Greater Manchester's Clean Air Plan to tackle Nitrogen Dioxide Exceedances at the Roadside

Evidence Submission for a new GM Clean Air Plan

Local Plan Air Quality Modelling Report (AQ3)

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Contents

1 Purpose of this Document

1.1.1 As required by JAQU, this 'AQ3' document provides the air quality results and discussion of the Investment-led Plan and Benchmark Clean Air Zone (CAZ) scenario. A summary of the methodology is set out in the *Local Plan Air Quality Modelling Tracking Table (AQ1)* and *Local Plan Air Quality Modelling Methodology Report (AQ2)*, which underpins any air quality modelling for the baseline (2016) and the Do-Minimum (2021, 2025 and 2026) scenarios.

1.1.2 Details of the approach to model verification are provided in **Appendix A**. The full set of air quality modelling results for exceedances in 2021 are tabulated in **Appendix B**. Details of the sensitivity testing will be reported in the *Sensitivity Testing Report*.

1.1.3 This document is part of a suite of documents that have been produced to describe the transport and air quality modelling deliverables for the study. The documents in the series include:

- Local Plan Transport Modelling Tracking Table (T1), which demonstrates that the transport modelling requirements for the study are being met;
- Local Plan Transport Model Validation Report (T2), which explains in detail how the road traffic model was validated against real-world data;
- Local Plan Transport Modelling Methodology Report (T3), this document details the development of the future year without scheme model (Do Minimum);
- Local Plan Transport Model Forecasting Report (T4), which presents baseline and scenario forecasts for GM CAP;
- Local Plan Air Quality Modelling Tracking Table (AQ1), which demonstrates that the air quality modelling requirements for the study are being met;
- Local Plan Air Quality Modelling Methodology Report (AQ2), which provides an overview of the air quality modelling process;
- Local Plan Air Quality Modelling Report (AQ3)(this document), which provides details of modelled NOx and NO2 concentrations for the base and forecast years, including comparisons with measured concentrations for the base year;
- Sensitivity Testing Report, which provides a summary of the sensitivity tests carried out on the core scenarios to test areas of uncertainty, understand whether the tests result in a positive or negative benefit and the scale of benefit; and
- Analytical Assurance Statement, consider the limitations, uncertainties and risks in the evidence base, and the implications of these for decision makers.

2 Greater Manchester Clean Air Plan Overview

2.1 Background to the Clean Air Plan

2.1.1 In 2017 the Secretary of State (SoS) for Environment, Food and Rural Affairs issued directions under the Environment Act 1995 requiring many local authorities, to produce feasibility studies to identify the option which will deliver compliance with the requirement to meet legal limits for nitrogen dioxide (NO_2) in the shortest possible time. The legal limit being defined as the long-term annual mean legal limit of 40 µg/m^3.

2.1.2 In Greater Manchester (GM), the ten local authorities, the Greater Manchester Combined Authority (GMCA) and Transport for Greater Manchester (TfGM) are working together to develop a Clean Air Plan to tackle NO_2 exceedances at the roadside, herein known as Greater Manchester Clean Air Plan (GM CAP).

2.1.3 The development of the GM CAP is funded by government and is overseen by the Joint Air Quality Unit (JAQU), the joint Department for Environment, Food and Rural Affairs (DEFRA) and Department for Transport (DfT) unit established to deliver national plans to improve air quality and meet legal limits. The costs related to the business case, implementation and operation of the GM CAP are either directly funded or underwritten by government acting through JAQU and any net deficit over the life of the GM CAP will be covered by the New Burdens Doctrine, subject to a reasonableness test[1].

2.1.4 In March 2019, the ten GM Local Authorities collectively submitted an Outline Business Case (OBC)[2] for the GM CAP to JAQU outlining a package of measures to deliver regional compliance with legal limits for NO_2 emissions in the shortest possible time.

2.1.5 In July 2019, the Environment Act 1995 (Greater Manchester) Air Quality Direction 2019 was made, which required all ten of the GM local authorities to implement a charging Clean Air Zone Class C[3] with additional measures. There was also an obligation to provide further scenarios appraisal information to demonstrate the applicable Class of Charging CAZ and other matters to provide assurance that the local plan would deliver compliance in the shortest possible time and by 2024 at the latest.

[1] The new burdens doctrine is part of a suite of measures to ensure Council Tax payers do not face excessive increases. New burdens doctrine: guidance for government departments - GOV.UK (www.gov.uk)
[2] https://cleanairgm.com/technical-documents/#outline-business-case
[3] https://www.gov.uk/government/publications/air-quality-clean-air-zone-framework-for-england/annex-a-clean-air-zone-minimum-classes-and-standards

2.2 In March 2020, the Environment Act 1995 (Greater Manchester) Air Quality Direction 2020 was made, which required the submission of an Interim FBC (along with confirmation that all public consultation activity has completed) as soon as possible and by no later than 30 October 2020. The 2020 direction confirmed that legal duty remains to ensure the GM CAP (Charging Clean Air Zone Class C with additional measures) is implemented so that NO_2 compliance is achieved in the shortest possible time and by 2024 at the latest and that human exposure is reduced as quickly as possible.The Ministerial letter accompanying the March 2020 direction confirmed that the minister was satisfied that the main evidence queries from the July 2019 direction had been addressed.

2.2.1 A statutory consultation on the proposals took place in Autumn 2020.

2.2.2 The GMCA - Clean Air Final Plan report[4] on 25th June 2021[5] endorsed GM's Final CAP and policy in compliance with this direction, following a review of all of the information gathered through the GM CAP consultation and wider data, evidence and modelling work. Throughout the development of the previous Plan, the JAQU reviewed and approved all technical and delivery submissions. Within this document, this is referred to as the Previous GM CAP.

2.3 The Previous GM CAP and the impacts of Covid-19

2.3.1 Under the Previous GM CAP, GM was awarded £123 million by government for funds aimed at encouraging vehicle upgrades to secure compliance and mitigating the impacts of the GM-wide CAZ. The funds included £15.4 million for bus retrofit, £3.2 million for bus replacement, £10.2 million for Private Hire Vehicles (PHVs), £10.1 million for Hackney Carriages, £7.6 million for Heavy Goods Vehicles (HGVs), £4.4 million for coaches, £2.0 million for minibuses and £70.0 million for Light Goods Vehicles (LGVs).

2.3.2 The June 2021 Clean Air Final Plan report set out that the Air Quality Administration Committee (AQAC) had the authority to establish and distribute the funds set out in the agreed GM Clean Air Plan policy. On 21 September 2021 the AQAC approved the establishment and distribution of the agreed bus replacement funds.

2.3.3 On 13 October 2021 the AQAC agreed the distribution of Clean Air funds set out in the agreed GM Clean Air Plan policy as follows:

- From 30 November 2021 applications for funding would open for HGVs.
- From the end of January 2022 applications for funding would open for PHVs, Hackney Carriages, coaches, minibuses and LGVs.

[4] https://democracy.greatermanchester-ca.gov.uk/documents/s15281/GMCA%20210621%20Report%20Clean%20Air%20Plan%20-%20FINAL%20FINAL.pdf

[5] Also considered by the GM authorities through their own constitutional decision-making arrangements.

2.3.4 On 20th January 2022, the AQAC considered the findings of an initial review of conditions within the supply chain of LGVs in particular following Covid-19 related impacts, which were impacting the availability of compliant vehicles and supply-side constraints resulting in price increases, particularly in the second-hand market[6]. The AQAC agreed that a request should be made to the SoS to pause the opening of the next phase of Clean Air Funds. This was to allow an urgent and fundamental joint policy review with government, to identify how a revised policy could be agreed to deal with the supply issues and local businesses' ability to comply with the GM CAP.

2.3.5 On 8th February 2022, the AQAC noted the submission of a report "Issues Leading to Delayed Compliance Based on the Approved GM CAP Assumptions". The report concluded that on balance, the latest emerging evidence suggested that with the approved plan in place, it was no longer likely that compliance would be achieved in 2024. Members also requested that arrangements were put in place for those vehicles owners who had already placed orders pending funding opening at the end of January to ensure they are not detrimentally impacted by the decision to pause the opening of the funds. Government subsequently issued The Environment Act 1995 (Greater Manchester) Air Quality Direction 2022[7] which confirmed that the March 2020 Direction had been revoked and required that by 1st July 2022 the GM authorities should:

- Review the measures specified in the local plan for NO_2 compliance and associated mitigation measures; and
- Determine whether to propose any changes to the detailed design of those measures, or any additional measures.

2.3.6 This Direction ('the Direction') also stated that the local plan for NO_2 compliance, with any proposed changes, must ensure the achievement of NO_2 compliance in the shortest possible time and by 2026 at the latest. It should also ensure that human exposure to concentrations of NO_2 above the legal limit is reduced as quickly as possible.

2.4 The Case for a new GM CAP

2.4.1 On 1st July 2022, the AQAC noted that the 'Case for a new Greater Manchester Clean Air Plan[8] document and associated appendices would be submitted to the SoS as a draft document subject to any comments of GM Authorities.

2.4.2 On 17th August 2022, the AQAC agreed to submit the 'Case for a new Greater Manchester Clean Air Plan' to the SoS as a final version and approved the Case for a New Plan - Air Quality Modelling Report for submission to JAQU.

[6] https://democracy.greatermanchester-ca.gov.uk/documents/s18685/ARUP%20Technical%20Note.pdf
[7] The Environment Act 1995 (Greater Manchester) Air Quality Direction 2022 (publishing.service.gov.uk)
[8] https://assets.ctfassets.net/tlpgbvy1k6h2/7jtkDc5AODypDQIw0cYwsl/67091a85f26e7c503a19ec7aeb2e8137/Appendix_1_-_Case_for_a_new_Greater_Manchester_Clean_Air_Plan.pdf

2.4.3 The 'Case for a new Greater Manchester Clean Air Plan' set out that challenging economic conditions, rising vehicle prices and ongoing pandemic impacts meant that the original plan of a GM-wide charging CAZ was no longer the right solution to achieve compliance, instead proposing an investment-led, non-charging GM CAP.

2.4.4 The primary focus of the 'Case for a new Greater Manchester Clean Air Plan' was to identify a plan to achieve compliance with the legal limit value for NO_2 in a way that considered the cost-of-living crisis and associated economic challenges faced by businesses and residents. This would be achieved through an investment-led approach combined with wider measures that the GM Authorities are implementing and aimed to reduce NO_2 emissions to within legal limits, in the shortest possible time and at the latest by 2026.

2.4.5 The 'Case for a new Greater Manchester Clean Air Plan' proposed using the remaining funding that the government has awarded to GM for the Previous GM CAP to deliver an investment-led approach to invest in vehicle upgrades, rather than imposing daily charges, and deliver new Zero Emission Buses (ZEBs) as part of the Bee Network[9] (a London-style integrated transport network for GM). The new plan would ensure that the reduction of harmful emissions would be at the centre of GM's wider objectives. Within this document, this plan is referred to as the 'Investment-led Plan'.

2.4.6 The GM Authorities committed to a participatory approach to the development of the new plan to ensure that the GM Authorities' proposals would be well-grounded in evidence in terms of the circumstances of affected groups and possible impacts of the new plan on them, and therefore the deliverability and effectiveness of that plan.

2.4.7 Between August and November 2022, the GM Authorities carried out engagement and research with key stakeholders - vehicle-owning groups and representatives of other impacted individuals, such as community, business, environment and equality-based groups. This activity included targeted engagement sessions with all groups, and an online survey and supporting qualitative research activity with vehicle-owning groups.

2.4.8 Input from those engaged informed the ongoing policy development process as the GM Authorities developed the package of measures forming the Investment-led Plan.

[9] The Bee Network is Greater Manchester integrated transport system joining together bus, Metrolink, rail and active travel https://tfgm.com/corporate/business-plan/case-studies/bee-network

2.5 The Investment-led Plan and the impact of bus retrofit issues

2.5.1 Having submitted the 'Case for a new Greater Manchester Clean Air Plan'[10] in July 2022, the GM Authorities were asked by government in January[11] 2023 to:

- *Provide modelling results for a benchmark CAZ to address the persistent exceedances identified in central Manchester and Salford, in order for these to be compared against your proposals.*
- *Identify a suitable approach to address persistent exceedances identified in your data on the A58 Bolton Road in Bury in 2025, and to propose a suitable benchmark.*
- *Set out how the measures you have proposed will be modelled and evidenced overall, and to ensure that they are modelled without any unnecessary delay.*

2.5.2 The GM Authorities undertook the work required to supply this further evidence and on 8th March 2023 submitted the report 'Approach to Address Persistent Exceedances Identified on the A58 Bolton Road, Bury'[12]. GM Authorities also worked to address the remaining two requests from government by June 2023 on the basis of providing further information to support its Investment-led Plan and testing the proposal against a suitable benchmark CAZ, herein referred to as the 'CAZ Benchmark'.

2.5.3 In April 2023, government advised TfGM that it was to pause any new spending on bus retrofit as it had evidence that retrofitted buses have poor and highly variable performance in real-world conditions[13]. This new evidence followed a JAQU-funded study to quantify nitrogen oxide (NO_X) and NO_2 emissions from buses under real-world driving conditions in three cities across the UK, including Manchester (monitoring took place in Manchester City Centre between 21st November and 12th December 2022). The monitoring indicated that retrofitted buses were not reducing emissions as expected, with significant variation in performance between bus models with retrofit technologies. Furthermore, emissions of primary-NO_2 (as opposed to NO_X) were highly variable, potentially worsening roadside NO_2 concentrations despite an overall reduction in NO_X emissions.

2.5.4 Government therefore commenced a six-month focused research programme to quickly investigate the causes of this poor performance and scope how it could be improved, which was anticipated to be reported in Autumn 2023.

[10] https://assets.ctfassets.net/tlpgbvy1k6h2/7jtkDc5AODypDQIw0cYwsl/67091a85f26e7c503a19ec7aeb2e8137/Appendix_1_-_Case_for_a_new_Greater_Manchester_Clean_Air_Plan.pdf

[11] https://democracy.greatermanchester-ca.gov.uk/documents/s24937/Appendix%201.%20Ministerial%20Letter%20to%20GM%20with%20attachment.pdf

[12] https://democracy.greatermanchester-ca.gov.uk/documents/s24939/Appendix%203.%20GM%20CAP%20A58%20Bury%20Measure%20Report%20DRAFT%20for%20AQAC%20Approval%20Feb%2023.pdf

[13] https://democracy.greatermanchester-ca.gov.uk/documents/s27699/Appendix%201.%20Letter%20from%20DfT%20to%20Greater%20Manchester%20regarding%20Bus%20Retrofit%20Update.pdf

2.5.5 In the light of government's new evidence, JAQU issued revised general guidance[14] to authorities producing CAPs nationwide. In summary, this required that air quality modelling should no longer assume any air quality benefits from a retrofitted bus.

2.5.6 GM incorporated the revised guidance, as agreed with JAQU, into the modelling which underpins the development of its CAP to produce a report that appraises the ability of the Investment-led Plan and the CAZ Benchmark to deliver compliance with the legal limit value in the shortest possible time and by no later than 2026. The key findings from government's six-month focused research programme were not available at the time this work was undertaken.

2.5.7 The first version of the *Appraisal Report* and supporting documentation was submitted to government in December 2023. The *Appraisal Report* concluded that GM's Investment-led Plan can deliver compliance in 2025 and performs better than a CAZ Benchmark.

2.6 Key developments since December 2023 submission

2.6.1 Since the submission of evidence to JAQU in December 2023 there have been a number of key developments, resulting in a need to update the modelling, the *Appraisal Report* and supporting documentation.

2.6.2 Further modelling was undertaken in Summer 2024 to consider and address the following key developments:

- Delay to Stockport all-electric bus depot;
- Changes to bus fleets (operational and planned); and
- Correction to Euro V retrofit bus modelling emission values.

2.6.3 Drafts of the *Appraisal Report* and supporting documentation were updated to take account of the key developments and the Summer 2024 modelling, in preparation for submission to government. These updates did not change GM's conclusion that the Investment-led, non-charging plan can deliver compliance in 2025 and performs better than a CAZ Benchmark.

2.7 Developments following Summer 2024 modelling

2.7.1 Following the substantial drafting to update the *Appraisal Report* and supporting material (to address the key developments since the December 2023 submission), two additional issues have arisen.

2.7.2 Firstly, a risk identified in the December 2023 submission "Delays to bus depot electrification" has materialised and there is now a delivery delay to the electrification of Queens Road depot. This was due to take place by January 2025, which was the assumed delivery date in the modelling of the Investment-led Plan.

[14] Bus Retrofit Update - Technical Guidance for Local Authorities, JAQU Guidance, May 2023

2.7.3 This poses a significant challenge to achieving compliance in 2025, as 73 ZEBs are to be operated out of Queens Road depot. The issue affects 12 bus services, which run through 17 forecast 'Do Minimum' exceedance sites in 2025.

2.7.4 Secondly, in July 2024 National Highways also advised TfGM that the temporary speed limit on the M602 is to be removed, and the 70mph speed limit reinstated. The M602 temporary speed limit is assumed to be in place in the Investment-led Plan modelling assumptions.

2.7.5 The implications of these two issues are addressed in the *Supplementary Appraisal Report*, included as part of this evidence submission documentation. Therefore, the *Appraisal Report* and associated documentation, including this report, should be read in conjunction with the *Supplementary Appraisal Report*.

2.7.6 In addition, since the drafting of the *Appraisal Report* and supporting material, government published the 'Bus Retrofit Performance Report'[15] on the 12th September 2024. The key findings of this report include that the retrofit technology fitted onto retrofitted buses is not reducing NO_X emissions to the levels expected and retrofit performance is highly variable. These findings are consistent with the guidance issued in May 2023. Therefore, the publication of the study findings has no impact on the Investment-led Plan, the *Appraisal Report* and supporting material.

[15] https://assets.publishing.service.gov.uk/media/66e1ab11951c1776394a003c/bus-retrofit-performance-24.pdf

3 Methodology Overview

3.1.1 Air quality in GM has been modelled as part of the GM CAP, and areas of exceedance of the Limit Values identified. This modelling has been updated at relevant stages throughout the development of the plan for a number of reasons; for example, to reflect changes to the key phasing dates, to revise underpinning assumptions such as vehicle fleet age (due to Covid-19), or as a response to policy refinements as a result of the public 'conversation' or consultations.

3.1.2 The core goal of the GM CAP is to address the legal requirement to achieve compliance with the annual mean legal Limit Value (40 µg/m3) for NO_2.

3.1.3 Air quality is expected to gradually improve over time as a result of the ongoing cycle of newly purchased vehicles replacing older more polluting equivalents. The Government has required that the GM CAP delivers compliant air quality, using modelling to forecast future concentrations and showing how potential measures might reduce concentrations.

