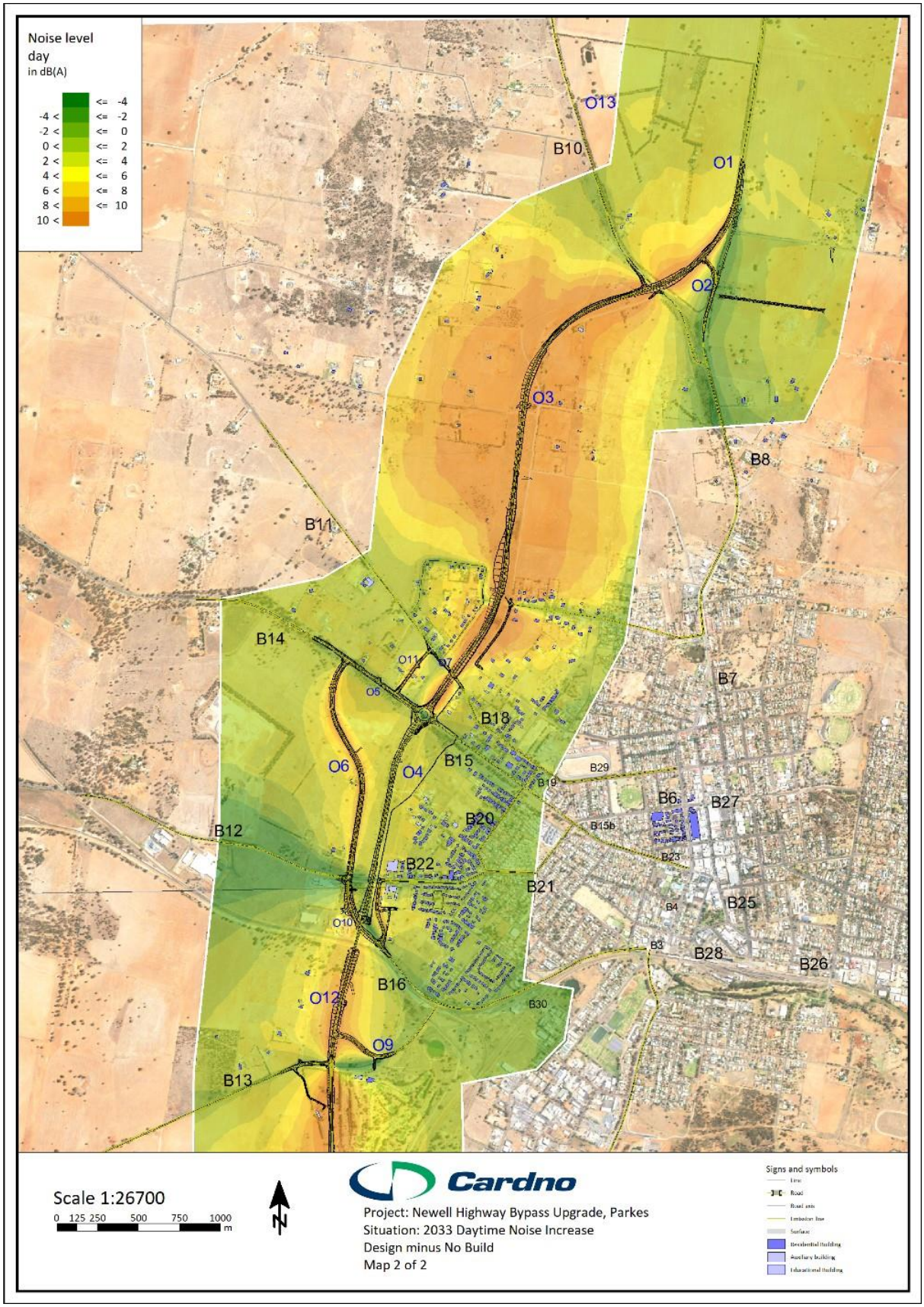

Figure E31: Year 2033 – Noise Increase above No Build – Night-time (South)

