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Mansfield Air Quality Impact Assessment

Local Plan Junctions Effects

Mansfield District Council

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Quality information

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1	8/03/18	Submission	TS	Tom Stenhouse	Associate
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1. Introduction

AECOM was commissioned by Mansfield District Council (MDC) to examine the local air quality effects arising at key junctions in Mansfield due to the implementation of the proposed Local Plan allocation.

The study has been commissioned in response to representations received to the Local Plan Preferred Options consultation. The Environmental Health Department at Mansfield District Council identified the following junctions of most concern:

1. Debdale Lane / Abbott Road junction (Location 1);
2. Chesterfield Road North Pleasley from the Mansfield ring road (MARR) route to the Landmark Centre (Location 2); and
3. Nottingham Road / Sainsbury's junction (Location 3).

Mansfield District Council has not declared any Air Quality Management Areas near to these junctions, although it is recognised that the local air quality should be considered in the Local Plan. Therefore, a robust dispersion modelling assessment has been undertaken to ensure that potential effects are properly considered.

Additional scenarios were appraised to determine the cumulative air quality effect of the Penniment Farm and Lindhurst residential developments. These developments are to be brought forward outside of the Local Plan.

2. Regulation and Policy Frameworks

2.1 Air Quality Legislation

The Clean Air for Europe (CAFE) programme revisited the management of air quality within the European Union (EU) and replaced the EU Framework Directive 96/62/EC (Council of European Communities, 1996), its associated Daughter Directives 1999/30/EC (Council of European Communities, 1999), 2000/69/EC (Council of European Communities, 2000), 2002/3/EC (Council of European Communities, 2002), and the Council Decision 97/101/EC (Council of European Communities, 1997) with a single legal act, the Ambient Air Quality and Cleaner Air for Europe Directive 2008/50/EC (Council of European Communities, 2008).

Directive 2008/50/EC (Council of European Communities, 2008) is transcribed into UK legislation by the Air Quality Standards Regulations 2010 (The Air Quality Standards Regulations, 2010) which came into force on the 11th June 2010. These limit values are legally binding on the UK and have been set with the aim of avoiding, preventing or reducing harmful effects of air quality on human health and on the environment as a whole.

Commission Directive 2015/1480 (Council of European Communities, 2015) amended Directives 2008/50/EC and 2004/107/EC (Council of European Communities, 2004). The amendment was transposed into national legislation by The Air Quality Standards (Amendment) Regulations 2016 (The Air Quality Standards (Amendment) Regulations, 2016), which came into force on 31 December 2016.

2.2 National Air Quality Strategy

The UK National Air Quality Strategy (Department of the Environment, 1997) was initially adopted in 1997, under the requirements of the Environment Act 1995 (H.M. Government, 1995). The most recent revision of the Strategy (Department for Environment, Food and Rural Affairs, 2007) sets objective values for key pollutants as a tool to help local authorities manage local air quality improvements in accordance with the EU Air Quality Framework Directive (Council of European Communities, 1996). Some of these objective values have been laid out within the Air Quality (England) Regulations 2000 (H.M. Government, 2000) and later amendment (H.M. Government, 2002).

The air quality objective values have been set down in regulation solely for the purposes of local air quality management. Under the local air quality management regime, local authorities have a duty to carry out regular assessments of air quality against the objective values and if it is unlikely that the objective values will be met in the given timescale, they must designate an AQMA and prepare an Air Quality Action Plan (AQAP) with the aim of achieving the objective values. The boundary of an AQMA is set by the governing local authority to define the geographical area that is to be subject to the management measures to be set out in a subsequent action plan. Consequently it is not unusual for the boundary of an AQMA to include within it, relevant locations where air quality is not at risk of exceeding an air quality objective.

The UK's national air quality objective values and EU limit values for the pollutants of relevance to this assessment are displayed in Table 2-1.

Table 2-1: Air Quality Strategy Objectives and EU Limit Values

Pollutant	Averaging Period	Value	Maximum Permitted Exceedances	Criteria
Nitrogen Dioxide (NO_2)	Annual Mean	40 µg/m^3	None	Objective & limit value
	Hourly Mean	200 µg/m^3	18 times per year	Objective & limit value
Particulate Matter (PM_{10})	Annual Mean	40 µg/m^3	None	Objective & limit value
	24-hour	50 µg/m^3	35 times per year	Objective & limit value
Fine Particulate Matter ($PM_{2.5}$)	Annual Mean	25 µg/m^3	None	Limit value

2.3 Local Air Quality Management

Under the requirements of Part IV of the Environment Act (The Environment Act, 1995), MDC has carried out a phased review and assessment of local air quality within their administrative area. MDC currently does not have any AQMAs.

MDC is one of the Councils who produced the Nottinghamshire Air Quality Improvement Strategy, “A Breath of Fresh Air”, and is involved in the updating of this document, led by Nottingham City Council. The original version of the strategy is available on the Nottinghamshire County Council website[1].

2.4 National Planning Policy Framework

The NPPF includes an obligation for local authorities to produce a Sustainability Appraisal of Local Plans. One such plan has been produced by Mansfield District Council[2]. Within the plan under Natural Environment planning policy NE9 concerns air quality ‘Maintaining a clean and healthy environment’.

> *‘The NPPF requires that Local Plans should take into account cumulative effects of air quality and prevent development from contributing to or being put an unacceptable risk from, or being adversely affected by unacceptable levels of air pollution. The proposed policy builds upon these principles.*
>
> *‘This policy is unlikely to have an effect on most other policies due to its specific focus on air quality. However, by ensuring that air quality does not deteriorate, the policy ought to have a positive effect on health and wellbeing (SA2), biodiversity (SA6) and transport (SA7). As air quality is not a major issue for Mansfield it is unlikely that the positive effects would be significant’*.

In line with the above policy this assessment was commissioned.

[1] http://cms.nottinghamshire.gov.uk/nottsairqualityimprovementstrategy2008.pdf.
[2] http://www.mansfield.gov.uk/CHttpHandler.ashx?id=8743&p=0

3. Assessment Methodology

3.1 Overview

There is no statutory guidance on the methodology for air quality impact assessments. Several bodies have published their own guidance relating to air quality assessment. For this project the overarching approach will be in line with Local Air Quality Management Technical Guidance published by the Department for Environment, Food and Rural Affairs (Defra) (Defra, 2016). Preparation of this report paid close attention to information produced by the Institute of Air Quality Management and Environmental Protection UK (IAQM and EPUK, 2017).

This section presents the methodology used to assess the potential effects on air quality during the operational phase of the Local Plan focusing on the three junctions.

The methods used to determine the significance of effects associated with air quality impacts are described in the Section 3.6.1.

The Environment and Public Protection Team at MDC was consulted within the assessment methodology adopted for this assessment. The first consultation confirmed the extent of the modelling domains around each of the junctions[3] of concern and the second consultation summarised the applied methodology[4].

3.2 Description of Pollutants Assessed

The incomplete combustion of fuel in vehicle engines results in the presence of hydrocarbons (HC) such as benzene and 1,3-butadiene, and sulphur dioxide (SO_2), carbon monoxide (CO), PM_{10} and $PM_{2.5}$ (aerodynamic diameter less than 2.5 µm) in exhaust emissions. Better emission control technology and fuel specifications (particularly the introduction of ultra-low sulphur fuels) are expected to reduce emissions per vehicle in the long term.

Although SO_2, CO, benzene and 1,3-butadiene are present in motor vehicle exhaust emissions, detailed consideration of the associated effects on local air quality is not considered relevant in the context of this assessment. This is because road traffic emissions of these substances have been reviewed by MDC as part of their local air quality management obligations, and nowhere within the administrative area is at risk of exceeding these objectives. Emissions of SO_2, CO, benzene and 1,3-butadiene from road traffic are therefore not considered further within this assessment.

At high temperatures and pressures found within vehicle engines, some of the nitrogen in air and fuel is oxidised to form NO_x, mainly in the form of nitric oxide (NO), which is then converted to NO_2 in the atmosphere. The presence of NO_2 in the atmosphere is associated with adverse effects on human health. Vehicle emissions can also result in the exposure at sensitive receptors to concentrations of particulate matter (PM_{10} and $PM_{2.5}$). Particulates from road vehicles are generated through combustion and from tyres and breaks. Whilst engine sources are managed particularly well using traps the non-exhaust contribution has now become the major concern. These concerns will be further exacerbated (even with the advent of low emission vehicles) unless regenerative breaking and tyre technologies are specifically developed to mitigate air quality concerns.

3.3 Determining Baseline Conditions

A review of existing baseline air quality has been undertaken using information from the most recent air quality report available (MDC, 2017). This report contains measured nitrogen dioxide concentrations from continuous monitoring locations up to the end of 2016.

Air quality monitoring stations were available in close proximity to the three junctions under review. The result of this monitoring is shown in Table 3-1 (MDC, 2017), comprising five passive diffusion tubes locations, including one that is collocated with an automatic analyser (CRN-Real Time)).

Exceedances of the annual mean NO_2 objective were recorded at two locations; CRN and DL.

[3] Personal communication with Katie Mills (07/02/2017)
[4] Personal communication with Katie Mills (13/02/2017)

Table 3-1: MDC Air Quality Monitoring Results

Site Name	Junction	X-coordinate	Y-coordinate	Type	Pollutants monitored	2016 Annual mean NO_2 (µg/m^3)	2016 Annual mean PM_{10} (µg/m^3)
CRN-Real Time & Collocated Diffusion Tubes	L2-Chesterfiled Road North	450802	364066	Automatic, Roadside	PM_{10}, NO_2	16.0	7.0
CRN	L2-Chesterfiled Road North	450820	364028	Diffusion tubes, Roadside	NO_2	**42.9**	na
PD	L2-Popular Drive	450856	363863	Diffusion tubes, Roadside	NO_2	36.3	na
DL	L1-Debdale Lane	452515	362508	Diffusion tubes, Roadside	NO_2	**47.3**	na
NR	L3-Nottingham Road	453842	360174	Diffusion tubes, Roadside	NO_2	37.1	na

Background pollutant concentration data used in this assessment have been sourced from Defra's background maps based on 2015 monitoring data (DEFRA, 2018) for the 2016 verification base year and 2021 and 2025 for the 2033 Local Plan full allocation year. The modelled background years are prior to the base-year and full allocation year in order to represent a cautious attitude to the introduction of emerging low emission vehicle technologies as forecast by the UK National Atmospheric Emissions Inventory[5].

Base year and future reference year pollutant concentrations have been predicted at existing sensitive receptors in the study area using ADMS Roads[6] detailed dispersion model.

3.4 Air Quality Sensitive Receptors

Sensitive receptors were selected to represent locations where people are likely to be present based on effects on human health. Non-sensitive receptors were also included in order to allow a more thorough spatial understanding of the impact of the Local Plan. The AQS Objectives (H.M. Government, 2000 and 2002) have been set at concentrations that provide protection to all members of the public, including more vulnerable groups such as the very young, elderly or unwell. As such the sensitivity of receptors was considered in the definition of the AQS Objectives and therefore no additional subdivision of human health receptors on the basis of building or location type is necessary.

The air quality sensitive receptors used in this assessment are those which correspond to existing residential dwellings where the annual mean objectives are relevant. For the junctions of concern there is no indication of specific development occurring within the proposed planned allocation. However, for completeness a number of non-sensitive receptors were identified within the extent of the modelling domain as a useful reference for sites which could potentially be subject to development.

All receptors that represent exposure to the public are of equal sensitivity as any member of the public could be present at those locations.

Operational impacts from road traffic emissions have been quantified at 49 receptors in the vicinity of the three junctions. Of these 49 receptors, NO_2 concentrations were modelled at four NO_2 diffusion tube locations and one

[5] http://naei.beis.gov.uk/
[6] http://www.cerc.co.uk/environmental-software/ADMS-Roads-model.html

real time monitoring site. This allowed the model set up to be tested resulting in a localised factor which adjusts the model to account for systematic and random errors.