3.1.4 The air quality problem for GM is assessed by reference to the "Do Minimum" scenario, which sets out air quality as forecast if no action is taken by the GM CAP. The forecast takes into account other investment/interventions that are planned, funded and committed, where they have an impact on travel, traffic or the road network. The forecast appraisal years were developed for the original planned scheme commencement date for the GM CAP (2021 – not updated), the current expected Investment-led Plan commencement date (2025) and a further year to inform the trajectory of improvement to compliance with the Limit Values (2026) and also earliest likely full operational year for the CAZ Benchmark

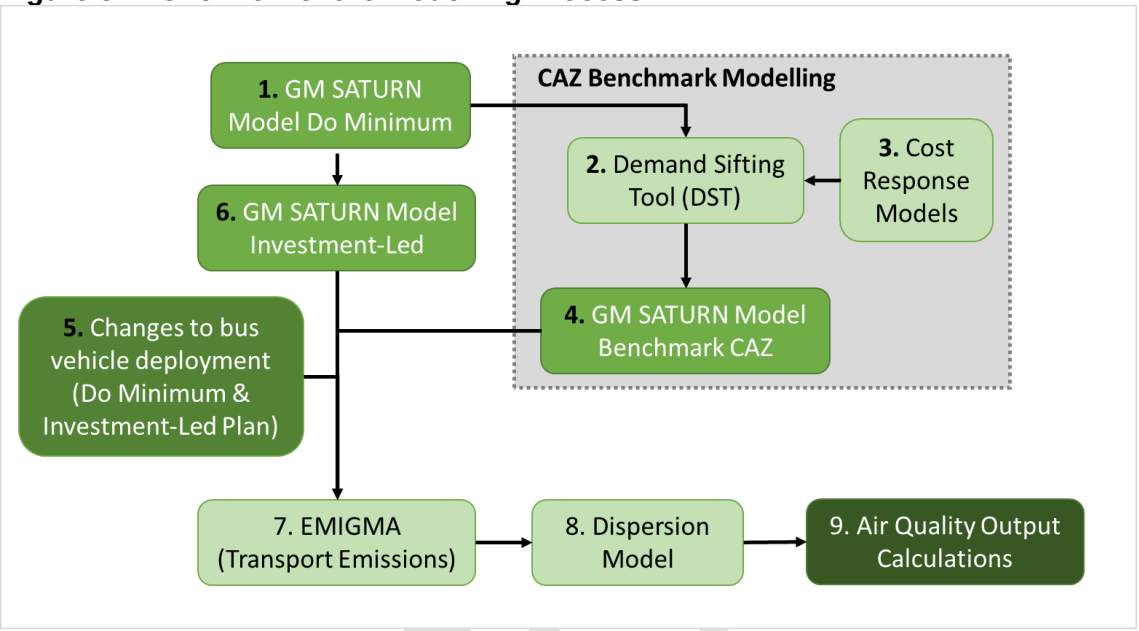
3.1.5 The GM CAP is underpinned by an evidence base derived from data collection, research, analysis and modelling. Throughout the technical development process from 2017 to date, GM has used best practice methodology and assumptions and worked closely with Government including, for example, by delivering updates to incorporate the impacts of Covid-19 to the GM CAP in accordance with national guidance and agreed with JAQU.

3.1.6 The modelling approach has been updated to reflect the impacts of Covid-19 in line with JAQU guidance and changes to the GM CAP Policy following public consultation and now in respect to changing market conditions and further Covid-19 related impacts. It also applies the latest JAQU guidance relating to the variable performance on exhaust emissions from retrofitted buses.

3.1.7 The purpose of the modelling process is to quantify the impact of traffic by vehicle type on emissions and consequently on concentrations of NO_2 at the roadside in GM.

3.1.8 A brief summary of the modelling input steps feeding into the appraisal is presented in Figure 3-1, which shows each of the modelling components and their linkages within the modelling suite. For a full description of the modelling methodology, please see the associated Technical Reports *T1* to *T4* and *AQ1* and *AQ2*.

Figure 3-1: Overview of the Modelling Process



3.1.9 The modelling system consists of the following components:

- **The Greater Manchester highway SATURN model (GMSM)**: which uses information about the road network and travel demands for different years and growth scenarios to estimate traffic flows and speeds for input to the emissions model and forecasts of travel times, distances and flows for input to the economic appraisal.
- **Cost Response models**: Developed to model a CAZ Benchmark only, these are models developed to better understand commercial vehicle, taxi, and coach/minibus behavioural changes to the GM CAP. These have been developed by assembling available data on the known fleets and movements within GM.
- **The Demand Sifting Tool (DST)**: Developed to model a CAZ Benchmark only, the DST has been developed to allow measures to be tested in a quick and efficient way prior to detailed assessments being undertaken using the highway and air quality models. The sifting tool uses fleet specific Cost Response models to determine behavioural responses to the CAP proposals (pay charge, upgrade vehicle, change mode, cancel trip etc.). The outputs comprise demand change factors which are applied to the do-minimum Saturn matrices to create do-something demands for assignment.

- **The emissions model:** which uses TfGM's EMIGMA (Emissions Inventory for GM) software to combine information about traffic speeds and flows from the Saturn model with road traffic emission factors and fleet composition data from the Emission Factor Toolkit (EFT) to provide estimates of annual mass emissions for a range of pollutants including oxides of nitrogen (NOx), primary-NO_2, particulate matter (PM_{10} and $PM_{2.5}$) and CO_2.
- **The dispersion model**: which uses ADMS-Urban software to combine information about mass emissions of pollution (from EMIGMA) with dispersion parameters such as meteorological data and topography to produce pollutant concentrations.

3.1.10 Finally, the outputs of the dispersion model are processed to convert them to the verified air quality concentrations, using Defra tools and national background maps.

3.1.11 Based on government guidance, the following local evidence was used to understand likely NO_2 concentrations in GM beyond 2023:

- Detailed Baseline Year (2016) and Future Years (2025 and 2026) transport model (actual and future demand on the road network);
- Local vehicle fleet profiles (e.g. ages and types of vehicle) using Automatic Number Plate Recognition (ANPR) data for various years;
- Vehicle fleet licensing data for bus and taxi fleets, and buses that had had exhaust emissions abatement equipment retrofitted;
- Local background concentrations of NO_x and NO_2;
- More detailed road network and junction data (e.g. alignment and width);
- Representation of "air pollution" canyons (e.g. tall buildings);
- Local air quality monitoring data from across GM, which is described in the *AQ2 Report*; and
- Confirmed future changes to the road network, expected regional traffic growth and changes to the traffic fleet.

3.1.12 This local modelling was necessary to provide a more comprehensive understanding of the air quality across the entirety of GM. The local modelling identified a larger number of locations which are expected to exceed the legal Limit Value, and higher concentrations of NO_2 in specific locations. This meant that all ten local authorities contained locations expected to be in exceedance of legal Limit Value for NO_2 after 2020. This reflected the fact that the local modelling used more detailed sources of data and more refined analytical tools. This resulted in three fundamental differences compared to the national modelling:

- The vehicle fleet in GM was older and more polluting than assumed in the national model;

- In some areas vehicles were moving more slowly than assumed in the national model; and
- The background concentrations from non-road vehicle emissions sources (for example, electricity production, industry, local heating etc.) were higher than expected and needed to be uplifted.

3.1.13 Dispersion modelling of air quality produces outputs at specific coordinate points which predict a concentration of NO_2. However, JAQU specify that these points should represent a worst-case location along a more general length of road, aimed at correlating with the relatively long sections of road links defined for use in the Government's coarser Pollution Climate Mapping (PCM) model. This guidance also states to exclude locations close to junctions. Presenting point data provides more specific and spatially detailed information about air quality, as it allows an understanding of how concentrations of NO_2 vary at different locations along the road.

3.1.14 In order to compare local modelling results with the PCM model outputs, receptors were automatically generated using a GIS script at 4m from the modelled road edge at 2m elevation, at locations >25m from junctions (as per the parameters set out in the JAQU Evidence Guidance), on both sides of the road. These receptors were generated for every road link in the GM Saturn model. The GM Saturn model is more spatially detailed than the PCM model, and each PCM link can extend over many Saturn links. The maximum locally modelled receptor concentration adjacent to each PCM road link was selected for comparison with the PCM model prediction.

3.1.15 A range of sensitivity tests have been undertaken based on the JAQU guidance[16]. These are reported in the *Sensitivity Testing Report.*.

3.2 Updates to the Modelling Process post-Consultation and to reflect the impacts of Covid-19

3.2.1 Since the production of the modelling for the Consultation Option, there have been a number of updates to tools and datasets, primarily to better account for the effects of Covid-19 on vehicle emissions and in response to updated JAQU guidance. These have led to updates to the modelling of projected future year traffic and vehicle emissions for the Do Minimum scenario. These changes are set out below.

3.2.2 There have been no updates to the 2016 Base or 2021 Do Minimum model applied.

3.3 Do Minimum 2025 & 2026

3.3.1 There have been a number of updates to the future year Do Minimum modelling process. During discussions with JAQU it was confirmed that these alterations did not constitute a change to the Target Determination process, but were appropriate technical refinements based on more up to date datasets.

[16] Supplementary Note on Sensitivity Testing, JAQU Guidance, October 2017

3.3.2 The majority of these updates are associated with traffic and emissions modelling and are described in detail in the equivalent traffic modelling technical reports (*T1/T2/T3/T4*) also published as part of this suite of documents. The substantive updates which could influence the Do Minimum scenario air quality modelling outputs are summarised below.

3.4 Updates to the Road Network

3.4.1 In recent years, there have been substantial changes to transport measures within the Regional Centre, with further planned changes into the future as part of the City Centre Transport Strategy (CCTS), which includes a significant investment in travel to and within the Regional Centre.

3.4.2 The CCTS, developed by TfGM, Manchester City Council and Salford City Council provides a strategy to guide how transport is improved across the Regional Centre over the next two decades. The strategy sets out proposals to further improve the city centre's public transport and active travel networks and reduce car-based trips over the longer term, leading to the cleaner, greener, healthier, inclusive and integrated transport network that supports the growth of the city centre.

3.4.3 Whilst the strategy includes developments planned over the next two decades, there are a number of planned interventions identified during the context of GM CAP, in particular those schemes which will be delivered for 2025.

3.4.4 A detailed review of the completed and planned schemes within the Regional Centre has been undertaken to identify measured required for inclusion within the Do Minimum modelling. This includes:

- Recently Completed and built schemes within the Regional Centre, comprising of bus priority, active travel and traffic restriction schemes; and
- Near certain and highly likely schemes, included within CCTS, which will be delivered by 2025 and should therefore be incorporated within the Do Minimum Model.

3.4.5 The Regional Centre schemes mainly comprise local traffic management and small-scale road and junction improvement schemes, (including road closures for through traffic), to improve conditions for public transport, walking and cycling.

3.4.6 Additionally, committed transport schemes have been reviewed and included based on the most recent development status of committed future schemes to be delivered within the timescales (by 2025), based on the Manchester City Council and Salford City Council's delivery programme as of October 2023.

3.4.7 National Highways have applied temporary 60mph speed limits on short sections of the strategic road network where there is a requirement to improve air quality[17]. One of these locations is the M602 between junction 1 and junction 3, in Salford. It was expected that this temporary speed limit would be in place for the lifetime of GM CAP and therefore this is incorporated within the Do Minimum SATURN Model.

3.4.8 The details of all these schemes are presented in *T3 Report*.

3.5 Updates to Bus Service Data

3.5.1 The modelled bus routing data was updated to include up-to-date information about local bus flows based on 2023 services.

3.5.2 Bus services have been reviewed against assumptions underpinning the highway assignment modelling including bus service routings, frequencies, and vehicle deployment.

3.5.3 To support the modelling an increased focus on bus, has applied several updates to the representation of bus within the model, these are discussed in detail below and include:

- Updated bus retrofit methodology following discussion with JAQU;
- Update to bus services, routes and frequency within the modelling to reflect 2023 bus network; and
- Further planned updates to the bus services and fleet by 2025 delivered as part of the GM bus franchising process.

3.5.4 The details of all the updates to the bus services are presented in the *T3 Report*. A key change is that full electrification of all services operating out of the Stagecoach depot in Stockport as part of GM's successful ZEBRA funding award, was expected from 2024 onwards, but is now not programmed to be operational by 2026.

3.5.5 GM has therefore modelled all buses operating from this depot as Euro V retrofitted vehicles based on information of the available fleet which could be used as an interim measure until the electrification project is live. The electric buses that will be delivered to GM will be deployed into other depots, and these operations have been reflected in the updated Do Minimum bus modelling.

3.5.6 This impacts the emissions and concentration predictions along these bus routes, with adverse impacts on the corridors from central Stockport towards the Regional Centre.

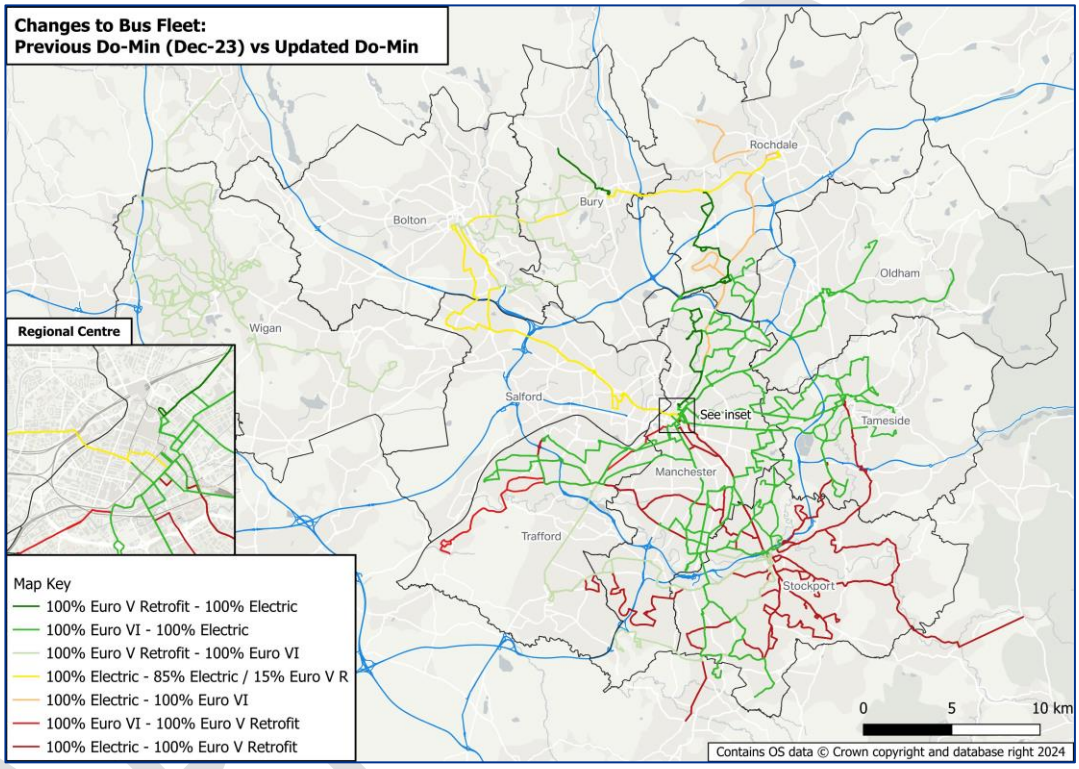
3.5.7 As part of the Bus Franchising process, operators have also supplied additional Euro VI vehicles, notably around Wigan as part of Tranche 1.

[17] https://nationalhighways.co.uk/our-work/environment/air-quality-and-noise/air-quality/air-quality-speed-limit-trials/

3.5.8 The projected fleet composition in forecast years has been adjusted to reflect contracted changes in the vehicle mix and engine technology over time, as the age profile of the bus fleet changes and older more polluting vehicles are replaced by newer/cleaner models. These reflect the vehicle fleets committed within GM Bus Franchising contract awards, which will be in place by the start of 2025 and 2026 on the roads with the poorest air quality.

3.5.9 The updates to the bus modelling by vehicle type and the routes of these services are shown in Figure 3-2.

Figure 3-2: Updates to the bus modelling by vehicle type and routes



3.5.10 The full ZEB electrification programme is still being defined with more ZEBs due to enter the GM fleet as the depot electrification programme continues. The GM CAP has worked with bus team to ensure there are sufficient Original Equipment Manufacturer (OEM) Euro VI and ZEBs available to serve key routes that pass forecast exceedance sites in 2025. However, for those roads where exceedances are not forecast, pessimistic assumptions on bus service fleet have been applied in lieu of known future year operational fleet, because the bus specification for these services has not yet been determined. These have been based on the buses operating at the start of bus franchising in 2023, and therefore include a high proportion of retrofit Euro V buses which will continue to serve GM until they are replaced by ZEBs. This means that extrapolation of concentrations beyond 2025/2026 is likely to over-predict bus emissions and under-predict the rate of improvement as the fleet is also electrified at roads not forecast to be in exceedance with the Investment-led Plan in place in 2025.

3.6 Updated Retrofit Position following April 2023 JAQU Guidance update

3.6.1 In 2022 JAQU funded a study to quantify NO_x and NO_2 emissions from buses under real-world driving conditions in three cities across the UK, including Manchester, (monitoring took place in Manchester City Centre between 21 November and 12 December 2022).

3.6.2 The monitoring indicated the retrofitted buses were not reducing emissions as expected, with significant variation in performance between bus models with different retrofit technologies. Furthermore, emissions of primary-NO_2 (as opposed to NO_x) were increased by the retrofit process, potentially worsening roadside NO_2 concentrations despite an overall reduction in NO_x emissions.

3.6.3 On 19 April 2023 Government advised TfGM that it is to pause any new spending on bus retrofit as they now have evidence that bus retrofit solutions that have been fitted and in real world use have variability in performance.

3.6.4 Government is currently undertaking a focused research programme to investigate the causes of poor performance and scope how performance can be improved. Additionally, a second JAQU monitoring survey has been conducted at three locations in Manchester in June 2023.

3.6.5 In the light of this new evidence the JAQU science team issued revised guidance[18] in May 2023, which sets out that air quality modelling should not assume any benefits from a retrofitted bus. JAQU also issued additional associated guidance specifically for GM giving the option to develop an option to develop a bespoke emissions modelling methodology for retrofitted buses. This could be based on the available monitoring data taken from the Manchester measurements only from the November and December 2022 survey.

3.6.6 JAQU provided the monitoring data from the first remote sensing survey, and some additional clarification on methodology between June and July 2023. GM have reviewed these datasets and recognise there is considerable variance within the data both in repeat samples of unique vehicles, and also between bus models, Euro standard and retrofit technology (if fitted). Whilst there is evidence of some possible improvement to NOx emissions, which indicates that the updated JAQU modelling guidance for retrofitted buses could be pessimistic and over representing real-world emissions, as set out below it is not considered possible at this stage to produce a robust and defensible bespoke GM fleet methodology.

3.6.7 It is also worth noting that the monitoring data indicated that the emissions performance from OEM Euro V and VI buses was less variable and provided additional confidence in the modelling of these vehicles.

[18] Bus Retrofit Update - Technical Guidance for Local Authorities, JAQU Guidance, May 2023

3.6.8 JAQU was due to publish the outcomes of their research project in improving the performance of retrofit buses in autumn 2023, however this is not yet available to GM, which could alter the assumptions used in our appraisal. GM will therefore keep the remote sensing data under review, and consider the potential impact of this variability as part of our adaptive planning process for the operational phase of the proposed CAP and within the Analytical Assurance process.

3.6.9 Based on GM's preliminary review of the remote sensing data, there are not considered to be sufficient sample sizes of data for key GM bus models pre- and post- retrofitting, to develop a robust and defensible bespoke GM fleet-specific methodology. Furthermore, any such analysis may need to be updated when the JAQU research project is published.

3.6.10 It is therefore considered that the most robust and time-efficient approach to delivering the GM CAP is to use the updated JAQU guidance for retrofit buses, rather than delay the appraisal to allow for on-going analysis of the remote sensing data. This is considered to be a conservative approach, meaning that the scale of targeted measures put in place should deliver sufficient improvements at locations of predicted exceedance, with greater confidence.

3.6.11 GM has therefore continued appraisal of the CAP using the updated JAQU guidance for retrofit bus emissions, which is reflected within the 2025 and 2026 Do Minimum, Investment-led Plan and CAZ Benchmark modelling.