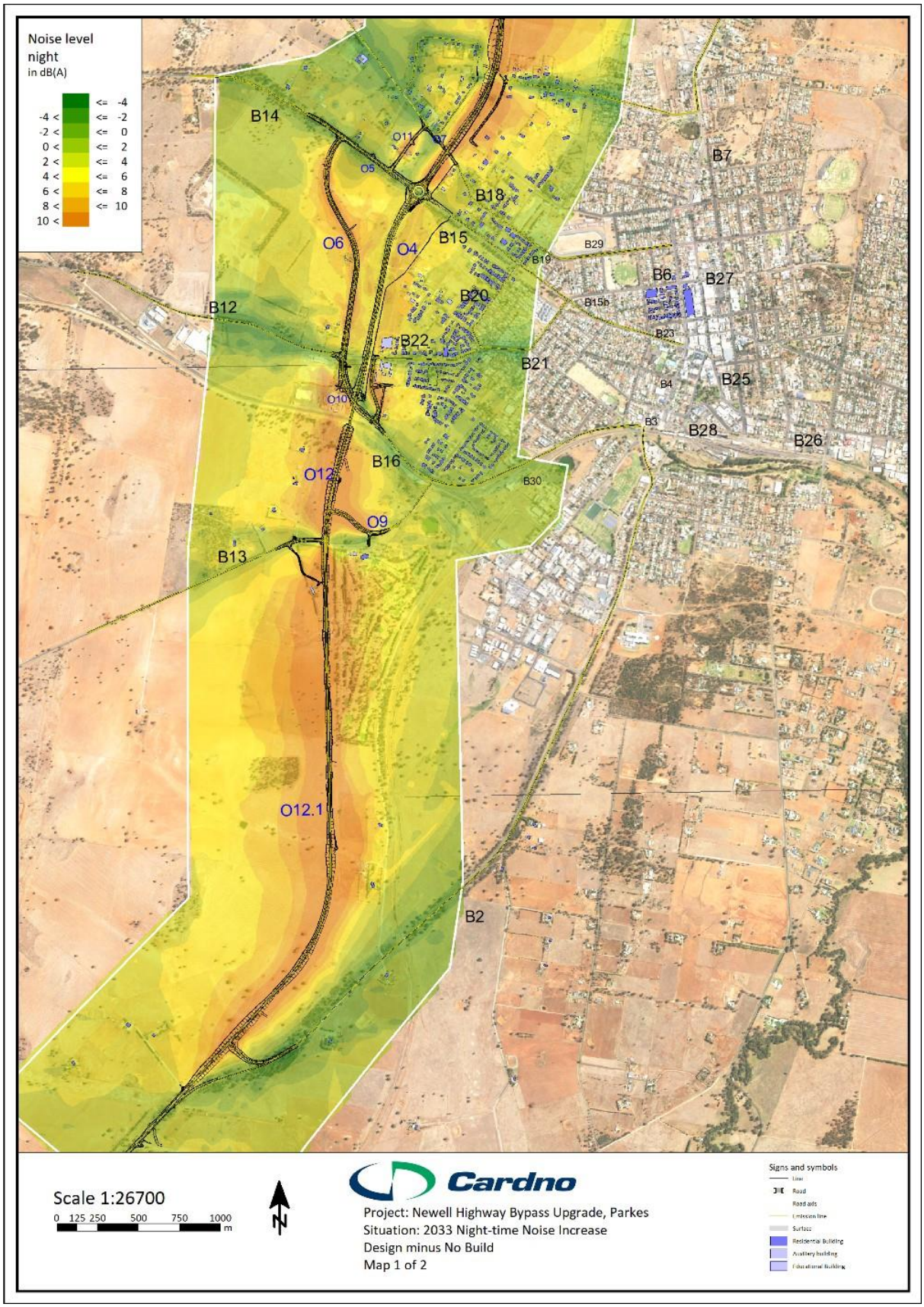

Figure E32: Year 2033 – Noise Increase above No Build – Night-time (North)