Receptors selected for this study are listed in Table 3-2. The second column indicates which receptors are considered sensitive. Monitoring site receptors are shown in bold. Locations have also been mapped and shown in Appendix A.

Table 3-2: Receptors - Operational Traffic Emissions

Receptor ID	Sensitive receptor	Junction	OS Grid Reference		Height (m)
			X (m)	Y (m)	
DL	n	L1	452515	362508	1.5
L1NSR1	n	L1	452453	362457	1.5
L1SR2	y	L1	452471	362443	1.5
L1SR3	y	L1	452517	362417	1.5
L1SR4	y	L1	452584	362389	1.5
L1SR5	y	L1	452617	362413	1.5
L1SR6	y	L1	452561	362446	1.5
L1SR7	y	L1	452537	362484	1.5
L1SR8	y	L1	452593	362511	1.5
L1SR9	y	L1	452640	362538	1.5
L1SR10	y	L1	452618	362534	1.5
L1SR11	y	L1	452607	362560	1.5
L1SR12	y	L1	452562	362540	1.5
L1SR13	n	L1	452465	362499	2.5
L1SR14	y	L1	452440	362513	1.5
L1SR15	y	L1	452407	362537	1.5
L1SR16	y	L1	452380	362559	1.5
L1SR17	y	L1	452344	362587	1.5
L1SR18	y	L1	452321	362604	1.5
L1SR19	y	L1	452288	362584	1.5
L1SR20	y	L1	452318	362563	1.5
L1SR21	y	L1	452356	362536	1.5
L1NSR22	n	L1	452385	362513	1.5
L1SR23	y	L1	452359	362485	1.5
L1SR24	y	L1	452310	362474	1.5
L1SR25	y	L1	452277	362440	1.5
L1SR26	y	L1	452339	362454	1.5
PD	n	L2	450856	363863	1.5
CRN	n	L2	450820	364028	1.5
CRN-RT	n	L2	450802	364066	1.5
L2SR1	n	L2	451109	363542	1.5
L2SR2	n	L2	451066	363584	1.5
L2SR5	y	L2	450921	363778	1.5
L2SR6	n	L2	451093	363603	1.5
L2SR8	n	L2	450947	363794	1.5
L2SR10	n	L2	450876	363874	1.5
L2SR3	n	L2	451186	363533	1.5

Receptor ID	Sensitive receptor	Junction	OS Grid Reference		Height (m)
			X (m)	Y (m)	
L2SR4	y	L2	451005	363667	1.5
L2SR7	n	L2	451025	363684	1.5
NR	n	L3	453842	360174	1.5
L3SR1	y	L3	453843	360159	1.5
L3SR2	y	L3	453844	360127	1.5
L3SR3	y	L3	453844	360102	1.5
L3SR4	y	L3	453839	360056	1.5
L3NSR5	n	L3	453791	360202	1.5
L3NSR6	n	L3	453901	360214	1.5
L3NSR7	n	L3	453945	360252	1.5
L3NSR8	n	L3	453802	360165	1.5
L3NSR9	n	L3	453813	360311	1.5

3.5 Methodology for Determining Operational Effects

The concentration of pollutants due to emissions from road traffic associated with the proposed Local Plan Development and the impact at sensitive receptors will be influenced by a number of factors. These include background pollution levels, location of receptors, and the level of traffic emissions dictated by traffic flow rates, vehicle flow composition and speed.

To determine baseline and operational phase air quality effects from road traffic conditions at the three junctions dispersion modelling was undertaken using ADMS-Roads v4.1.1.0. The ADMS model suite is a set of modern dispersion models with an extensive published track record of use in the UK for the assessment of local air quality effects, including model validation and verification studies (CERC, 2015).

The scenarios considered within the assessment of road traffic effects include:

- Existing baseline situation (2016 for model verification)
- Future reference year 2033; and
- Future Local Plan allocation scenario 2033.

Traffic generation associated with the proposed Local Plan development has been assessed by AECOM transport consultants. The traffic data are presented in Appendix B. The increase in traffic in the reference year and owing to the Local Plan across the road links of interest in 2033 is shown in Table 3-3.

Table 3-3: Summary of traffic growth

Situation	% Growth
Base Year 2016	N/A
Reference Year 2033	18% above Base Year 2016
With LP development	6% above Reference Year 2033

The ADMS-Roads model calculates concentrations of pollutants emitted from vehicles using the following parameters:

- Traffic volume: The number of vehicles travelling a length of road in a given time will affect the subsequent emissions and dispersion of pollutants;

- Fleet composition: The proportion of cars, light goods vehicles, rigid heavy goods vehicles, artic heavy goods vehicles, buses and coaches, and motorcycles will affect the mass emissions of pollutants; and
- Fleet velocity: The speed of the fleet affects the mass emissions of pollutants.

Emission factors from the Emission Factor Toolkit (EFT) Version 8.0.1 (Defra, 2018b) were used.

The implementation year for the Local Plan is 2033. While emission factors are predicted in the National Atmospheric Emissions Inventory (NAEI) to decrease in future years, it is commonly agreed that the current predicted rates of decreases may be too optimistic. To account for the uncertainty in emissions factor improvement, a sensitivity test was undertaken using 2021 and 2025 emission factors and background concentrations for the 2033 traffic data. This approach provides a worst case assessment in the event that the full rates of air quality improvements anticipated in the NAEI do not occur as quickly as predicted. Similarly, a cautious approach was also undertaken for the modelling verification whereby 2015 emission factors were assumed for traffic in 2016. Year 2015 is the earliest emission factors available in the EFT Version 8.0.1.

The dispersion model input data and model conditions are presented in Table 3-4.

Table 3-4: General Dispersion Model Conditions

Variables	ADMS-Roads Model Input
Surface roughness at source	0.5m (Large urban areas)
Minimum Monin-Obukhov length for stable conditions	Model default
Terrain Types	Flat
Receptor Locations	x,y coordinates determined by GIS, z = various
Emissions	NO_x, PM_{10}, $PM_{2.5}$
Emission Factors	EFT Version 8.0.1 emission factor dataset
Meteorological Data	1 year (2016) hourly sequential data from East Midland Airport meteorological station
Emission Profiles	Average through the day
Receptors	Selected receptors only
Model Output	Long-term annual mean NO_x concentrations Long-term annual mean PM_{10} concentrations Long-term annual mean $PM_{2.5}$ concentrations

Using Google Maps it was possible to review the extent of queuing on roads around each junction on an average hourly basis. Following this review standing queues were not considered to be a particular issue. However, slow moving traffic on certain approaches was identified. These included the traffic leaving and accessing Location 3 on Baums Lane at 5pm and travelling south on Chesterfield Road North from the Landmark Centre to the junction of the A617. Here, slow moving traffic regularly occurs between 7am and 9am. To represent these events the model was set up to switch on these additional links during the required hours (which have the same levels of traffic as the base links) but with a slower average speed of 15 km/h.

In addition to observing queues and or slow moving traffic accessing intersections it was also important to appropriately represent traffic movements and subsequent emissions across each junction. There are various ways in which this can be achieved. The first is to observe all turning movements and then represent these as individual modelled road links with appropriate emission rates. The second approach is to assume that all traffic entering the junction travels a certain distance (the distance being equal to the diagonal length across the intersection). By multiplying the travel distance by the volume of traffic per day and then in turn multiplying this activity by a fleet weighted emission factor based on an average speed of 10 km/h the mass of emissions can be estimated. The mass of emissions (i.e. NOx, PM_{10} and $PM_{2.5}$) can then be converted into an emissions rate and then dispersed as an area based source using ADMs Roads. For this study the second approach was applied.

3.5.1 Model Verification

The road model verification was undertaken following the methodology described in LAQM TG(16) (Defra, 2016). The extent of air quality monitoring data allowed model verification to be conducted independently at each location. However, a more thorough verification study was conducted for Location 2 owing to there being three AQ monitoring sites to include in the analysis. For Locations 1 and 3 one monitoring site was available. Essentially, verification involves comparing modelled road NOx concentrations with measured contributions (which are derived by subtracting the background component from the total measured values using various tools provided on the Defra air quality website). For Location 2 the background concentrations were reduced slightly to account for the contribution from the road sources under investigation. This is to avoid introducing an element of double counting emissions when converting the NOx concentration to NO_2. The verification factor for each location is shown in Table 3-5.

Table 3-5: Modelling verification factors for each location

Junction	Model Adjustment Factor
Location 1	2.6
Location 2	2.2
Location 3	2.0

In the absence of sufficient locally measured PM_{10} or $PM_{2.5}$ data, an assumption has been made that the model would perform similarly for each traffic emitted pollutant considered. As such, a factor of the same value has been applied to the modelled road PM_{10}, $PM_{2.5}$ and NO_X contributions, as recommended in LAQM TG (16) (Defra, 2016).

More details of the verification are shown in Appendix D.

3.5.2 Meteorological Data

One year (2016) of hourly sequential observation data from East Midland Airport meteorological station has been used in this assessment. The station is located approximately 27 miles southwest of Mansfield and experiences meteorological conditions that are representative of those experienced in the East Midland area. The 2016 of meteorological data is used to match the year of modelled traffic data. A wind rose indicating the 2016 weather pattern is shown in Figure 3-1.

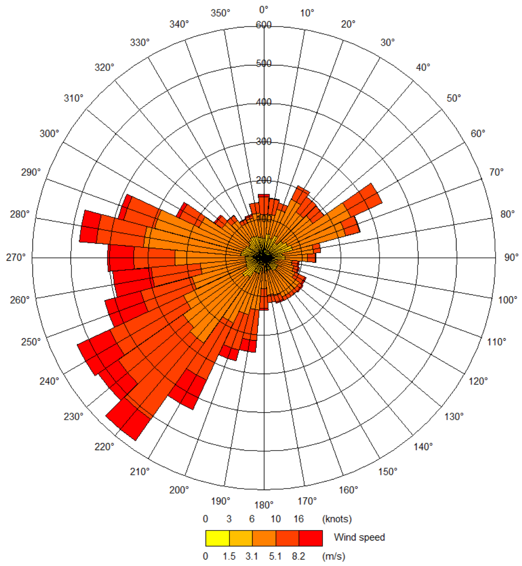

Figure 3-1: Wind Rose 2016 East Midlands Airport

3.5.3 Background Data

Background concentrations of NO_2, PM_{10} and $PM_{2.5}$ have been sourced from the latest 2015 based Defra Background Maps (Defra, 2018a) and are presented in Table 3-6. The approach considered the average background concentration from adjacent to each junction unless the junction itself was fully within a particular grid as per Location 1.

The background maps include emissions from nearby sources such as local road networks and emissions from industry, and were downloaded in February 2018.

Table 3-6: Background Pollutant Concentrations

Assessment Year (fleet year)	Defra mapped grid centre	Receptor ID	NO_2	PM_{10}	$PM_{2.5}$
			Annual Mean µg/m^3		
2016(15)	453500-360500; 454500-360500; 453500-359500; 454500-359500	All receptors - Location 3	23.8	17.2	14.1
2033(2021)			18.7	13.6	13.4
2033(2025)			16.3	12.0	13.3
2016(15)	452500-362500	All receptors - Location 1	22.2	15.9	14.4
2033(2021)			17.2	12.6	13.7
2033(2025)			14.8	11.0	13.6
2016(15)	451500-364500; 450500-363500; 451500-363500	All receptors - Location 2	12.8	15.1	9.9
2033(2021)			13.6	10.2	14.5
2033(2025)			11.7	8.9	14.3

3.5.4 Predicting the Number of Days in which the NO_2 Hourly Mean Objective is Exceeded

The assessment evaluates the likelihood of exceeding the hourly mean NO_2 objective by comparing predicted annual mean NO_2 concentrations at all receptors to an annual mean equivalent threshold of 60 µg/m^3 NO_2. The threshold of 60 µg/m^3 is derived from research projects (AEAT, 2008; Laxen and Marner, 2003) which identified that the hourly mean NO_2 objective is unlikely to be exceeded if annual mean concentrations are predicted to be less the 60 µg/m^3.

