Noise Assessment:
Fox Lane Area Quieter Neighbourhood

January 2022






Experts in noise and vibration assessment and management

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1 Introduction

1.1 This report describes the potential noise impacts associated with the Quieter Neighbourhood Scheme at Fox Lane (the 'scheme') in Enfield. The assessment has been carried out by Noise Consultants Ltd (NCL) on behalf of London Borough of Enfield (LB Enfield). This noise assessment has been delivered in conjunction with an air quality assessment undertaken by NCL's sister company Air Quality Consultants Ltd (AQC), which is presented in a separate report.

1.2 A Quieter Neighbourhood Scheme is an area in which *"through motor vehicle traffic is discouraged or removed"* in alignment with the Mayor's Transport Strategy 2018 (GLA, 2018a) to transform London's streets. The Fox Lane scheme was introduced in 2020.

1.3 This assessment takes the approach of a comparison of ambient road traffic noise levels with and without the scheme in place. The report describes the modelling of road traffic noise exposure levels for each scenario i.e. before and after the scheme in terms of the following noise metrics: $L_{Aeq,16hr}$ for daytime noise impacts; and $L_{night,8hr}$, for night-time noise impacts. These metrics can be used to consider perceptible changes in road traffic noise as a result of the scheme.

Proposed Scheme

1.4 A series of measures were implemented on residential roads within the streets bounded by the A105 Green Lanes, the A1004 Aldermans Hill / Cannon Hill / The Green / High Street and the A111 The Bourne / Bourne Hill to reallocate through traffic from these minor roads onto the surrounding 'key distributor roads'.

1.5 The scheme was implemented as a trial under an Experimental Traffic Order in September 2020, with a number of restrictions to motorised vehicles implemented through camera enforcement and the placement of bollards. In addition, Devonshire Road was converted from a one-way road to allow two-way traffic flows. A summary of the proposed amendments is provided in **Figure 1.**

Figure 1: Fox Lane Quieter Neighbourhood Trial

Downloaded from LB Enfield's website.

1.6 Automatic Traffic Counts (ATCs) in March 2019 (prior to scheme implementation) and September 2021 (post-scheme implementation) were commissioned by LB Enfield at the locations shown in **Figure 2**; each data collection period lasted seven days**.** The raw traffic data were processed into the appropriate format for air quality modelling through adjustments to represent an Annual Average Daily Traffic (AADT) flow by NRP Ltd[1]. Uncertainties associated with this process, as well as with other parameters that would have influenced measured traffic data (i.e. the Covid-19 pandemic), have, to some extent, been taken into account within the assessment and conclusions, as further discussed in this report. Further details regarding the locations of traffic counts, derivation of traffic data and transformations are provided in in the standalone Post Scheme Monitoring Data Analysis Report completed by NRP Ltd.

[1] NRP Ltd were appointed as traffic consultants for the scheme.

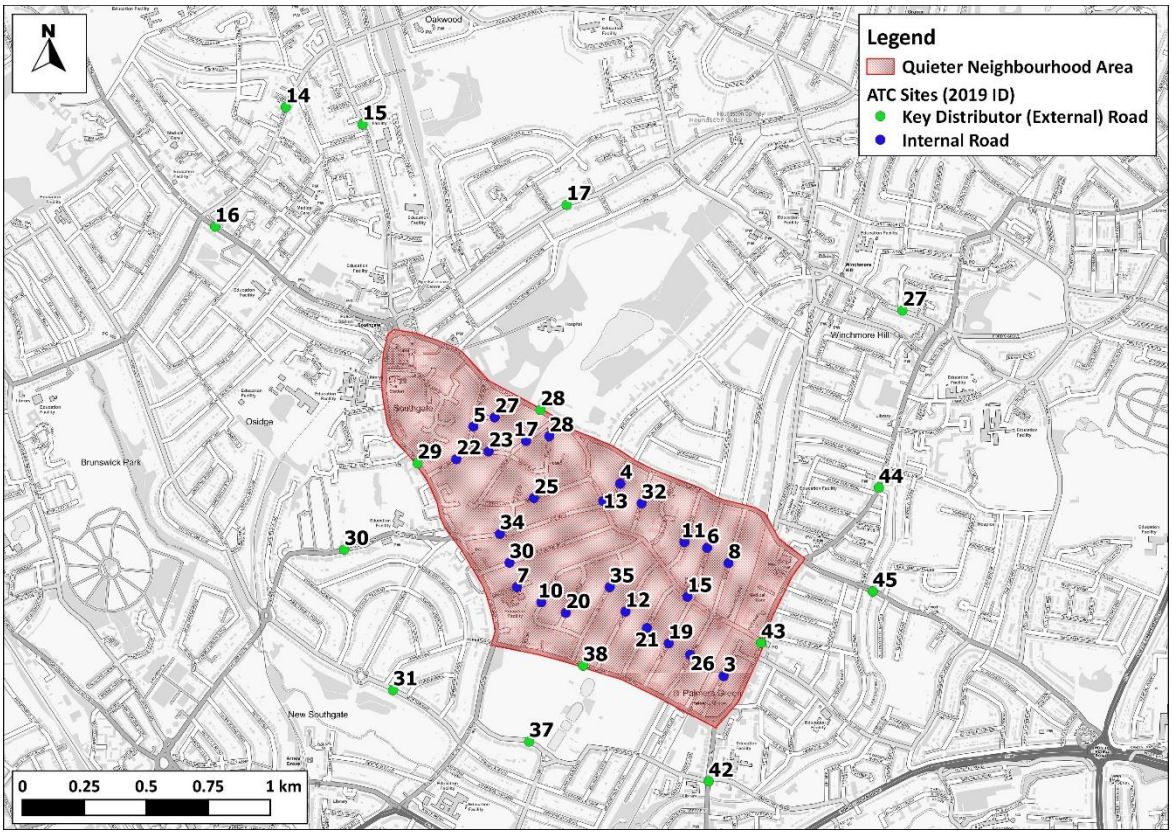

Figure 2: ATC Sites

2 Relevant Policy and Guidance

National Noise Policy

Noise Policy Statement for England (NPSE, 2010)

2.1 The Noise Policy Statement for England (NPSE, 2010) sets out the Government's Noise Policy Vision to:

"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development".

2.2 This long-term vision is supported by three Noise Policy Aims that can be delivered through effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development. These aims are to:

1. *avoid significant adverse impacts on health and quality of life;*
2. *mitigate and minimise adverse impacts on health and quality of life; and*
3. *where possible, contribute to the improvement of health and quality of life.*

2.3 The explanatory note to the NPSE sets out 'effect levels' which are aligned to the Policy Aims. Drawing upon established concepts from toxicology, the NPSE defines the following noise effect levels:

- NOEL - 'No Observed Effect Level';
- LOAEL - 'Lowest Observed Adverse Effect Level'; and
- SOAEL - 'Significant Observed Adverse Effect Level'.

2.4 The explanatory note describes SOAEL as the effect level above which significant adverse effects on health and quality of life occur, aligning this level with the first policy aim.

2.5 LOAEL is described as the level at which adverse effects begin and the second aim of the NPSE refers to a situation where the effect lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8 of the NPSE) however this does not mean that such adverse effects cannot occur.

2.6 NOEL is described as a level of noise exposure below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life.

2.7 The third aim seeks, where possible, to positively improve health and quality of life through the pro-active management of noise while also taking into account the guiding principles of sustainable

development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society.

2.8 The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.

2.9 NPSE states that it is not possible have a single, numerical definition of the SOAEL that is applicable to all sources of noise in all situations, since the SOAEL is likely to be different for different noise sources, for different receptors and at different times.

2.10 The setting of LOAELs and SOAELs for transportation sources has however reached a form of consensus following a number of high-profile infrastructure projects in England, namely HS2 and a series of Highways England road schemes which have been successful through the Government's Hybrid Bill and Development Consent Order (DCO) consenting processes.

2.11 In these projects, the setting of SOAEL has been aligned to Government policy and legislation in relation to the provision of noise insulation where it has been argued that significant adverse effects can be avoided through these means. **Table 1** provides a summary of the LOAEL and SOAEL values applied on these projects.

Table 1: Road Traffic LOAELs and SOAELs for L_{Aeq} based metrics

Source / Project	Period	LOAEL	SOAEL
Road Traffic (Highway Agency A14 DCO)	Daytime	50 dB $L_{Aeq, 16hr}$ (free-field)	63 dB $L_{Aeq, 16hr}$ (free-field)
	Night-time	40 dB $L_{Aeq, 8hr}$ (free-field)	55 dB $L_{Aeq, 8hr}$ (free-field)

2.12 The Highway England publication, LA111 (Noise and Vibration, Revision 2, May 2020) reports LOAELs and SOAELs for noise sensitive receptors as part of assessing the impacts of noise from highway projects. These are reproduced in **Table 2** below.

Table 2: Road Traffic LOAELs and SOAELs as reported in LA111

Source / Project	Period	LOAEL	SOAEL
Road Traffic	Daytime	55 dB $L_{A10, 18hr}$ facade[1]	68 dB $L_{A10, 18hr}$ facade[2]
	Night-time	40 dB $L_{night, outside}$ (free-field)	55 dB $L_{night, outside}$ (free-field)

[1] Equivalent to 50 dB $L_{Aeq, 16hr}$ (free-field)

[2] Equivalent to 63 dB $L_{Aeq, 16hr}$ (free-field)

Planning Policy

National Planning Policy

National Planning Policy Framework (NPPF, 2019)

2.13 The National Planning Policy Framework (NPPF, 2019) sets out the Government's planning policies for England and how these should be applied. The NPPF provides a framework within which locally-prepared plans for housing and other development can be produced.

2.14 In relation to noise, it states:

> *"170. Planning policies and decisions should contribute to and enhance the natural local environment by: …*
>
> - *preventing new and existing development from contributing to, and being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability …."*

2.15 The NPPF includes policy which makes reference to 'significant adverse impacts on health and quality of life', as per the NPSE. NPPF policy states:

> *180. Planning policies and decisions should aim to ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*
>
> - *mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;…"*

2.16 The NPPF makes reference to the NPSE in respect of achieving these aims.

2.17 Notably, NPPF has also recently introduced the 'Agent of Change' principle as follows:

> *182. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent 60 See Explanatory Note to the Noise Policy Statement for England (Department for Environment, Food & Rural Affairs, 2010). 53 of change') should be required to provide suitable mitigation before the development has been completed.*

2.18 Whilst the development is in proximity to existing commercial uses, Section 182 is not considered applicable to the proposed development. The existing site comprises residential uses as well as there being significant amounts of residential use nearby. Therefore, potential noise constraints upon nearby business and community facilities will be unchanged.

Planning Practice Guidance – Noise (PPG-Noise, 2019)

2.19 The Planning Practice Guidance (PPG-Noise, 2019) provides further detail about how the effects of noise can be described in terms of perception and outcomes. It aligns this to increasing effect levels as defined in the NPSE. In addition, the PPG-Noise adds a fourth term and corresponding effect level:

- UAEL – 'Unacceptable Adverse Effect Level'.

Table 3: Planning Practice Guidance – Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

2.20 This effect level is higher than the significant adverse effect on health and quality of life (SOAEL) and requires that unacceptable adverse effects are to be prevented. In PPG-Noise, prevention is not in the context of Government policy on sustainable development. **Table 3** presents the noise exposure hierarchy described in PPG-Noise.

2.21 This noise exposure hierarchy is based on the principle that once noise or vibration becomes perceptible, the effect on people and other receptors increases as the level increases. PPG-Noise presents example outcomes to help characterise these effects using non-technical language. In general terms, an observed adverse effect is characterised as a perceived change in quality of life for occupants of a building or a perceived change in the acoustic character of an area, whereas a significant observed adverse effect disrupts activities.

2.22 PPG-Noise also provides guidance in terms of what factors may influence whether noise could become a concern, and how adverse effects of noise can be mitigated. Examples of mitigation provided include:

- *"engineering: reducing the noise generated at source and/or containing the noise generated;*
- *layout: where possible, optimising the distance between the source and noise-sensitive receptors and/or incorporating good design to minimise noise transmission through the use of screening by natural or purpose built barriers, or other buildings;*
- *using planning conditions/obligations to restrict activities allowed on the site at certain times and/or specifying permissible noise levels differentiating as appropriate between different times of day, such as evenings and late at night, and;*
- *mitigating the impact on areas likely to be affected by noise including through noise insulation when the impact is on a building".*

Local and Regional Policy

London-Specific Policies

The London Plan

2.23 The London Plan (GLA, 2021) sets out the spatial development strategy for London. It describes a strategic plan which considers an integrated approach to economic, environmental, transport and social framework for London's development over the next 20-25 years.

2.24 Policy D14, '*Noise*' states that:

"In order to reduce, manage and mitigate noise to improve health and quality of life, residential and other non-aviation development proposals should manage noise by:

A

1) avoiding significant adverse noise impacts on health and quality of life

2) reflecting the Agent of Change principle as set out in Policy D13 Agent of Change

3) mitigating and minimising the existing and potential adverse impacts of noise on, from, within, as a result of, or in the vicinity of new development without placing unreasonable restrictions on existing noise-generating uses

4) improving and enhancing the acoustic environment and promoting appropriate soundscapes (including Quiet Areas and spaces of relative tranquillity)

5) separating new noise-sensitive development from major noise sources (such as road, rail, air transport and some types of industrial use) through the use of distance, screening, layout, orientation, uses and materials – in preference to sole reliance on sound insulation

6) where it is not possible to achieve separation of noise-sensitive development and noise sources without undue impact on other sustainable development objectives, then any potential adverse effects should be controlled and mitigated through applying good acoustic design principles

7) promoting new technologies and improved practices to reduce noise at source, and on the transmission path from source to receiver.

B

Boroughs, and others with relevant responsibilities, should identify and nominate new Quiet Areas and protect existing Quiet Areas in line with the procedure in Defra's Noise Action Plan for Agglomerations."