3.6.12 It should be noted that the JAQU monitoring evidence indicates that the modelling of bus emissions is a source of uncertainty in CAP process. The measured variability of bus emissions performance also indicates monitored concentrations will be subject to the vagaries of location- and temporally-specific variation, making comparison of modelled and monitored data less reliable. However, fortunately the base year modelling which is derived from 2016 is less susceptible to the issue because retrofitted buses were less prevalent in the GM fleet at this point in time, with the ULEB programme commencing in 2020. Whilst the Do Minimum modelling is based on operational data from 2023, buses within the bus fleet are known to be moved around by operators throughout the year, and GM had little control over this process while bus operations were under private control. Since the commencement of bus franchising, GM is able to specify the vehicle fleet running on specific bus services. Therefore, whilst there is greater uncertainty in the Do Minimum modelling, the Investment-led Plan helps to address this concern by targeting OEM Euro VI and ZEB buses, with more reliable emissions factors, on the roads where greatest air quality risk is forecast.

3.7 Delay of Natural Vehicle Fleet Replenishment Rates due to Covid-19

3.7.1 Sales of new cleaner vehicles lead to a natural turnover of the on-road fleet, as the replaced vehicles pass into the second-hand market, with the oldest most polluting vehicles gradually scrapped out of the fleet. It is this effect which reduces overall road transport emissions as the fleet becomes cleaner leading to projected future improvements in NO_2, and it is this trend which the CAP seeks to accelerate by making older more polluting vehicles less financially attractive compared with cleaner models.

3.7.2 The age of the fleet affects the CAP modelling process both at the Demand Model and Cost Model stages, because the number of vehicles and age profile within the non-compliant/compliant categories is impacted, and then in the assumptions used for the EMIGMA emissions calculations.

3.7.3 Covid-19 has led to a substantial reduction in new vehicle sales in 2020, which have continued into 2021 for private cars and taxis. Therefore, the predicted age of the fleet in the core scenario used for the Consultation Option modelling forecasts was considered to be optimistic, as lower sales reduce the rate of vehicle upgrades and also impact on the second-hand market.

3.7.4 The impact of the pandemic on vehicle sales has varied by vehicle type, with commercial vehicle sales having been more resilient than those for the private car and taxi markets.

3.7.5 GM has undertaken analysis of the evidence associated with vehicle sales by vehicle type, which is summarised in Table 3-1. Further details can be found in *T3 Report*.

Table 3-1: Recommendations of Vehicle Fleet and Upgrade Rates: assumptions by vehicle type

Vehicle Type	Criteria	Changes
HGV	Fleet Age	No changes identified in 2021 evidence review, which did not suggest HGV purchases had been affected by the pandemic in 2020 (given impact of regulatory change in 2019 which had distorted purchase patterns such that lower than normal purchases were expected in 2020 anyway). No change in latest forecasts **No changes made in latest forecast.**
LGV	Fleet Age	Delay (c.1 month) applied in 2021 version. Evidence suggests recent sales data were similar to GM's forecast and therefore no additional changes are proposed. **A delay of 1 month was applied**
Car	Fleet Age	Delay (c.7 months) applied in 2021 version to reflect loss of sales in 2020 and SMMT forecast of gradual COVID-19 recovery. Subsequent evidence suggested that car purchases were lower than expected in 2021 and therefore this additional delay has been reflected in this forecast version, with a delay of one year applied in the 'Case for a new Clean Air Plan' (July 2022), and retained during the 2023 evidence review. **A delay of 1 year was applied**
Taxi	Fleet Age	Evidence in 2021 suggested that upgrades had been delayed but could not quantify impact, therefore a delay of one year was applied as a cautious estimate in that version. - No changes made in latest forecast. **A delay of 1 year was applied**
Bus	Funding	Bus network reflects 2023 service operation and fleet serving *Tranche 1* & *Tranche 2* priority routes (<7years old). Bus fleet updated to reflect the latest guidance regarding the position regarding emissions from retrofitted buses. Electric bus funding was represented in the model includes the removal of ULEB funding from Vantage and Free Bus routes, are no longer being implemented via the ULEB. ZEBRA funding for Stockport services has been confirmed, though delivery and operation of these services as EV will not commence by 2026, so have been excluded from the 2025 & 2026 modelling and are assumed to be operated by retrofitted Euro V buses in the interim.

3.7.6 Delaying vehicle fleet upgrade rates for LGVs, taxis and cars will have two impacts on the modelling. Firstly, it will increase the emissions from these vehicle types as the overall fleet will be older and therefore there will be a slight increase in the proportion of vehicles in older more polluting Euro standard classes. Secondly, for LGVs and taxis a greater number of non-compliant vehicles would be in-scope for the Benchmark CAZ scenario charge.

3.7.7 These alterations have therefore been passed onto the EMIGMA emissions calculations, and also the behavioural response and traffic demand models.

3.7.8 These changes along with other methodological updates to the appraisal process are described in greater detail in the relevant *T1-T4* reports published as part of this suite of supporting documents.

3.7.9 The performance of fleet upgrade methodology on vehicle fleet mix projections is recognised as a source of uncertainty in the CAP modelling process. It has been analysed based on comparison of projections with ANPR data as part of the sensitivity testing process, which is reported in in the *T3 Report* and the *Sensitivity Testing Report*.

3.8 Updates to the Dispersion and Air Quality Model

3.8.1 The dispersion and air quality modelling process has not been altered from the approach approved by JAQU and the T-IRP.

3.8.2 The motorway and trunk road network, which is operated by National Highways, is necessarily part of the GM modelling structure but outside the scope of the CAP because they are not operated by the GM local authorities.

3.8.3 Some minor refinements were made to the air quality modelling of the National Highways operated section of the A57/A628 through Mottram/Tintwistle in Tameside, developed in conjunction with National Highways. The modelling results for locations on the SRN have not been reported in the GM CAP documentation at any stage.

3.9 Correction to modelling emission values

3.9.1 As part of updating the emissions modelling tool to prepare for the sensitivity testing on the impacts of bus retrofit performance, an issue was found in the emissions modelling. It was identified that the amount of primary nitrogen dioxide has been underrepresented in the model outputs and therefore in the predicted NO2 concentrations that have been reported in the December 2023 submission for both the with and without scheme scenarios.

3.9.2 Following this issue being identified and to ensure the robustness of modelling going forward, TfGM's Head of Modelling & Analysis has reviewed the modelling processes, to consider any weaknesses in the process, to strengthen the Quality Assurance process for these steps and to identify the checking/reviewing process.

3.9.3 TfGM's Audit & Assurance Team have audited the modelling analysis that underpins the Clean Air Plan submission and reviewed the documentation of the analysis to assure that it has been completed as per the documented QA process. Further information is provided in the Clean Air Plan Modelling QA Process Report, included as part of this evidence submission documentation.

3.10 Review of 2023 CAP Air Quality Monitoring

3.10.1 The GM CAP has implemented an air quality monitoring survey, which commenced in 2018 prior to the finalisation of the target determination process, and has evolved as the project has developed. A review of the monitoring data from 2023 is provided in **Appendix C.**

3.10.2 This shows that there are exceedances recorded on 33 roads links in 2023, and reasonable agreement between the locations of modelled exceedance. The range of issues which prevent direct comparison of with the modelling available from the GM CAP are also discussed.

4 Do Minimum Scenario Model Results

4.1 Model Results and PCM Exceedance Link Comparison: Do Minimum 2021

4.1.1 As part of approved 'Target Determination' process, the local modelling must be compared against the national PCM model (2015 base, as referenced in the Ministerial Direction from 2018) for 2021. The results for these locations, where the PCM model for 2021 has predicted exceedances leading to authorities being included in the National Plan[19], are presented in Table 4-1.

4.1.2 The results of the modelling are subsequently presented for each local authority separately. This discussion reports the total number of assessed modelled locations in exceedance by road link. The maximum result for each PCM link is then also tabulated and along with information on background concentrations and vehicle type source apportionment.

4.1.3 It should be noted that the Government's PCM modelling pre-dated the Covid-19 pandemic and therefore the published PCM data are not representative of conditions in 2021. Furthermore, whilst the modelling for the 2025/2026 forecast years has sought to take into account the impacts of Covid-19 on vehicle fleet age, there have been various phases of transport and economic restrictions and lockdowns that took place in 2021 which cannot be represented in either the PCM or the GM CAP modelling.

4.1.4 It is expected that the Covid-related influences present in 2021 reduce with time after restrictions were removed and economic recovery takes place. This means that there is considered to be greater uncertainty in the model predictions for 2021 compared with the 2025/2026 forecast years.

4.1.5 It should be noted that the 2021 scenario model results are provided for information purposes, and should not be compared with monitored concentrations from 2021 which would have measured the influence of Covid-19 restrictions.

[19] Air quality plan for nitrogen dioxide (NO2) in UK (2017): UK plan for tackling roadside nitrogen dioxide concentrations, Detailed plan, Defra & DfT, July 2017

Table 4-1: Model results and PCM Links leading to Districts being named in the National Plan – Do Minimum 2021

Census ID	Road Name	Local authority	PCM NO_2 conc. ($\mu g/m^3$)	Local Model Results ($\mu g/m^3$)					Local Model : PCM
				Total NO_2	BG[20] NOx	BG NO_2	Road NOx	Road NO_2	
7431	A666	Bolton	40.6	44.6	26.5	18.4	55.0	26.2	+10%
38354	A58	Bury	41.5	53.6	23.0	16.3	90.6	37.3	+29%
37809	A5103	Manchester	41.2	39.6	16.8	12.3	56.4	27.3	-4%
70273	A635	Manchester	40.4	38.2	32.5	21.7	37.9	16.4	-5%
46068	A57M	Manchester	40.0	39.9	32.0	21.5	41.0	18.4	0%
56370	A57	Manchester	41.5	37.6	26.5	18.4	43.3	19.2	-9%
36632	A62	Oldham	38.4	43.6	27.4	18.9	53.1	24.7	+14%
36585	A57	Salford	38.7	49.1	26.5	18.4	71.3	30.7	+27%
26352	A34	Stockport	40.3	45.5	20.5	14.7	66.1	30.8	+13%
38735	A34	Stockport	40.6	42.4	20.5	14.7	58.7	27.7	+5%
99618	A635	Tameside	42.2	48.0	26.9	18.5	67.9	29.5	+14%
58022	A56	Trafford	38.5	38.9	16.8	12.3	55.4	26.6	+1%

[20] BG = Background

4.1.6 Comparison of the model results for 2021 show reasonable agreement between the PCM links predicted to be in exceedance and local model total NO_2 concentrations for the majority of road links assessed. Of the 12 links identified, the local model concentrations are typically greater, but only at two sites (38354: A58 in Bury and 36585: A57 in Salford) is the difference greater than ±25%, and Bury is also the worst case location as identified in the local modelling. The local road network in the vicinity of these PCM links is complex so direct comparison is difficult. The Bury A58 concentration of 53.6 µg/m^3 is the maximum of any PCM receptor point on roads managed by local authorities.

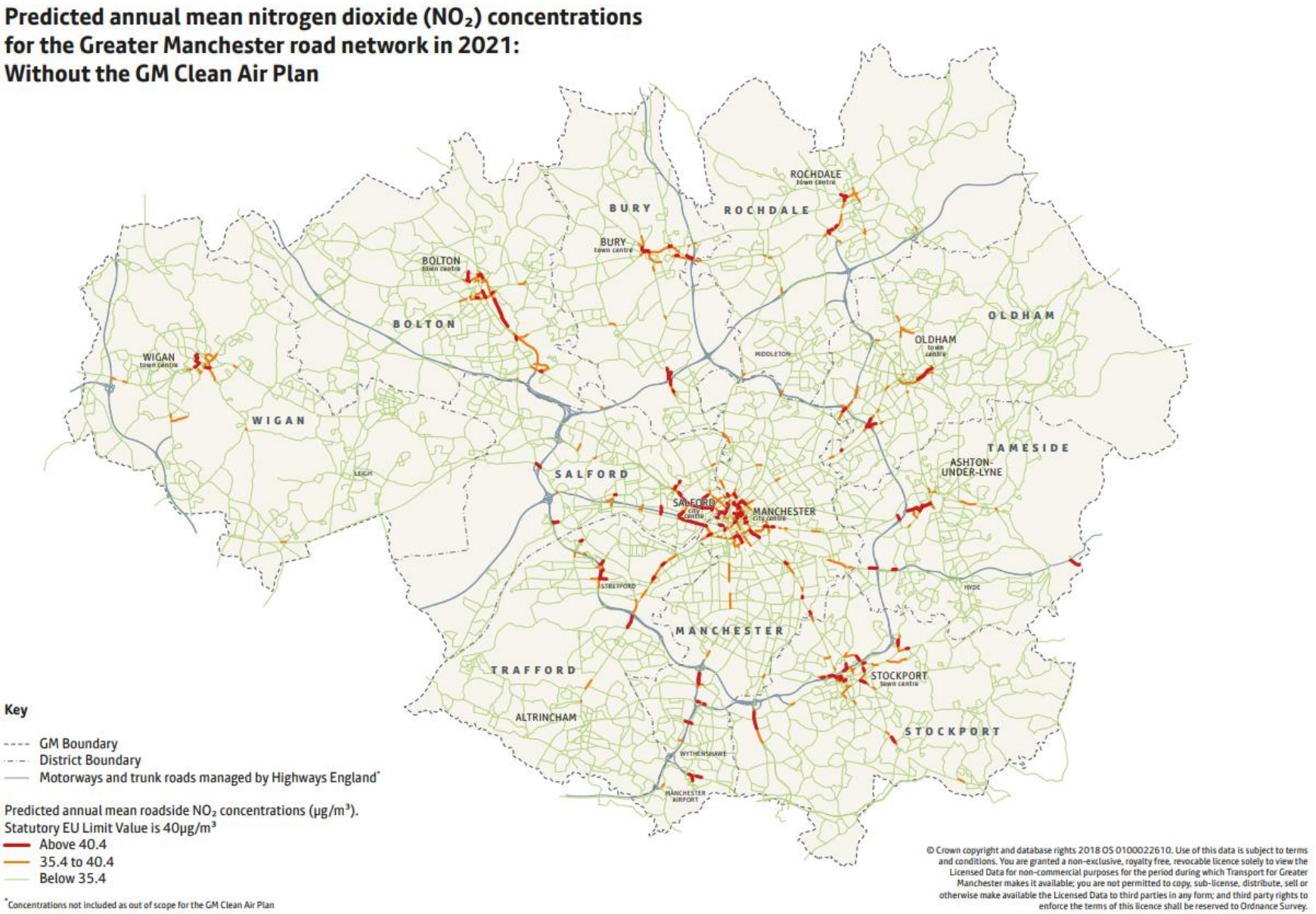
4.1.7 The A635 in Tameside (Census ID:99618) has the highest PCM link concentration of 42.2 µg/m^3, and is predicted to have a maximum concentration of 48.0 µg/m^3 in the detailed local modelling. Again, the local road network in the vicinity of this PCM link is complex so direct comparison between the models is difficult.

4.1.8 However, the local modelling also predicts exceedances at a number of additional PCM links across GM in 2021. These include locations in districts that were not identified as non-compliant in the national modelling, i.e. Rochdale and Wigan. There are 173 stretches of local road (road links) or 224 modelled points, where concentrations of NO_2 are forecast to exceed 40 µg/m^3 for NO_2 beyond 2020, across GM as a whole. 139 of these local road links (or 180 modelled points) coincide with roads identified in the national PCM model. Typically, these roads have the greatest car use and heavy freight flows. The remaining 34 road link exceedances (or 44 modelled points) are on shorter stretches of local roads, primarily around town and city centres across GM, which are not included in the national model but carry high volumes of traffic, including significant numbers of buses, taxis and Light Goods Vehicles (LGVs).

4.1.9 These results are summarised in the following section of this report, split by district. They are described based on the number of output points from the local network (rather the PCM network), and also include roads managed by the local authority excluded from the PCM network. The reporting does not include those roads managed by National Highways (formerly known as (Highways England) - which include motorways and trunk roads, although these roads and vehicle traffic are necessarily included in the modelling process.

4.1.10 Table 4-1 and Figure 4-1 show the exceedances identified by local modelling and upon which the proposed GM CAP is based. Exceedances are found in the town and city centres and on major roads, particularly those close to the motorway network. The greatest cluster of sites in exceedance of the Limit Value is found in Manchester city centre, and this is also where some of the highest annual mean concentrations are predicted. This reflects higher traffic volumes, congestion, high buildings which create air pollution 'canyons', and high background levels of pollution. The aim of the GM CAP is to deliver measures that deliver compliance at these locations as soon as possible, without redistributing the problem to other locations. The geographical spread of NO_2 exceedances throughout GM in 2021 is shown in Figure 4-1 and clearly highlights the complexity of the air quality issues the Clean Air Plan is trying to address.

Figure 4-1: Modelled Road Links with NO_2 Exceedances in Greater Manchester in the Local Modelling in 2021



4.1.11 Table 4-2 shows the exceedances identified in the national modelling, using the PCM, and in the local modelling. The local modelling encompasses a wider road network than the PCM, including local and strategic roads. The primary spending objective of the GM CAP, as set out by JAQU, is to tackle exceedances identified by the local modelling on roads included within the PCM network.

Table 4-2: Predicted NO_2 Exceedances in Greater Manchester in the PCM and Local Modelling in 2021

Local authority	National (PCM) Model exceedances links	Local Model exceedances points on PCM links	Additional Local Model point exceedances on minor roads (non-PCM links)*	Total Local Model point exceedances
Bolton Metropolitan Borough Council	1	15	1	16
Bury Metropolitan Borough Council	1	14	4	18
Manchester City Council	3	55	22	77
Oldham Metropolitan Borough Council	0	10	0	10
Rochdale Metropolitan Borough Council	0	7	0	7
Salford City Council	1	37	2	39
Stockport Metropolitan Borough Council	2	21	5	26
Tameside Metropolitan Borough Council	1	15	0	15
Trafford Metropolitan Borough Council	1	4	5	9
Wigan Metropolitan Borough Council	0	2	5	7
Total	**10**	**180**	**44**	**224**

*These are road links that are not included in the national PCM model but have been modelled locally

4.1.12 Table 4-3 shows the distribution of non-compliant sites across Greater Manchester, both by spatial type and also in terms of how close they are to compliance. This shows that, whilst levels of NO_2 are below the Limit Value across much of the road network, in 2021 it was anticipated that 224 sites would be non-compliant. However, it is recognised that 2021 has been affected by restrictions due to Covid-19 and therefore these model predictions are not fully representative of real-world conditions, where travel restrictions reduced road traffic levels and therefore reduced vehicle emissions and NO_2 concentrations.

4.1.13 Figure 4-1, Table 4-2 and Table 4-3 demonstrate the spatial diversity of predicted exceedances across GM, with predicted exceedances occurring both in urban centres, and close to heavily trafficked routes serving them (including those sites influenced by nearby National Highways' motorways and trunk roads).

4.1.14 Full data for all modelled links with exceedances in the Target Determination 2021 modelling is presented in **Appendix B**.

4.2 Do Minimum 2025 & 2026

4.2.1 By 2025, the first full operational year of the proposed CAP scheme, the transition towards cleaner vehicles that would be expected without further action for the CAP, as well as a reduction in background concentrations, leads to a very substantial reduction in the number of sites in exceedance of the Limit Value. It is anticipated that 26 sites would be non-compliant, with no concentrations predicted to experience annual mean concentrations greater than 50 µg/m3. A further 95 sites are compliant but experience annual mean concentrations close to but below the Limit Value.