Where predicted concentrations are below this value, it can be concluded that the hourly mean NO_2 objective (200 µg/m^3 NO_2 not more than 18 times per year) will be achieved.

3.5.5 NO_x to NO_2 Conversion

For road transport emissions a 'NO_X to NO_2' conversion spreadsheet (Defra, 2018c) was made available by Defra as a tool to calculate the road NO_2 contribution from modelled road NO_X contributions. The tool comes in the form of an MS Excel spreadsheet and uses local authority specific data to calculate annual mean concentrations of NO_2 from dispersion model output values of annual mean concentrations of NO_X. The most recent release of this tool (v6.1, released in October 2017) was used to calculate the total NO_2 concentrations at receptors from the modelled road NO_X contribution and associated background concentration. Due to the location of the junctions, the 'All other urban UK traffic' setting was selected.

3.6 Method for Assessment of Significance

3.6.1 Operational Emissions

With regard to road traffic emissions, the change in pollutant concentrations, with respect to the baseline concentrations, has been described at receptors that are representative of exposure to impacts on local air quality within the study area. The absolute magnitude of pollutant concentrations in the modelled scenarios is also described, and this is used to identify the risk of the Air Quality Objective values being exceeded in each scenario.

Descriptors which have been developed by EPUK/ IAQM (2017) to explain the impact at individual receptors have been used in this assessment. These descriptors are set out in Table 3-7.

Table 3-7: Effects Descriptors at Individual Receptors – Annual Mean NO_2 and PM10[7] (the table has been modified to reflect actual annual concentrations rather than percentages as per the IAQM guidance)

Annual Mean Pollutant Concentration at Receptor in Assessment Year (µg/m^3)	Change in Annual Mean Concentration of NO_2/PM10 (µg/m^3)			
	< 0.4	0.4 – 2.2	2.2 - 4	> 4
≤30.4	Negligible	Negligible	Slight	Moderate
30.4– 37.9	Negligible	Slight	Moderate	Moderate
38 – 41.1	Slight	Moderate	Moderate	Substantial
41.2 – 43.9	Moderate	Moderate	Substantial	Substantial
≥44	Moderate	Substantial	Substantial	Substantial

The EPUK / IAQM guidance includes seven explanatory notes to accompany the terminology for the effect descriptors. In particular it is noted that the descriptors are for individual receptors only and that overall significance is determined using professional judgement. Additionally, it is noted that it is unwise to ascribe too much accuracy to incremental changes or background concentrations, and this is especially important when total concentrations are close to the objective value. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the objective value, rather than being exactly equal to it.

A change in predicted annual mean concentrations of less than 0.5% would be described as Negligible in all situations, i.e. given normal bounds of variation it would not be capable of having a direct effect on local air quality that could be considered to be significant. A change in concentration of 1% (i.e. 0.4 µg/m^3 for NO_2 and PM_{10} and 0.25 µg/m^3 for $PM_{2.5}$) is considered negligible at receptors where concentrations are well below the objective. At concentrations above 95% of the objective value (i.e. 38 µg/m^3 for NO_2 and PM_{10}), the change (impact) may be slight and at concentrations above the objective, the change is considered to be moderate at individual receptors. In practice this assessment inherently considers cumulative impacts through the use of traffic data and background concentrations. Therefore, it is considered highly unlikely that significant air quality impacts could occur with the development for changes in concentrations of 1%.

[7] See section 6.26 Land-Use Planning & Development Control: Planning For Air Quality (January 2017) – IAQM.

Additionally, the EPUK / IAQM guidance also includes the potential for sight to substantial air quality effects as a result of changes in pollutant concentrations between 2% and 5% of relevant Air Quality Objectives. For annual average NO_2 and PM_{10} concentrations, this relates to changes in concentrations ranging from 0.4 – 2 µg/m^3. In practice, for $NO_{2,}$ changes in concentration of this magnitude, and in particular changes at the lower end of this band are likely to be very difficult to distinguish through any post operational monitoring regime due to the number of sources of NO_2 in an urban environment and the inter annual effects of varying meteorological conditions. Changes in concentration of more than 5% (the two highest bands) are considered to be of a magnitude which is far more likely to be discernible and as such carry additional weight within the overall evaluation of significance for air quality. In these situations, changes may be considered to moderate to substantial for individual receptors that already have concentrations above the objective value.

4. Baseline and Air Quality Impacts

4.1 Baseline Conditions

4.1.1 Monitoring Data

Measured pollutant concentrations from five monitoring sites for year 2016 were reviewed for this study and have been presented in Table 3-1. Two of the five sites, CRN at Location 2 and DL at Location 1 exceeded the annual mean NO_2 national objective value recording concentrations of 42.9 µg/m^3 47µg/m^3 respectively. However, both of these monitoring sites are not at sensitive locations and therefore not directly relevant for compliance with national objectives.

The road emissions component was adjusted using a factor of 2.6, 2.2, and 2.0 applied to Locations 1,2 and 3 respectively, as discussed in Appendix D.

4.1.2 Predicted Baseline and Reference Year Pollutant Concentrations

Predicted annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ at the selected receptors are listed in Table 4-1.

Table 4-1. Air Quality Statistics Predicted for Baseline and Reference Year Scenarios

Receptor	Sensitive receptor	Junction	Annual Mean Concentration (µg/m^3)					
			2016 NO_2	2033 NO_2	2016 PM_{10}	2033 PM_{10}	2016 $PM_{2.5}$	2033 $PM_{2.5}$
DL	n	L1	**47.6**	31.6	20.0	19.0	13.2	12.7
L1NSR1	n	L1	37.5	24.7	17.7	16.7	11.7	11.4
L1SR2	y	L1	31.1	20.7	16.7	15.9	11.1	11.0
L1SR3	y	L1	27.8	18.7	16.3	15.5	10.9	10.8
L1SR4	y	L1	26.7	18.0	16.1	15.3	10.8	10.7
L1SR5	y	L1	31.8	21.8	17.2	16.6	11.4	11.4
L1SR6	y	L1	28.2	19.1	16.4	15.7	10.9	10.9
L1SR7	y	L1	32.7	21.7	17.1	16.2	11.4	11.1
L1SR8	y	L1	28.5	18.9	16.4	15.5	10.9	10.7
L1SR9	y	L1	34.9	22.8	17.5	16.4	11.6	11.2
L1SR10	y	L1	36.3	23.8	17.7	16.6	11.8	11.4
L1SR11	y	L1	30.8	20.3	16.8	15.9	11.2	11.0
L1SR12	y	L1	33.4	22.1	17.3	16.3	11.5	11.2
L1SR13	n	L1	**45.0**	29.7	18.9	17.8	12.5	12.1
L1SR14	y	L1	**40.6**	27.4	18.2	17.4	12.1	11.8
L1SR15	y	L1	36.9	25.4	17.8	17.1	11.8	11.6
L1SR16	y	L1	35.6	24.5	17.5	16.9	11.6	11.5
L1SR17	y	L1	35.2	24.4	17.5	16.9	11.6	11.5
L1SR18	y	L1	32.5	22.5	17.0	16.4	11.3	11.2
L1SR19	y	L1	21.7	14.7	15.3	14.6	10.3	10.2
L1SR20	y	L1	24.0	16.2	15.7	14.9	10.5	10.4
L1SR21	y	L1	26.9	18.1	16.2	15.4	10.8	10.7
L1NSR22	n	L1	30.7	20.5	16.9	16.0	11.2	11.0
L1SR23	y	L1	33.9	22.4	17.4	16.4	11.5	11.3
L1SR24	y	L1	33.4	22.1	17.3	16.3	11.5	11.2
L1SR25	y	L1	26.0	16.9	16.1	15.1	10.7	10.5
L1SR26	y	L1	31.5	20.3	17.0	16.0	11.3	11.0
PD	n	L2	35.3	25.3	19.4	18.7	12.5	11.5

Receptor	Sensitive receptor	Junction	Annual Mean Concentration (µg/m³)					
			2016 NO_2	2033 NO_2	2016 PM_{10}	2033 PM_{10}	2016 $PM_{2.5}$	2033 $PM_{2.5}$
CRN	n	L2	38.6	27.8	20.0	19.4	12.9	11.9
CRN-RT	n	L2	27.0	19.6	17.7	17.1	11.5	10.6
L2SR1	n	L2	20.9	15.3	16.6	15.9	10.8	10.0
L2SR2	n	L2	21.4	15.7	16.7	16.0	10.9	10.0
L2SR5	y	L2	22.8	16.7	17.0	16.3	11.0	10.2
L2SR6	n	L2	30.7	23.5	18.4	17.9	11.9	11.1
L2SR8	n	L2	29.8	22.8	18.2	17.7	11.8	11.0
L2SR10	n	L2	27.3	20.7	17.8	17.2	11.5	10.7
L2SR3	n	L2	33.4	25.3	18.7	18.2	12.1	11.3
L2SR4	y	L2	24.9	18.1	17.3	16.7	11.3	10.4
L2SR7	n	L2	29.8	22.7	18.2	17.7	11.8	11.0
NR	n	L3	37.5	24.9	17.3	16.3	11.4	10.3
L3SR1	y	L3	32.6	21.7	16.6	15.7	10.9	9.9
L3SR2	y	L3	30.5	20.3	16.3	15.4	10.8	9.8
L3SR3	y	L3	29.9	19.9	16.3	15.3	10.7	9.7
L3SR4	y	L3	29.2	19.5	16.2	15.3	10.7	9.7
L3NSR5	n	L3	27.5	18.5	15.6	14.7	10.4	9.4
L3NSR6	n	L3	25.5	17.4	15.4	14.5	10.2	9.3
L3NSR7	n	L3	24.0	16.8	15.2	14.5	10.1	9.3
L3NSR8	n	L3	28.3	19.0	15.8	14.9	10.5	9.5
L3NSR9	n	L3	28.6	19.5	15.9	15.0	10.5	9.6

Note: Bold type denotes exceedances of the annual mean objective.

For 2016 the baseline annual mean concentrations of NO_2 are predicted to be above the air quality objective value (40 µg/m³) at receptor DL on the A6075 Debdale Lane (Location 1), L1SR13 which is closer and to the north side of the junction (Location 1) and L1SR14 which is to the north of the junction on Chesterfield Road North (Location 1). L1SR14 was the only relevant receptor predicted to exceed being located at a residential dwelling. No exceedances of national objectives were predicted at Locations 2 and 3 in year 2016. It should be noted that these receptor locations have been chosen to represent the worst exposure, thus increasing the confidence when no exceedance is predicted. However, when exceedance is predicted, it only represents the worst exposure, and does not necessarily mean all the nearby areas have a problem of exceedance. While annual mean concentrations are predicted to be below 60 µg/m³, it is unlikely that the hourly mean NO_2 objective is breached.

Some improvement is predicted for future years. By 2033, annual mean concentrations of NO_2 are predicted to be below the air quality objective value (40 µg/m³) at all selected receptors, the highest annual mean being 31.6 µg/m³ predicted at receptor DL. It is worth being reminded that the Baseline and Reference predictions assume a less technically matured vehicle fleet and higher pollutant background forecast. Hence, a more conservative view of emissions for those years.

Annual mean concentrations of PM_{10} and $PM_{2.5}$ are all below or well below their respective objective values across the study area in the Baseline and Reference cases.

4.2 Predicted Impacts

Predicted annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$, at selected air quality receptors across the three junctions in the year when the proposed Local Plan is fully implemented (2033), are listed in Table 4-2. The results considered a 2025 background concentration and emission factors. Receptors which are directly sensitive to national air quality objectives have been highlighted in blue text.