2.25 The London Plan states that the management of noise *"is about encouraging the right acoustic environment, both internal and external, in the right place at the right time"*. It states that this is important with respect to health and quality of life but also promotes noise management for the purposes of *"improving and enhancing the acoustic environment and promoting appropriate soundscapes"*.

2.26 Building on this, and as is relevant to the Scheme, the policy states that:

"This can mean allowing some places or certain times to become noisier within reason, whilst others become quieter. Consideration of existing noise sensitivity within an area is important to minimise

potential conflicts of uses or activities, for example in relation to internationally important nature conservation sites which contain noise sensitive wildlife species, or parks and green spaces affected by traffic noise and pollution"

2.27 Policy D8, 'Public Realm' also has some regard for noise. Of relevant to the Scheme is Policy D8, Part C which states that Development Plans and development proposals should:

"maximise the contribution that the public realm makes to encourage active travel and ensure its design discourages travel by car and excessive onstreet parking, which can obstruct people's safe enjoyment of the space. This includes design that reduces the impact of traffic noise and encourages appropriate vehicle speeds" [Underlined for Emphasis]

London Environment Strategy

2.28 The London Environment Strategy was published in May 2018 (GLA, 2018a). The strategy considers ambient noise in Chapter 9 with a primary aim of "*reducing the number of people adversely affected by noise*". Policy 9.1.1 aims to *"Minimise the adverse impacts of noise from London's road transport network"*, while Policy 9.3.1 aims to improve *"understanding of the sources and impacts of noise to better target policies and action".* An implementation plan for the strategy has also been published which sets out what the Mayor will do to help achieve the ambitions in the strategy.

Mayor's Transport Strategy

2.29 The Mayor's Transport Strategy (GLA, 2018b) sets out the Mayor's policies and proposals to reshape transport in London over the next two decades. The Strategy focuses on reducing car dependency and increasing active sustainable travel, with the aim of reducing noise and creating healthier streets. It notes that development proposals should *"be designed so that walking and cycling are the most appealing choices for getting around locally".*

Local Policies

2.30 The Core Strategy (Enfield Council, 2010) was adopted in November 2010, and contains one policy which refers to noise. Core Policy 32 refers to pollution and states that Enfield Council:

"…will work with its partners to minimise air, water, noise and light […]. In particular, new development will be required to […] ensure that noise and light pollution is minimized."

Guidance

World Health Organization 'Environmental Noise Guidelines for the European Region' (WHO, 2018)

2.31 The guidelines presented within the World Health Organization's (WHO) '*Environmental Noise Guidelines for the European Region*' (WHO, 2018) complement the WHO '*Guidelines for Community Noise*' (WHO, 1999) and the WHO '*Night Noise Guidelines for Europe*' (WHO NNG, 2009).

2.32 The guidelines recommend noise exposure-response relationships that are mostly related to the noise exposure indicators L_{den} and L_{night}, with the aim of "*protecting human health from exposure to environmental noise originating from various sources: transportation (road traffic, railway, aircraft) noise, wind turbine noise and leisure noise*".

2.33 The guidelines provide source-specific recommendations on noise exposures. **Table 4** presents the recommendations relating to transportation sources from the guidance.

Table 4: Source Specific Recommendations on Noise Exposures

Source	Average Noise Exposure	Night Noise Exposure
Road traffic noise	Below 53 dB L_{den} strongly recommended	Below 45 dB L_{night} strongly recommended
Railway noise	Below 54 dB L_{den} strongly recommended	Below 44 dB L_{night} strongly recommended
Aircraft noise	Below 45 dB L_{den} strongly recommended	Below 40 dB L_{night} strongly recommended

2.34 Notably, the L_{den} parameter in is a compound noise rating indicator, and is representative of the average sound pressure level over all days, evenings, and night in a year, subject to an evening penalty of 5 dB and a night penalty of 10 dB. Whilst the WHO guidelines (2018) adopt the L_{den} as an appropriate indicator for adverse health effects, the $L_{Aeq,T}$ parameter, as advocated in Government policy and legislation is deemed to be the appropriate parameter for the determination of likely adverse impacts on health and quality of life.

Design Manual for Roads and Bridges: Sustainability & Environment Appraisal: LA 111 – Noise and vibration (LA 111, 2020)

2.35 LA 111 Noise and Vibration Revision 2 (formerly HD 213/11, IAN 185/15) provides guidance on the assessment of noise impacts from road schemes. The Design Manual for Roads and Bridges (DMRB) contains advice and information on undertaking noise and vibration assessments on the impact of road projects. This includes assessing changes in traffic on existing roads, where it outlines the magnitude of impact in the short and long term. It also provides guideline significance criteria for assessing the impact of road traffic noise exposure.

2.36 The change in noise level criteria from road traffic for both short- and long-term impacts advocated in LA 111 are summarised in **Table 5**.

Table 5: DMRB Change in Noise Level Categories

Noise Change Category	Road Traffic Noise
Negligible	<1 dB
Low	1 – 2.9 dB
Medium	3 – 4.9 dB
High	5 – 10 dB
Very High	>10 dB

Subjective Effect of Changes in Ambient Sound Level

2.37 A change in ambient sound level of +10 dB is perceived by the human ear as being twice as loud (Hellman, 1976; Zwicker & Scharf, 1965). Further categories associated with a subjective change in noise levels are advocated by the World Health Organisation (Hansen, 2001) as summarised in **Table 6**.

Table 6: Subjective Effect of Changes in Ambient Sound Level

Change in Sound Level (dB)	Change in Sound Power		Change in Apparent Loudness
	Decrease	Increase	
3	1 / 2	2	Just perceptible
5	1 / 3	3	Clearly noticeable
10	1 / 10	10	Half or twice as loud
20	1 / 100	100	Much quieter / louder

3 Assessment Approach

Proposed Scheme

3.1 The re-distribution of traffic on local roads associated with the scheme may affect the levels of road traffic noise that local residents and users are exposed to. The impacts of the proposed scheme on road traffic noise has therefore been assessed using detailed noise modelling with the assistance of traffic data which has been obtained by the commissioned surveys prior to, and after, the implementation of the scheme.

Study Area

3.2 The study area covers all internal roads affected by the implementation of the scheme. The study area also incorporates peripheral roads where traffic volumes may change as a result of the scheme. Only roads where traffic counts were undertaken have been included so as not to mix sources of data.

Assessment Scenarios

3.3 Noise exposure has been modelled for the following scenarios:

- Without the scheme – which has been based on traffic data collected in March 2019; and
- With the scheme – which has been based on traffic data collected in September 2021.

3.4 For each average day, noise modelling has estimated average noise levels (in dB $L_{Aeq,T}$, where T is the period duration) over a 12-hour day (L_{day}, from 07:00-19:00), 4-hour evening (L_{eve}, from 19:00-23:00), and 8-hour night (L_{night}, from 23:00-07:00), as well and a 16-hour day ($L_{Aeq,16hr}$, 07:00-23:00).

3.5 The relative change in road traffic noise levels in each scenario was calculated to provide an estimation of the difference between noise levels before the scheme and with the scheme, and therefore estimate the impact of the scheme on local noise levels.

Modelling Methodology

3.6 The model has been developed using the LimA® computational sound modelling software (v2021) and has been configured to calculate levels of noise in accordance with the CNOSSOS-EU:2015 '*Common Noise Assessment Methods for Europe*' (CNOSSOS-EU). Details of the model inputs, assumptions are provided in **Appendix A2**. Where assumptions have been made, a realistic worst-case approach has been adopted.

3.7 Due to the low traffic flows that have arisen as a result of the scheme, noise modelling using the UK's current national road traffic noise calculation method, the '*Calculation of Road Traffic Noise*' (CRTN, 1988) has been avoided as this would lead to major uncertainties. This methodology is not designed to address such circumstances and was originally conceived to identify locations eligible

for noise insulation under the Noise Insulation Regulations 1975. The main issue with using CRTN in the context of this scheme is that the calculation methodology is limited to modelling above a minimum traffic flow. As such, where the Scheme has led to road closures, CRTN will result in unreliable comparisons.

3.8 NCL's approach has therefore been to base the study on modelling using the road traffic noise calculation method described within CNOSSOS-EU. This method is to be adopted by Defra for all strategic noise mapping in England from 2021. It has specific provisions the noise produced by different vehicle types, including buses, and is designed to address low traffic speeds and flows, as is the case with the Low Traffic Neighbourhood.

3.9 The Design Manual for Roads and Bridges: Sustainability & Environment Appraisal LA 111 Noise and vibration (LA 111) (2020). Provides guidance on undertaking noise and vibration assessments on the impact of road projects. This includes assessing changes in traffic on existing roads, where it outlines the magnitude of impact in the short term and long term.

Traffic Data and Road Noise Emissions Calculations

3.10 Traffic data for the assessment have been informed by 40 traffic counts commissioned by LB Enfield, at the locations shown in **Figure 2.**

3.11 The noise model has been developed to maintain a consistent approach with that used as part of the air quality assessment. This has been to prepare the data so to make it representative of annual average conditions. Traffic data for each of the 40 traffic counts have, therefore, been provided by NRP Ltd as AADT flows, the format required for input into the noise model, for the 'with' and 'without' scheme scenarios.

3.12 The 'without scheme' scenario has been based on traffic data obtained in March 2019 with the 'with scheme' scenario based on traffic data collected in September 2021.

3.13 The collected traffic data have been annualised, a process which addresses the seasonal variations in traffic, and how this could have impacted the recorded number of vehicles over the two seven-day traffic counts undertaken by the LB Enfield. In this instance, the traffic flows in September 2021 would also have been affected by residual impacts of the Covid-19 restrictions on travel activities.

3.14 To account for reductions in traffic flows as a result of Covid-19, NRP Ltd uplifted the Automatic Traffic Count (ATC) data as follows:

- Data from January 2019 to October 2021 were provided for a TfL count site located away from the area which recorded continuous traffic data;
- The annualisation factors for the pre-implementation (11th – 17th March 2019 – internal roads) and (21st - 27th March 2019 – external roads) and post-implementation (21st – 24th September 2021) surveys were calculated using the specific days of the surveys and the

average of these dates for 2019 were compared to the yearly average for 2019 to derive an annualisation factor; and

- A factor of 0.8% (internal roads) and -0.4% (external roads) for 2019 (pre-scheme) and 0.004% for 2021 (post-scheme) was applied to the data for the Fox Lane AADTs.

3.15 This process has in effect meant that the 2021 'with scheme' scenario reflects traffic flows observed in 2019 but inclusive of the effects of the scheme.

3.16 The ATCs provide data every 15-minutes on the number of each vehicle type (e.g. cars, motorcycles, heavy duty vehicles) for each day of the week, as well as vehicle speeds. The measured distribution of traffic throughout the day ('diurnal profiles') on each specific road were then used within the dispersion model.

3.17 For the purposes of noise modelling, it has been necessary to generate diurnal traffic flows for each vehicle category as required by the CNOSSOS methodology. To achieve this, the following processing has taken place:

- The annualised 24-hour AADT traffic flows for each ATC have been scaled according to the 'diurnal profiles' at each site. This has involved computing the proportion of the traffic flow in the 24-hour period which occurred in the day, evening and night-time periods i.e. 0700-1900hrs; 1900-2300hrs; and 2300-0700hrs.
- Using detailed outputs from the ATC sites the vehicle composition in each of the periods has been estimated so to indicate the proportion of vehicles in each time period as they conform to the CNOSSOS class descriptions as per **Table 7**.

Table 7: CNOSSOS vehicle classification descriptions

Vehicle classes

Category	Name	Description		Vehicle category in EC Whole Vehicle Type Approval (1)
1	Light motor vehicles	Passenger cars, delivery vans ≤ 3,5 tons, SUVs (2), MPVs (3) including trailers and caravans		M1 and N1
2	Medium heavy vehicles	Medium heavy vehicles, delivery vans > 3,5 tons, buses, motorhomes, etc. with two axles and twin tyre mounting on rear axle		M2, M3 and N2, N3
3	Heavy vehicles	Heavy duty vehicles, touring cars, buses, with three or more axles		M2 and N2 with trailer, M3 and N3
4	Powered two-wheelers	4a	Two-, Three- and Four-wheel Mopeds	L1, L2, L6
		4b	Motorcycles with and without sidecars, Tricycles and Quadricycles	L3, L4, L5, L7
5	Open category	To be defined according to future needs		N/A

(1) Directive 2007/46/EC of the European Parliament and of the Council of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles (OJ L 263, 9.10.2007, p. 1).
(2) Sport Utility Vehicles.
(3) Multi-Purpose Vehicles.

3.18 Noise modelling is based on average speeds on each section of road. The ATC data provided the speed of each vehicle movement, which can be averaged to a speed appropriate to that point for modelling purposes. Average speeds pre- and post-scheme were calculated, and it was not possible to generate diurnal traffic speeds for each vehicle category as required by the CNOSSOS methodology. Therefore, the 24-hours average speeds pre- and post-scheme were used for each modelled road link.

Point of Interest-Receptors

3.19 Receptors have been identified which are considered to represent exposure to road traffic noise on roads and streets relevant to the scheme. These worst-case locations (these being 1 meter from the façades of the residential properties closest to affected road links).

3.20 When selecting receptors, particular attention has been paid to assessing impacts close to junctions, where traffic may become congested and where there is a combined effect of several road links, and alongside those roads where changes in traffic volumes are most significant.