4.2.2 By 2026, concentrations have improved further, with 17 exceedances forecast.

Table 4-3: Predicted annual mean NO_2 concentrations at points on the GM road network - 2021, 2025 and 2026 without further action ('Do Minimum')

Road classification[21]	Compliant sites		Non-compliant sites			
	Very compliant (below 35 µg/m^3)	Compliant but marginal (35 to 40 µg/m^3)	Non-compliant (>40 to 45 µg/m^3)	Very non-compliant (>45 to 50 µg/m^3)	Extremely non-compliant (>50 µg/m^3)	Total non-compliant (>40 µg/m^3)
2021[22]						
Inside Manchester-Salford Inner Relief Route (IRR)*	148	73	31	18	5	54
Other urban centres	168	50	14	5	0	19
Other locations	1480	399	108	35	8	151
Total	**1796**	**522**	**153**	**58**	**13**	**224**
2025						
Inside IRR	235	22	9	7	0	**16**
Other urban centres	225	12	0	0	0	**0**
Other locations	1959	61	10	0	0	**10**
Total	2419	95	19	7	0	**26**
2026						
Inside IRR	241	21	6	5	0	**11**
Other urban centres	233	4	0	0	0	**0**
Other locations	1993	31	6	0	0	**6**
Total	2467	56	12	5	0	**17**

[21] "Inside Inner Relief Route" is the area encircled by the Inner Relief Route in Manchester city centre. "Other urban centres" are areas that met a definition used for the purposes of air quality modelling for Option 4 testing during the OBC, but generally comprise the town centres of the relevant district. "Other locations" are roads outside of Urban centres and the Inner Relief Route.

[22] The results for 2021 are provided for information purposes only and should not be compared with measured concentrations from 2021 which would include the impacts of travel restrictions due to Covid-19.

4.2.3 Extrapolation of the concentrations beyond 2025/26 is likely to be pessimistic due to the assumptions made about the GM bus fleet for the Do Minimum scenario modelling. The modelled scenarios based on the 2025 bus fleet indicates that GM is not predicted to become fully compliant with the legal limit for NO_2 until after 2029 but, in reality, compliance would occur once the Stockpot depot is electrified, and operational with electric buses serving the A6 corridor to Piccadilly bus station. It is currently anticipated that the Zero Emission Bus Depot in Stockport would be delivered and available for use during late 2028 / early 2029, meaning the first year of compliance would be 2029 in the Do Minimum scenario.

4.3 Comparison of Do Minimum Results with those used in the Consultation

4.3.1 There is an increase in the number of points of exceedance in 2021 from those presented in the Consultation from 203 to 224, and from 12 to 26 in 2025, primarily because of the effects of slowing down the natural turnover of vans, cars and taxi fleet due to reduced new vehicle sales associated with Covid-19, but also the impacts of retrofitted buses which are now modelled to be more polluting than in the Consultation modelling.

4.3.2 There are predicted to be exceedances in all 10 districts in the Do Minimum scenarios for both 2021. By 2025, exceedances are only predicted in Manchester, Salford, Bury and Stockport. These are shown in Figure 4-2.

4.3.3 The majority of exceedances are inside the IRR in Manchester, where 16 are located. The other remaining points of exceedance are at:

- A57 Regent Road, Salford [consistent with Consultation]
- A58 Bury Bridge, Bury (x2) [consistent with Consultation]
- A6 corridor between Stockport and the IRR (x6) [new]
- B6104 Carrington Road, Stockport [new]

4.4 Influence of National Highway's Strategic Road Network

4.4.1 While the maps and tables show a number of exceedances on local roads that are in close proximity to the Strategic Road Network (SRN), which is managed by National Highways (formerly known as Highways England), it should be noted that the mapping and analysis does not include exceedances actually allocated to the SRN. Nevertheless, at local roads close to the SRN, pollution caused by motorway traffic can be as much as 50% greater than that from the local road. Furthermore, there are properties in exceedance situated along the motorway where there is very little local road traffic and 100,000 vehicles passing per day on the SRN.

4.4.2 National Highways had eight links predicted to be non-compliant in the PCM network based on national modelling. National Highways is currently assessing sections of the SRN around GM to explore potential Measures to reduce air quality impacts. The modelling outputs of PCM equivalence points on National Highways managed roads have been produced in the CAP modelling process, but it should be noted that these points may not be representative of exposure and have not been checked against the criteria for 'qualifying features' agreed between JAQU and National Highways. Therefore, use of these results for interpretation of compliance of the SRN with the Limit Value is not appropriate.

4.5 Why is there a problem in GM?

4.5.1 As demonstrated by the scale of exceedances identified in the Government's PCM model and the local modelling, GM suffers from some of the worst air quality in the UK. The reasons for this are complex and multi-faceted.

4.5.2 The success of any potential scheme is determined by the removal of all predicted exceedances in the shortest possible time. The transport and emissions modelling process was developed based on the published JAQU guidance[23], and a range of indicative early schemes were tested to understand the likely scale of impact on NO_2 of charging CAZ schemes in 2021. This determined that compliance was not feasible in 2021, and as the GM CAP appraisal has developed over time, transport models were also constructed for 2025 and 2026 to understand the trajectory of NO_2 concentrations into the future.

4.5.3 Vehicles travelling on the roads in GM traffic are older and more polluting than the national average, and traffic speeds are slower than average. This means the options considered in GM may need to be bolder.

4.5.4 The transport modelling has also been analysed to understand the origins and destinations of traffic, by vehicle type, on these links. This shows that whilst a large proportion of traffic is associated with accessing the urban centres, there is also a significant use of the local road network to access the motorway for trips spread around GM and beyond. The analysis indicates that a range of measures will be necessary to tackle GM's NO_2 concentrations due to the diverse spatial context and reasons for travel.

4.5.5 Vehicle travel in GM has been changing over the past 20 years. Traffic volumes on National Highways' controlled motorways have been increasing but elsewhere on the local road network traffic levels have been stable or falling.

4.5.6 Analysis of the pollution sources at each location of exceedance has been undertaken, and an estimate of the emissions reduction required from vehicle transport has been calculated to enable compliance with the Limit Value for NO_2. This was utilised to inform the detail of measures required by the GM CAP.

[23] Clean Air Zone Framework Principles for Setting Up Clean Air Zones in England, Defra & DfT, May 2017

4.5.7 The analysis shows that there are very diverse factors affecting vehicle emissions across GM, with vehicle types and levels often differing between roads in close proximity to each other. In many locations where there are significant exceedances, such as on roads in a city/town centre, the road network performs a variety of complex transport functions and therefore carries a diverse range of traffic, including cars, vans, Heavy Goods Vehicles (HGVs), buses and taxis.

4.5.8 To describe how the GM CAP delivers compliance across GM, the results for a subset of the modelled receptors have been summarised. Figure 4-2 shows 32 of the key points that come to define compliance within GM. These sites have been selected based on the maximum predicted concentrations i.e. exceedances in 2025 or the maximum concentration in each district.

4.5.9 The air quality data and emissions source apportionment are provided in Table 4-4 for 2025, the earliest predicted year of compliance with the Investment-led Plan in place. This table shows how each vehicle type contributes to the total road transport emissions on a given road link, and how variable they are across GM.

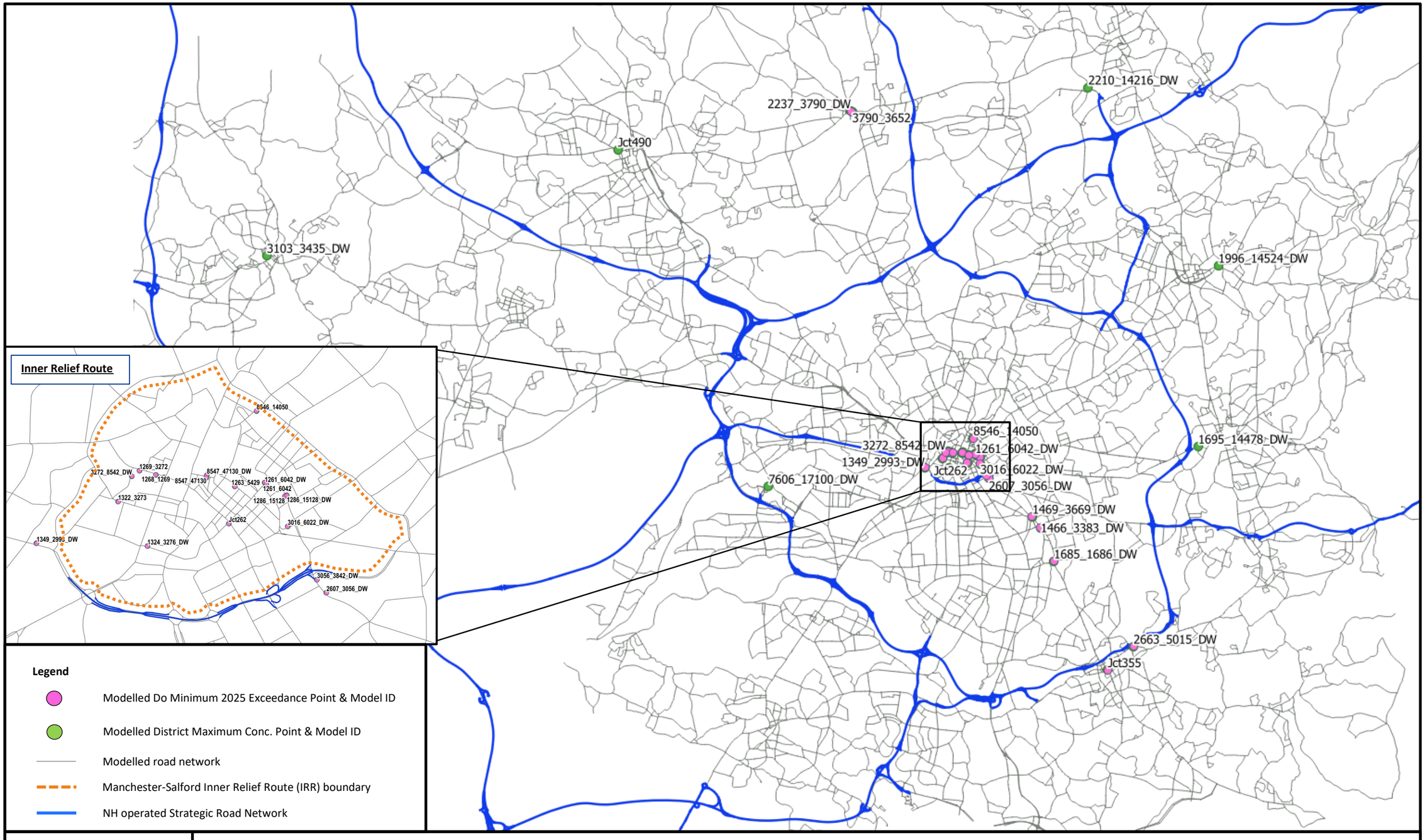
4.5.10 At the locations of poorest air quality, there are two quite distinct groups.

4.5.11 The majority of the last points of exceedance are in the regional centre, or on the A6 bus corridor between the regional centre and Stockport bus depot. On these links in Manchester and Stockport, bus emissions typically dominate emissions from 24% to 100% of total transport emissions.

4.5.12 However, outside of the IRR, on the links in Bolton, Bury Rochdale, Salford and Tameside emissions from freight vehicles (HGVs & LGVs) are often 30-50% of emissions. Cars form a more consistently substantial proportion of total emissions, but also comprise the vast majority of vehicle movements, usually more than 75%.

4.5.13 One element of the Investment-led Plan aimed at addressing the last remaining exceedances after the deployment of bus and taxi measures are two packages of Local Traffic Management (LTM) measures, which are located at A57 Regent Road and St John's area (covering the A34 Quay Street and modelled to be effective on Great Bridgewater Street). To describe how these measures impact traffic and air quality, a range of model points have been selected which show roads where concentrations are altered as a result of the LTM measures. These are shown in Figure 4-3, with the air quality data and emissions source apportionment is provided in Table 4-6 for 2025, and Table 4-7 for 2026.

Figure 4-2: Do Minimum 2025 Exceedance Points and Maximum Concentrations for Each District



Transport for Greater Manchester

Key Exceedance Points across GM

Drawn by: NB	Scale: NTS	Date: 25-6-24	

Table 4-4: Predicted annual mean NO_2 concentrations and source apportionment at key compliance points on the Greater Manchester road network - 2025 Do Minimum

Point ID	x	y	Census ID	Road name	Local Authority	PCM/ LA	PCM Total NO_2 conc ($\mu g/m^3$)	Annual mean NO_2 conc ($\mu g/m^3$)	BG[24] NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	Traffic Flow (veh per day)	NOx contribution by vehicle type (%)				
														Bus	Taxi	HGV	LGV	Car
2237_3790_DW	379830	410975	38354	A58 Bolton St	Bury	PCM	33.2	**42.4**	20.1	14.4	61.3	28.0	80,638	8%	6%	19%	26%	41%
3790_3652	379874	410937	38354	A58 Bolton St	Bury	PCM	33.2	**40.7**	20.1	14.4	58.1	26.3	80,638	8%	6%	19%	26%	41%
3016_6022_DW	384639	397855	46165	A6 Whitworth St	Manchester	PCM	23.7	**49.5**	30.0	20.3	66.2	29.2	6,809	79%	2%	3%	6%	11%
1322_3273	383249	398058	27975	A34 Quay St	Manchester	PCM	22.8	**48.2**	33.2	22.1	62.1	26.1	14,103	28%	5%	17%	21%	30%
1261_6042	384466	398201	77003	Portland St	Manchester	PCM	25.7	**48.2**	33.2	22.1	56.9	26.0	1,023	100%	0%	0%	0%	0%
1261_6042_DW	384451	398215	77003	Portland St	Manchester	PCM	25.7	**47.8**	33.2	22.1	55.9	25.6	1,023	100%	0%	0%	0%	0%
1286_15128	384616	398101	70158	A6 Piccadilly	Manchester	PCM	24.0	**47.7**	33.2	22.1	56.5	25.6	3,588	89%	1%	3%	3%	4%
3272_8542_DW	383361	398267	N/A	Gartside St	Manchester	LA	N/A	**46.2**	33.2	22.1	53.8	24.1	6,418	42%	5%	5%	15%	33%
8547_47130	383973	398256	N/A	King St	Manchester	LA	N/A	**45.7**	33.2	22.1	54.0	23.6	21,601	24%	6%	9%	21%	40%
1263_5429	384207	398182	N/A	New York St	Manchester	LA	N/A	**45.3**	33.2	22.1	52.2	23.1	9,726	26%	6%	5%	23%	40%
1286_15128_DW	384632	398110	70158	A6 Piccadilly	Manchester	PCM	24.0	**44.9**	33.2	22.1	49.8	22.8	3,588	89%	1%	3%	3%	4%
1469_3669_DW	386578	395884	28695	A6 Stockport Rd	Manchester	PCM	21.3	**44.1**	22.9	16.1	56.3	28.0	28,272	56%	4%	4%	12%	25%
1268_1269	383558	398278	27974	A34 Bridge St	Manchester	PCM	21.5	**43.7**	33.2	22.1	50.4	21.6	11,868	52%	4%	5%	12%	27%
2607_3056_DW	384957	397311	26157	A6 Ardwick Green	Manchester	PCM	27.3	**43.0**	30.0	20.3	46.6	22.7	33,431	40%	4%	4%	21%	31%
3056_3842_DW	384880	397418	26157	A6 London Rd	Manchester	PCM	27.3	**42.9**	30.0	20.3	46.6	22.6	34,845	39%	4%	4%	20%	32%
1685_1686_DW	387382	394221	73778	A6 Stockport Rd	Manchester	PCM	22.4	**42.8**	21.8	15.5	55.4	27.3	27,865	55%	3%	8%	13%	21%
NonPCM_207	383624	398258	N/A	A34 Bridge St	Manchester	LA	N/A	**42.1**	33.2	22.1	46.3	20.1	11,868	52%	4%	5%	12%	27%
1324_3276_DW	383489	397693	N/A	Great Bridgewater St	Manchester	LA	N/A	**41.8**	27.6	18.9	57.1	22.9	10,810	7%	6%	26%	26%	35%
8547_47130_DW	383976	398274	N/A	King St	Manchester	LA	N/A	**41.7**	33.2	22.1	43.9	19.6	21,601	24%	6%	9%	21%	40%
8546_14050	384384	398801	57427	A664 Shudehill	Manchester	PCM	23.5	**41.6**	33.2	22.1	45.7	19.5	10,814	50%	4%	8%	12%	26%
1466_3383_DW	386887	395470	7946	A6 Stockport Rd	Manchester	PCM	22.9	**41.2**	22.9	16.1	50.1	25.1	25,110	55%	4%	4%	12%	25%
Jct262	384156	397878	N/A	Portland St	Manchester	LA	N/A	**40.7**	30.0	20.3	43.8	20.3	4,639	87%	1%	1%	6%	4%
1269_3272	383423	398312	27974	A34 Bridge St	Manchester	PCM	21.5	**40.6**	33.2	22.1	44.2	18.5	12,643	57%	3%	8%	12%	20%
1349_2993_DW	382580	397716	73792	A57 Regent Rd	Salford	PCM	29.9	**41.2**	23.2	16.3	54.3	24.9	56,847	1%	6%	18%	31%	44%
Jct355	389388	390175	N/A	A6 Wellington Rd South	Stockport	LA	N/A	**44.9**	22.4	15.9	60.1	29.0	24,755	40%	4%	9%	19%	28%
2663_5015_DW	390344	391047	N/A	B6104 Carrington Rd	Stockport	LA	N/A	**43.8**	17.9	13.0	66.8	30.8	18,005	40%	2%	24%	18%	16%
Jct490	371155	409546	N/A	Vernon St	Bolton	LA	N/A	39.8	24.3	17.0	47.6	22.8	10,338	5%	6%	7%	37%	44%
1996_14524_DW	393502	405226	36632	A62 Bottom o' th' Moor	Oldham	PCM	31.1	40.2	24.4	17.0	47.4	23.2	33,683	29%	5%	9%	22%	35%
2210_14216_DW	388664	411856	17322	A664 Edinburgh Way	Rochdale	PCM	25.2	39.3	17.0	12.4	63.1	26.9	34,575	0%	4%	41%	26%	29%
1695_14478_DW	392753	398494	99618	A635 Manchester Rd	Tameside	PCM	33.9	37.6	24.5	17.0	43.6	20.6	46,661	0%	6%	18%	33%	43%
7606_17100_DW	376759	397007	N/A	B5214 Trafford Blvd	Trafford	LA	N/A	38.8	18.3	13.3	54.5	25.5	28,908	36%	4%	20%	10%	29%
3103_3435_DW	358085	405595	N/A	King St West	Wigan	LA	N/A	40.0	27.5	18.8	47.2	21.2	7,198	77%	1%	9%	5%	8%