Although road traffic emissions owing to the Local Plan across the three junctions have an adverse effect, the annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations are predicted to be well below respective objective values for all receptors.

The changes that are predicted to occur as a result of the Local Plan, in relation to the reference conditions for each of the receptors are also shown Table 4-2

Table 4-2: Changes in Air Quality Statistics between the Reference and Local Plan in 2033

Receptor	Sensitive	NO_2 annual mean (µg m^{-3})		Descriptor for change	PM_{10} annual mean (µg m^{-3})		Descriptor for change	$PM_{2.5}$ annual mean (µg m^{-3})		Descriptor for change
		LP2033	Δ from Ref		LP2033	Δ from Ref		LP2033	Δ from Ref	
DL (L1)	n	33.8	2.2	slight	19.5	0.5	Negligible	12.2	0.3	Negligible
L1NSR1	n	25.9	1.2	Negligible	16.9	0.2	Negligible	10.8	0.1	Negligible
L1SR2	y	21.6	0.9	Negligible	16.0	0.1	Negligible	10.2	0.1	Negligible
L1SR3	y	19.4	0.7	Negligible	15.6	0.1	Negligible	10.0	0.0	Negligible
L1SR4	y	18.6	0.6	Negligible	15.4	0.1	Negligible	9.9	0.0	Negligible
L1SR5	y	21.7	-0.1	Negligible	16.5	-0.1	Negligible	10.5	-0.1	Negligible
L1SR6	y	19.4	0.3	Negligible	15.7	0.0	Negligible	10.0	0.0	Negligible
L1SR7	y	22.6	1.0	Negligible	16.3	0.1	Negligible	10.4	0.1	Negligible
L1SR8	y	19.7	0.9	Negligible	15.6	0.1	Negligible	10.0	0.1	Negligible
L1SR9	y	24.3	1.5	Negligible	16.6	0.2	Negligible	10.6	0.1	Negligible
L1SR10	y	25.4	1.6	Negligible	16.9	0.2	Negligible	10.7	0.1	Negligible
L1SR11	y	21.5	1.1	Negligible	16.1	0.2	Negligible	10.3	0.1	Negligible
L1SR12	y	23.3	1.3	Negligible	16.6	0.2	Negligible	10.5	0.1	Negligible
L1SR13	n	31.1	1.3	Negligible	18.1	0.3	Negligible	11.5	0.1	Negligible
L1SR14	y	28.9	1.6	Negligible	17.6	0.2	Negligible	11.2	0.1	Negligible
L1SR15	y	27.0	1.6	Negligible	17.3	0.2	Negligible	11.0	0.1	Negligible
L1SR16	y	26.0	1.5	Negligible	17.0	0.1	Negligible	10.8	0.1	Negligible
L1SR17	y	25.9	1.5	Negligible	17.0	0.2	Negligible	10.8	0.1	Negligible
L1SR18	y	23.8	1.3	Negligible	16.5	0.1	Negligible	10.5	0.1	Negligible
L1SR19	y	14.9	0.2	Negligible	14.6	0.0	Negligible	9.4	0.0	Negligible
L1SR20	y	16.5	0.3	Negligible	14.9	0.0	Negligible	9.6	0.0	Negligible
L1SR21	y	18.5	0.5	Negligible	15.4	0.0	Negligible	9.9	0.0	Negligible
L1NSR22	n	21.2	0.7	Negligible	16.1	0.1	Negligible	10.3	0.0	Negligible
L1SR23	y	24.0	1.6	Negligible	16.7	0.3	Negligible	10.6	0.2	Negligible
L1SR24	y	23.8	1.7	Negligible	16.6	0.3	Negligible	10.6	0.2	Negligible
L1SR25	y	18.0	1.1	Negligible	15.3	0.2	Negligible	9.8	0.1	Negligible
L1SR26	y	21.8	1.5	Negligible	16.3	0.3	Negligible	10.4	0.2	Negligible
PD (L2)	n	25.9	0.6	Negligible	18.7	0.0	Negligible	11.8	0.0	Negligible
CRN (L2)	n	28.5	0.7	Negligible	19.5	0.0	Negligible	12.3	0.0	Negligible
CRN-RT (L2)	n	20.1	0.4	Negligible	17.1	0.0	Negligible	10.9	0.0	Negligible
L2SR1	n	15.7	0.4	Negligible	15.9	0.0	Negligible	10.3	0.0	Negligible
L2SR2	n	16.1	0.4	Negligible	16.0	0.0	Negligible	10.3	0.0	Negligible

Receptor	Sensitive	NO_2 annual mean (μg m^{-3})		Descriptor for change	PM_{10} annual mean (μg m^{-3})		Descriptor for change	$PM_{2.5}$ annual mean (μg m^{-3})		Descriptor for change
		LP2033	Δ from Ref		LP2033	Δ from Ref		LP2033	Δ from Ref	
L2SR5	y	17.2	0.5	Negligible	16.3	0.0	Negligible	10.5	0.0	Negligible
L2SR6	n	25.1	1.6	Negligible	18.1	0.2	Negligible	11.5	0.1	Negligible
L2SR8	n	24.1	1.3	Negligible	17.9	0.2	Negligible	11.4	0.1	Negligible
L2SR10	n	21.8	1.1	Negligible	17.3	0.1	Negligible	11.1	0.1	Negligible
L2SR3	n	26.8	1.6	Negligible	18.4	0.2	Negligible	11.7	0.1	Negligible
L2SR4	y	18.7	0.5	Negligible	16.7	0.0	Negligible	10.7	0.0	Negligible
L2SR7	n	24.0	1.3	Negligible	17.9	0.2	Negligible	11.4	0.1	Negligible
NR (L3)	n	26.0	1.1	Negligible	16.6	0.3	Negligible	10.6	0.2	Negligible
L3SR1	y	22.4	0.7	Negligible	15.9	0.2	Negligible	10.2	0.1	Negligible
L3SR2	y	20.8	0.5	Negligible	15.6	0.2	Negligible	10.0	0.1	Negligible
L3SR3	y	20.4	0.5	Negligible	15.5	0.1	Negligible	10.0	0.1	Negligible
L3SR4	y	20.0	0.5	Negligible	15.4	0.1	Negligible	9.9	0.1	Negligible
L3NSR5	n	19.0	0.5	Negligible	14.8	0.1	Negligible	9.6	0.1	Negligible
L3NSR6	n	18.7	1.2	Negligible	14.8	0.3	Negligible	9.6	0.2	Negligible
L3NSR7	n	18.3	1.5	Negligible	14.8	0.3	Negligible	9.6	0.2	Negligible
L3NSR8	n	19.5	0.6	Negligible	15.0	0.1	Negligible	9.7	0.1	Negligible
L3NSR9	n	20.6	1.1	Negligible	15.3	0.2	Negligible	9.9	0.1	Negligible

Table 4-2 shows that when the total concentrations are taken into account the changes of annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations are all at the magnitude of being negligible apart from receptor DL (Location 1) which is the location of the monitoring site and is not a sensitive receptor. Overall, these impacts are considered to be '**not significant**'.

In case vehicle emission factors are not improving as forecasted in the NAEI, a sensitivity test has been undertaken assuming that the 2033 background and vehicle emission factors stay at the projection level of 2021. Predicted annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ at the selected air quality receptors in 2033 using 2021 background and vehicle emission factors are listed in Table 4-3.

Table 4-3: Sensitivity Test: Pollutant Concentration Predicted for 2033 Local Plan Development Scenario Using 2021 Background and Vehicle Emission Factors

Receptor	Sensitive	NO_2 annual mean (μg m^{-3})		Descriptor for change	PM_{10} annual mean (μg m^{-3})		Descriptor for change	$PM_{2.5}$ annual mean (μg m^{-3})		Descriptor for change
		LP2033	Δ from Ref		LP2033	Δ from Ref		LP2033	Δ from Ref	
DL (L1)	n	**43.4**	2.8	**Moderate**	18.6	0.5	Negligible	12.2	0.3	Negligible
L1NSR1	n	33.1	1.6	Slight	16.0	0.2	Negligible	10.8	0.1	Negligible
L1SR2	y	27.3	1.2	Negligible	15.1	0.1	Negligible	10.2	0.1	Negligible
L1SR3	y	24.2	0.9	Negligible	14.6	0.1	Negligible	10.0	0.0	Negligible
L1SR4	y	23.2	0.9	Negligible	14.5	0.1	Negligible	9.9	0.0	Negligible
L1SR5	y	27.4	-0.1	Negligible	15.6	-0.1	Negligible	10.5	-0.1	Negligible
L1SR6	y	24.2	0.4	Negligible	14.7	0.0	Negligible	10.0	0.0	Negligible

Receptor	Sensitive	NO_2 annual mean (µg m^{-3})		Descriptor for change	PM_{10} annual mean (µg m^{-3})		Descriptor for change	$PM_{2.5}$ annual mean (µg m^{-3})		Descriptor for change
		LP2033	Δ from Ref		LP2033	Δ from Ref		LP2033	Δ from Ref	
L1SR7	y	28.7	1.4	Negligible	15.4	0.2	Negligible	10.4	0.1	Negligible
L1SR8	y	24.8	1.3	Negligible	14.6	0.1	Negligible	10.0	0.1	Negligible
L1SR9	y	30.9	2.0	Negligible	15.7	0.2	Negligible	10.6	0.1	Negligible
L1SR10	y	32.4	2.1	Slight	16.0	0.2	Negligible	10.7	0.2	Negligible
L1SR11	y	27.1	1.6	Negligible	15.2	0.2	Negligible	10.3	0.1	Negligible
L1SR12	y	29.7	1.8	Negligible	15.6	0.2	Negligible	10.5	0.1	Negligible
L1SR13	n	39.9	1.7	**Moderate**	17.3	0.3	Negligible	11.5	0.2	Negligible
L1SR14	y	37.1	2.0	Slight	16.8	0.2	Negligible	11.2	0.1	Negligible
L1SR15	y	34.5	2.1	Slight	16.4	0.2	Negligible	11.0	0.1	Negligible
L1SR16	y	33.3	2.0	Slight	16.2	0.2	Negligible	10.8	0.1	Negligible
L1SR17	y	33.1	2.0	Slight	16.1	0.2	Negligible	10.8	0.1	Negligible
L1SR18	y	30.3	1.8	Negligible	15.6	0.1	Negligible	10.5	0.1	Negligible
L1SR19	y	18.0	0.2	Negligible	13.6	0.0	Negligible	9.4	0.0	Negligible
L1SR20	y	20.3	0.4	Negligible	14.0	0.0	Negligible	9.6	0.0	Negligible
L1SR21	y	23.1	0.6	Negligible	14.5	0.0	Negligible	9.9	0.0	Negligible
L1NSR22	n	26.7	1.0	Negligible	15.2	0.1	Negligible	10.3	0.1	Negligible
L1SR23	y	30.6	2.2	Slight	15.8	0.3	Negligible	10.6	0.2	Negligible
L1SR24	y	30.3	2.3	Slight	15.7	0.3	Negligible	10.6	0.2	Negligible
L1SR25	y	22.3	1.4	Negligible	14.4	0.2	Negligible	9.8	0.1	Negligible
L1SR26	y	27.6	2.2	Negligible	15.4	0.3	Negligible	10.4	0.2	Negligible
PD (L2)	n	33.3	0.7	Slight	14.7	0.0	Negligible	11.8	0.0	Negligible
CRN (L2)	n	36.9	0.9	Slight	15.5	0.0	Negligible	12.3	0.0	Negligible
CRN-RT (L2)	n	25.7	0.7	Negligible	13.1	0.0	Negligible	10.9	0.0	Negligible
L2SR1	n	19.7	0.5	Negligible	11.9	0.0	Negligible	10.3	0.0	Negligible
L2SR2	n	20.2	0.5	Negligible	12.0	0.0	Negligible	10.3	0.0	Negligible
L2SR5	y	21.76	0.6	Negligible	12.3	0.0	Negligible	10.5	0.0	Negligible
L2SR6	n	32.4	2.1	Slight	14.1	0.2	Negligible	11.5	0.1	Negligible
L2SR8	n	31.2	1.9	Slight	13.9	0.2	Negligible	11.4	0.1	Negligible
L2SR10	n	28.1	1.5	Negligible	13.4	0.1	Negligible	11.1	0.1	Negligible
L2SR3	n	34.7	2.0	Slight	14.4	0.2	Negligible	11.7	0.1	Negligible
L2SR4	y	23.8	0.7	Negligible	12.7	0.0	Negligible	10.7	0.0	Negligible
L2SR7	n	31.1	1.9	Slight	13.9	0.2	Negligible	11.4	0.1	Negligible
NR (L3)	n	32.9	1.5	Negligible	17.0	0.3	Negligible	10.6	0.2	Negligible
L3SR1	y	28.1	1.0	Negligible	16.2	0.2	Negligible	10.2	0.1	Negligible
L3SR2	y	25.9	0.8	Negligible	15.9	0.2	Negligible	10.0	0.1	Negligible
L3SR3	y	25.3	0.7	Negligible	15.8	0.1	Negligible	10.0	0.1	Negligible
L3SR4	y	24.7	0.7	Negligible	15.8	0.1	Negligible	9.9	0.1	Negligible