3.21 These points of interest are shown in the **Figure 3**. More details figures showing the various recpetor IDs of each receptor and the road and/or street they are located on can be found in **Appendix A3.**

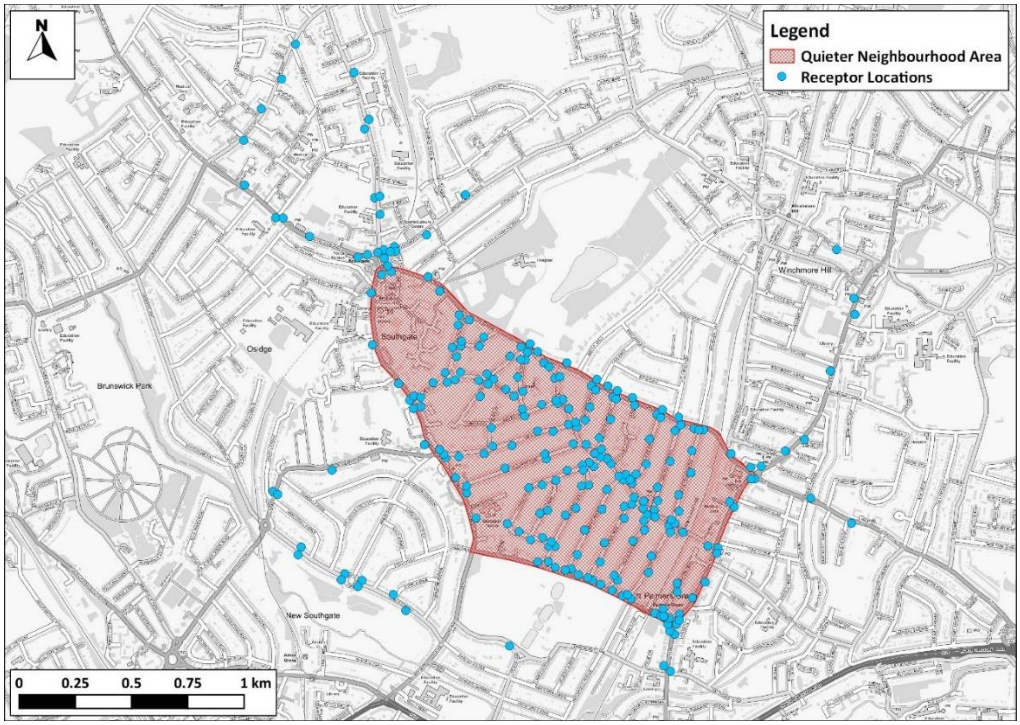

Figure 3: Points of interest

Uncertainty in Road Traffic Modelling Predictions

3.22 There are many components that contribute to the uncertainty of modelling results. The road traffic noise models used in this assessment are dependent upon the traffic data input, which will have inherent uncertainties. In particular, the annualization process to 2019 is based on traffic flows recorded prior to the Covid-19 pandemic, and thus 2019 AADT flows can be expected to be representative of 'typical' flows on modelled roads. The adjustment of 2021 flows to represent 2019-equivalent flows (pre- and post- implementation of the scheme) has, therefore, addressed, as far as possible, the uncertainties relating to the irregular traffic flows associated with the Covid-19 pandemic. This noise assessment, however, is primarily a relative study focused on the changes in noise levels associated with the scheme, which will not be significantly impacted by total traffic volumes. In this sense, the study is considering primarily the significance of changes in road traffic noise.

3.23 There are inherent uncertainties within the modelling, including the traffic data as primary input, and as such the results should not be considered exact, but represent the best possible estimates, using the best available data available at the time this report was undertaken.

Assessment Criteria

3.24 Due to the comparative nature of this study, assessment criteria which look at absolute noise levels are not relevant. This study will aim to present the results such as to indicate where differences in noise exposure levels are clearly noticeable on a perceptual basis.

3.25 The change in road noise level criteria used in this assessed are derived from methodologies advocated in LA 111 (2020) (as summarised in **Table 5)** and are presented in full in **Table 8**. A beneficial change has been deemed to occur where there is a reduction in road traffic noise, and an adverse change has been deemed to occur where there is an increase.

3.26 Due to the aforementioned uncertainties in the modelling inputs and the imperfections of comparing traffic flow at different points in time, it has been deemed that any changes within the range of $L_{Aeq,T}$ < ±3 dB could occur within a margin of error. This is in line with the research presented in **Table 6**. These minor changes may well be due to the scheme but may also be due to uncertainties within the processing and comparisons of the road traffic data.

3.27 This assessment has therefore only made firm conclusions regarding the influence of the scheme where modelling has indicated that a road has experienced a change of $L_{Aeq,T} \geq \pm 3$ dB. Such changes are described as a 'moderate' or 'major' change based on the DMRB guidance. Such changes may be considered 'significant' as highlighted in **Table 8** below.

Table 8: Change in Noise Level Assessment Criteria Derived from DMRB

Noise Change Category	Significant?	Road Traffic Noise
Major beneficial	Yes - Beneficial	≤ -5 dB $L_{Aeq,T}$
Moderate beneficial	Yes – Beneficial	-3 to -4.9 dB $L_{Aeq,T}$
Minor beneficial	No	-1 to -2.9 dB $L_{Aeq,T}$
Negligible	No	-1 to 1 dB $L_{Aeq,T}$
Minor adverse	No	1 to 2.9 dB $L_{Aeq,T}$
Moderate adverse	Yes – Adverse	3 to 4.9 dB $L_{Aeq,T}$
Major adverse	Yes - Adverse	> 5 dB $L_{Aeq,T}$

4 Scheme Impact Assessment

4.1 This section presents the changes in annualised daily noise exposure calculated as a result of the scheme. Detailed results of the noise modelling exercise are presented as noise exposure for receptors in **Appendix A3**, and a summary is presented and discussed below.

4.2 The calculated percentage changes in traffic flow are shown in **Figure 4**. The decreases in road traffic illustrated in **Figure 4** correlate with road closures, and the increases occur on roads where traffic has been reassigned to as a result of the scheme. Traffic flow changes detailed by period and vehicle category are provided in **Table A2.4** in **Appendix A2.**

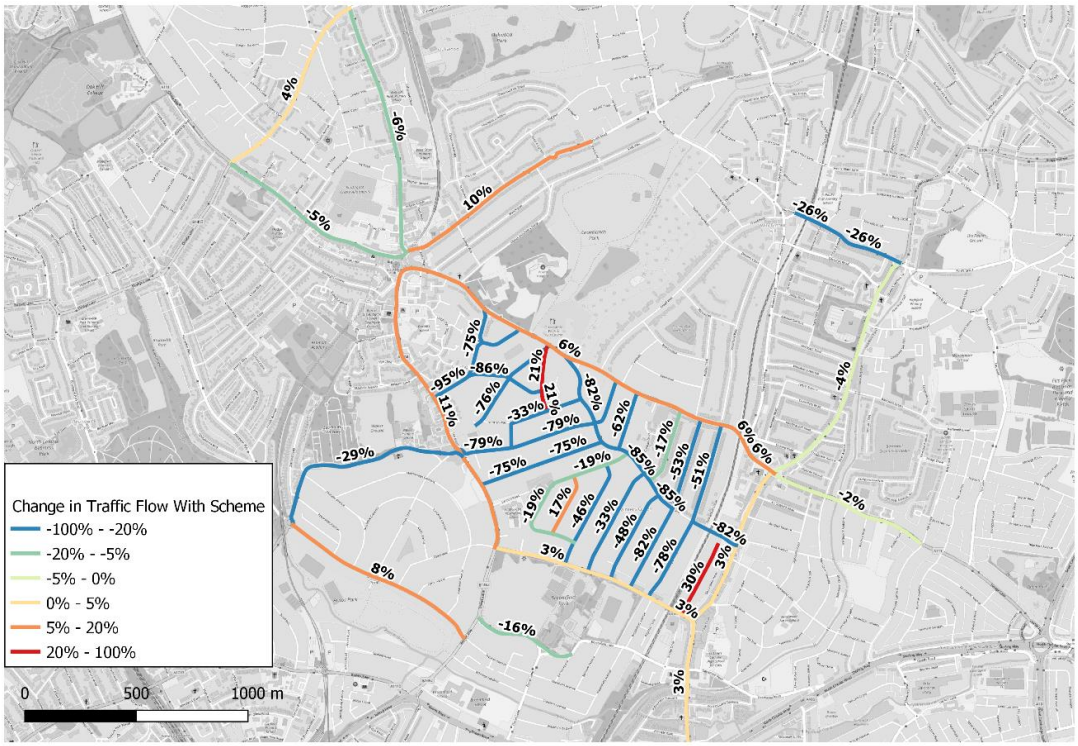

Figure 4: Percentage Change in Total Traffic Flows Resulting from the Scheme

Contains Ordnance Survey data © Crown copyright and database right 2021. Ordnance Survey licence number 100046099. ATC15, situated on Wolves Lane, to the east of the study area, is not included in the above figure, as there was insufficient data at this count.

4.3 **Table 9** and **Table 10** presents summaries of the range of noise exposure at receptors before and after scheme along with the general change in noise exposure in terms of $L_{Aeq,16hr}$, and $L_{night,8hr}$ representing daytime and night-time road traffic noise exposure respectively. Beneficial changes are represented by '**-**' and shaded green where these are considered 'significant beneficial' whilst adverse changes are represented by '**+**' and shaded red where these are considered 'significant adverse' followed by the criteria threshold in dB. The results are presented for the following indicators: $L_{Aeq,16hr}$, and $L_{night,8hr}$.

Table 9: Summary of Changes in Daytime Road Noise Exposure (in dB), $L_{Aeq,16hr}$

Road Name	ATC ID	Range of Noise Exposure for Receptors on Road before Scheme	Range of Noise Exposure for Receptors on Road after Scheme	General Change in Exposure at Receptors	Magnitude of Change
Surrounding Roads					
Avenue Road	14	61-62	62-63	<1	Negligible
Chase Road	15	61-65	61-65	0	Negligible
Chase Side	16	61-68	61-67	0	Negligible
Winchmore Hill Road	17	62-65	63-66	0	Negligible
The Bourne	28	63-67	63-67	-1	Negligible
High Street	29	58-67	57-67	-1	Negligible
Waterfall Road	30	62-64	59-61	-3	Moderate beneficial
Morton Way	31	59-60	59-60	0	Negligible
Powys Lane	37	64-64	63-63	-1	Negligible
Aldermans Hill	38	61-66	61-66	0	Negligible
G Lanes (South of Oakthorpe Road)	42	61-65	61-65	0	Negligible
G Lanes at Park Avenue	43	63-67	62-66	0	Negligible
G Lanes at River Avenue	44	60-65	60-65	0	Negligible
Hedge Lane	45	65-67	65-67	0	Negligible
Internal Roads					
Devonshire Road	3	53-60	55-60	+1	Minor Adverse
Amberley Road	4	57-63	50-62	-7	Major beneficial
Bourne Avenue	5	54-62	47-61	-5	Major beneficial
Burford Gardens	6	55-61	52-60	-2	Minor beneficial
Caversham Avenue	8	57-63	54-61	-3	Moderate beneficial
Conway Road	10	45-57	44-53	-3	Moderate beneficial
Cranley Gardens	11	54-61	53-60	-1	Negligible
Derwent Road	12	50-57	47-56	-2	Minor beneficial
Fox Lane	13,15	52-65	45-63	-7	Major beneficial
Greenway	17	48-61	42-60	-5	Major beneficial
Grovelands Road	19	54-56	46-51	-6	Major beneficial
Harlech Road	20	48-49	48-49	0	Negligible
Lakeside Road	21	53-57	48-52	-5	Major beneficial
Meadway	22,23	45-59	38-51	-8	Major beneficial
Oakfield Road	25	49-57	47-51	-4	Moderate beneficial
Old Park Road	26	58-61	50-59	-5	Major beneficial
Parkway	27	49-53	46-51	-2	Minor beneficial
Ridgeway	28	46-57	46-55	-1	Negligible
Selborne Road	30	54-60	49-58	-5	Major beneficial
St Georges Road	32	55-62	50-61	-3	Moderate beneficial
The Mall	34	57-64	51-62	-5	Major beneficial
Ulleswater Road	35	49-54	46-51	-3	Moderate beneficial

Table 10: Summary of Changes in Night-time Road Noise Exposure (in dB), $L_{night, 8hr}$

Road Name	ATC ID	Range of Noise Exposure for Receptors on Road before Scheme	Range of Noise Exposure for Receptors on Road after Scheme	General Change in Exposure at Receptors	Magnitude of Change
Surrounding Roads					
Avenue Road	14	52-53	52-53	0	Negligible
Chase Road	15	54-58	54-58	0	Negligible
Chase Side	16	55-62	55-62	0	Negligible
Winchmore Hill Road	17	54-58	55-58	0	Negligible
The Bourne	28	57-61	57-61	0	Negligible
High Street	29	48-58	48-58	0	Negligible
Waterfall Road	30	52-54	51-53	-1	Negligible
Morton Way	31	50-51	50-51	0	Negligible
Powys Lane	37	58-58	57-57	-1	Negligible
Aldermans Hill	38	55-60	55-60	0	Negligible
G Lanes (South of Oakthorpe Road)	42	57-60	57-60	0	Negligible
G Lanes at Park Avenue	43	56-61	56-61	0	Negligible
G Lanes at River Avenue	44	54-59	54-59	0	Negligible
Hedge Lane	45	60-61	60-61	0	Negligible
Internal Roads					
Devonshire Road	3	45-53	46-53	+1	Minor Adverse
Amberley Road	4	49-57	41-56	-5	Major beneficial
Bourne Avenue	5	43-55	38-55	-5	Major beneficial
Burford Gardens	6	47-54	43-54	-2	Minor beneficial
Caversham Avenue	8	48-55	45-54	-2	Minor beneficial
Conway Road	10	36-48	35-45	-2	Minor beneficial
Cranley Gardens	11	46-54	45-54	-1	Negligible
Derwent Road	12	42-50	41-50	-1	Negligible
Fox Lane	13,15	42-58	36-57	-7	Major beneficial
Greenway	17	38-54	32-54	-5	Major beneficial
Grovelands Road	19	44-46	37-43	-5	Major beneficial
Harlech Road	20	39-40	40-41	0	Negligible
Lakeside Road	21	43-47	40-43	-4	Moderate beneficial
Meadway	22,23	35-48	28-41	-7	Major beneficial
Oakfield Road	25	38-47	37-42	-4	Moderate beneficial
Old Park Road	26	48-53	42-52	-5	Major beneficial
Parkway	27	39-45	38-45	0	Negligible
Ridgeway	28	36-49	36-48	0	Negligible
Selborne Road	30	46-51	40-49	-5	Major beneficial
St Georges Road	32	46-55	42-55	-3	Moderate beneficial
The Mall	34	48-54	42-53	-5	Major beneficial
Ulleswater Road	35	39-44	38-42	-1	Negligible

4.4 **Table 9** and **Table 10** shows that for both daytime and night-time periods respectively, the effect of the scheme on road traffic noise on internal roads has been largely beneficial. Most of the internal roads have observed significant beneficial changes in road traffic noise. A minor adverse change in road traffic noise has been calculated for Devonshire Road. Although an adverse change, this change is not significant.