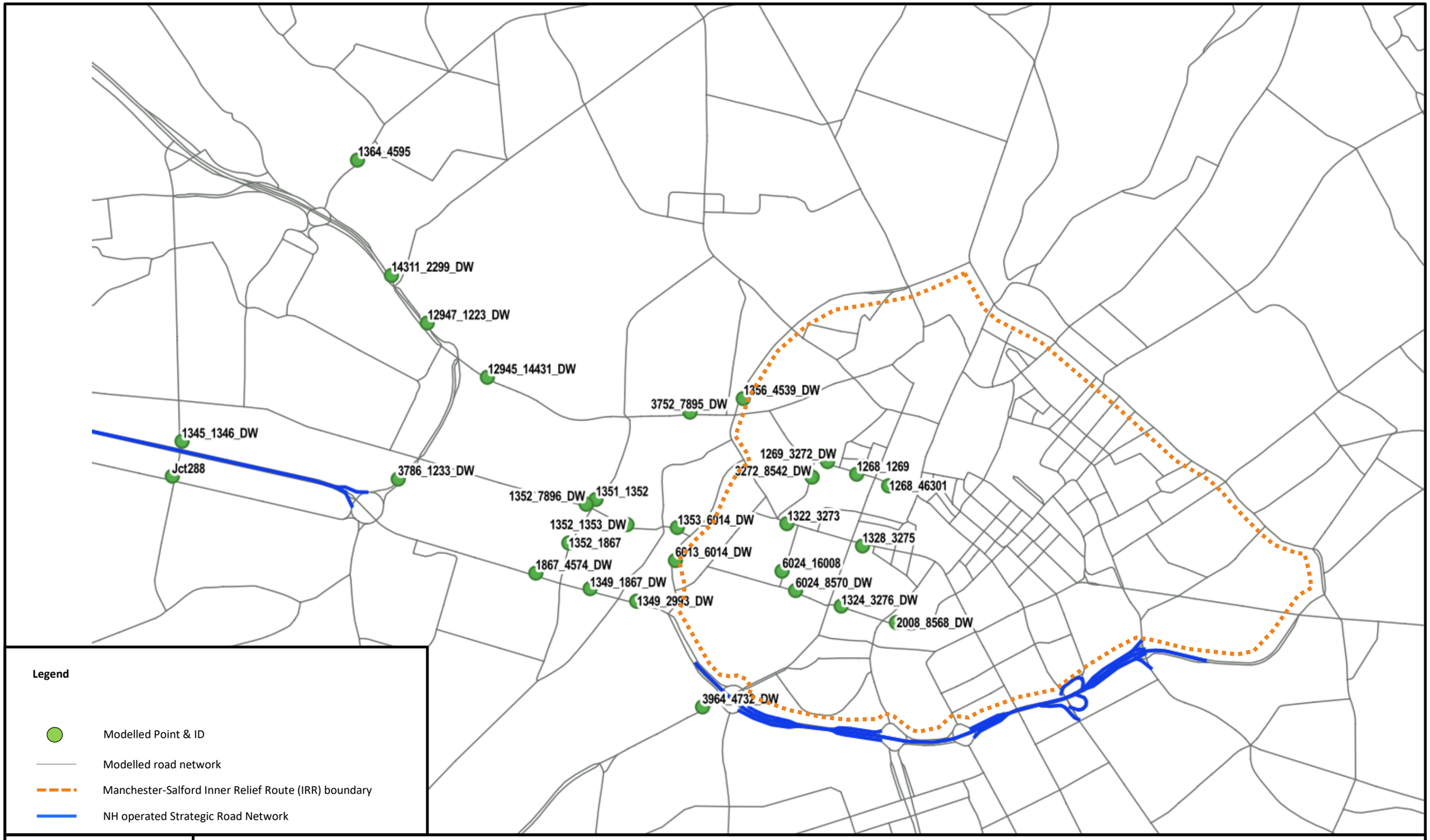
[24] BG = Background

Table 4-5: Predicted annual mean NO_2 concentrations and source apportionment at key compliance points on the Greater Manchester road network - 2026 Do Minimum

Point ID	x	y	Census ID	Road name	Local Authority	PCM/ LA	PCM Total NO_2 conc ($\mu g/m^3$)	Annual mean NO_2 conc ($\mu g/m^3$)	BG[25] NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	Traffic Flow (veh per day)	NOx contribution by vehicle type (%)				
														Bus	Taxi	HGV	LGV	Car
2237_3790_DW	379830	410975	38354	A58 Bolton St	Bury	PCM	31.5	40.0	19.6	14.1	56.2	25.8	80,745	9%	6%	19%	25%	40%
3790_3652	379874	410937	38354	A58 Bolton St	Bury	PCM	31.5	38.5	19.6	14.1	53.5	24.4	80,745	9%	6%	19%	25%	40%
3016_6022_DW	384639	397855	46165	A6 Whitworth St	Manchester	PCM	22.7	**47.4**	29.4	19.9	61.8	27.5	6,899	79%	2%	3%	6%	11%
1322_3273	383249	398058	27975	A34 Quay St	Manchester	PCM	21.9	**46.2**	32.5	21.7	58.0	24.6	14,131	30%	4%	17%	20%	29%
1261_6042	384466	398201	77003	Portland St	Manchester	PCM	24.4	**47.6**	32.5	21.7	56.6	25.9	1,033	100%	0%	0%	0%	0%
1261_6042_DW	384451	398215	77003	Portland St	Manchester	PCM	24.4	**47.2**	32.5	21.7	55.6	25.5	1,033	100%	0%	0%	0%	0%
1286_15128	384616	398101	70158	A6 Piccadilly	Manchester	PCM	22.9	**46.9**	32.5	21.7	55.5	25.2	3,610	89%	1%	3%	3%	4%
3272_8542_DW	383361	398267	N/A	Gartside St	Manchester	LA	N/A	**44.4**	32.5	21.7	50.4	22.7	6,403	44%	5%	4%	15%	32%
8547_47130	383973	398256	N/A	King St	Manchester	LA	N/A	**43.7**	32.5	21.7	50.2	22.1	21,707	26%	6%	9%	21%	39%
1263_5429	384207	398182	N/A	New York St	Manchester	LA	N/A	**43.4**	32.5	21.7	48.6	21.7	9,804	28%	6%	5%	22%	39%
1286_15128_DW	384632	398110	70158	A6 Piccadilly	Manchester	PCM	22.9	**44.1**	32.5	21.7	48.8	22.5	3,610	89%	1%	3%	3%	4%
1469_3669_DW	386578	395884	28695	A6 Stockport Rd	Manchester	PCM	20.4	**42.6**	22.3	15.8	53.6	26.8	28,281	58%	3%	3%	11%	24%
1268_1269	383558	398278	27974	A34 Bridge St	Manchester	PCM	20.9	**42.3**	32.5	21.7	47.8	20.6	11,917	55%	4%	4%	12%	26%
2607_3056_DW	384957	397311	26157	A6 Ardwick Green	Manchester	PCM	26.0	**41.3**	29.4	19.9	43.6	21.4	33,383	42%	4%	3%	20%	30%
3056_3842_DW	384880	397418	26157	A6 London Rd	Manchester	PCM	26.0	**41.1**	29.4	19.9	43.3	21.2	34,685	42%	4%	4%	19%	31%
1685_1686_DW	387382	394221	73778	A6 Stockport Rd	Manchester	PCM	21.4	**41.3**	21.2	15.1	52.9	26.2	27,873	57%	3%	8%	12%	20%
NonPCM_207	383624	398258	N/A	A34 Bridge St	Manchester	LA	N/A	**40.8**	32.5	21.7	43.9	19.1	11,917	55%	4%	4%	12%	26%
1324_3276_DW	383489	397693	N/A	Great Bridgewater St	Manchester	LA	N/A	39.4	27.0	18.6	51.2	20.8	10,726	5%	6%	27%	26%	35%
8547_47130_DW	383976	398274	N/A	King St	Manchester	LA	N/A	40.0	32.5	21.7	40.8	18.3	21,707	26%	6%	9%	21%	39%
8546_14050	384384	398801	57427	A664 Shudehill	Manchester	PCM	22.5	40.3	32.5	21.7	43.7	18.7	10,825	53%	4%	7%	11%	24%
1466_3383_DW	386887	395470	7946	A6 Stockport Rd	Manchester	PCM	21.9	39.8	22.3	15.8	47.7	24.0	25,107	57%	4%	4%	11%	24%
Jct262	384156	397878	N/A	Portland St	Manchester	LA	N/A	40.0	29.4	19.9	43.1	20.1	4,638	88%	1%	1%	5%	4%
1269_3272	383423	398312	27974	A34 Bridge St	Manchester	PCM	20.9	39.4	32.5	21.7	42.3	17.7	12,669	59%	3%	8%	11%	19%
1349_2993_DW	382580	397716	73792	A57 Regent Rd	Salford	PCM	28.6	38.6	22.7	16.0	48.8	22.6	56,881	1%	6%	17%	31%	45%
Jct355	389388	390175	N/A	A6 Wellington Rd South	Stockport	LA	N/A	**43.5**	21.9	15.5	57.5	28.0	24,866	42%	4%	8%	18%	28%
2663_5015_DW	390344	391047	N/A	B6104 Carrington Rd	Stockport	LA	N/A	**42.1**	17.5	12.7	63.1	29.4	18,048	41%	2%	23%	18%	15%
Jct490	371155	409546	N/A	Vernon St	Bolton	LA	N/A	38.0	23.7	16.6	44.6	21.3	10,314	14%	6%	6%	34%	40%
1996_14524_DW	393502	405226	36632	A62 Bottom o' th' Moor	Oldham	PCM	29.7	38.3	23.9	16.7	43.8	21.6	33,692	31%	5%	8%	22%	34%
2210_14216_DW	388664	411856	17322	A664 Edinburgh Way	Rochdale	PCM	24.0	37.2	16.7	12.2	58.4	25.0	34,721	0%	4%	42%	26%	28%
1695_14478_DW	392753	398494	99618	A635 Manchester Rd	Tameside	PCM	32.4	35.4	24.1	16.8	39.1	18.6	46,718	0%	6%	17%	34%	43%
7606_17100_DW	376759	397007	N/A	B5214 Trafford Blvd	Trafford	LA	N/A	37.0	17.9	13.0	50.7	24.0	28,958	39%	4%	19%	10%	29%
3103_3435_DW	358085	405595	N/A	King St West	Wigan	LA	N/A	39.3	27.2	18.6	45.9	20.7	7,198	79%	1%	8%	5%	7%

[25] BG = Background

Figure 4-3: Locations where Local Traffic Management Measures Impact on Air Quality



Transport for Greater Manchester	**Key LTM Points**		
Drawn by: NB	**Scale: NTS**	**Date: 25-6-24**	

Table 4-6: Predicted annual mean NO_2 concentrations and source apportionment at key LTM measure points on the Greater Manchester road network - 2025 Do Minimum

Point ID	x	y	Census ID	Road name	Local Authority	PCM/ LA	PCM Total NO_2 conc ($\mu g/m^3$)	Annual mean NO_2 conc ($\mu g/m^3$)	BG[26] NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	Traffic Flow (veh per day)	NOx contribution by vehicle type (%)				
														Bus	Taxi	HGV	LGV	Car
1268_1269	383558	398278	27974	A34 Bridge St	Manchester	PCM	21.5	**43.7**	33.2	22.1	50.4	21.6	11,868	52%	4%	5%	12%	27%
1268_46301	383702	398229	7947	A34 John Dalton St	Manchester	PCM	21.9	40.0	33.2	22.1	40.2	17.9	13,435	42%	5%	5%	18%	31%
1269_3272_DW	383429	398334	27974	A34 Bridge St	Manchester	PCM	21.5	35.7	33.2	22.1	31.4	13.6	12,643	57%	3%	8%	12%	20%
12945_14431_DW	381917	398711	56160	A6 Crescent	Salford	PCM	21.0	33.9	22.1	15.6	38.1	18.3	32,894	11%	7%	9%	24%	49%
12947_1223_DW	381649	398952	6161	A6 Broad St	Salford	PCM	23.8	30.4	22.1	15.6	30.1	14.8	24,030	6%	8%	5%	27%	55%
1322_3273	383249	398058	27975	A34 Quay St	Manchester	PCM	22.8	**48.2**	33.2	22.1	62.1	26.1	14,103	28%	5%	17%	21%	30%
1324_3276_DW	383489	397693	N/A	Great Bridgewater St	Manchester	LA	N/A	**41.8**	27.6	18.9	57.1	22.9	10,810	7%	6%	26%	26%	35%
1328_3275	383583	397960	7948	A34 Peter St	Manchester	PCM	21.0	25.0	27.6	18.9	12.8	6.1	7,337	0%	8%	12%	29%	52%
1345_1346_DW	380555	398426	56535	A5186 Langworthy Rd	Salford	PCM	20.1	33.8	24.4	17.0	35.4	16.8	14,087	6%	5%	29%	25%	35%
1349_1867_DW	382371	397772	48023	A57 Regent Rd	Salford	PCM	30.0	38.6	23.2	16.3	48.4	22.3	48,037	0%	6%	23%	29%	42%
1349_2993_DW	382580	397716	73792	A57 Regent Rd	Salford	PCM	29.9	**41.2**	23.2	16.3	54.3	24.9	56,847	1%	6%	18%	31%	44%
1351_1352	382397	398167	27752	A5066 Oldfield Rd	Salford	PCM	19.4	27.1	23.7	16.6	21.6	10.5	10,805	0%	4%	36%	29%	30%
1352_1353_DW	382537	398056	N/A	Middlewood St	Salford	LA	N/A	25.7	23.7	16.6	18.0	9.1	13,074	0%	8%	11%	22%	58%
1352_1867	382276	397975	27752	A5066 Oldfield Rd	Salford	PCM	19.4	26.7	23.2	16.3	21.1	10.4	12,328	8%	6%	25%	23%	38%
1352_7896_DW	382355	398146	N/A	Liverpool St	Salford	LA	N/A	31.3	23.7	16.6	31.2	14.6	16,860	5%	5%	38%	20%	32%
1353_6014_DW	382761	398040	N/A	B5225 Hampson St	Salford	LA	N/A	27.5	23.7	16.6	22.0	10.9	11,182	0%	7%	20%	24%	48%
1356_4539_DW	383054	398617	99519	A6042 Trinity Way	Manchester	PCM	28.2	37.6	33.2	22.1	37.8	15.5	28,116	0%	5%	36%	27%	32%
1364_4595	381339	399678	17245	A576 Broughton Rd	Salford	PCM	24.0	33.8	23.1	16.2	35.8	17.6	34,831	21%	6%	11%	19%	42%
14311_2299_DW	381488	399165	6161	A6 Broad St	Salford	PCM	23.8	36.5	23.1	16.2	43.0	20.3	50,416	10%	7%	10%	22%	50%
1867_4574_DW	382129	397840	36585	A57 Regent Rd	Salford	PCM	31.1	37.8	23.2	16.3	46.6	21.5	51,421	1%	6%	22%	30%	42%
2008_8568_DW	383735	397620	N/A	Great Bridgewater St	Manchester	LA	N/A	33.7	27.6	18.9	31.6	14.8	20,347	32%	5%	6%	21%	36%
3272_8542_DW	383361	398267	N/A	Gartside St	Manchester	LA	N/A	**46.2**	33.2	22.1	53.8	24.1	6,418	42%	5%	5%	15%	33%
3752_7895_DW	382815	398555	17926	A6 Chapel St	Salford	PCM	22.4	27.8	23.7	16.6	22.7	11.1	19,743	14%	6%	16%	26%	38%
3786_1233_DW	381517	398259	27751	A5063 Albion Way	Salford	PCM	22.5	32.2	22.1	15.6	34.0	16.5	34,441	1%	7%	14%	25%	53%
3964_4732_DW	382871	397244	99516	A56 Chester Rd	Salford	PCM	29.3	35.6	23.2	16.3	39.6	19.3	41,421	9%	6%	12%	29%	44%
6013_6014_DW	382751	397897	78673	A6042 Trinity Way	Salford	PCM	24.2	25.8	23.2	16.3	20.1	9.5	26,533	0%	8%	12%	28%	53%
6024_16008	383227	397848	N/A	Lower Byrom St	Manchester	LA	N/A	27.2	27.6	18.9	17.9	8.3	8,361	13%	5%	24%	27%	31%
6024_8570_DW	383286	397761	7922	A6143 Liverpool Rd	Manchester	PCM	20.0	28.2	27.6	18.9	19.6	9.3	13,294	21%	6%	7%	25%	41%
Jct288	380512	398269	N/A	A5186 Langworthy Rd	Salford	LA	N/A	27.4	24.4	17.0	21.3	10.4	14,087	6%	5%	29%	25%	35%

[26] BG = Background

Table 4-7: Predicted annual mean NO_2 concentrations and source apportionment at key LTM measure points on the Greater Manchester road network - 2026 Do Minimum

Point ID	x	y	Census ID	Road name	Local Authority	PCM/ LA	PCM Total NO_2 conc ($\mu g/m^3$)	Annual mean NO_2 conc ($\mu g/m^3$)	BG[27] NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	Traffic Flow (veh per day)	NOx contribution by vehicle type (%)				
														Bus	Taxi	HGV	LGV	Car
1268_1269	383558	398278	27974	A34 Bridge St	Manchester	PCM	20.9	**42.3**	32.5	21.7	47.8	20.6	11,917	55%	4%	4%	12%	26%
1268_46301	383702	398229	7947	A34 John Dalton St	Manchester	PCM	21.0	38.6	32.5	21.7	37.8	16.9	13,486	44%	4%	5%	17%	30%
1269_3272_DW	383429	398334	27974	A34 Bridge St	Manchester	PCM	20.9	34.7	32.5	21.7	30.0	13.0	12,669	59%	3%	8%	11%	19%
12945_14431_DW	381917	398711	56160	A6 Crescent	Salford	PCM	20.1	32.1	21.7	15.4	34.8	16.7	33,161	12%	7%	8%	24%	49%
12947_1223_DW	381649	398952	6161	A6 Broad St	Salford	PCM	22.7	28.8	21.7	15.4	27.3	13.5	24,109	6%	8%	4%	27%	55%
1322_3273	383249	398058	27975	A34 Quay St	Manchester	PCM	21.9	**46.2**	32.5	21.7	58.0	24.6	14,131	30%	4%	17%	20%	29%
1324_3276_DW	383489	397693	N/A	Great Bridgewater St	Manchester	LA	N/A	39.4	27.0	18.6	51.2	20.8	10,726	5%	6%	27%	26%	35%
1328_3275	383583	397960	7948	A34 Peter St	Manchester	PCM	20.2	24.1	27.0	18.6	11.6	5.5	7,361	0%	8%	12%	29%	52%
1345_1346_DW	380555	398426	56535	A5186 Langworthy Rd	Salford	PCM	19.3	31.8	23.9	16.7	31.5	15.1	14,158	7%	5%	27%	25%	36%
1349_1867_DW	382371	397772	48023	A57 Regent Rd	Salford	PCM	28.6	36.2	22.7	16.0	43.5	20.2	48,101	1%	6%	22%	29%	43%
1349_2993_DW	382580	397716	73792	A57 Regent Rd	Salford	PCM	28.6	38.6	22.7	16.0	48.8	22.6	56,881	1%	6%	17%	31%	45%
1351_1352	382397	398167	27752	A5066 Oldfield Rd	Salford	PCM	18.6	25.9	23.3	16.3	19.7	9.6	10,868	0%	4%	36%	29%	30%
1352_1353_DW	382537	398056	N/A	Middlewood St	Salford	LA	N/A	24.5	23.3	16.3	16.3	8.2	13,108	0%	8%	11%	23%	58%
1352_1867	382276	397975	27752	A5066 Oldfield Rd	Salford	PCM	18.6	25.5	22.7	16.0	19.1	9.5	12,417	9%	5%	24%	23%	39%
1352_7896_DW	382355	398146	N/A	Liverpool St	Salford	LA	N/A	29.7	23.3	16.3	28.5	13.4	16,845	6%	5%	38%	20%	32%
1353_6014_DW	382761	398040	N/A	B5225 Hampson St	Salford	LA	N/A	26.2	23.3	16.3	19.9	9.9	11,309	0%	7%	20%	25%	49%
1356_4539_DW	383054	398617	99519	A6042 Trinity Way	Manchester	PCM	27.1	35.9	32.5	21.7	34.4	14.2	28,217	0%	5%	36%	27%	32%
1364_4595	381339	399678	17245	A576 Broughton Rd	Salford	PCM	23.0	32.2	22.6	15.9	33.1	16.3	34,819	23%	6%	11%	19%	41%
14311_2299_DW	381488	399165	6161	A6 Broad St	Salford	PCM	22.7	34.7	22.6	15.9	39.8	18.8	50,481	11%	7%	10%	22%	50%
1867_4574_DW	382129	397840	36585	A57 Regent Rd	Salford	PCM	29.6	35.5	22.7	16.0	41.9	19.5	51,701	1%	6%	21%	30%	42%
2008_8568_DW	383735	397620	N/A	Great Bridgewater St	Manchester	LA	N/A	32.4	27.0	18.6	29.5	13.9	20,596	34%	5%	5%	21%	35%
3272_8542_DW	383361	398267	N/A	Gartside St	Manchester	LA	N/A	**44.4**	32.5	21.7	50.4	22.7	6,403	44%	5%	4%	15%	32%
3752_7895_DW	382815	398555	17926	A6 Chapel St	Salford	PCM	21.4	26.5	23.3	16.3	20.8	10.2	19,916	15%	6%	14%	26%	38%
3786_1233_DW	381517	398259	27751	A5063 Albion Way	Salford	PCM	21.5	30.2	21.7	15.4	30.4	14.9	34,405	1%	7%	13%	25%	53%
3964_4732_DW	382871	397244	99516	A56 Chester Rd	Salford	PCM	28.0	33.6	22.7	16.0	36.0	17.6	41,527	10%	6%	11%	29%	44%
6013_6014_DW	382751	397897	78673	A6042 Trinity Way	Salford	PCM	23.1	24.5	22.7	16.0	18.1	8.6	26,619	0%	8%	11%	28%	53%
6024_16008	383227	397848	N/A	Lower Byrom St	Manchester	LA	N/A	26.2	27.0	18.6	16.4	7.6	8,320	14%	5%	24%	26%	31%
6024_8570_DW	383286	397761	7922	A6143 Liverpool Rd	Manchester	PCM	19.4	27.2	27.0	18.6	18.1	8.6	13,407	23%	6%	7%	24%	41%
Jct288	380512	398269	N/A	A5186 Langworthy Rd	Salford	LA	N/A	26.1	23.9	16.7	19.1	9.4	14,158	7%	5%	27%	25%	36%

[27] BG = Background

5 Investment-Led Plan Scenario Model Scenario

5.1 Overview

5.1.1 As previously described, local modelling has revealed the problem to be larger than that initially identified by Government for 2021. Local modelling predicts a greater spatial distribution of NO_2 exceedances across roads in GM and generally higher concentrations of NO_2 in specific locations. However, by 2025 following the gradual improvement of vehicle emissions from the natural turnover of cars, vans and HGVs, the number of exceedances is forecast to have significantly reduced.