Receptor	Sensitive	NO_2 annual mean (µg m^{-3})		Descriptor for change	PM_{10} annual mean (µg m^{-3})		Descriptor for change	$PM_{2.5}$ annual mean (µg m^{-3})		Descriptor for change
		LP2033	Δ from Ref		LP2033	Δ from Ref		LP2033	Δ from Ref	
L3NSR5	n	23.4	0.7	Negligible	15.2	0.1	Negligible	9.6	0.1	Negligible
L3NSR6	n	22.9	1.8	Negligible	15.2	0.3	Negligible	9.6	0.2	Negligible
L3NSR7	n	22.3	2.0	Negligible	15.2	0.4	Negligible	9.6	0.2	Negligible
L3NSR8	n	24.1	0.7	Negligible	15.3	0.1	Negligible	9.7	0.1	Negligible
L3NSR9	n	25.6	1.5	Negligible	15.6	0.2	Negligible	9.9	0.1	Negligible

The sensitivity test indicates that the annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations are predicted to be below the national air quality objective value at all sensitive receptors, except one. The magnitudes of change are slightly larger, but mostly remain within the same range as per the initial evaluation (i.e. negligible to slight impact).

The test, which is considered very conservative, shows that if emissions and fuels do not improve between 2021 and 2033 and localised low emission interventions are not implemented exceedances of national objectives are possible at receptor DL and L1SR13 both at Location 1 (Debdale Lane), although these should not be considered to be sensitive receptors. The change in the annual mean NO_2 with respect to the absolute concentration may be described as 'moderate' for these two non-sensitive receptors.

Higher total concentrations owing to the limited technical emissions improvements will mean that the area would be more sensitive to any additional emissions, even if the additional emissions are at the same magnitude.

4.3 Penniment Farm and Lindhurst

The road traffic effects of the Lindhurst and Penniment Farm (L&PF) residential developments were incorporated into the 2033 Reference Case scenario, and modelled using the 2033 traffic data in 2021.

The results in Table 4-4 show the predicted annual mean concentrations of the Reference Case excluding L&PF (and excluding the Local Plan), and the change resulting from these two development going ahead.

The model predicted that the pollutant concentrations would be lower in all locations without the two L&PF developments going ahead.

The largest change due to the two developments was predicted at receptor L1SR13, of 5.6 µg/m^3, although this was not a sensitive location.

The largest change due to the two developments at a sensitive location was described as Moderate Adverse at receptor L1SR14, with an increase of 3.9 µg/m^3. The remaining effects at sensitive locations were described as Slight or Negligible.

Table 4-4: Pollutant Concentration Predicted for 2033 Reference Case Excluding Lindhurst and Penniment Farm Scenario Using 2021 Background and Vehicle Emission Factors

Receptor	Sensitive	NO_2 annual mean (µg m^{-3})		Descriptor for change	PM_{10} annual mean (µg m^{-3})		Descriptor for change	$PM_{2.5}$ annual mean (µg m^{-3})		Descriptor for change
		Ref exc. L&PF	Δ from Ref		Ref exc. L&PF	Δ from Ref		Ref exc. L&PF	Δ from Ref	
DL (L1)	n	38.5	2.1	**Moderate**	17.9	0.2	Negligible	11.8	0.1	Negligible
L1NSR1	n	27.8	3.7	**Moderate**	15.6	0.2	Negligible	10.5	0.2	Negligible
L1SR2	y	24.1	2.0	Negligible	14.8	0.2	Negligible	10.0	0.1	Negligible
L1SR3	y	22.3	1.0	Negligible	14.4	0.1	Negligible	9.8	0.1	Negligible
L1SR4	y	21.6	0.8	Negligible	14.3	0.1	Negligible	9.7	0.1	Negligible

Receptor	Sensitive	NO_2 annual mean (μg m^{-3})		Descriptor for change	PM_{10} annual mean (μg m^{-3})		Descriptor for change	$PM_{2.5}$ annual mean (μg m^{-3})		Descriptor for change
		Ref exc. L&PF	Δ from Ref		Ref exc. L&PF	Δ from Ref		Ref exc. L&PF	Δ from Ref	
L1SR5	y	26.2	1.3	Negligible	15.5	0.3	Negligible	10.4	0.1	Negligible
L1SR6	y	22.7	1.1	Negligible	14.6	0.2	Negligible	9.9	0.1	Negligible
L1SR7	y	25.9	1.5	Negligible	15.1	0.1	Negligible	10.2	0.1	Negligible
L1SR8	y	22.7	0.8	Negligible	14.4	0.1	Negligible	9.8	0.0	Negligible
L1SR9	y	28.1	0.9	Negligible	15.4	0.1	Negligible	10.4	0.1	Negligible
L1SR10	y	29.3	1.0	Slight	15.6	0.1	Negligible	10.5	0.1	Negligible
L1SR11	y	24.8	0.7	Negligible	14.9	0.1	Negligible	10.1	0.1	Negligible
L1SR12	y	26.9	1.0	Negligible	15.3	0.1	Negligible	10.3	0.1	Negligible
L1SR13	n	32.7	5.6	**Substantial**	16.7	0.3	Negligible	11.1	0.2	Negligible
L1SR14	y	31.2	3.9	**Moderate**	16.2	0.3	Negligible	10.8	0.2	Negligible
L1SR15	y	30.3	2.1	Slight	15.9	0.3	Negligible	10.7	0.2	Negligible
L1SR16	y	29.4	1.8	Slight	15.7	0.3	Negligible	10.6	0.1	Negligible
L1SR17	y	29.3	1.8	Slight	15.7	0.3	Negligible	10.6	0.1	Negligible
L1SR18	y	27.0	1.5	Negligible	15.2	0.2	Negligible	10.3	0.1	Negligible
L1SR19	y	17.4	0.4	Negligible	13.5	0.0	Negligible	9.3	0.0	Negligible
L1SR20	y	19.3	0.5	Negligible	13.9	0.1	Negligible	9.5	0.0	Negligible
L1SR21	y	21.6	0.8	Negligible	14.4	0.1	Negligible	9.8	0.1	Negligible
L1NSR22	n	24.4	1.3	Negligible	15.0	0.1	Negligible	10.1	0.1	Negligible
L1SR23	y	26.3	2.2	Negligible	15.2	0.2	Negligible	10.3	0.1	Negligible
L1SR24	y	25.9	2.1	Negligible	15.2	0.2	Negligible	10.2	0.2	Negligible
L1SR25	y	19.8	1.1	Negligible	14.0	0.1	Negligible	9.6	0.1	Negligible
L1SR26	y	23.8	1.6	Negligible	14.8	0.2	Negligible	10.0	0.1	Negligible
PD (L2)	n	31.5	1.2	Slight	14.6	0.1	Negligible	11.8	0.1	Negligible
CRN (L2)	n	34.6	1.4	Slight	15.3	0.2	Negligible	12.2	0.1	Negligible
CRN-RT (L2)	n	24.0	0.9	Negligible	12.9	0.1	Negligible	10.8	0.1	Negligible
L2SR1	n	18.4	0.9	Negligible	11.8	0.1	Negligible	10.2	0.0	Negligible
L2SR2	n	18.9	0.9	Negligible	11.9	0.1	Negligible	10.2	0.0	Negligible
L2SR5	y	20.3	0.9	Negligible	12.1	0.1	Negligible	10.4	0.1	Negligible
L2SR6	n	27.6	2.7	**Moderate**	13.6	0.3	Negligible	11.2	0.2	Negligible
L2SR8	n	26.8	2.5	Slight	13.5	0.3	Negligible	11.1	0.2	Negligible
L2SR10	n	24.5	2.1	Negligible	13.0	0.2	Negligible	10.9	0.1	Negligible
L2SR3	n	28.7	4.0	**Moderate**	13.9	0.4	Negligible	11.4	0.2	Negligible
L2SR4	y	22.1	1.0	Negligible	12.5	0.1	Negligible	10.6	0.1	Negligible
L2SR7	n	26.8	2.4	Slight	13.5	0.3	Negligible	11.1	0.2	Negligible
NR (L3)	n	28.7	2.7	**Moderate**	16.6	0.1	Negligible	10.4	0.1	Negligible
L3SR1	y	25.8	1.3	Negligible	16.0	0.1	Negligible	10.0	0.1	Negligible
L3SR2	y	24.5	0.6	Negligible	15.7	0.1	Negligible	9.9	0.0	Negligible

Receptor	Sensitive	NO_2 annual mean (µg m^{-3})		Descriptor for change	PM_{10} annual mean (µg m^{-3})		Descriptor for change	$PM_{2.5}$ annual mean (µg m^{-3})		Descriptor for change
		Ref exc. L&PF	Δ from Ref		Ref exc. L&PF	Δ from Ref		Ref exc. L&PF	Δ from Ref	
L3SR3	y	24.2	0.4	Negligible	15.6	0.1	Negligible	9.9	0.0	Negligible
L3SR4	y	23.7	0.3	Negligible	15.6	0.1	Negligible	9.8	0.0	Negligible
L3NSR5	n	21.7	1.0	Negligible	15.0	0.0	Negligible	9.5	0.0	Negligible
L3NSR6	n	20.2	1.0	Negligible	14.8	0.1	Negligible	9.4	0.0	Negligible
L3NSR7	n	19.5	0.8	Negligible	14.7	0.1	Negligible	9.3	0.1	Negligible
L3NSR8	n	22.0	1.4	Negligible	15.2	0.0	Negligible	9.6	0.0	Negligible
L3NSR9	n	23.4	0.7	Negligible	15.3	0.1	Negligible	9.7	0.1	Negligible

4.4 Impact Summary

When considering the overall effect of the Local Plan on road transport emissions and the effect on background concentrations using IAQM significance criteria the overall conclusion is that the impact of the Plan would be **'not significant'**.

When considering the effect of the Lindhurst and Penniment Farm residential developments separately from the Local Plan, the overall conclusion is that the impacts would be **'not significant'** (only one sensitive receptor was predicted to experience a moderate impact; the rest were predicted to experience slight or negligible).

The approach undertaken considered worst case receptor locations and a very cautious view on improving vehicle technologies.

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5. Conclusion

AECOM was commissioned by Mansfield District Council to examine the local air quality effects arising at three key junctions in Mansfield due to the implementation of the proposed Local Plan allocation.

A quantitative operational phase assessment has been undertaken in accordance with the EPUK/IAQM 'Land Use Planning & Development Control: Planning for Air Quality' (EPUK/IAQM, 2017). Detailed dispersion modelling, using the ADMS Roads software, was undertaken to determine the impact of traffic derived pollutant concentrations at nearby sensitive receptors.