4.5 On the surrounding roads, the calculated changes in road traffic are broadly negligible. There are no significant changes in road traffic noise on the surrounding roads.

4.6 **Table A3.1** in **Appendix A3** shows the noise exposure levels for each receptor on each road for the 'with' and 'without' Scheme scenarios, rounded to the nearest dB. These results are presented for the $L_{Aeq,16hr}$, and L_{night} metrics.

4.7 **Figure 5** presents changes in road traffic noise exposure levels for daytime periods ($L_{Aeq,16hr}$). **Figure 5** demonstrates that the overall effect of the scheme on daytime road traffic noise has been largely beneficial given the numbers of roads and dwellings observing such changes. This is evidenced by the areas shown in **Figure 5** to be observing moderate and major beneficial changes, which are considered to represent significant improvements. A small location showing a minor adverse change in road traffic noise is visible on Devonshire Road.

Figure 5: Change in 16-hour Day Noise Levels Due to the Scheme.

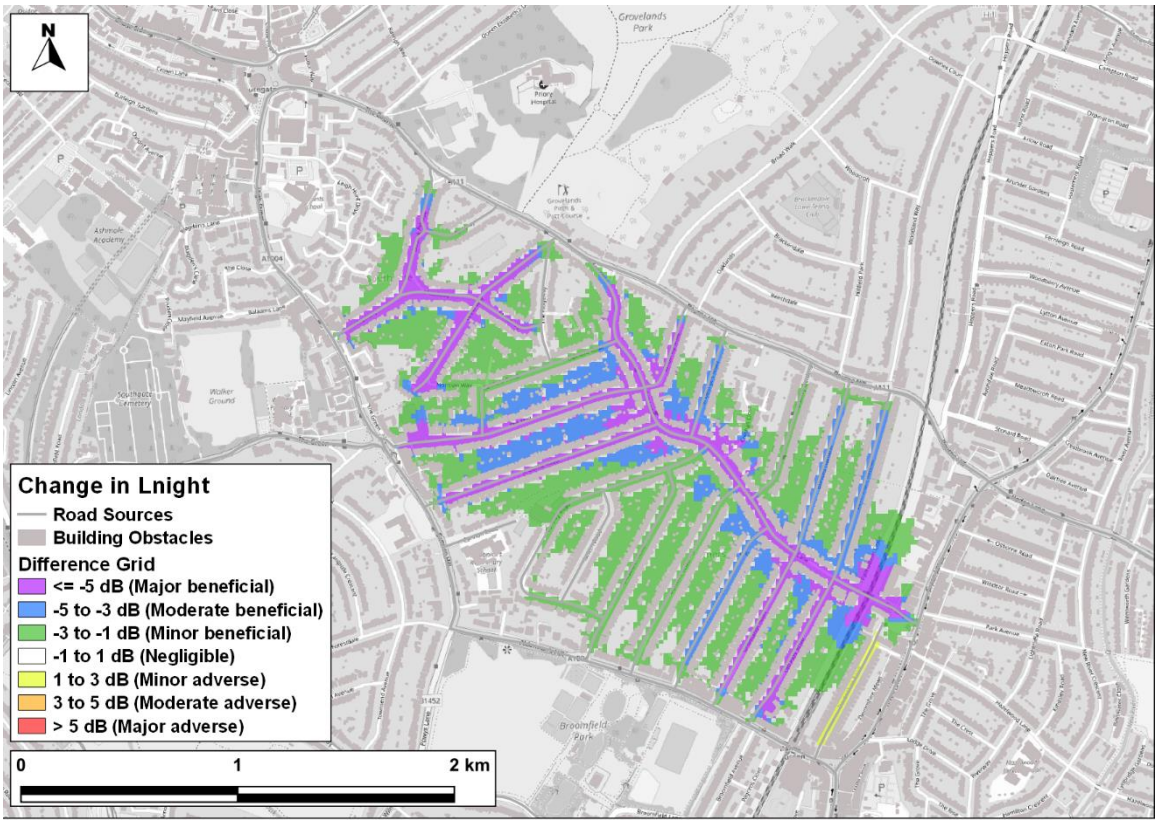

Figure 6: Change in Night-time Noise Levels Due to the Scheme.

4.8 **Figure 6** shows a similar trend with respect to changes in night-time road traffic noise. However, compared to daytime periods, there are fewer areas which experience moderate and major beneficial changes.

4.9 **Figure 7** and **Figure 8** show, as an example, noise level contours for the $L_{Aeq,16hr}$ indicator for the 'without' and 'with' Scheme scenarios respectively. These show clear reductions in road traffic noise on Fox Lane, and streets such as Caversham Avenue, Burford Gardens, St. George's Road and Amberley Road.

4.10 A full set of noise change and contour maps can be found in **Appendix A3**.

Figure 7: Absolute $L_{Aeq,16hr}$ Noise Grid (Without-Scheme Scenario).

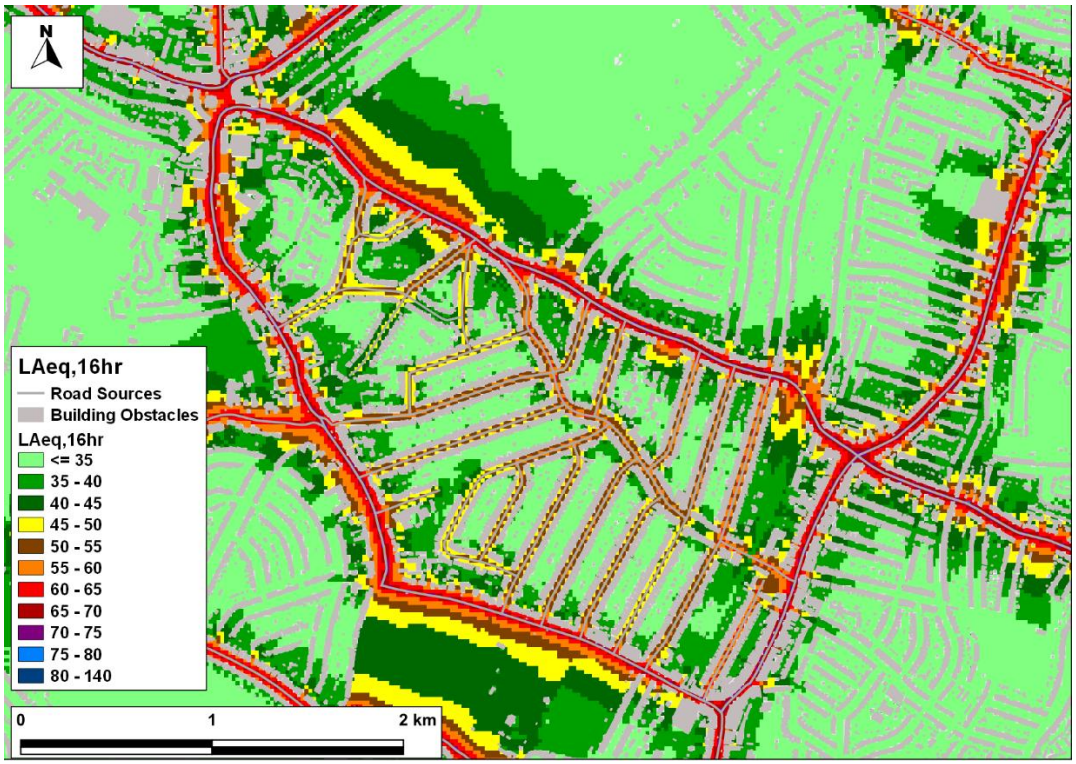

Figure 8: Absolute $L_{Aeq,16hr}$ Noise Grid (With-Scheme Scenario).

5 Summary and Conclusions

5.1 The assessment has considered the local noise impacts of the Quieter Neighbourhood Scheme at Fox Lane. Traffic flows were measured in March 2019 (prior to scheme implementation) and September 2021 (post-scheme implementation). This traffic data has been used as the basis of 'without' and 'with' scheme scenarios.

5.2 This data has been used to estimate changes in road traffic attributable to the scheme. CNOSSOS-EU road noise modelling has then been undertaken using LimA® to estimate the effect that these changes in traffic would have had on local noise exposure levels on the internal and surrounding roads.

5.3 Changes in road traffic noise have been assigned a magnitude having regard for relevant guidance. Where moderate and major changes in road traffic noise are found to have occurred, these have been considered significant.

5.4 The assessment shows that the implementation of the Quieter Neighbourhood Scheme has led to broadly beneficial significant changes in road traffic noise exposure on internal roads and streets. On the surrounding road network, the assessment has identified largely negligible changes in road traffic noise despite the change in traffic arising from the scheme.

6 Glossary

AADF	Average Annual Daily Flows
A-weighting	Frequency weighting applied to measured sound in order to account for the relative loudness perceived by the human ear.
CNOSSOS-EU	Common Noise Assessment Methods in Europe
CRTN	Calculation of Road Traffic Noise
dB	Decibel. The logarithmically scaled measurement unit of sound.
Defra	UK Government Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges
$L_{Aeq,T}$	A-weighted equivalent continuous sound level over a given time period. It is the sound level of a steady sound that has the same energy as a fluctuating sound over the same time period.
L_{day}	A-weighted equivalent continuous sound level over a 12-hour daytime period.
L_{eve}	A-weighted equivalent continuous sound level over a 4-hour evening period.
L_{night}	A-weighted equivalent continuous sound level over an 8-hour night-time period.
NCL	Noise Consultants Limited
TfL	Transport for London

Appendices

A1 Professional Experience

[redacted], BSc (Hons) MIOA MIEnvSc

[redacted] is the Managing Director at NCL. He holds a First-Class Bachelor of Science degree in Acoustics from Salford University and is a Full Corporate Member of the Institute of Acoustics and a Member of the Institution of Environmental Sciences. He has over 17 years' experience working exclusively in the field of environmental noise delivering high profile projects in both the public and private sector. His experience includes technical leadership roles, policy and research work, and delivery of strategic noise mapping and action planning projects and major EIA. He has been involved in noise mapping projects since 2003 and contributed to some of the earliest UK feasibility studies for the deliver of Directive 2002/49/EC. He has developed techniques, coding solutions, QA procedures and systems to allow the scalability of noise calculations.

[redacted] MSc

[redacted] is a Consultant with NCL, having joined the company in September 2021. Prior to joining, he completed an MSc degree in Environmental and Architectural Acoustic Engineering from Polytechnic University of Madrid, Spain. Prior to joining NCL she worked for more than 3 years at Ineco, SA. She is experienced in airport noise assessment and consultancy work for Strategic Noise Mapping, Action Plans and Airspace Change, and has also supported aircraft noise modelling and GIS modelling and air quality assessment.

A2 Modelling Methodology

Model Inputs

A2.1 The model has been developed using the LimA® computational sound modelling software (v2021). A model employing the CNOSSOS-EU methodology requires the user to provide various input data, including noise source definitions for traffic along each section of road along with the characteristics of the road section. This includes the AADF for each vehicle category, average daily speeds for each vehicle category, direction of traffic, road surface type, road classification (urban, highway or speedway), the width of the road, and the slope of the road in the direction of traffic.

A2.2 The model also considers terrain and building obstacles. Terrain data was obtained from the UK Environment Agency's LiDAR Composite Digital Terrain Model (DTM) 2019 and LiDAR Composite Digital Surface Model (DSM) 2017 datasets (public sector information licenced under the Open Government Licence v3.0), whilst building shapes were obtained from the Ordnance Survey (OS) MasterMap Topography layer. Building heights were obtained by intersecting the difference between the DSM and DTM with the building heights.

A2.3 Constant model input parameters are summarised in **Table A2.1**and other dynamic parameters are discussed below.

Table A2.1: Summary of Model Inputs and Assumptions

Model Parameter	Value Used
Terrain Effects Modelled	Yes
Building Obstacles Modelled	Yes
Road Surface Type	Porous asphalt
Road Gradient	0 %
Road Classification	All Urban Roads
Direction of Traffic	All the sources are defined as bi-directional
Ground Absorption Coefficient	0.5 (Mixed ground)
Receptor Grid Height	1.5 m
Receptor Grid Resolution	10 m

Traffic Data

A2.4 Traffic counts in March 2019 (prior to scheme implementation) and September 2021 (post-scheme implementation) were commissioned by LB Enfield. The raw traffic data was processed into an appropriate format for air quality and noise modelling through adjustments to represent an AADT flow by NRP Ltd (as described in Section 3 of the main report).

Traffic Speeds

A2.5 Noise modelling is based on average speeds on each section of road. The ATC data provided the speed of each vehicle movement, which can be averaged to a speed appropriate to that point for modelling purposes. Average speeds pre- and post-scheme were calculated, and it was not possible to generate traffic speeds for each vehicle category and each evaluation period, as required by the CNOSSOS methodology. Therefore, the 24-hours average speeds pre- and post-scheme were used for each modelled road link.

A2.6 Details of the average speeds used in the model are provided in **Figure A2.1** and **Figure A2.2.**

Vehicle Classifications

A2.7 The noise emissions calculated within the model are determined by vehicle type, according to the five vehicle categories defined in the CNOSSOS-EU methodology. The ATC data provides a breakdown of movements in terms of the fifteen classifications shown in **Table A2.2**. Prior to modelling, these classifications were converted to the CNOSSOS-EU categories according to the assumptions given in **Table A2.2**. Any bicycle movements were excluded from the model as they do not have any associated noise emissions.