5.1.2 This has meant that whilst there are differing source apportionment profiles to the remaining 26 exceedances, the scale of the challenge means that targeted solutions are viable.

5.1.3 The Investment-led Plan (ILP) scenario has applied a series of measures aimed at reducing emissions and smoothing traffic flows to deliver compliance in 2025.

5.1.4 The plan has applied the following incremental measures at the last exceedances:

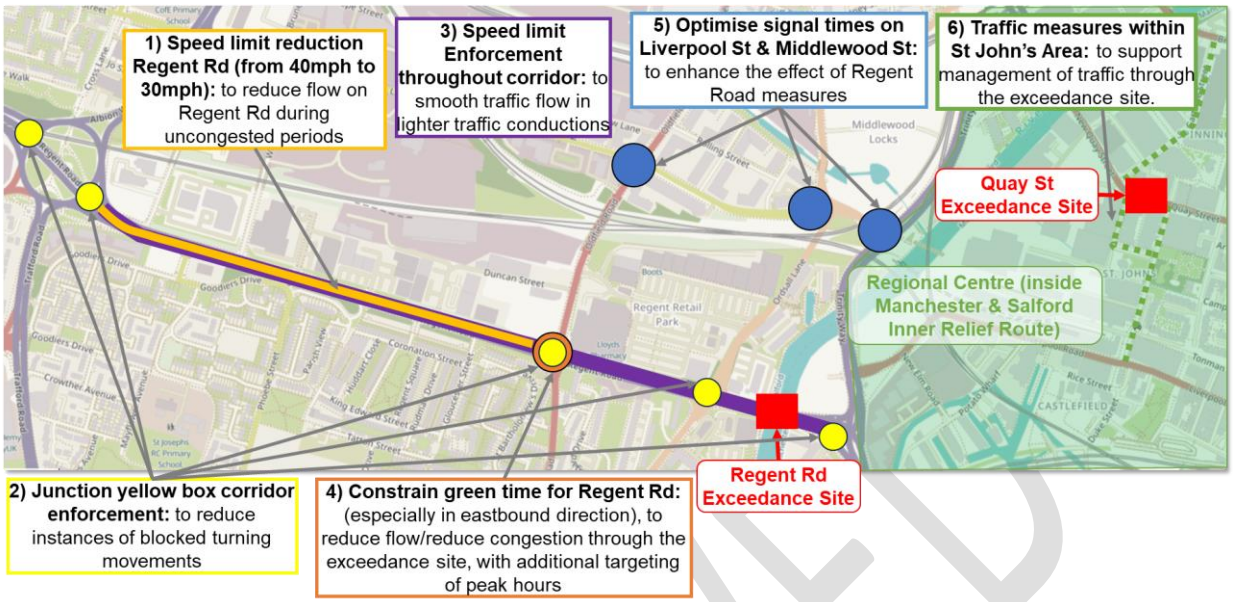
- Bus fleet upgrade
    - Upgrade services operated by retrofit Euro V buses to OEM Euro VI; then
    - Upgrade bus services operated by retrofit Euro V buses or OEM Euro VI to ZEB
- GM Taxi Emissions Standards[28] (and Clean Taxi Fund)
- Local Traffic Management (LTM) measures

5.1.5 The package of targeted LTM can be summarised into the following, as shown in Figure 5-1.

- Signal optimisation at A57 Regent Road and adjacent parallel routes;
- Speed restrictions on A57 Regent Road with supporting enforcement measures;
- Yellow box enforcement along the A57 Regent Road corridor; and
- Traffic management measures – St John's area.

[28] Minimum emissions standards to meet national CAZ standards, of Euro 4 petrol or Euro 6 diesel vehicles.

Figure 5-1 Overview of local measures



5.2 Modelling Assumptions for the Investment-led Plan scenario

Initial Testing of Bus & Taxi Measures

5.2.1 Initial measure scenario testing over the development of the GM CAP has demonstrated that even with a 100% Zero Emission Bus (ZEB) fleet operating and upgraded taxi fleet, A57 Regent Road, A34 Quay Street and Great Bridgewater Street would not be compliant in 2025.

5.2.2 Therefore, local traffic management (LTM) measures were developed at these locations to smooth vehicle flows and reduce congestion at the road sections with the exceedances. The LTM measures are described in Figure 5-1 and are discussed in the section below.

Local Traffic Management Measures -

A57: Signal optimisation at A57 Regent Road & adjacent parallel routes

5.2.3 Signal timing adjustments were applied within the modelling on A57 Regent Road, namely at the A57 Regent Road / Oldfield Road junction and the M602 J3 west arm approach. These adjustments would be supported by further adjustments to parallel routes at the junctions of Oldfield Road / Middlewood Street, Ordsall Lane / Middlewood Street / Hampson Street and Hampson Street / Trinity Way.

5.2.4 These adjustments would be conducted to improve average speeds through the exceedance site and constrain overall traffic flows travelling eastbound along Regent Road to increase capacity on parallel routes. Signal optimisation has been modelled to have a materially beneficial impact on compliance at the A57 Regent Road exceedance site by improving the flow of traffic, leading to a reduction in congestion and a resulting emission benefit.

5.2.5 The proposed changes to signal timings would be implemented through GM Urban Traffic Control[29] and agreement with Salford City Council and delivered by 31st December 2024, which allows sufficient time to capture the full year air quality benefit of this scheme being in place in 2025.

A57: Speed reductions on A57 Regent Road with supporting enforcement measures

5.2.6 Multiple modelling scenarios were also undertaken for a speed reduction from 40mph to 30mph on the A57 Regent Road between Oldfield Road and the M602. The measure would reduce the number of vehicles travelling past the Regent Road exceedance sites with some displacement to nearby parallel routes, thus reducing the modelled NO_2 concentrations at this exceedance site. The displaced trips are being accommodated by the adjustments to signals at the junctions of Oldfield Road / Middlewood Street, Ordsall Lane / Middlewood Street / Hampson Street and Hampson Street / Trinity Way.

5.2.7 The implementation of the speed reduction would be delivered through a Traffic Regulation Order made by Salford City Council by 31st December 2024 which allows sufficient time to capture the full year air quality benefit of this scheme being in place in 2025.

5.2.8 GM is seeking to add robustness to this measure with GM Police enforcing the speed limit change via average speed cameras along the A57 Regent Road corridor. It is proposed that average speed cameras are deployed to cover the route which will be operational seven days a week across a 24-hour period. This supporting measure will help to regulate the traffic flow travelling through the exceedance site, particularly out of the peak periods where higher average speeds are observed.

A57: Yellow box enforcement along the A57 Regent Road corridor

5.2.9 The implementation of enforcement measures for incursions into existing yellow box junctions along the A57 Regent Road corridor are planned as a supporting measure to achieve compliance in 2025. There are currently yellow boxes present at the following junctions along the corridor:

- M602/A5063 Albion Way/A57 Regent Road/A6042 Trinity Way roundabout
- A57 Regent Road/ A5066 Oldfield Road
- A57 Regent Road/Ordsall Lane
- A57 Regent Road/A6042 Trinity Way

[29] Transport for Greater Manchester's Urban Traffic Control (UTC) team provides a high quality traffic signal control service to the 10 Authorities of Greater Manchester and National Highways, using a range of technologies including optimised traffic signal control through SCOOT (Split Cycle Offset Optimisation Technique) and MOVA (Microprocessor Optimised Vehicle Actuation).

5.2.10 The strategic highway model (SATURN) used to assess the GM CAP assumes compliant driver behaviour at junctions and thus the model does not reflect instances where queueing traffic blocks turning movements at junctions along the A57 Regent Road corridor. The A57 Regent Road, as one of the main highway corridors in and out of the Regional Centre is subject to instances of incursions into the yellow boxes, predominately during the peak periods. The introduction of enforcement at junctions will provide added robustness to the local measures along the A57 Regent Road Corridor. The local highway authority, Salford City Council, will manage the implementation of yellow box enforcement along the corridor with the measure implemented to support compliance being achieved at the exceedance site in 2025.

St John's area Traffic Management Measures

5.2.11 In the December 2023 submission GM outlined that based on the modelling undertaken, the St John's area around A34 Quay Street and Great Bridgewater Street was forecast to be one of the final exceedance sites and local measures would be needed to manage the flow of traffic on some roads to reduce nitrogen dioxide concentrations.

5.2.12 Manchester City Council and TfGM have considered several possible options and have identified a scheme which complements the objectives of the wider City Centre Transport Strategy (CCTS) and local plans for the regional centre.

5.2.13 The scheme includes traffic management measures in the St John's area of Manchester City Centre, reducing movements for general traffic whilst supporting movement for bus and local residents.

5.2.14 This scheme models a reduction in turning movements onto the A34 Quay Street from Lower Byrom Street and achieves a sufficient reduction in traffic flow past one of the final exceedance sites to bring it into compliance in 2025.

5.2.15 The next step is to develop a detailed design along with an assessment of the costs and an implementation plan that identifies any risks. The final design, costs and timescales will be submitted to JAQU as part of the final Investment-led Clean Air Plan.

Bus Measure

5.2.16 Once the scale improvement expected from the LTM measures was known, the target road NO_x reduction to achieve compliance was then back-calculated, and converted into the equivalent required proportion of OEM Euro VI or ZEB bus flows on the relevant exceedance link. The bus team used this information to identify which buses services should be upgraded. This was a function of both the bus service frequency and the deliverability of ZEB services in 2025 where depot electrification could be a logistical constraint.

5.2.17 These targeted bus services were then set to the specified vehicle type in the bus fleet file for the emissions calculations, and re-run through the modelling process to show the impacts of cleaner bus performance on modelled NO_2 concentrations.

5.2.18 From a review of bus services, the peak vehicle requirement to operate these services was identified (including spares). The depot the services operate out of and which tranche of bus franchising the services were allocated to was also noted.

5.2.19 The details of the bus measure services proposed to be upgraded are described in Table 5-1, and the locations are shown in Figure 5-1.

Table 5-1: Summary of Fleet and Depot Change Requirements for the Investment-led Plan

Route	Tranche	Depot	Bus Type	Additional Vehicles *	Indicative Changes to Fleet Type	Exceedance
36	1	Bolton	ZEB	20	40 additional ZEBs required with depot electrification additional capacity (90 ZEBs required in total, with 50 currently operating	A34 Bridge St, Manchester King St, Manchester New York St, Manchester Portland St, Manchester
37	1	Bolton	ZEB	20		
163	1	Bolton	ZEB	20		A664 Shudehill, Manchester
471	1	Bolton	ZEB	19		A58 Bolton Street, Bury
472 / 474	1	Bolton	ZEB	10		
X39	1	Bolton	ZEB	0**		A34 Bridge St, Manchester King St, Manchester New York St, Manchester
1	2	Queens Road	ZEB	6	73 ZEBs required (no funding required for ZEBs) with depot electrification.	A6 Piccadilly, Manchester A34 Bridge St, Manchester A34 Quay St, Manchester Gartside St, Manchester King St, Manchester New York St, Manchester Portland St, Manchester
2	2	Queens Road	ZEB	3		King Street / A34 Quay Street, Manchester
33/ 33B	2	Queens Road	ZEB	5		57 Regent Rd, Salford

Route	Tranche	Depot	Bus Type	Additional Vehicles *	Indicative Changes to Fleet Type	Exceedance
						Great Bridgewater St, Manchester Portland St, Manchester
67/ 67A	2	Queens Road	ZEB	12		A34 Bridge St, Manchester
97/ 98	2	Queens Road	ZEB	16		A58 Bolton Street, Bury
100	2	Queens Road	ZEB	13		A34 Bridge St, Manchester
135	2	Queens Road	ZEB	14		Site of risk at Lever Street, Manchester (High NO_2 monitored results recorded at this site)
477	2	Queens Road	ZEB	1		A58 Bolton St, Bury
480	2	Queens Road	ZEB	5		
192 /X92	3	Stockport	EURO VI	47	Upgrade of 77 buses to OEM Euro VI.	A6 Ardwick Green, Manchester A6 London Rd, Manchester A6 Piccadilly, Manchester A6 Stockport Rd, Manchester A6 Wellington Rd South, Stockport A6 Whitworth St, Manchester Portland St, Manchester
325	3	Stockport	EURO VI	5		B6104 Carrington Rd, Stockport
330	3	Stockport	EURO VI	16		
383/384	3	Stockport	EUOR VI	9		A6 Wellington Rd South, Stockport

* This assumes delivery of committed franchising service upgrades to ZEB and OEM Euro VI.

** The X39 is operated with the fleet used for the 36, 37 & 471 services, therefore no additional ZEBs are required for this service.

5.2.20 In summary, it has been determined that there are a number of exceedance sites located in the Regional Centre and along the A6 corridor to Stockport which can achieve compliance through 77 buses upgraded to OEM Euro VI. In addition, 40 buses would require upgrade to ZEBs to achieve compliance at A664 Shudehill (Manchester) and A58 Bolton Street (Bury) based on the peak vehicle requirement to operate the services past these exceedance locations. This excludes the ZEBs which are being rolled out as part of the bus franchising programme.

5.2.21 However, even with these changes to the bus fleet and expected franchising deployment, three exceedance sites remain (A57 Regent Road, A34 Quay Street and Great Bridgewater Street) after the deployment of buses across the three tranches. This position is consistent with the results presented in the December 2023 evidence submission.

Taxi Measure

5.2.22 The Investment-led Plan taxi emissions standard measure comes into effect as a licensing condition from the 1st January 2025. As a consequence, GM-licensed taxi drivers with non-compliant vehicles will need to make preparations to meet the licensing condition over the preceding period, by upgrading their vehicle. It has been assumed that this will occur linearly over the year as licenses are naturally renewed. The modelled test assumes that the fleet is fully compliant in 2025, and therefore to represent the assumed linear phased transition that will occur over the year, the modelled taxi increment impact for road NOx has been halved before calculating the NO_2 concentration for the reported results.

5.2.23 However, it should be noted that the taxi modelling applies of the following pessimistic assumptions:

- there is no allowance for compliant hackney carriages to upgrade to ZEC models despite funding being available; and
- taxi emissions are modelled based on the GM-wide average fraction of taxi flow of 7% as a proportion of total car trip demand, based on the evidence from ANPR data used for Target Determination. However, whilst ANPR evidence indicates that this continues to be representative of the majority of GM, the prevalence of taxi movements is greater in the Regional Centre. Inside the IRR taxi movements can be up to 25% of car traffic in 2023. The modelled impact of the ILP will therefore underestimate the effect of the taxi upgrade.

5.2.24 Therefore, it is expected that the modelled response will underestimate the level of improvement that would occur under the Investment-led Plan taxi measure.

5.3 Summary Results for the Investment-led Plan scenario

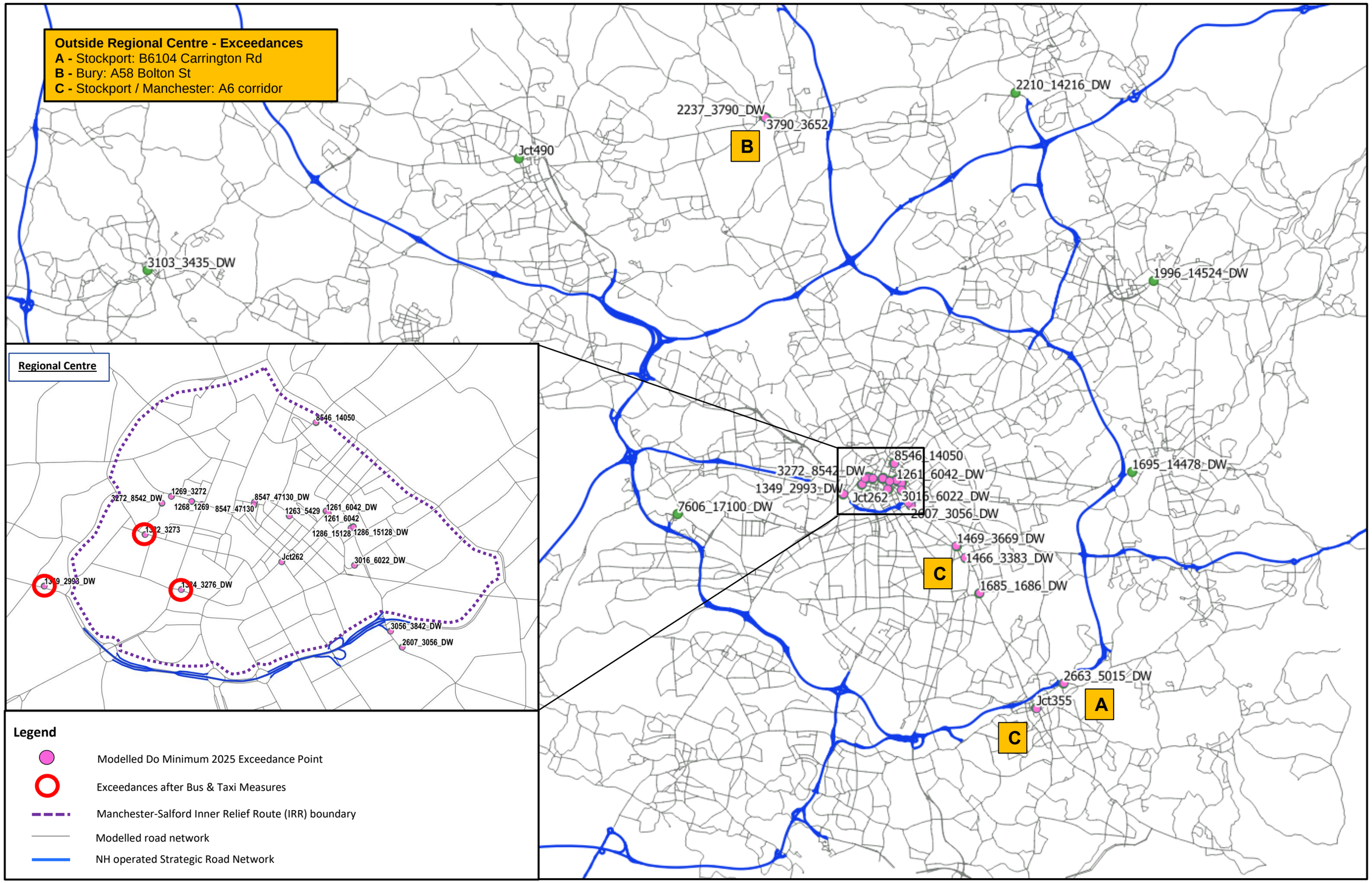
5.3.1 Table 5-2 shows the number of sites remaining in exceedance of legal limits in 2025 under the Do Minimum scenario and with each incremental measure from the Investment-led Plan, by local authority. The location of the modelled exceedances is presented in Figure 5-2. The results show:

- without action, there are predicted to be 26 non-compliant sites across GM in 2025;
- with the inclusion of the Bus measures the exceedances in Bury and Stockport are removed, with only two sites in Manchester and one in Salford remaining non-compliant;
- the taxi measure further reduces concentrations, but the three exceedances in Manchester in Salford are not yet removed; and
- with the inclusion of the local traffic management measures at A57 Regent Road and St John's area, GM achieves compliance in 2025 by removal of the last three exceedances, as a result of the ILP.