Implementation of the Local Plan would cause an increase in the number of vehicles travelling through the junctions of concern. This level of traffic increase would not have significant impacts on local air quality. The detailed modelling of local road traffic emissions shows that in the year of operation (2033) all sensitive receptors will be subject to air pollutant concentration changes considered to be 'negligible' when reviewed against EPUK/IAQM (2017) evaluation criteria. A sensitivity test shows that even if the expected improvements in vehicle emissions do not materialise and remain stagnant at 2021 levels, the impact would still be 'negligible' to 'slight'.

The effects of the Lindhurst and Penniment Farm residential developments would contribute to increased pollutant concentrations compared to the Reference Case without the Local Plan. The largest effect was described as Moderate Adverse for NO_2, at a single sensitive receptor, and negligible to slight adverse at all other sensitive receptors.

The overall conclusion is that the Local Plan will not have a significant effect on local air quality at the three targeted junctions in 2033, and similarly the Lindhurst and Penniment Farm residential developments would not have a significant effect at the same junctions in 2021.

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Appendix A Air Quality Assessment Figures

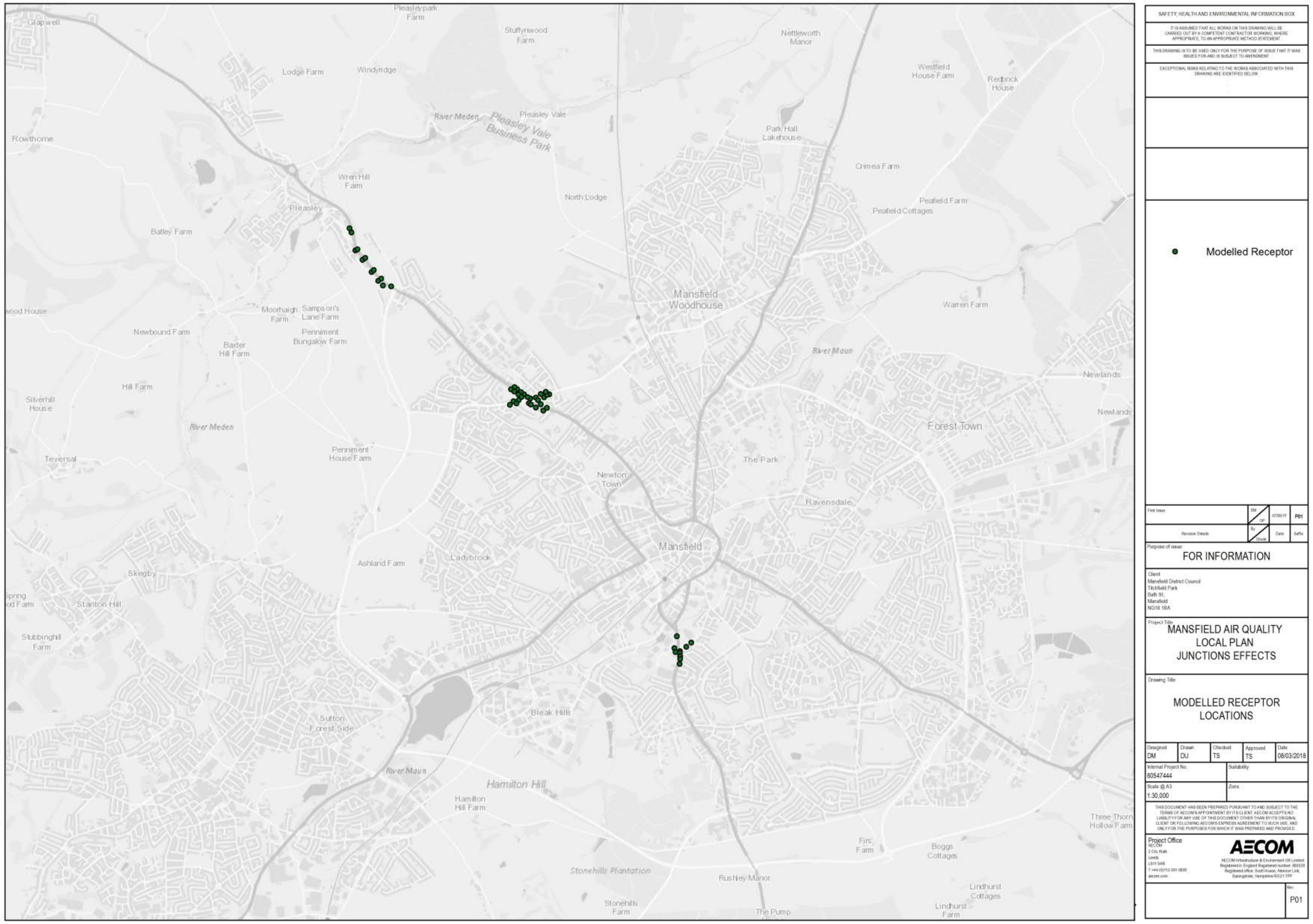

Figure 6-1: Modelled Locations

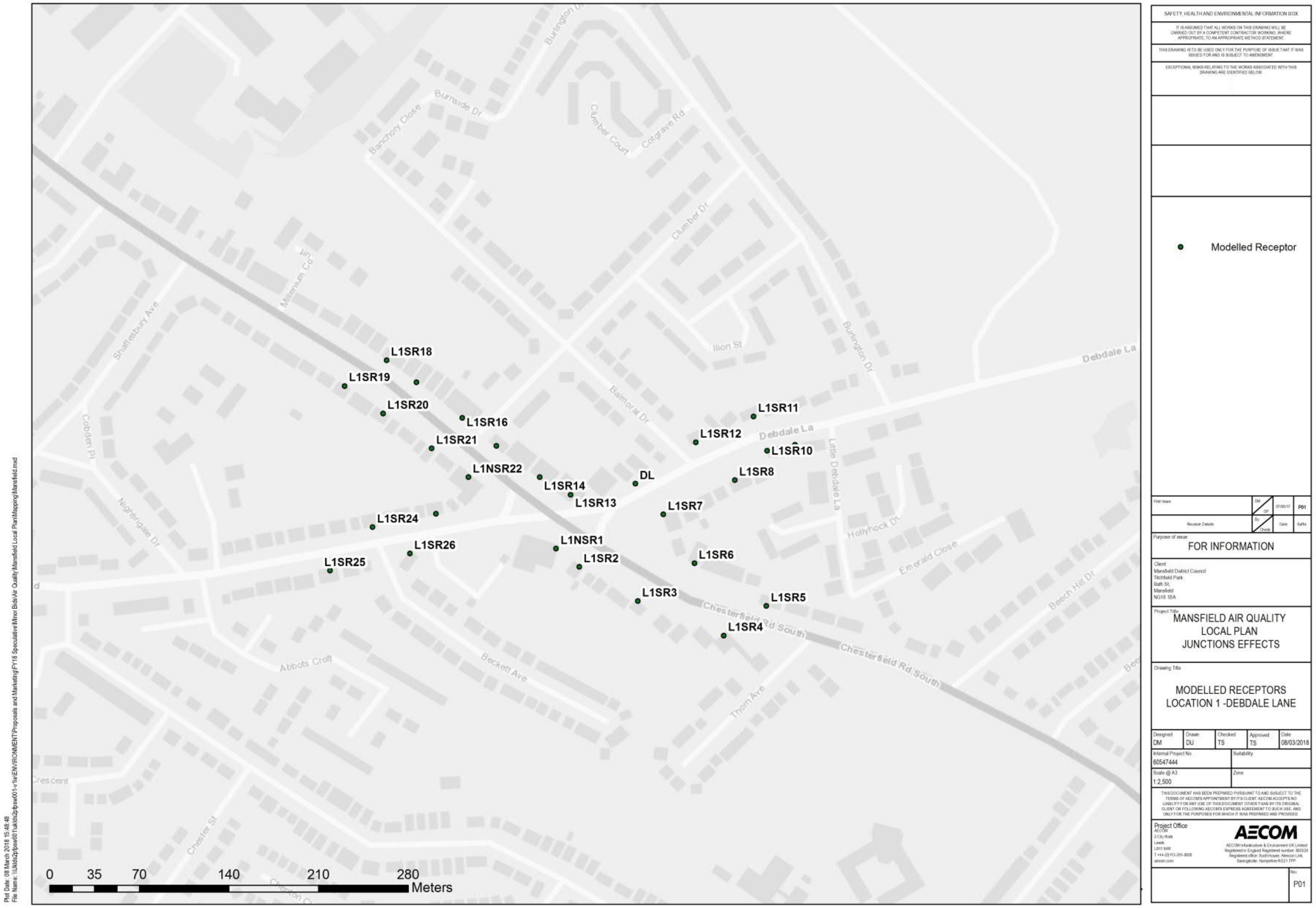

Figure 6-2: Location 1 – Debdale Lane

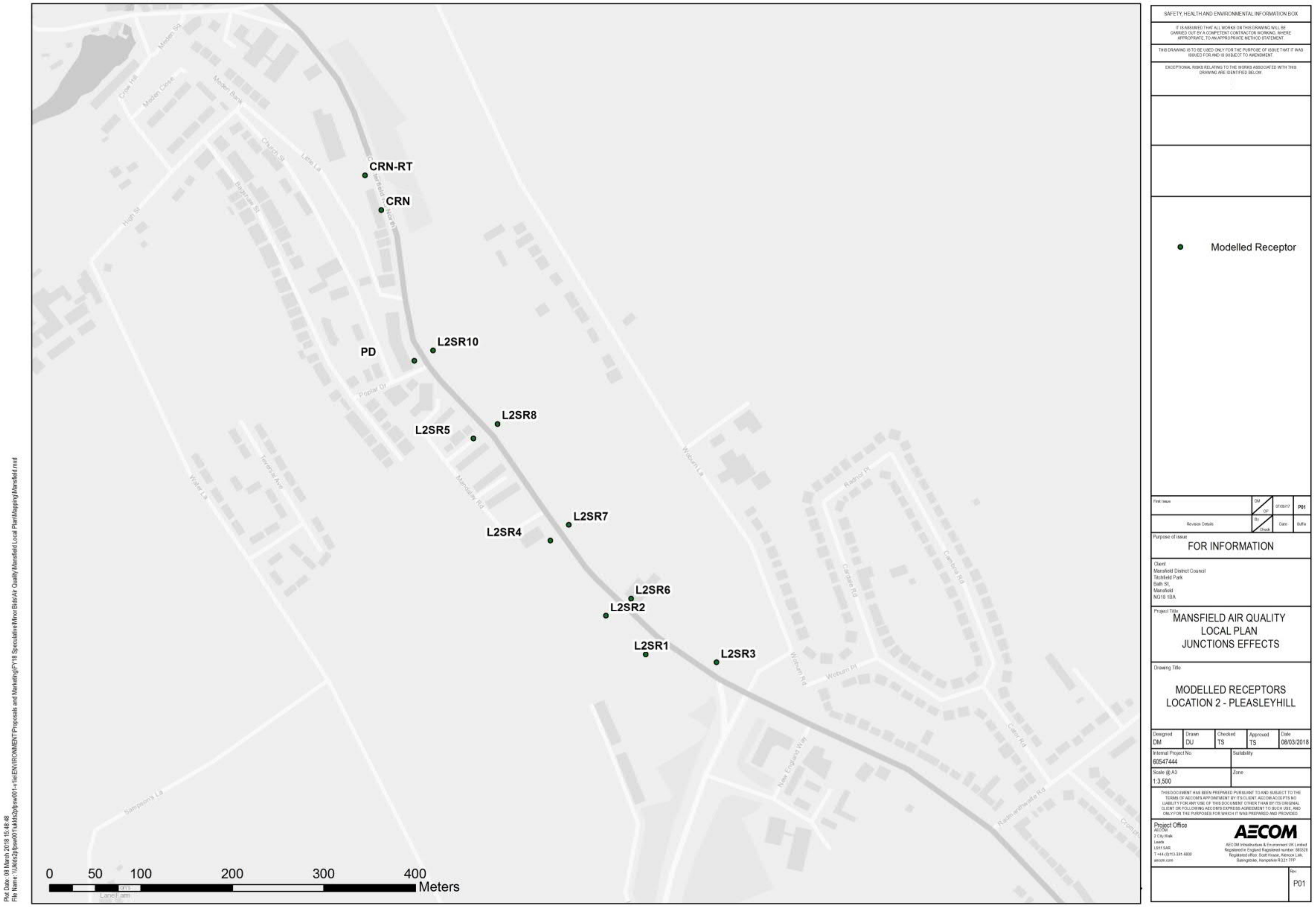

Figure 6-3: Location 2 –Chesterfield Road North Pleasley

Figure 6-4: Location 3 - Nottingham Road / Sainsbury's junction

Appendix B Traffic Data

This air quality assessment has used predicted traffic flows for the proposed Local Plan Development derived by AECOM transport consultants. The base year, reference year and with development traffic activity is shown in Table 6-1 to Table 6-2. The locations of links are shown in Appendix C in Figure 6-5 to Figure 6-7.