Table A2.2: Conversion of Measured Vehicle Classifications to CNOSSOS Categories

<table>
<tr><th colspan="4">Vehicle Classifications from ATC Survey</th><th colspan="2">Adopted CNOSSOS-EU Categories</th></tr>
<tr><th>Class</th><th>Code</th><th colspan="2">Description</th><th>Category</th><th>Description</th></tr>
<tr><td>1</td><td>SV</td><td colspan="2">Short - car, light van</td><td rowspan="2">1</td><td rowspan="2">Light vehicles: Passenger cars, delivery vans ≤ 3,5 tons, including trailers and caravans</td></tr>
<tr><td>2</td><td>SVT</td><td colspan="2">Short towing – trailer, caravan, boat etc</td></tr>
<tr><td>3</td><td>TB2</td><td colspan="2">Two axle truck or bus</td><td>2</td><td>Medium heavy vehicles: delivery vans > 3.5 tons, buses, etc. with two axles</td></tr>
<tr><td>4</td><td>TB3</td><td colspan="2">Three axle truck or bus</td><td rowspan="11">3</td><td rowspan="11">Heavy duty vehicles, touring cars, buses, with three or more axles</td></tr>
<tr><td>5</td><td>T4</td><td colspan="2">Four axle truck</td></tr>
<tr><td>6</td><td>ART3</td><td>Three axle</td><td rowspan="4">articulated vehicle or rigid vehicle & trailer</td></tr>
<tr><td>7</td><td>ART4</td><td>Four axle</td></tr>
<tr><td>8</td><td>ART5</td><td>Five axle</td></tr>
<tr><td>9</td><td>ART6</td><td>Six+ axle</td></tr>
<tr><td>10</td><td>BD</td><td colspan="2">B-double or heavy truck and trailer</td></tr>
<tr><td>11</td><td>DRT</td><td colspan="2">Double road train / heavy tuck & two trailers</td></tr>
<tr><td>12</td><td>TRT</td><td colspan="2">Triple road train / heavy truck & 3+ trailers</td></tr>
<tr><td>14</td><td>M/C</td><td colspan="2">Motorcycle</td><td>4b</td><td>Motorcycles, tricycles and quadricycles</td></tr>
</table>

15	CYCLE	Cycle	**Ignore**

A2.8 Traffic data for all pre-scheme implementation internal roads does not consider vehicle classification. Therefore, proportions of each vehicle category for the internal roads have been estimated by data taken from the traffic data of each vehicle category for post-scheme implementation internal roads.

Missing Data

A2.9 Several ATCs included periods of missing data. This is not unusual and could be due to cars parked on the device's tube for long periods of time. Where possible, assumptions have been made in order to account for these missing data. Otherwise, these sources of the model have been omitted.

A2.10 Where data were identified as missing periods, these were 'patched' based on an average profile generated from profiles with full data capture. Separate average profiles were generated to patch internal residential roads and external key distributor roads, and for each assessment scenario (pre and post implementation). Once the missing data had been patched, the profiles were re-standardised to one for consistency with complete diurnal profiles.

A2.11 There were no external roads with missing data. A list of ATCs for the internal roads with missing data are provided in **Table A2.3**; in most cases several hours were missing, rather than complete days.

Table A2.3: Summary of Missing ATC Data

Scenario	Internal Roads
Pre-Implementation	Site 3, on Thursday and Friday Site 6, on Tuesday Site 8, Thursday through to Sunday Site 9, Monday through to Wednesday Site 10, Monday through to Thursday Site 15, Tuesday to Thursday Site 18, Thursday Site 21, Wednesday, Thursday and Sunday Site 23, Wednesday to Thursday Site 26, Monday, Thursday and Friday Site 31, Tuesday to Wednesday and Friday to Saturday Site 34, Tuesday and Sunday
Post Implementation	Site 3, on Saturday Site 11, Tuesday, Wednesday and Saturday Site 19, on Tuesday Site 26, on several days Site 32, on Thursday Site 35, on Wednesday

Road Lines and Widths

A2.12 A network of roads in and around the consultation area were selected according to proximity to the ATC and reasonable representation by the measured traffic flows. For the roads of interest, road widths were obtained from the OS MasterMap Highways Network dataset. The road lines were then converted to acoustic line sources and attributed with the relevant road and traffic data as discussed in the sections above.

Data Summary

A2.13 The percentage change in traffic flows at each ATC, based on the annualised values used in this assessment, are summarised in **Table A2.4** by time of day and vehicle category.

Table A2.4: Percentage Change of Annualised Traffic Flows with Scheme Implemented

	Percentage Change in Traffic Flow by Period and CNOSSOS-EU Vehicle Category														
	Day (07:00-19:00)					Evening (19:00-23:00)					Night (23:00-07:00)				
Cat	**1**	**2**	**3**	**4A**	**4B**	**1**	**2**	**3**	**4A**	**4B**	**1**	**2**	**3**	**4A**	**4B**
3	30%	32%	-100%	100%	29%	30%	31%	-100%	50%	31%	30%	20%	-100%	-100%	50%
4	-83%	-84%	-75%	-86%	-84%	-83%	-84%	-80%	-89%	-83%	-83%	-85%	-100%	-100%	-82%
5	-75%	-74%	-100%	-100%	-75%	-75%	-72%	-100%	-100%	-73%	-75%	-67%	-100%	-100%	-80%
6	-53%	-53%	-100%	-100%	-50%	-53%	-53%	-100%	0%	-50%	-52%	-55%	-100%	-100%	-50%
7	0%	0%	-100%	-100%	0%	0%	0%	-100%	-100%	0%	0%	0%	-100%	-100%	-100%
8	-51%	-51%	-100%	0%	-52%	-51%	-51%	-100%	-50%	-51%	-51%	-53%	-100%	-100%	-50%
9	-19%	-18%	-100%	0%	-19%	-19%	-20%	-100%	0%	-20%	-19%	-20%	-100%	-100%	-100%
10	-18%	-18%	-100%	-100%	-17%	-18%	-20%	-100%	-100%	-14%	-18%	-25%	-100%	-100%	-100%
11	-17%	-17%	-100%	-100%	-20%	-17%	-17%	-100%	0%	-17%	-17%	-18%	-100%	-100%	-50%
12	-33%	-33%	-100%	0%	-33%	-33%	-31%	-100%	0%	-30%	-33%	-33%	-100%	-100%	0%
13	-82%	-82%	-75%	-80%	-82%	-82%	-82%	-100%	-82%	-82%	-82%	-82%	-100%	-100%	-82%
14	-82%	-82%	-80%	-80%	-82%	-82%	-82%	-100%	-83%	-82%	-82%	-82%	-100%	-100%	-83%
15	-85%	-85%	-100%	-80%	-85%	-85%	-86%	-100%	-85%	-85%	-85%	-85%	-100%	-100%	-88%

16	-85%	-85%	-100%	-83%	-85%	-85%	-86%	-100%	-88%	-85%	-85%	-86%	-100%	-100%	-90%
17	-76%	-77%	-100%	-67%	-78%	-76%	-75%	-100%	-100%	-76%	-77%	-80%	-100%	-100%	-100%
18	-76%	-77%	-100%	-100%	-71%	-76%	-75%	-100%	-100%	-80%	-75%	-100%	-100%	-100%	-100%
19	-82%	-81%	-100%	-100%	-83%	-82%	-81%	-100%	-67%	-81%	-81%	-83%	-100%	-100%	-75%
20	17%	19%	-100%	-100%	33%	18%	20%	-100%	-100%	17%	19%	0%	-100%	-100%	-100%
21	-48%	-47%	-100%	0%	-47%	-48%	-50%	-100%	-50%	-48%	-48%	-50%	-100%	-100%	-50%
22	-95%	-95%	-100%	-100%	-95%	-95%	-95%	-100%	-100%	-95%	-95%	-94%	-100%	-100%	-96%
23	-86%	-86%	-100%	-100%	-86%	-86%	-86%	-100%	-100%	-85%	-86%	-83%	-100%	-100%	-100%
24	-86%	-83%	-100%	-100%	-75%	-85%	-100%	-100%	-100%	-75%	-89%	-100%	-100%	-100%	-100%
25	-33%	-32%	-100%	-100%	-29%	-34%	-40%	-100%	0%	-38%	-32%	0%	-100%	-100%	-100%
26	-78%	-78%	-67%	-80%	-78%	-78%	-78%	-100%	-82%	-78%	-78%	-77%	-100%	-100%	-77%
27	-46%	-48%	-100%	-100%	-33%	-46%	-43%	-100%	-100%	-40%	-50%	0%	-100%	-100%	-100%
28	21%	23%	-100%	-100%	25%	22%	50%	-100%	-100%	20%	20%	0%	-100%	-100%	-100%
29	21%	25%	-100%	-100%	0%	22%	0%	-100%	-100%	25%	21%	0%	-100%	-100%	-100%
30	-75%	-75%	-100%	-67%	-74%	-75%	-74%	-100%	-67%	-74%	-75%	-73%	-100%	-100%	-67%
31	-75%	-75%	-100%	-50%	-74%	-75%	-72%	-100%	-50%	-74%	-75%	-73%	-100%	-100%	-67%
32	-62%	-62%	-100%	-100%	-58%	-62%	-60%	-100%	-50%	-61%	-62%	-64%	-100%	-100%	-100%
33	-79%	-79%	-80%	-80%	-79%	-79%	-78%	-100%	-78%	-79%	-79%	-78%	-100%	-100%	-79%
34	-79%	-79%	-80%	-80%	-78%	-79%	-79%	-100%	-78%	-79%	-79%	-78%	-100%	-100%	-79%
35	-46%	-46%	-100%	-100%	-46%	-46%	-45%	-100%	0%	-47%	-45%	-33%	-100%	-100%	-100%
14	4%	4%	0%	0%	4%	4%	4%	0%	0%	3%	4%	2%	0%	-100%	0%
15	-6%	-6%	0%	-17%	-7%	-6%	-6%	0%	-11%	-6%	-6%	-6%	0%	0%	-7%
16	-5%	-5%	-5%	0%	-5%	-5%	-5%	-6%	-5%	-5%	-5%	-5%	0%	0%	-6%
17	10%	10%	8%	0%	10%	10%	10%	17%	9%	10%	10%	10%	-100%	0%	10%
27	-26%	-26%	-25%	-20%	-27%	-26%	-26%	-50%	-25%	-26%	-26%	-27%	-100%	-100%	-20%
28	6%	6%	9%	0%	6%	6%	6%	0%	9%	6%	6%	6%	0%	0%	8%
29	11%	11%	18%	0%	10%	11%	11%	0%	17%	11%	11%	11%	0%	0%	8%

30	-29%	-29%	-27%	-20%	-29%	-29%	-29%	0%	-29%	-29%	-29%	-29%	0%	-100%	-33%
31	8%	8%	0%	0%	7%	8%	7%	0%	50%	9%	8%	10%	-100%	-100%	14%
37	-16%	-16%	-13%	-11%	-16%	-16%	-16%	-15%	-10%	-16%	-16%	-16%	0%	0%	-17%
38	3%	3%	5%	0%	4%	3%	3%	0%	0%	3%	3%	3%	0%	0%	4%
42	3%	3%	2%	0%	3%	3%	3%	3%	0%	3%	3%	3%	0%	0%	4%
43	3%	3%	3%	0%	3%	3%	4%	5%	6%	4%	3%	3%	0%	0%	3%
44	-4%	-4%	-4%	0%	-4%	-4%	-4%	0%	-8%	-3%	-4%	-4%	0%	0%	-4%
45	-2%	-2%	-3%	0%	-2%	-2%	-2%	-13%	0%	-2%	-2%	-2%	0%	0%	0%

A2.14 **Figure A2.1** and **Figure A2.2** show the road network included within the model, both pre-and post-implementation of the scheme. **Figure A2.1** shows the average pre-implementation speeds at which each link was modelled, whereas **Figure A2.2** shows the average post-implementation speeds for each modelled road link.