Table 5-2: Number of sites remaining in exceedance of legal limits for NO_2 concentrations by year, Greater Manchester, by local authority for each Investment-led Plan measure

	2025			
	Do Min.	**With Bus Measures**	**With Bus & Taxi Measures**	**With Bus & Taxi & LTM Measures**
Bolton	0	0	0	0
Bury	2	0	0	0
Manchester	21	2	2	0
Oldham	0	0	0	0
Rochdale	0	0	0	0
Salford	1	1	1	0
Stockport	2	0	0	0
Tameside	0	0	0	0
Trafford	0	0	0	0
Wigan	0	0	0	0
GM Total	**26**	**3**	**3**	**0**

Figure 5-2: Exceedance Points in the Investment-led Plan Scenario by Measure Increment - 2025



5.3.2 GM aims to deliver compliance in the shortest possible time in a way that takes into account the need to minimise human exposure. Table 5-3 demonstrates the benefits being delivered in terms of reduced concentrations. This also shows that the number of sites close to exceedance reduces as a result of the Plan. Health benefits continue to be delivered by reductions in NO_2 concentrations even below the Limit Values.

5.3.3 With action, there are no sites that are non-compliant, and an increase in the number of sites predicted to have concentrations less than 35 µg/m^3.

Table 5-3: Number of modelled sites by scale of NO_2 exceedance by year, Greater Manchester

Scenario	Compliant sites		Non-compliant sites				Change in no. of sites in exceedance
	Very compliant (below 35 µg/m^3)	Compliant but close (35 to 40 µg/m^3)	Non-compliant (40 to 45 µg/m^3)	Very non-compliant (45 to 50 µg/m^3)	Extremely non-compliant (> 50 µg/m^3)	Total non-compliant (> 40 µg/m^3)	
2025							
Do minimum	2419	95	19	7	0	**26**	na
Investment-led Plan	2470	70	0	0	0	**0**	**-26**

5.4 Detailed Discussion of Transport and Air Quality Impacts for the Investment-led Plan

5.4.1 This section considers the modelled impacts of the Investment-led Plan with reference to the key exceedance points identified earlier, examining the changes to traffic and emissions by vehicle type.

5.4.2 Table 5-4 shows the concentration with each incremental Investment-led Plan measure, at the exceedances or the highest concentration site for each district in the Do Minimum 2025 scenario.

5.4.3 The air quality and source apportionment data for 2025 is provided in Table 5-5, whilst the impacts on the traffic flows are provided in Table 5-6.

5.4.4 The A58 Bolton Street, Bury receives an improvement of -2.3 µg/m^3 because of the bus measures in place, which is sufficient to make this site compliant.

5.4.5 On the A6 corridor between the Stockport depot and Piccadilly bus station in the IRR, the bus upgrades deliver the greatest impact of the three ILP measures at all the sites, with reductions of -15 µg/m^3 at A6 Piccadilly and Portland Street, ranging down to -1.5 µg/m^3 at other exceedance points inside the IRR. Outside the IRR the reductions range from -10.1 µg/m^3 at A6 Stockport Road to -5.5 µg/m^3 at A6 London Road. All exceedances on routes served by the Stockport depot are removed as a result of the bus measure.

5.4.6 At exceedances sites elsewhere in the IRR, the bus measure leads to reductions of between -9.4 µg/m^3 on Gartside Street and -4.3 µg/m^3 on A664 Shudehill.

5.4.7 There are two exceedances which receive smaller reductions. The A57 Regent Road, Salford only improves by -0.1 µg/m^3 and Great Bridgewater Street by -1.1 µg/m^3 because there are a low number of buses using these roads.

5.4.8 Following the application of the bus measure, three sites remain in exceedance A57 Regent Road (41.1 µg/m^3), A34 Quay St (41.2 µg/m^3) and Great Bridgewater Street (40.7 µg/m^3).

5.4.9 The taxi measure further reduces concentrations by -0.2 ug/m^3 at A57 Regent Road and A34 Quay Street, and -0.1 µg/m^3 at Great Bridgewater Street, but is not sufficient bring any of these sites into compliance. This level of improvement from the taxi measure is consistent at other areas of poor air quality across GM.

5.4.10 Finally, the local traffic management (LTM) measures at the St John's area around A34 Quay Street deliver large improvements at Quay Street and Great Bridgewater St of -3.0 µg/m^3 and -3.1 µg/m^3 respectively, which then become compliant.

5.4.11 The LTM measures on the A57 Regent Road deliver -0.6 µg/m^3 which is also sufficient to deliver compliance. This is the only site which requires all three of the bus, taxi and LTM measures in combination to become compliant.

Table 5-4: NO_2 concentration with each ILP Measure at key compliance sites – 2025 (µg/m^3)

Point ID	Road name	Local Authority	Do Min.	With Bus Measure	With Bus & Taxi Measure	With Bus & Taxi & LTM Measure	Total ILP Change in NO_2 conc.
2237_3790_DW	A58 Bolton St	Bury	**42.4**	40.3	40.1	40.1	-2.3
3790_3652	A58 Bolton St	Bury	**40.7**	38.8	38.6	38.6	-2.1
3016_6022_DW	A6 Whitworth St	Manchester	**49.5**	37.1	37.1	37.1	-12.4
1322_3273	A34 Quay St	Manchester	**48.2**	**41.2**	**41.0**	38.0	-10.2
1261_6042	Portland St	Manchester	**48.2**	32.9	32.8	32.9	-15.3
1261_6042_DW	Portland St	Manchester	**47.8**	32.8	32.7	32.7	-15.1
1286_15128	A6 Piccadilly	Manchester	**47.7**	32.4	32.4	32.4	-15.3
3272_8542_DW	Gartside St	Manchester	**46.2**	36.8	36.7	37.3	-8.9
8547_47130	King St	Manchester	**45.7**	40.2	40.1	40.1	-5.6
1263_5429	New York St	Manchester	**45.3**	39.6	39.5	39.5	-5.8
1286_15128_DW	A6 Piccadilly	Manchester	**44.9**	31.4	31.4	31.4	-13.5
1469_3669_DW	A6 Stockport Rd	Manchester	**44.1**	34.0	33.8	33.9	-10.2
1268_1269	A34 Bridge St	Manchester	**43.7**	38.2	38.1	39.2	-4.5
2607_3056_DW	A6 Ardwick Green	Manchester	**43.0**	37.1	37.0	37.0	-6.0
3056_3842_DW	A6 London Rd	Manchester	**42.9**	37.4	37.3	37.2	-5.7
1685_1686_DW	A6 Stockport Rd	Manchester	**42.8**	33.7	33.6	33.6	-9.2
NonPCM_207	A34 Bridge St	Manchester	**42.1**	37.1	36.9	37.9	-4.2
1324_3276_DW	Great Bridgewater St	Manchester	**41.8**	**40.7**	**40.6**	37.5	-4.3
8547_47130_DW	King St	Manchester	**41.7**	37.1	37.0	37.0	-4.7
8546_14050	A664 Shudehill	Manchester	**41.6**	37.3	37.2	37.2	-4.4
1466_3383_DW	A6 Stockport Rd	Manchester	**41.2**	32.0	31.9	32.0	-9.2
Jct262	Portland St	Manchester	**40.7**	39.2	39.2	39.3	-1.4
1269_3272	A34 Bridge St	Manchester	**40.6**	35.9	35.8	35.6	-5.0
1349_2993_DW	A57 Regent Rd	Salford	**41.2**	**41.1**	**40.9**	40.4	-0.8
Jct355	A6 Wellington Rd South	Stockport	**44.9**	38.8	38.7	38.8	-6.1
2663_5015_DW	B6104 Carrington Rd	Stockport	**43.8**	37.6	37.5	37.5	-6.3
Jct490	Vernon St	Bolton	39.8	39.8	39.6	39.7	-0.1
1996_14524_DW	A62 Bottom o' th' Moor	Oldham	40.2	40.2	40.1	40.1	-0.1
2210_14216_DW	A664 Edinburgh Way	Rochdale	39.3	39.2	39.1	39.1	-0.2
1695_14478_DW	A635 Manchester Rd	Tameside	37.6	37.6	37.4	37.5	-0.1
7606_17100_DW	B5214 Trafford Blvd	Trafford	38.8	38.5	38.3	38.4	-0.4
3103_3435_DW	King St West	Wigan	40.0	40.0	39.9	39.9	-0.1

Table 5-5: Predicted annual mean NO_2 concentrations and source apportionment at key compliance sites on the Greater Manchester road network – With Investment-led Plan including Bus, Taxi & LTM Measures 2025

Point ID	Census ID	Road name	Local Authority	Annual mean NO_2 conc ($\mu g/m^3$)	BG[30] NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	Traffic Flow (veh per day)	NOx contribution by vehicle type (%)					Change in Annual mean NO_2 conc ($\mu g/m^3$)
										Bus	Taxi	HGV	LGV	Car	
2237_3790_DW	38354	A58 Bolton St	Bury	40.1	20.1	14.4	56.5	25.8	80,634	1%	6%	21%	28%	45%	-2.3
3790_3652	38354	A58 Bolton St	Bury	38.6	20.1	14.4	53.5	24.2	80,634	1%	6%	21%	28%	45%	-2.1
3016_6022_DW	46165	A6 Whitworth St	Manchester	37.1	30.0	20.3	42.1	16.8	6,790	66%	2%	4%	10%	18%	-12.4
1322_3273	27975	A34 Quay St	Manchester	38.0	33.2	22.1	35.9	15.9	13,206	0%	6%	11%	34%	49%	-10.2
1261_6042	77003	Portland St	Manchester	32.9	33.2	22.1	25.0	10.7	1,023	100%	0%	0%	0%	0%	-15.3
1261_6042_DW	77003	Portland St	Manchester	32.7	33.2	22.1	24.7	10.6	1,023	100%	0%	0%	0%	0%	-15.1
1286_15128	70158	A6 Piccadilly	Manchester	32.4	33.2	22.1	24.8	10.2	3,543	72%	2%	8%	8%	10%	-15.3
3272_8542_DW	N/A	Gartside St	Manchester	37.3	33.2	22.1	34.4	15.2	5,400	0%	8%	13%	27%	53%	-8.9
8547_47130	N/A	King St	Manchester	40.1	33.2	22.1	41.4	18.0	21,594	0%	7%	12%	28%	53%	-5.6
1263_5429	N/A	New York St	Manchester	39.5	33.2	22.1	39.1	17.3	9,679	0%	7%	7%	30%	55%	-5.8
1286_15128_DW	70158	A6 Piccadilly	Manchester	31.4	33.2	22.1	22.1	9.2	3,543	72%	2%	8%	8%	10%	-13.5
1469_3669_DW	28695	A6 Stockport Rd	Manchester	33.9	22.9	16.1	37.3	17.8	28,221	30%	5%	6%	19%	40%	-10.2
1268_1269	27974	A34 Bridge St	Manchester	39.2	33.2	22.1	40.7	17.1	12,476	37%	5%	6%	16%	36%	-4.5
2607_3056_DW	26157	A6 Ardwick Green	Manchester	37.0	30.0	20.3	34.6	16.7	33,077	16%	5%	6%	29%	44%	-6.0
3056_3842_DW	26157	A6 London Rd	Manchester	37.2	30.0	20.3	35.2	16.9	34,287	15%	5%	6%	28%	45%	-5.7
1685_1686_DW	73778	A6 Stockport Rd	Manchester	33.6	21.8	15.5	38.3	18.2	27,853	33%	4%	13%	19%	31%	-9.2
NonPCM_207	N/A	A34 Bridge St	Manchester	37.9	33.2	22.1	37.4	15.9	12,476	37%	5%	6%	16%	36%	-4.2
1324_3276_DW	N/A	Great Bridgewater St	Manchester	37.5	27.6	18.9	43.1	18.6	10,180	0%	6%	21%	28%	45%	-4.3
8547_47130_DW	N/A	King St	Manchester	37.0	33.2	22.1	33.7	15.0	21,594	0%	7%	12%	28%	53%	-4.7
8546_14050	57427	A664 Shudehill	Manchester	37.2	33.2	22.1	35.8	15.1	10,796	37%	5%	10%	15%	33%	-4.4
1466_3383_DW	7946	A6 Stockport Rd	Manchester	32.0	22.9	16.1	32.0	15.9	25,132	26%	5%	7%	20%	41%	-9.2
Jct262	N/A	Portland St	Manchester	39.3	30.0	20.3	40.7	19.0	4,867	86%	1%	2%	6%	6%	-1.4
1269_3272	27974	A34 Bridge St	Manchester	35.6	33.2	22.1	32.7	13.5	12,095	43%	4%	10%	16%	27%	-5.0
1349_2993_DW	73792	A57 Regent Rd	Salford	40.4	23.2	16.3	52.4	24.1	55,004	0%	6%	19%	31%	45%	-0.8
Jct355	N/A	A6 Wellington Rd South	Stockport	38.8	22.4	15.9	48.2	22.9	24,748	17%	5%	12%	26%	40%	-6.1
2663_5015_DW	N/A	B6104 Carrington Rd	Stockport	37.5	17.9	13.0	54.1	24.6	18,016	18%	3%	33%	25%	21%	-6.3
Jct490	N/A	Vernon St	Bolton	39.7	24.3	17.0	47.4	22.7	10,314	5%	6%	7%	38%	44%	-0.1
1996_14524_DW	36632	A62 Bottom o' th' Moor	Oldham	40.1	24.4	17.0	47.3	23.1	33,661	29%	4%	9%	22%	35%	-0.1
2210_14216_DW	17322	A664 Edinburgh Way	Rochdale	39.1	17.0	12.4	62.8	26.7	34,574	0%	4%	41%	26%	29%	-0.2
1695_14478_DW	99618	A635 Manchester Rd	Tameside	37.5	24.5	17.0	43.4	20.5	46,668	0%	5%	18%	34%	43%	-0.1
7606_17100_DW	N/A	B5214 Trafford Blvd	Trafford	38.4	18.3	13.3	52.9	25.1	28,904	34%	4%	21%	11%	30%	-0.4
3103_3435_DW	N/A	King St West	Wigan	39.9	27.5	18.8	47.0	21.1	7,202	77%	1%	9%	5%	8%	-0.1

[30] BG = Background

Table 5-6: Predicted impact on traffic flows at key compliance sites on the Greater Manchester road network – With Investment-led Plan including Bus, Taxi & LTM Measures 2025

Point ID	Local Authority	Do Min ; Total Annual Average Daily Traffic (AADT) Flows (no. veh per day)									ILP : Change in AADT Flows (no. veh per day) from Do Min.								
		All Vehicles	Taxi (comp)	Taxi (non-comp)	HGV (comp)	HGV (non-comp)	LGV (comp)	LGV (non-comp)	Car (comp)	Car (non-comp)	All Vehicles	Taxi (comp)	Taxi (non-comp)	HGV (comp)	HGV (non-comp)	LGV (comp)	LGV (non-comp)	Car (comp)	Car (non-comp)
2237_3790_DW	Bury	80,638	3,908	639	1,639	158	9,248	2,559	55,532	5,951	-4	642	-639	0	0	-25	-8	23	2
3790_3652	Bury	80,638	3,908	639	1,639	158	9,248	2,559	55,532	5,951	-4	642	-639	0	0	-25	-8	23	2
3016_6022_DW	Manchester	6,809	316	51	48	5	613	168	4,586	493	-19	55	-51	1	0	17	4	-41	-4
1322_3273	Manchester	14,103	714	118	287	28	1,818	498	9,458	1,016	-897	38	-118	-58	-6	8	12	-694	-74
1261_6042	Manchester	1,023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1261_6042_DW	Manchester	1,023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1286_15128	Manchester	3,588	186	33	54	05	346	95	1,898	194	-45	34	-33	0	0	-10	-2	-39	1
3272_8542_DW	Manchester	6,418	344	56	128	12	654	179	4,444	477	-1,017	9	-56	-20	-2	-65	-18	-772	-88
8547_47130	Manchester	21,601	1,087	177	379	37	2,316	634	14,960	1,608	-7	173	-177	0	0	-21	-6	22	2
1263_5429	Manchester	9,726	501	82	187	18	1,146	314	6,528	701	-47	77	-82	0	0	-12	-4	-23	-2
1286_15128_DW	Manchester	3,588	186	33	54	05	346	95	1,898	194	-45	34	-33	0	0	-10	-2	-39	1
1469_3669_DW	Manchester	28,272	1,375	223	459	44	2,944	806	19,512	2,096	-51	223	-223	-1	0	14	4	-52	-15
1268_1269	Manchester	11,868	551	90	168	16	1,160	318	7,650	820	608	122	-90	8	1	41	11	458	51
2607_3056_DW	Manchester	33,431	1,478	239	559	54	4,495	1,230	21,884	2,333	-354	233	-239	-4	0	15	3	-319	-42
3056_3842_DW	Manchester	34,845	1,549	250	566	54	4,507	1,234	23,056	2,461	-557	235	-250	-4	0	7	1	-483	-60
1685_1686_DW	Manchester	27,865	1,359	224	499	48	3,122	856	18,818	2,016	-12	217	-224	-1	0	-4	-1	3	-2
NonPCM_207	Manchester	11,868	551	90	168	16	1,160	318	7,650	820	608	122	-90	8	1	41	11	458	51
1324_3276_DW	Manchester	10,810	562	93	314	30	1,509	413	7,023	748	-630	16	-93	24	2	-175	-48	-318	-36
8547_47130_DW	Manchester	21,601	1,087	177	379	37	2,316	634	14,960	1,608	-7	173	-177	0	0	-21	-6	22	2
8546_14050	Manchester	10,814	562	91	181	17	964	264	6,931	746	-18	92	-91	1	0	7	2	-25	-3
1466_3383_DW	Manchester	25,110	1,241	203	500	48	2,651	726	17,069	1,823	22	201	-203	-6	-1	27	7	-1	-3
Jct262	Manchester	4,639	162	28	86	08	650	178	1,690	176	228	25	-28	5	0	-33	-8	237	28
1269_3272	Manchester	12,643	620	102	195	19	1,231	337	8,170	876	-548	78	-102	-17	-2	-21	-6	-428	-49
1349_2993_DW	Salford	56,847	2,522	406	2,378	229	8,141	2,223	36,649	3,932	-1,843	322	-406	13	1	-311	-88	-1,222	-142
Jct355	Stockport	24,755	1,116	182	1,055	102	3,237	885	15,734	1,674	-8	183	-182	2	0	-5	0	-3	-2
2663_5015_DW	Stockport	18,005	673	110	1,675	162	3,567	980	9,346	994	11	112	-110	3	0	13	2	-4	-4
Jct490	Bolton	10,338	464	76	156	15	1,695	465	6,598	704	-24	74	-76	1	0	-2	0	-22	0
1996_14524_DW	Oldham	33,683	1,542	252	917	88	4,612	1,265	22,092	2,370	-21	256	-252	1	0	-1	-1	-24	0
2210_14216_DW	Rochdale	34,575	1,536	248	2,100	202	4,884	1,338	21,750	2,332	-1	247	-248	1	0	-3	-1	4	-1
1695_14478_DW	Tameside	46,661	2,078	337	2,315	223	6,972	1,916	29,274	3,142	7	337	-337	0	0	-3	-2	10	2
7606_17100_DW	Trafford	28,908	1,373	224	1,715	166	2,234	613	19,675	2,093	-4	224	-224	-6	-1	-1	-1	3	0
3103_3435_DW	Wigan	7,198	291	49	321	31	801	220	3,904	415	4	55	-49	0	0	-25	-4	23	5

5.4.12 The potential for rerouting from the LTM measures has also been considered. Figure 5-3 shows the location of sites on roads which traffic flows are re-routed and which therefore experience local air quality impacts.