Table 6-1: Traffic Data Used in Model

		Base Year 2016			Reference Year Exc Lind & Penn			Reference Year				With Local Plan			
Road ID	Location	AADT	% HDV	km/h	AADT	% HDV	km/h	Location	AADT	% HDV	km/h	Location	AADT	% HDV	km/h
150-20SoJ	L3	8495	3.7%	33	9365	3%	33	L3	9856	3%	33	L3	11014	3%	33
150-235EoJ	L3	3054	1.7%	39	3775	1%	37	L3	4603	1%	36	L3	6036	1%	34
150-235EoJQ5	L3	3054	1.7%	15	3775	1%	15	L3	4603	1%	15	L3	6036	1%	15
150-315NoJ	L3	9642	3.2%	33	10613	3%	33	L3	10747	3%	33	L3	11953	2%	33
150-316WoJ	L3	5525	1.3%	48	5776	1%	48	L3	5496	1%	48	L3	5373	1%	48
199-45NEoJ	L2	1345	2.5%	8	1503	2%	8	L2	1929	2%	8	L2	2282	2%	8
20-150SoJ	L3	9019	3.5%	25	9699	3%	25	L3	9578	3%	25	L3	9392	3%	25
203-44SEoJ	L1	9151	5.8%	20	10202	5%	20	L1	10739	5%	19	L1	11743	5%	15
204-44NWoJ	L1	9039	3.5%	16	10835	3%	17	L1	12101	3%	16	L1	12894	3%	12
235-150EoJ	L3	3470	1.9%	23	3731	2%	23	L3	3566	2%	23	L3	5197	1%	19
235-150EoJQ5	L3	3470	1.9%	15	3731	2%	15	L3	3566	2%	15	L3	5197	1%	15
289-45SEoJ	L2	9084	3.3%	31	10541	3%	30	L2	10454	3%	30	L2	9885	3%	30
315-150Noj	L3	9619	3.2%	8	11026	3%	7	L3	12428	3%	8	L3	14633	2%	7
316-150WoJ	L3	4876	1.2%	9	5336	1%	9	L3	5398	1%	9	L3	5575	1%	9
326-44EoJ	L1	12200	2.0%	19	12025	2%	14	L1	12276	2%	13	L1	12987	2%	10
44-203SEoJ	L1	10672	4.8%	48	12507	4%	48	L1	13855	4%	48	L1	12347	4%	48
44-204NWoJ	L1	9140	3.7%	48	10502	3%	48	L1	10351	3%	48	L1	9561	3%	48
44-326EoJ	L1	10790	2.8%	36	12154	3%	36	L1	12565	3%	35	L1	14046	2%	34
44-84WoJ	L1	9668	1.6%	39	8190	2%	40	L1	8973	2%	39	L1	11013	2%	36
45-199NEoJ	L2	645	3.8%	36	692	3%	36	L2	843	3%	36	L2	959	2%	36
45-289SEoJ	L2	7337	4.8%	32	9254	4%	31	L2	10489	4%	30	L2	11290	4%	30
45-46NWoJ	L2	14045	2.9%	35	16075	2%	33	L2	15860	2%	33	L2	15387	2%	33
45-85SWoJ	L2	6388	3.1%	63	7343	3%	62	L2	7320	3%	62	L2	7206	3%	62
46-45NWoJ	L2	11987	4.3%	31	14657	4%	29	L2	16649	4%	20	L2	18006	4%	15
46-45NWoJQ79	L2	11987	4.3%	10	14657	4%	10	L2	16649	4%	10	L2	18006	4%	10
84-44WoJ	L1	10458	2.2%	23	11274	2%	23	L1	12355	2%	18	L1	13085	2%	14
85-45SWoJ	L2	5993	2.0%	49	6739	2%	48	L2	6960	2%	48	L2	7595	2%	45

The total traffic (AADT) traversing the junctions in the Base, Reference and With Local Plan development is shown in Table 6-2. These data were applied to area based emission sources in the modelling.

Table 6-2: Daily traffic traversing each junction

Junction	Base (AADT & % HDV)	Ref exc Lind & Penn (AADT & % HDV)	Reference (AADT & % HDV)	With Development (AADT & % HDV)	Speed (km/h)
L1	75537 (3.1)	81751 (2.8)	86260 (2.8)	90166 (2.6)	10
L2	58198 (3.2)	67536 (2.9)	72404 (2.9)	75811 (2.8)	10
L3	57907 (3.1)	64526 (2.7)	66727 (2.6)	73483 (2.3)	10