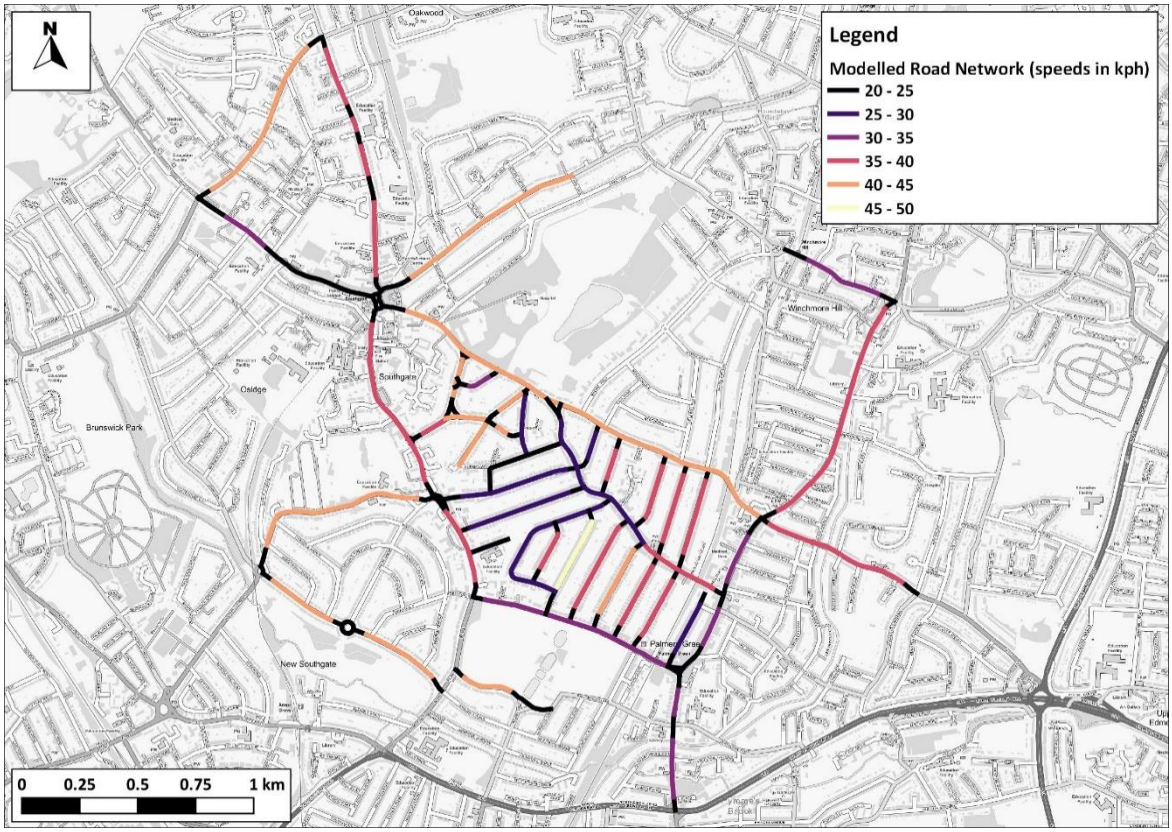

Figure A2.1: Modelled Road Network & Speeds (kph) – Pre-implementation of Scheme

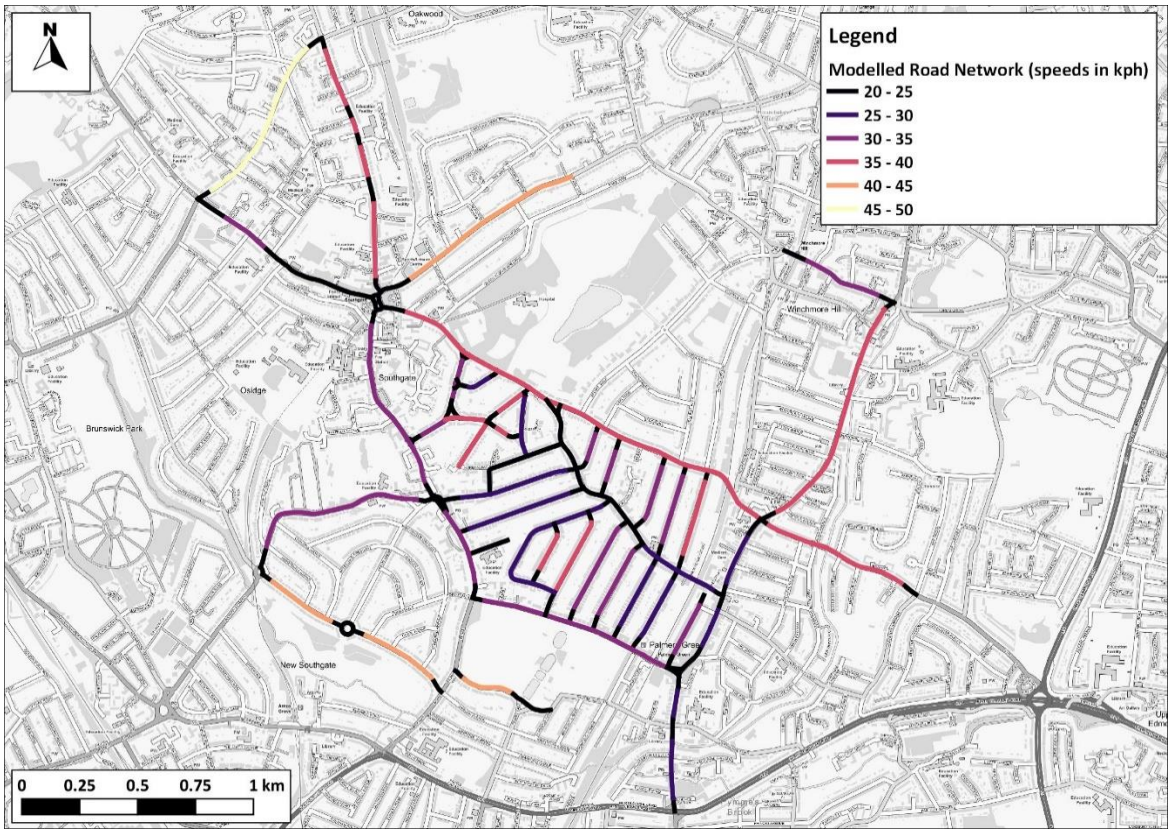

Figure A2.2: Modelled Road Network & Speeds (kph) – Post-implementation of Scheme

Post-processing

A2.15 CNOSSOS-EU models were calculated in LimA® for the 'March Base' and 'September with Scheme' scenarios for each of the L_{day}, L_{eve} and L_{night} indicators. The model predicts the $L_{Aeq,T}$ in decibels (dB) at each square within the receptor grid. Once calculated, the L_{day} and L_{eve} results were combined to derive the $L_{Aeq,16hr}$ grids. The absolute differences were then calculated by subtracting the 'March Base' scenarios from the 'September with Scheme' scenarios, the results of which are presented in **Appendix A3**.

A3 Modelling Results

A3.1 **Figure A3.1, Figure A3.2, Figure A3.3** and **Figure A3.4** show the receptor locations and included within the model along with their ID numbers as per **Table A3.1**

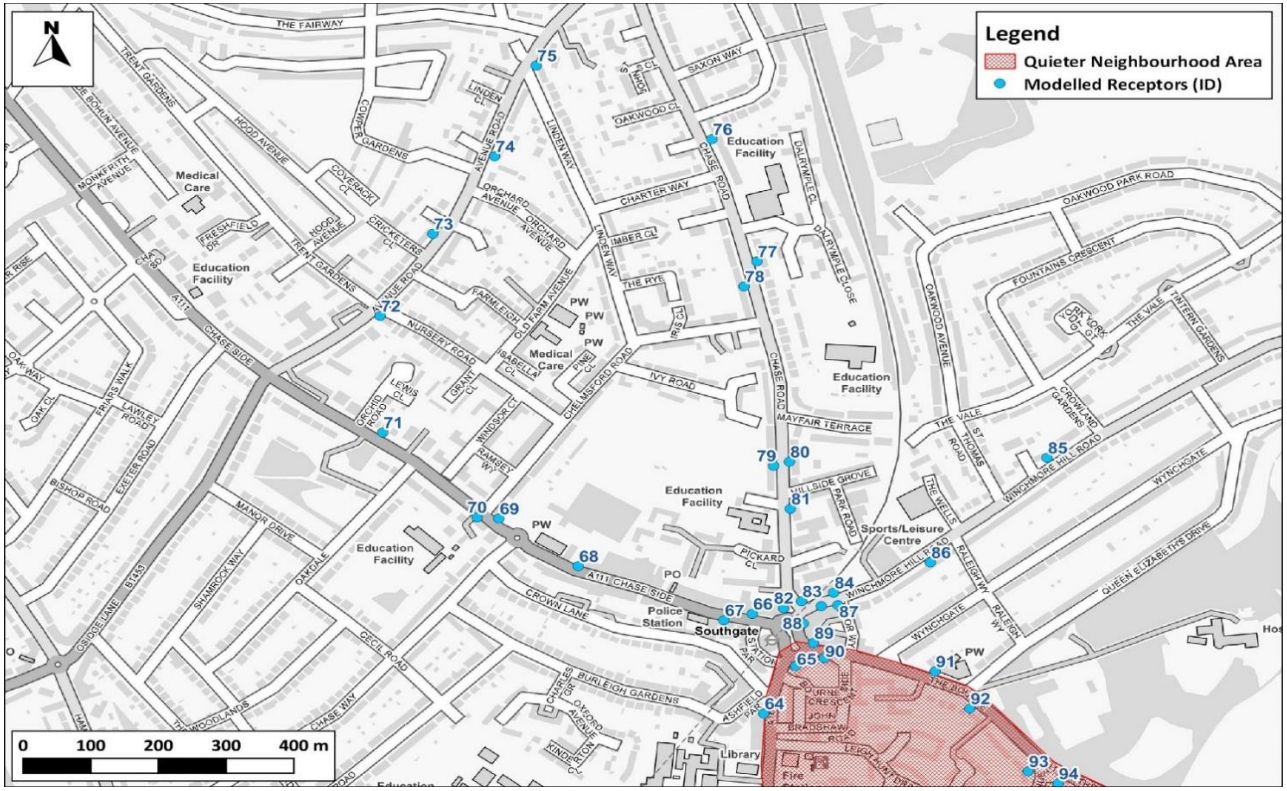

Figure A3.1: Modelled Receptors – North West

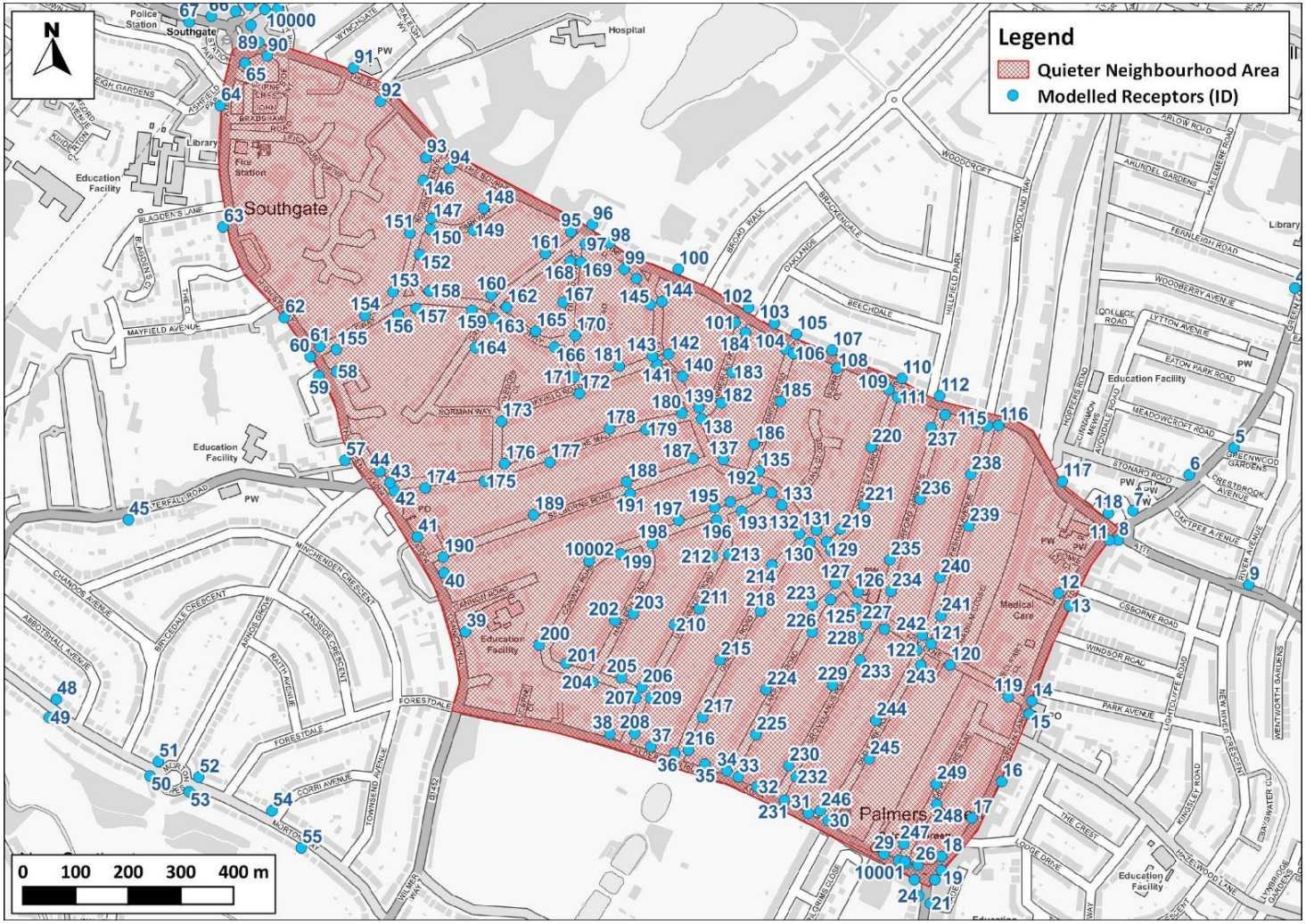

Figure A3.2: Modelled Receptors - Central

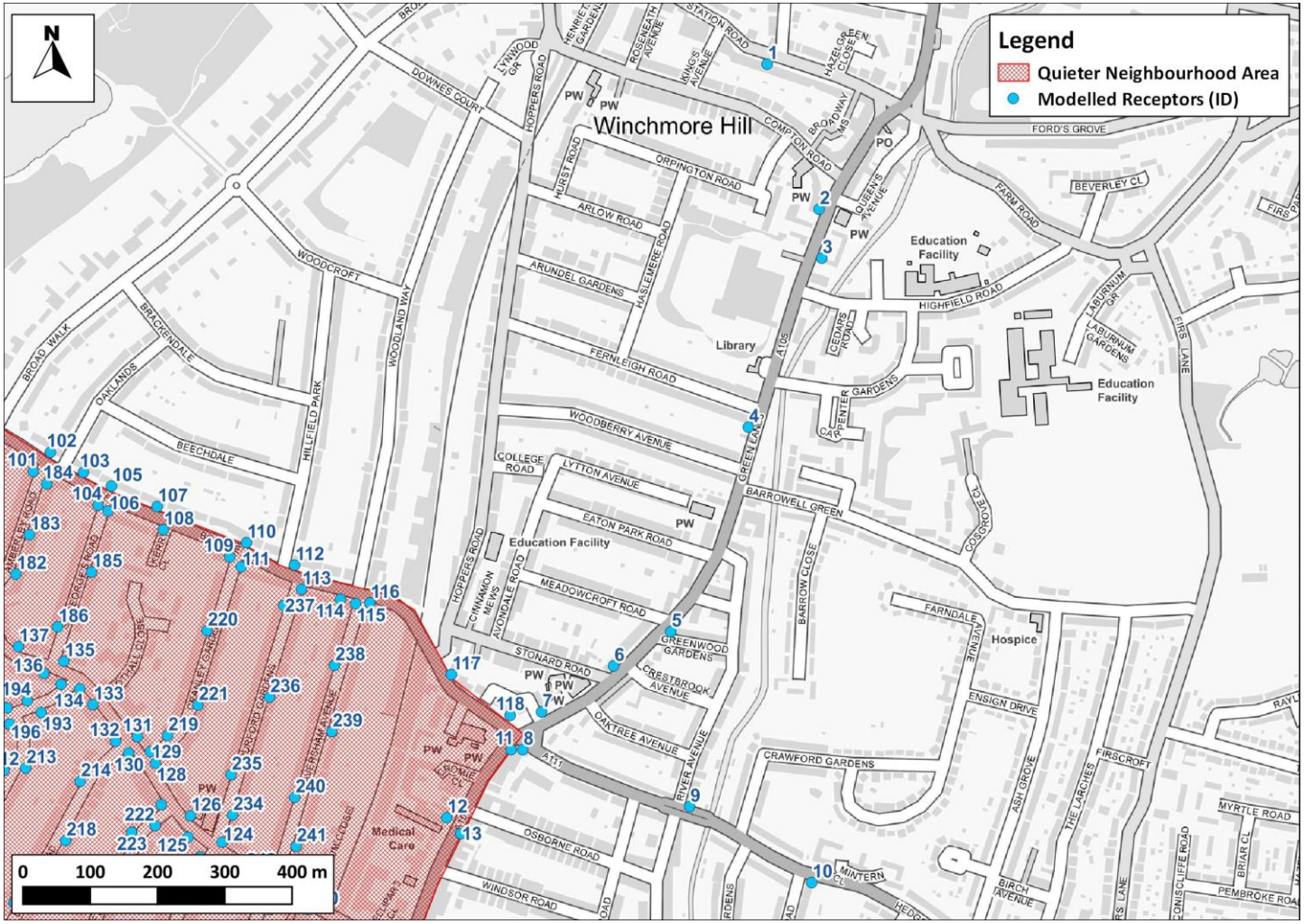

Figure A3.3: Modelled Receptors – North East

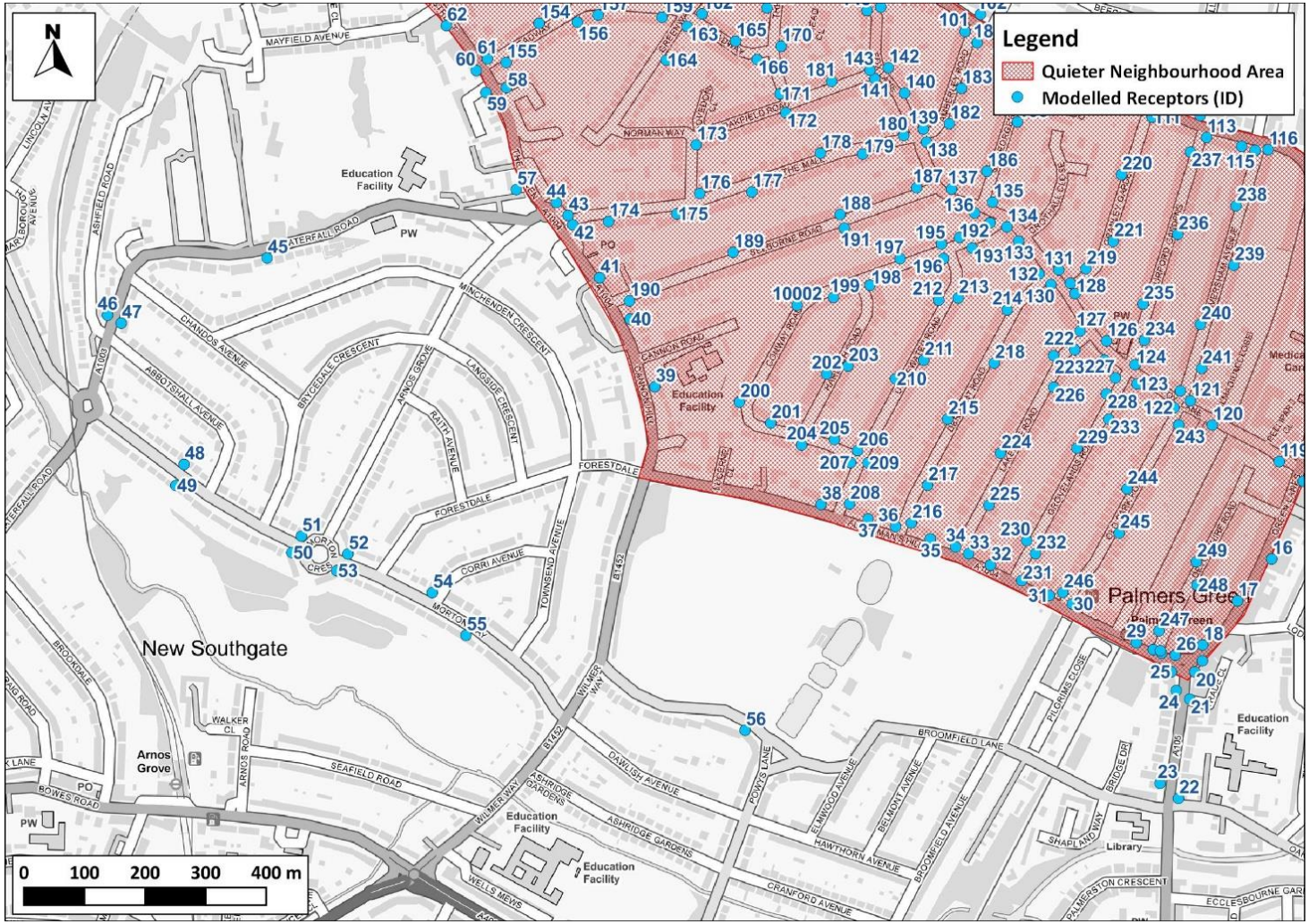

Figure A3.4: Modelled Receptors – South

Table A3.1: Absolute Noise Levels Before and With the Scheme for each receptor on each Road dB $L_{Aeq,T}$

Road Name	Receptor ID	Noise Exposure for Receptors on Road before Scheme				Noise Exposure for Receptors on Road after Scheme			
		L_{day}	L_{eve}	L_{night}	$L_{Aeq,16hr}$	L_{day}	L_{eve}	L_{night}	$L_{Aeq,16hr}$
Aldermans Hill	25	64	65	58	64	64	64	59	64
	26	63	63	57	63	63	63	57	63
	27	65	64	58	64	65	64	58	64
	29	66	66	60	66	66	66	60	66
	31	65	64	58	65	65	64	58	65
	32	65	64	58	65	65	64	58	64
	33	64	63	57	63	63	63	57	63
	34	62	62	55	62	62	61	55	62
	35	62	61	55	61	62	61	55	61
	37	62	61	55	61	61	61	55	61
	38	61	61	55	61	61	61	55	61
	231	65	64	58	65	65	64	58	64
Amberley Road	101	64	63	57	63	62	62	56	62
	182	57	57	49	57	50	50	41	50
	183	59	58	50	58	52	51	43	51
	184	63	62	56	62	61	61	55	61
Avenue Road	72	63	61	53	62	63	62	53	63
	73	63	62	53	62	63	62	53	63
	74	62	61	52	61	63	61	52	62
	75	62	60	52	61	62	61	52	62
Bourne Avenue	93	62	62	55	62	61	61	55	61
	94	62	61	55	61	61	61	55	61
	146	57	56	48	57	53	53	47	53

	147	57	56	45	57	51	49	40	50
	151	55	53	43	54	48	46	38	47
	152	56	54	43	55	49	47	38	48
	153	57	55	45	56	49	47	38	48
Burford Gardens	113	62	61	54	61	60	60	54	60
	124	59	58	49	58	54	53	45	53
	234	56	55	47	56	52	51	43	52
	235	56	54	47	55	53	51	44	52
	236	56	55	47	55	52	51	43	52
	237	57	56	49	56	55	54	48	54
Caversham Avenue	115	63	62	55	63	61	60	54	61
	121	60	59	51	60	55	54	46	54
	238	58	57	49	58	55	53	46	54
	239	58	56	49	57	54	53	45	54
	240	58	56	49	57	55	53	45	54
	241	58	56	48	57	54	53	45	54
	242	59	58	50	59	55	54	46	55
Chase Road	76	61	61	54	61	61	61	54	61
	77	62	61	54	61	61	61	54	61
	78	61	62	54	61	61	61	54	61
	79	62	62	55	62	62	62	55	62
	80	64	64	57	64	64	63	56	63
	81	64	63	56	63	63	63	56	63
	83	65	65	58	65	65	65	58	65
Chase Side	66	65	65	60	65	65	65	59	65
	67	68	68	62	68	67	68	62	67
	68	66	66	61	66	66	66	60	66
	69	66	66	60	66	65	65	60	65
	70	66	67	61	67	66	66	61	66

	71	63	63	58	63	63	63	58	63
	82	64	64	58	64	64	64	57	64
	88	61	61	55	61	61	61	55	61
Conway Road	192	58	56	48	57	54	52	45	53
	193	54	53	45	54	53	52	44	52
	194	54	53	45	53	53	51	44	52
	195	54	53	45	53	53	51	43	52
	196	55	54	45	55	53	52	44	53
	197	53	52	44	53	52	51	43	52
	198	53	52	44	53	53	51	43	52
	199	49	47	40	48	48	47	39	48
	200	49	47	40	48	48	46	39	47
	201	48	47	40	48	48	46	39	47
	204	48	47	40	48	48	47	39	47
	205	46	44	36	45	44	43	35	44
	10002	46	45	37	45	45	44	36	45
Cranley Gardens	109	61	61	54	61	61	60	54	60
	111	61	60	53	61	60	60	53	60
	129	59	57	49	58	55	53	46	54
	219	55	54	46	55	54	52	45	53
	220	55	54	46	54	54	52	45	53
	221	55	54	46	55	54	53	45	53
Derwent Road	36	57	57	50	57	56	56	50	56
	214	53	52	45	53	50	49	44	50
	215	53	52	45	53	50	49	43	50
	216	50	49	42	50	48	47	41	47
	217	53	52	45	52	50	49	43	50
	218	53	52	45	53	50	50	43	50
Devonshire Road	28	60	60	53	60	60	60	53	60

	247	54	55	47	54	55	56	48	56
	248	53	54	46	54	55	56	47	56
	249	52	54	45	53	54	56	46	55
	10001	59	59	52	59	59	60	52	60
Fox Lane	99	65	64	58	65	63	63	57	63
	119	62	61	54	62	58	58	52	58
	120	64	64	55	64	57	56	48	57
	123	52	51	42	52	45	44	36	45
	125	60	59	50	60	51	50	42	51
	126	60	59	50	60	51	50	42	51
	127	61	59	51	60	53	51	43	52
	128	61	60	51	61	54	52	44	53
	130	62	60	52	61	54	53	45	54
	131	61	60	52	61	54	52	44	53
	132	59	58	50	59	53	51	45	52
	133	61	59	51	60	53	51	43	52
	134	61	59	51	60	55	53	45	54
	135	60	59	51	60	53	52	43	52
	136	62	60	52	61	54	53	45	54
	137	60	59	51	60	53	52	44	52
	138	62	61	53	62	55	54	45	54
	139	62	61	52	61	54	53	45	54
	140	62	61	52	61	54	53	45	54
	142	60	59	51	60	53	52	43	52
	144	63	62	54	62	56	56	48	56
	145	62	61	53	62	56	56	49	56
	10003	64	63	56	64	61	61	55	61
Green Lanes at Park Avenue	11	66	66	60	66	66	66	61	66
	12	62	63	56	63	62	62	56	62

	13	65	65	59	65	64	64	59	64
	14	66	66	59	66	65	65	59	65
	15	65	65	59	65	64	64	59	64
	16	66	66	60	66	66	66	60	66
	17	65	66	59	65	65	65	59	65
	18	67	67	61	67	66	67	61	66
	19	65	65	59	65	65	65	59	65
	20	65	65	59	65	64	64	59	64
Green Lanes at River Avenue	1	64	63	58	64	63	63	57	63
	2	64	64	58	64	64	64	58	64
	3	63	63	57	63	63	62	57	63
	4	61	60	54	60	60	60	54	60
	5	65	65	59	65	65	65	59	65
	6	64	64	58	64	64	64	58	64
	7	63	63	57	63	63	63	57	63
Green Lanes (South of Oakthorpe Road)	**21**	65	65	60	65	65	65	60	65
	22	61	62	57	61	61	62	57	61
	23	61	62	57	62	61	62	57	62
	24	63	64	58	63	63	64	58	63
Greenway	95	61	61	54	61	60	60	54	60
	160	57	55	45	56	49	47	38	48
	161	56	55	46	56	51	49	41	50
	163	54	52	42	53	46	44	35	46
	164	49	47	38	48	43	41	32	42
Grovelands Road	227	56	55	45	56	49	47	39	48
	228	55	53	44	54	47	45	37	46
	229	55	54	44	54	47	46	37	46
	230	55	54	45	55	49	48	41	48
	232	56	55	46	55	51	50	43	51