Appendix C Link Maps

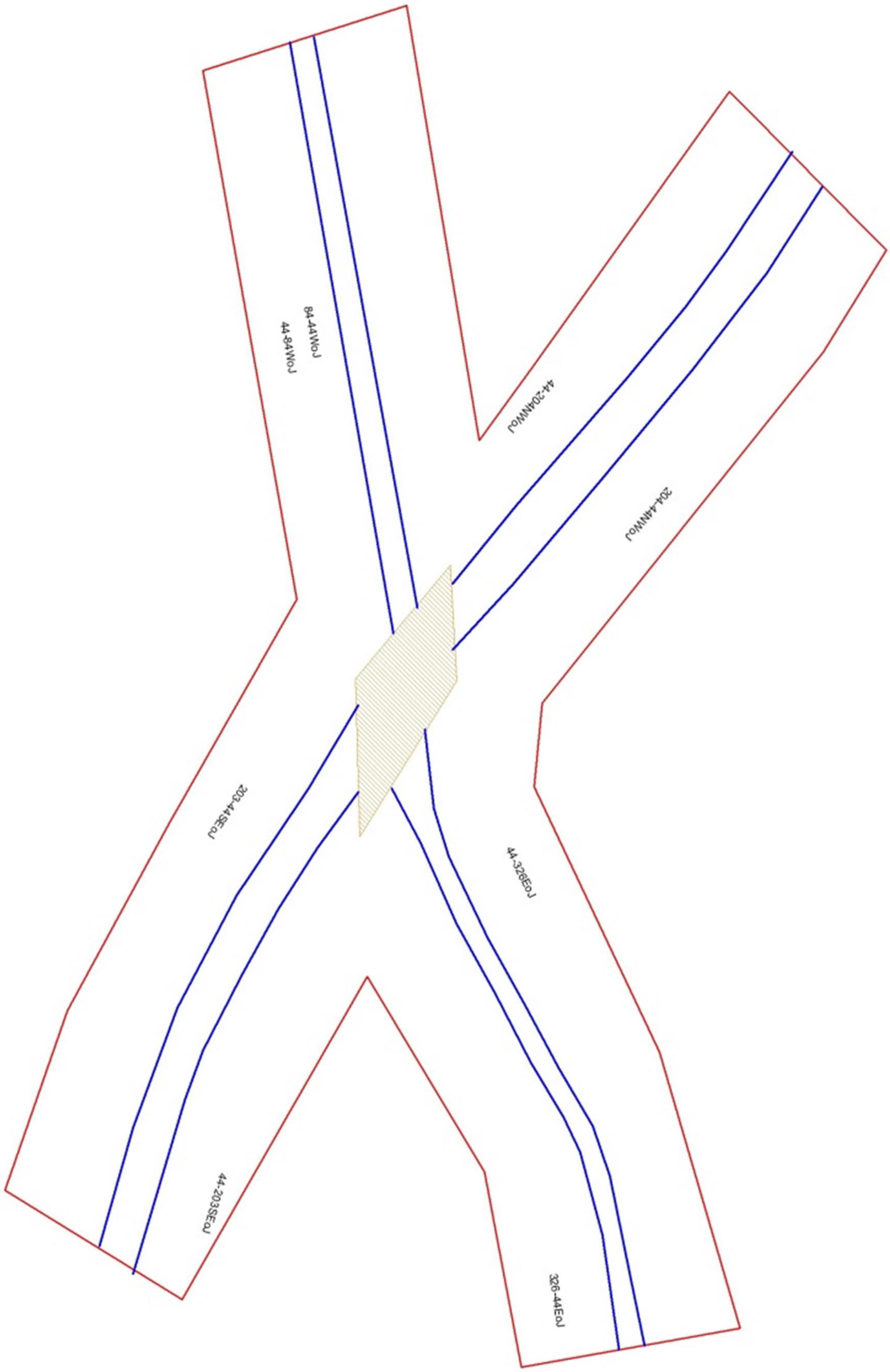

Figure 6-5: Location 1 – Modelled Road Links

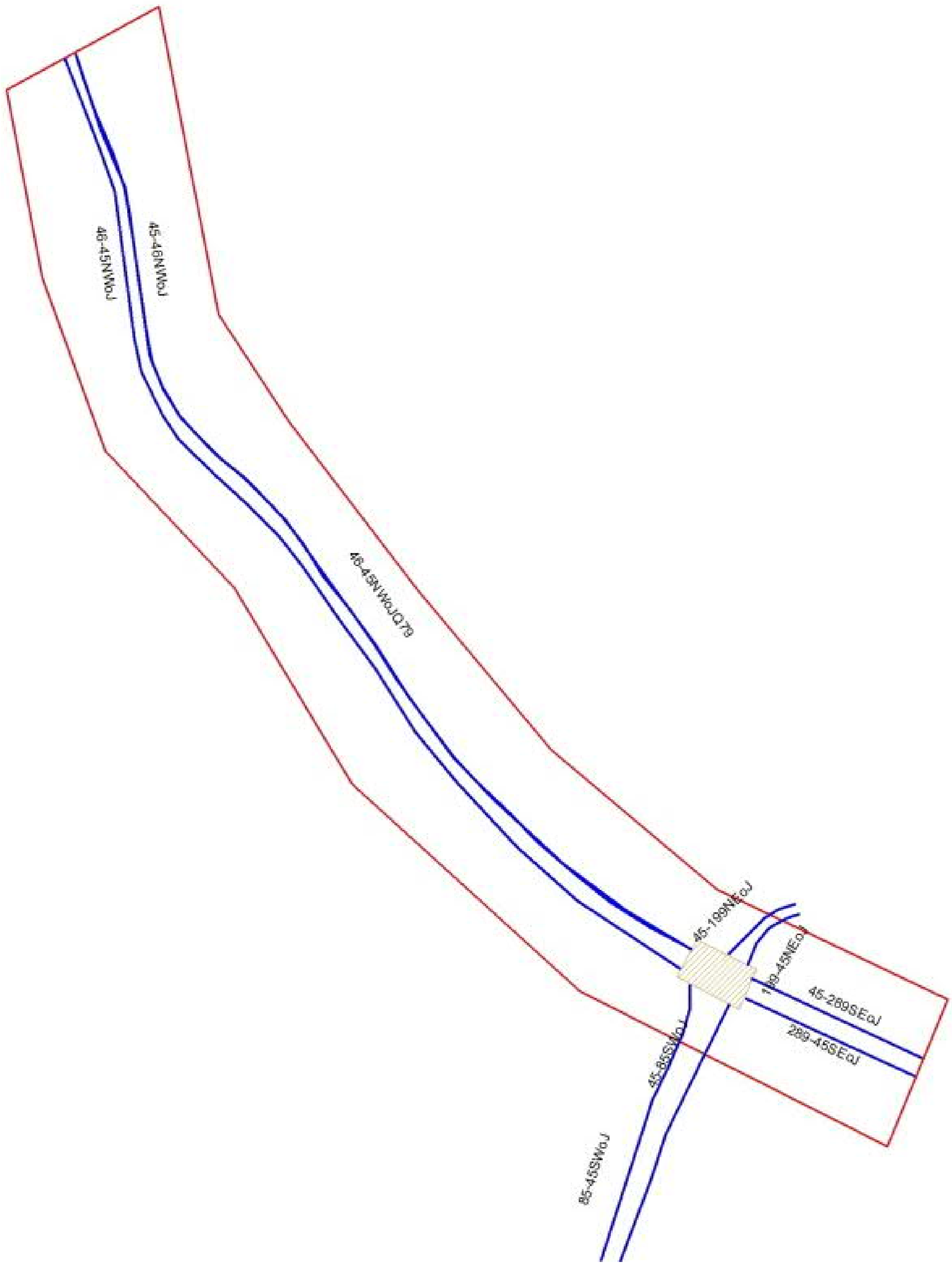

Figure 6-6: Location 2 – Modelled Road Links

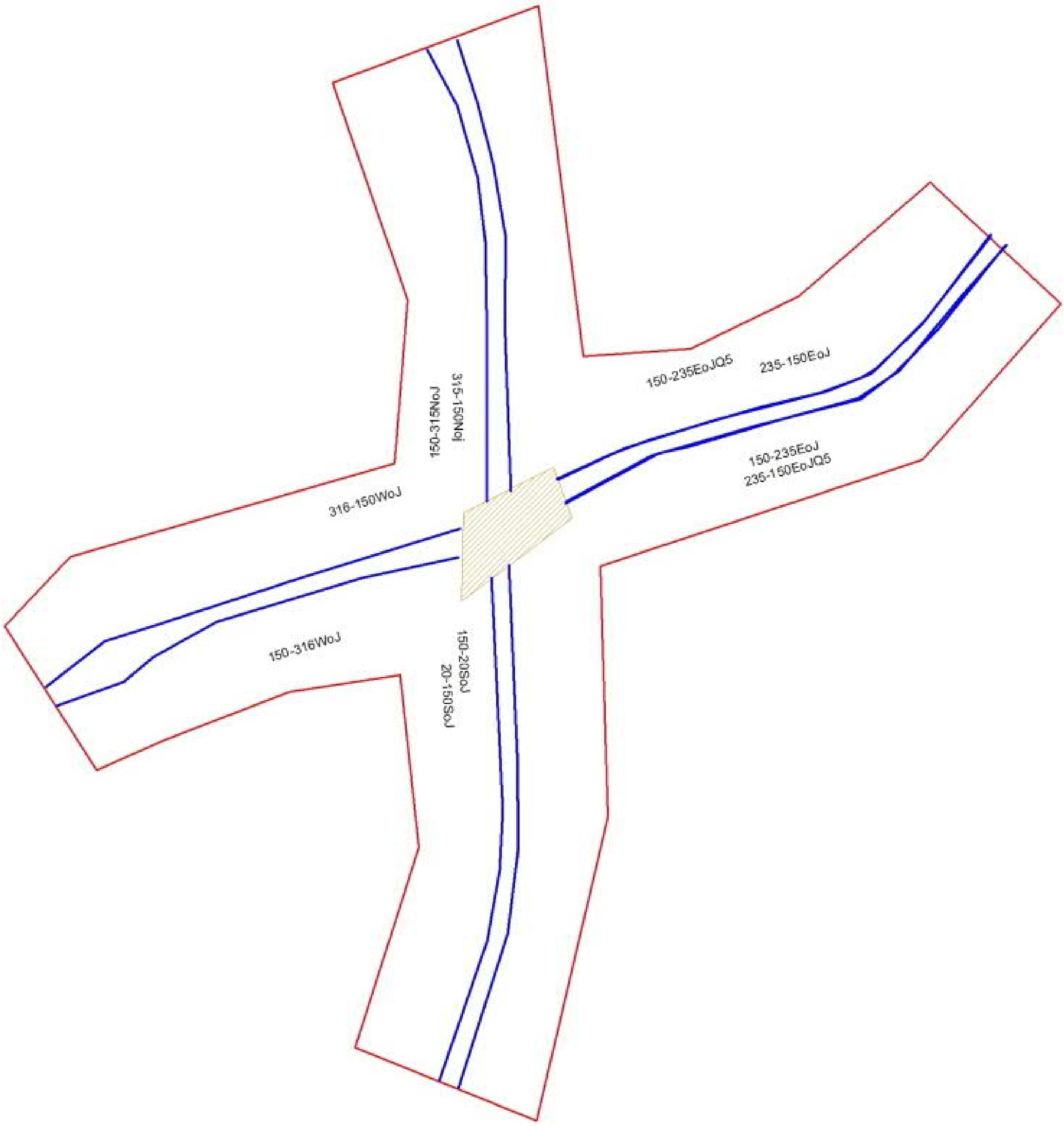

Figure 6-7: Location 3 – Modelled Road Links

Appendix D Modelling Verification

The verification analysis was performed on NOx and applied AQ monitoring data obtained from site CRN-RT, CRN and PD for year 2016. The first step involves comparing the unadjusted modelled and measured annual mean NO_2 and plotting the results (see Figure 6-8). In order to provide more confidence in the model predictions and the decisions based on these, the majority of results should be within 25% of the monitored concentrations as a minimum, preferably within 10%. From the figure the best agreement occurred at the real time monitoring site CRN-RT.

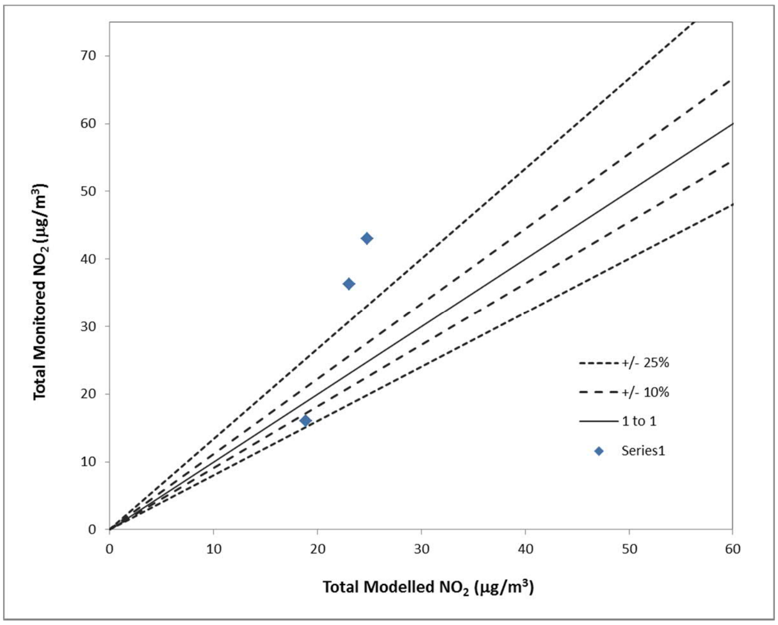

Figure 6-8: Initial comparison of modelled and measured NO_2

The next step is to compare the monitored road NOx contributions from the modelling results with the measured results. Again these results are plotted as shown in Figure 6-9. Forcing the relationship through zero provides a an adjustment factor of 2.1783.

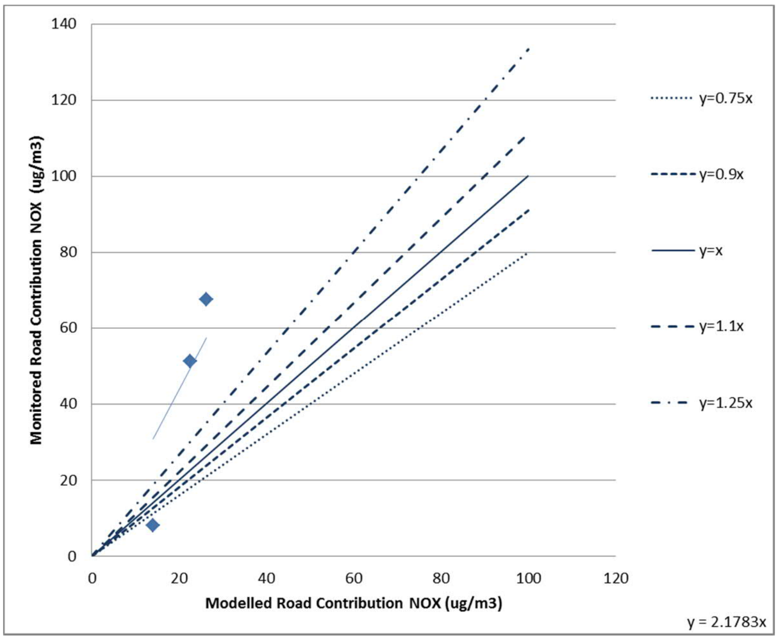

Figure 6-9: Comparison of modelled verses measured road NOx

This adjustment factor is then reapplied to the modelled road NOx contribution and together with the background NO_2 contribution an adjusted modelled annual mean NO_2 is derived for each monitoring site. The results are plotted. The adjustment made to all three sites resulted in over adjusting the model result for CRN-RT by 68%. Taking in to account all three monitoring sites the overall post adjusted uncertainty for the annual mean NO_2 was 6.83 µg/m^3 (unadjusted the RMSE was 13 µg/m^3 (or 32%) which is unacceptable) or 17% of the objective value which is within acceptable limits according to TG16.

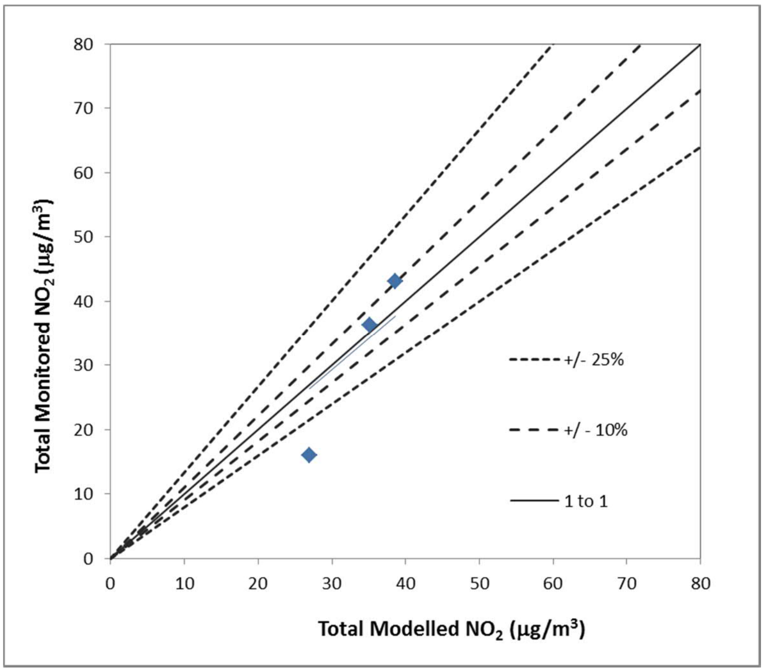

Figure 6-10: Adjusted total modelled verses monitored annual mean NO_2