	233	55	54	44	55	47	46	37	47
Harlech Road	202	49	48	40	49	50	48	41	49
	203	48	47	39	48	49	48	40	48
Hedge Lane	8	67	67	61	67	67	67	61	67
	9	66	65	61	66	66	65	61	66
	10	65	65	60	65	65	65	60	65
High Street	39	59	57	48	58	58	57	49	58
	40	63	62	53	63	63	62	53	62
	41	66	65	56	66	66	65	56	65
	57	59	58	49	58	58	56	48	57
	58	63	61	52	62	62	61	52	62
	59	65	64	55	64	65	63	55	64
	60	67	66	57	67	67	65	57	66
	61	65	64	55	65	64	63	54	63
	62	68	66	58	67	68	66	58	67
	63	64	63	53	63	64	62	54	63
	64	66	64	55	65	66	64	56	65
	65	65	64	55	64	64	64	56	64
Lakeside Road	222	57	56	47	57	52	51	43	52
	223	53	52	43	53	49	48	40	48
	224	53	52	44	53	49	48	41	49
	225	54	53	45	54	50	50	42	50
	226	54	53	44	53	50	49	41	49
Meadway	154	59	58	47	58	46	45	36	45
	155	59	59	48	59	51	50	41	51
	156	57	56	46	57	46	45	36	46
	157	57	55	44	56	47	45	36	46
	158	57	55	44	56	47	45	36	46
	159	58	55	45	57	48	46	37	47

	162	54	52	42	53	46	44	35	46
	165	46	44	35	45	39	37	28	38
	166	46	44	35	45	41	39	30	40
Morton Way	48	60	59	50	60	60	59	51	59
	49	60	58	50	59	59	58	50	59
	50	60	59	50	60	60	58	51	59
	51	61	59	51	60	61	59	51	60
	52	61	59	51	60	60	59	51	60
	53	60	58	50	59	60	58	51	59
	54	61	59	51	60	61	59	51	60
	55	61	59	51	60	61	59	51	60
Oakfield Road	141	57	56	47	57	52	50	42	51
	143	56	55	47	56	51	49	41	50
	172	50	47	38	49	49	46	37	47
	173	50	47	39	49	49	46	37	47
	176	54	53	44	53	49	47	39	48
	181	50	48	39	49	48	46	37	47
Old Park Road	30	61	60	53	61	59	58	52	58
	122	61	60	51	60	54	53	45	53
	243	58	57	48	58	51	50	42	51
	244	58	57	48	58	51	50	42	50
	245	58	57	48	58	51	50	42	50
	246	61	60	53	61	59	58	52	59
Parkway	148	52	52	45	52	51	51	45	51
	149	49	48	39	49	47	46	39	46
	150	54	52	42	53	49	47	38	48
Powys Lane	56	63	64	58	64	63	63	57	63
Ridgeway	97	57	57	49	57	55	55	48	55
	167	46	45	37	46	47	46	37	46

	168	55	54	47	55	53	52	46	53
	169	53	52	45	53	51	51	44	51
	170	46	45	36	46	47	45	36	46
	171	50	49	40	50	51	49	40	50
Selborne Road	187	58	56	48	57	51	50	42	51
	188	56	54	46	55	50	48	40	49
	189	55	53	46	54	49	47	40	49
	190	61	59	51	60	58	57	49	58
	191	56	55	47	56	50	49	41	50
St Georges Road	104	62	62	55	62	61	61	55	61
	106	61	61	54	61	60	59	54	60
	185	55	54	46	55	51	50	43	50
	186	56	55	47	55	51	50	42	50
The Bourne	89	65	64	58	64	64	64	58	64
	90	66	66	59	66	65	65	60	65
	91	64	64	58	64	64	63	58	63
	92	63	63	57	63	63	62	57	63
	96	65	65	59	65	65	64	59	64
	98	67	67	61	67	67	66	61	67
	100	64	64	58	64	64	63	58	63
	102	64	64	58	64	63	63	58	63
	103	64	64	58	64	64	63	58	64
	105	64	64	57	64	63	63	58	63
	107	64	64	58	64	64	63	58	64
	108	65	65	59	65	65	65	59	65
	110	65	64	58	65	64	64	58	64
	112	64	64	58	64	64	64	58	64
	114	65	65	58	65	64	64	59	64
	116	66	66	59	66	65	65	60	65

	117	66	66	60	66	66	65	60	65
	118	63	63	57	63	63	63	57	63
The Mall	42	62	61	52	61	58	57	49	57
	43	64	63	54	64	63	61	53	62
	44	64	63	54	63	63	62	53	62
	174	58	57	48	57	52	51	43	51
	175	58	58	49	58	52	51	43	51
	177	58	58	49	58	51	51	42	51
	178	58	57	49	58	51	51	42	51
	179	59	58	50	58	52	51	43	52
	180	61	60	52	60	54	53	45	53
Ulleswater Road	206	54	52	42	53	50	49	40	49
	207	54	53	44	54	52	50	42	51
	208	50	49	39	49	47	46	38	46
	209	53	52	42	53	50	48	40	49
	210	53	52	41	52	49	48	39	48
	211	53	52	42	53	49	48	39	49
	212	53	52	41	52	49	47	39	48
	213	53	52	41	53	49	48	39	49
Waterfall Road	45	62	61	52	62	60	58	51	59
	46	64	63	54	64	61	61	53	61
	47	63	61	53	62	60	59	51	59
Winchmore Hill Road	84	64	64	57	64	65	65	57	65
	85	62	62	54	62	63	62	55	63
	86	63	62	55	62	63	63	55	63
	87	65	64	57	64	65	64	57	65
	10000	66	65	58	65	66	65	58	66

A3.2 **Figure A3.5, Figure A3.6, Figure A3.7** and **Figure A3.8** show the noise change grid for an average $L_{Aeq,16hr}$, L_{day}, $L_{evening}$, and L_{night}

Figure A3.5: $L_{Aeq,16hr}$ Noise Grid Change Due to the Scheme.

Figure A3.6: L_{day} Noise Grid Change Due to the Scheme.

Figure A3.7: L_{eve} Noise Grid Change Due to the Scheme.

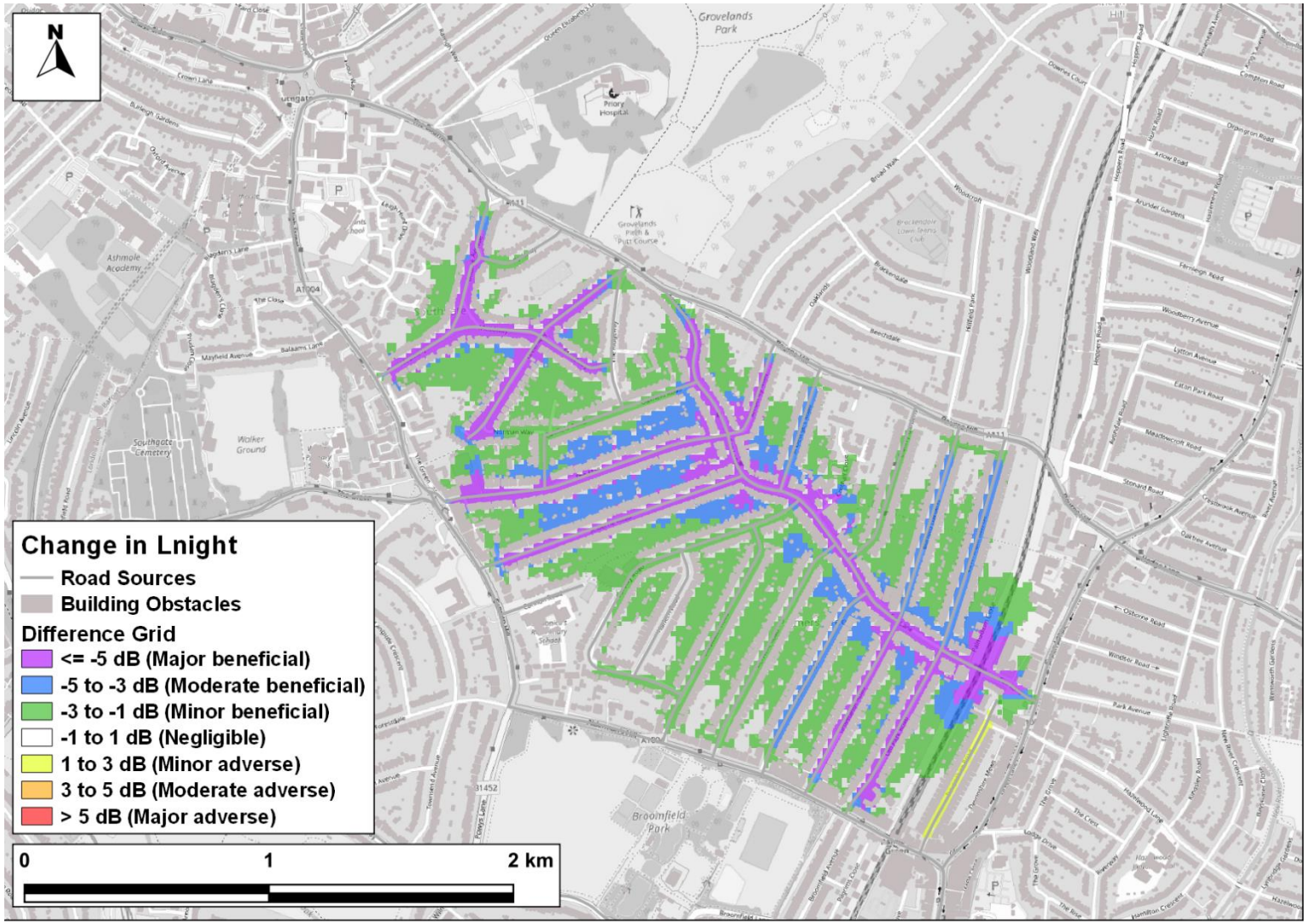

Figure A3.8: L_{night} Noise Grid Change Due to the Scheme.

A3.3 **Figure A3.9, Figure A3.10, Figure A3.11** and **Figure A3.12** show the absolute noise grids for the LAeq,16hr and LAeq,8hr, for the 'without' and 'with' Scheme scenarios respectively.

Figure A3.9: Absolute $L_{Aeq,16hr}$ Noise Grid (Without-Scheme Scenario).

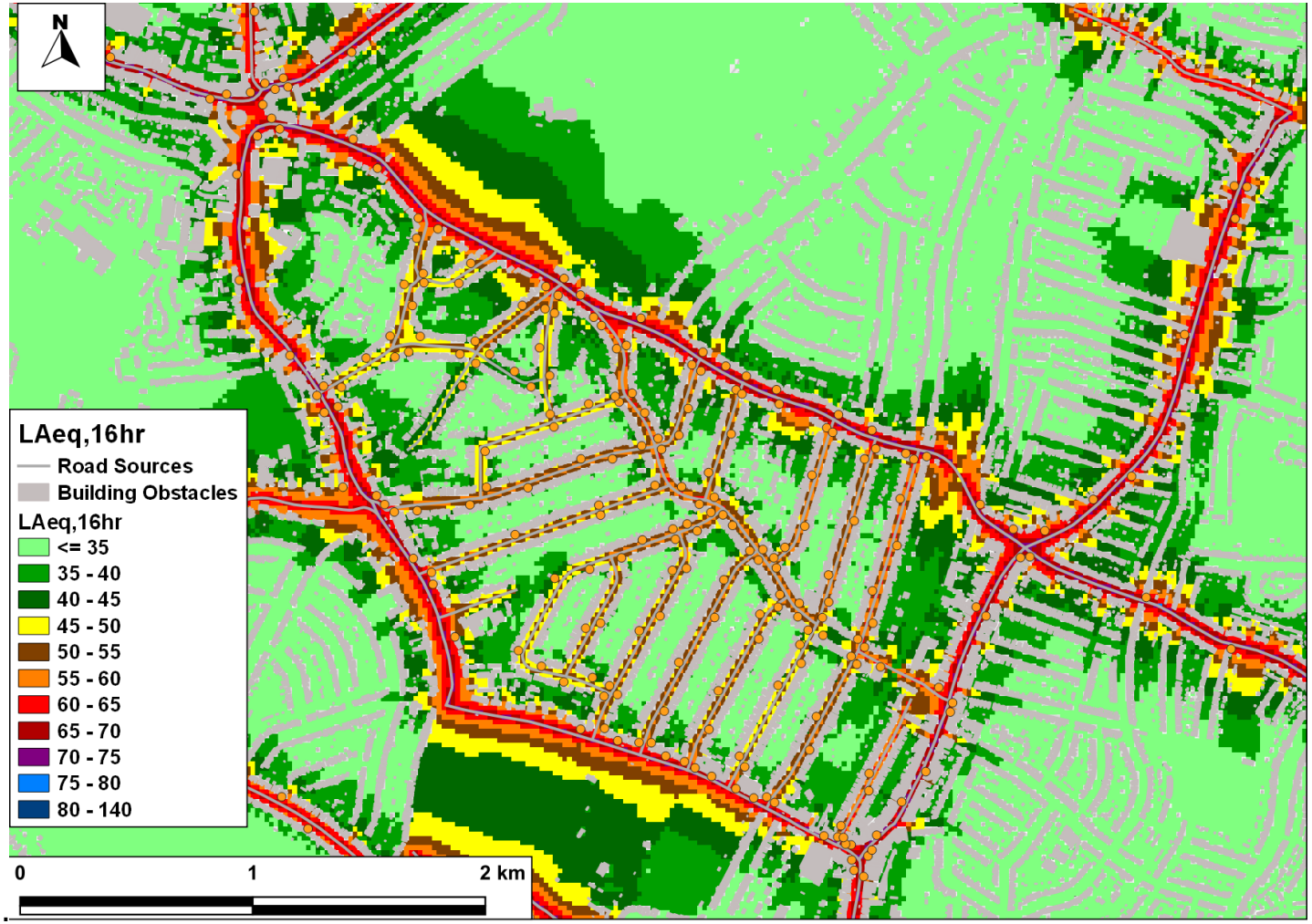

Figure A3.10: Absolute $L_{Aeq,16hr}$ Noise Grid (With-Scheme Scenario).

Figure A3.11: Absolute $L_{Aeq,8hr}$ Noise Grid (Without-Scheme Scenario).

Figure A3.12: Absolute $L_{Aeq,8hr}$ Noise Grid (With-Scheme Scenario).

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