5.4.13 There are two main corridors related to the A57 Regent Road measures where traffic flows increase and emissions are worsened, which are Liverpool Road (up to +4.3 µg/m^3) and A6 Chapel Street (up to +0.7 µg/m^3), in Salford. The St John's area measures lead to disbenefit primarily along the A34 Bridge Street, Manchester (up to +1.1 µg/m^3). However, none of these increases leads to an exceedance.

5.4.14 Table 5-7 shows the concentration with each incremental Investment-led Plan measure, at the LTM measure receptor sites in the Do Minimum 2025 scenario.

5.4.15 The air quality and source apportionment data for 2025 is provided in Table 5-8, whilst the impacts on the traffic flows are provided in Table 5-9. At Liverpool Road, flows increase by 5,900 vehicles per day, whilst at A6 Chapel Street and A34 Bridge Street flows increase by approximately 600 vehicles per day.

Table 5-7: NO_2 concentration with each ILP Measure at LTM measure receptor sites – 2025 (µg/m3)

Point ID	Road name	Local Authority	Do Min.	With Bus Measure	With Bus & Taxi Measure	With Bus & Taxi & LTM Measure	Total ILP Change in NO_2 conc.
1268_1269	A34 Bridge St	Manchester	**43.7**	38.2	38.1	39.2	-4.5
1268_46301	A34 John Dalton St	Manchester	40.0	37.5	37.4	38.5	-1.5
1269_3272_DW	A34 Bridge St	Manchester	35.7	32.3	32.3	32.1	-3.6
12945_14431_DW	A6 Crescent	Salford	33.9	33.1	32.9	33.3	-0.6
12947_1223_DW	A6 Broad St	Salford	30.4	30.0	29.9	30.2	-0.2
1322_3273	A34 Quay St	Manchester	**48.2**	**41.2**	**41.0**	38.0	-10.2
1324_3276_DW	Great Bridgewater St	Manchester	**41.8**	**40.7**	**40.6**	37.5	-4.3
1328_3275	A34 Peter St	Manchester	25.0	24.9	24.8	26.2	1.2
1345_1346_DW	A5186 Langworthy Rd	Salford	33.8	33.8	33.7	32.3	-1.5
1349_1867_DW	A57 Regent Rd	Salford	38.6	38.5	38.3	36.9	-1.7
1349_2993_DW	A57 Regent Rd	Salford	**41.2**	**41.1**	**40.9**	40.4	-0.8
1351_1352	A5066 Oldfield Rd	Salford	27.1	27.1	27.0	27.8	0.7
1352_1353_DW	Middlewood St	Salford	25.7	25.6	25.6	26.0	0.3
1352_1867	A5066 Oldfield Rd	Salford	26.7	26.7	26.6	25.4	-1.3
1352_7896_DW	Liverpool St	Salford	31.3	31.2	31.1	35.4	4.1
1353_6014_DW	B5225 Hampson St	Salford	27.5	27.5	27.4	27.7	0.2
1356_4539_DW	A6042 Trinity Way	Manchester	37.6	37.4	37.3	37.1	-0.5
1364_4595	A576 Broughton Rd	Salford	33.8	33.7	33.6	33.1	-0.7
14311_2299_DW	A6 Broad St	Salford	36.5	36.0	35.8	36.5	0.0
1867_4574_DW	A57 Regent Rd	Salford	37.8	37.7	37.6	35.6	-2.2
2008_8568_DW	Great Bridgewater St	Manchester	33.7	31.5	31.4	31.6	-2.1
3272_8542_DW	Gartside St	Manchester	**46.2**	36.8	36.7	37.3	-8.9
3752_7895_DW	A6 Chapel St	Salford	27.8	27.1	27.0	27.2	-0.6
3786_1233_DW	A5063 Albion Way	Salford	32.2	32.1	32.0	33.5	1.3
3964_4732_DW	A56 Chester Rd	Salford	35.6	35.5	35.4	35.6	0.0
6013_6014_DW	A6042 Trinity Way	Salford	25.8	25.7	25.6	26.1	0.3
6024_16008	Lower Byrom St	Manchester	27.2	26.3	26.2	24.3	-2.9
6024_8570_DW	A6143 Liverpool Rd	Manchester	28.2	26.6	26.5	26.0	-2.2
Jct288	A5186 Langworthy Rd	Salford	27.4	27.4	27.3	26.7	-0.7

Figure 5-3: Air Quality Impacts of the LTM Measure Increment at Locations Where Local Traffic Management Measures Impact on Air Quality - 2025

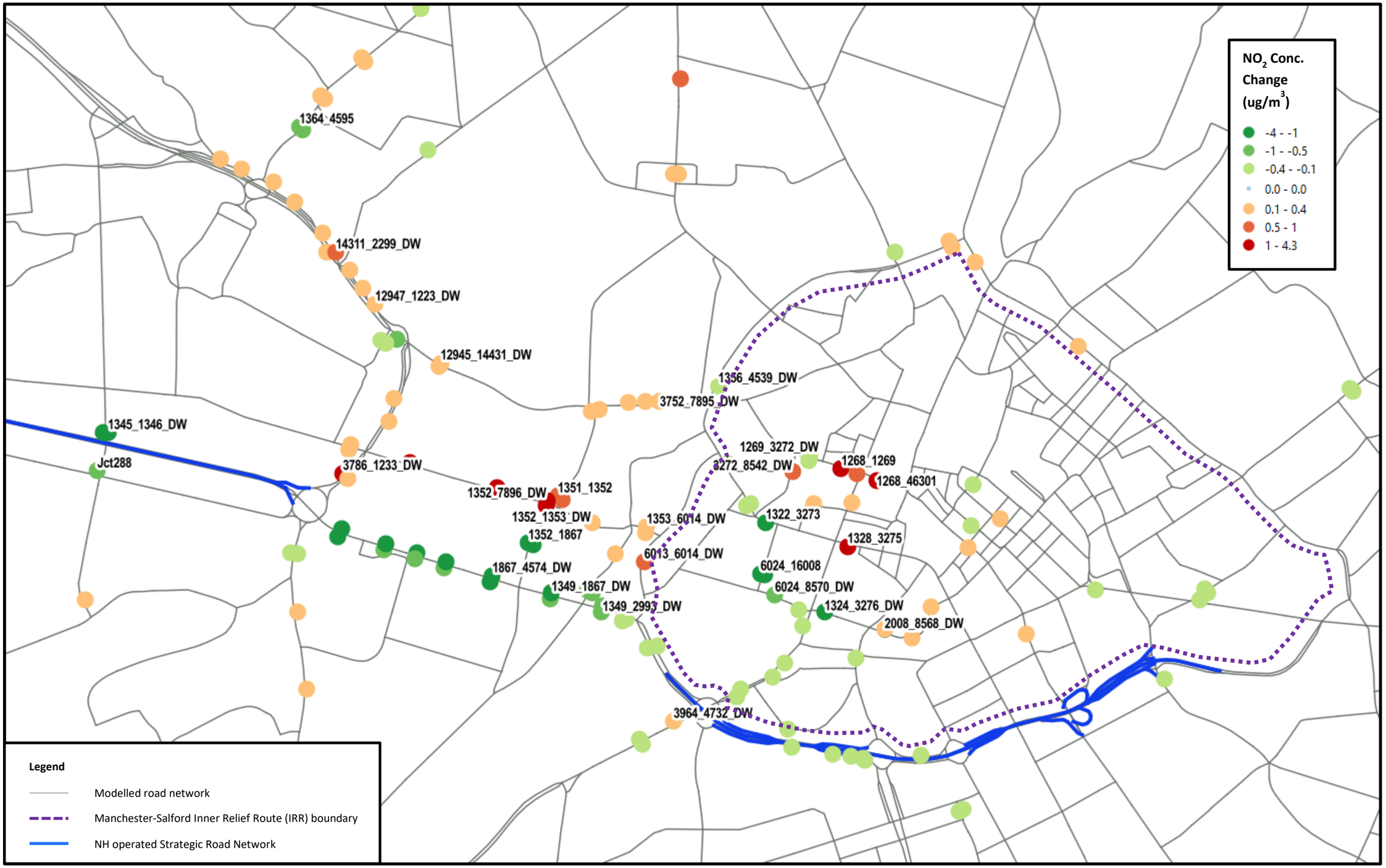


Table 5-8: Predicted annual mean NO_2 concentrations and source apportionment at LTM measure receptor sites on the Greater Manchester road network – With Investment-led Plan including Bus, Taxi & LTM Measures 2025

Point ID	Census ID	Road name	Local Authority	Annual mean NO_2 conc ($\mu g/m^3$)	BG[31] NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	Traffic Flow (veh per day)	NOx contribution by vehicle type (%)					Change in Annual mean NO_2 conc ($\mu g/m^3$)
										Bus	Taxi	HGV	LGV	Car	
1268_1269	27974	A34 Bridge St	Manchester	39.2	33.2	22.1	40.7	17.1	12,476	37%	5%	6%	16%	36%	-4.5
1268_46301	7947	A34 John Dalton St	Manchester	38.5	33.2	22.1	37.3	16.5	14,059	30%	5%	7%	21%	37%	-1.5
1269_3272_DW	27974	A34 Bridge St	Manchester	32.1	33.2	22.1	23.5	10.0	12,095	43%	4%	10%	16%	27%	-3.6
12945_14431_DW	56160	A6 Crescent	Salford	33.3	22.1	15.6	36.5	17.6	33,654	6%	7%	8%	27%	52%	-0.6
12947_1223_DW	6161	A6 Broad St	Salford	30.2	22.1	15.6	29.5	14.5	24,987	3%	7%	5%	28%	57%	-0.2
1322_3273	27975	A34 Quay St	Manchester	38.0	33.2	22.1	35.9	15.9	13,206	0%	6%	11%	34%	49%	-10.2
1324_3276_DW	N/A	Great Bridgewater St	Manchester	37.5	27.6	18.9	43.1	18.6	10,180	0%	6%	21%	28%	45%	-4.3
1328_3275	7948	A34 Peter St	Manchester	26.2	27.6	18.9	15.8	7.3	8,283	0%	6%	22%	30%	42%	1.2
1345_1346_DW	56535	A5186 Langworthy Rd	Salford	32.3	24.4	17.0	31.6	15.3	13,690	6%	5%	24%	27%	38%	-1.5
1349_1867_DW	48023	A57 Regent Rd	Salford	36.9	23.2	16.3	44.3	20.6	44,578	0%	5%	22%	30%	43%	-1.7
1349_2993_DW	73792	A57 Regent Rd	Salford	40.4	23.2	16.3	52.4	24.1	55,004	0%	6%	19%	31%	45%	-0.8
1351_1352	27752	A5066 Oldfield Rd	Salford	27.8	23.7	16.6	23.4	11.2	11,144	0%	4%	39%	28%	29%	0.7
1352_1353_DW	N/A	Middlewood St	Salford	26.0	23.7	16.6	18.4	9.3	14,815	0%	8%	8%	20%	64%	0.3
1352_1867	27752	A5066 Oldfield Rd	Salford	25.4	23.2	16.3	18.1	9.1	10,470	10%	6%	17%	23%	44%	-1.3
1352_7896_DW	N/A	Liverpool St	Salford	35.4	23.7	16.6	42.8	18.7	22,771	3%	3%	50%	16%	27%	4.1
1353_6014_DW	N/A	B5225 Hampson St	Salford	27.7	23.7	16.6	22.4	11.1	11,114	0%	6%	21%	24%	50%	0.2
1356_4539_DW	99519	A6042 Trinity Way	Manchester	37.1	33.2	22.1	36.2	15.0	28,188	0%	5%	34%	28%	33%	-0.5
1364_4595	17245	A576 Broughton Rd	Salford	33.1	23.1	16.2	34.1	16.9	35,032	20%	6%	10%	20%	45%	-0.7
14311_2299_DW	6161	A6 Broad St	Salford	36.5	23.1	16.2	43.3	20.3	50,982	7%	6%	11%	24%	51%	0.0
1867_4574_DW	36585	A57 Regent Rd	Salford	35.6	23.2	16.3	41.3	19.3	43,610	0%	5%	24%	31%	40%	-2.2
2008_8568_DW	N/A	Great Bridgewater St	Manchester	31.6	27.6	18.9	27.0	12.6	20,835	18%	6%	7%	26%	44%	-2.1
3272_8542_DW	N/A	Gartside St	Manchester	37.3	33.2	22.1	34.4	15.2	5,400	0%	8%	13%	27%	53%	-8.9
3752_7895_DW	17926	A6 Chapel St	Salford	27.2	23.7	16.6	21.5	10.6	20,126	8%	6%	16%	29%	41%	-0.6
3786_1233_DW	27751	A5063 Albion Way	Salford	33.5	22.1	15.6	37.5	17.8	35,344	1%	6%	20%	25%	48%	1.3
3964_4732_DW	99516	A56 Chester Rd	Salford	35.6	23.2	16.3	39.6	19.2	41,425	9%	6%	12%	29%	44%	0.0
6013_6014_DW	78673	A6042 Trinity Way	Salford	26.1	23.2	16.3	20.9	9.8	27,697	0%	7%	12%	28%	53%	0.3
6024_16008	N/A	Lower Byrom St	Manchester	24.3	27.6	18.9	11.3	5.3	4,993	0%	6%	19%	28%	47%	-2.9
6024_8570_DW	7922	A6143 Liverpool Rd	Manchester	26.0	27.6	18.9	15.0	7.1	12,700	0%	7%	10%	31%	53%	-2.2
Jct288	N/A	A5186 Langworthy Rd	Salford	26.7	24.4	17.0	19.7	9.7	13,690	6%	5%	24%	27%	38%	-0.7

[31] BG = Background

Table 5-9: Predicted impact on traffic flows at LTM measure receptor sites on the Greater Manchester road network – With Investment-led Plan including Bus, Taxi & LTM Measures 2025

Point ID	Local Authority	Do Min ; Total AADT Flows (no. veh per day)									ILP : Change in AADT Flows (no. veh per day) from Do Min.								
		All Vehicles	Taxi (comp)	Taxi (non-comp)	HGV (comp)	HGV (non-comp)	LGV (comp)	LGV (non-comp)	Car (comp)	Car (non-comp)	All Vehicles	Taxi (comp)	Taxi (non-comp)	HGV (comp)	HGV (non-comp)	LGV (comp)	LGV (non-comp)	Car (comp)	Car (non-comp)
1268_1269	Manchester	11,868	551	90	168	16	1,160	318	7,650	820	608	122	-90	8	1	41	11	458	51
1268_46301	Manchester	13,435	622	101	230	22	1,467	402	8,639	927	624	136	-101	-3	0	47	13	474	53
1269_3272_DW	Manchester	12,643	620	102	195	19	1,231	337	8,170	876	-548	78	-102	-17	-2	-21	-6	-428	-49
12945_14431_DW	Salford	32,894	1,584	259	780	75	3,458	950	22,138	2,373	760	311	-259	-72	-7	211	58	480	36
12947_1223_DW	Salford	24,030	1,217	200	341	33	2,391	655	16,823	1,799	958	227	-200	17	2	101	28	685	92
1322_3273	Manchester	14,103	714	118	287	28	1,818	498	9,458	1,016	-897	38	-118	-58	-6	8	12	-694	-74
1324_3276_DW	Manchester	10,810	562	93	314	30	1,509	413	7,023	748	-630	16	-93	24	2	-175	-48	-318	-36
1328_3275	Manchester	7,337	366	60	132	13	897	246	5,041	541	946	120	-60	1	0	163	45	608	63
1345_1346_DW	Salford	14,087	599	97	717	69	1,979	542	8,905	955	-397	76	-97	-4	0	0	0	-330	-40
1349_1867_DW	Salford	48,037	2,086	335	2,314	223	6,791	1,855	30,800	3,316	-3,459	184	-335	3	0	-365	-104	-2,525	-296
1349_2993_DW	Salford	56,847	2,522	406	2,378	229	8,141	2,223	36,649	3,932	-1,843	322	-406	13	1	-311	-88	-1,222	-142
1351_1352	Salford	10,805	472	77	816	79	1,628	446	6,534	698	339	85	-77	153	15	-11	-3	156	19
1352_1353_DW	Salford	13,074	666	108	316	31	1,164	319	9,387	1,003	1,741	210	-108	-52	-5	-50	-9	1,564	177
1352_1867	Salford	12,328	557	90	690	66	1,536	421	8,011	860	-1,858	24	-90	-320	-31	-350	-96	-892	-95
1352_7896_DW	Salford	16,860	830	136	778	75	1,838	504	11,363	1,211	5,911	422	-136	533	51	472	134	3,964	438
1353_6014_DW	Salford	11,182	537	87	338	33	1,203	332	7,750	838	-68	98	-87	-50	-5	-77	-18	67	3
1356_4539_DW	Manchester	28,116	1,379	228	1,259	121	3,822	1,048	18,162	1,942	72	235	-228	-71	-7	75	21	46	1
1364_4595	Salford	34,831	1,744	285	1,011	97	3,132	859	24,477	2,620	202	289	-285	-13	-1	18	6	165	22
14311_2299_DW	Salford	50,416	2,441	397	1,341	129	4,967	1,360	34,888	3,748	567	412	-397	-26	-2	193	61	282	41
1867_4574_DW	Salford	51,421	2,175	349	2,556	246	7,230	1,975	33,000	3,556	-7,811	2	-349	-405	-39	-814	-227	-5,359	-577
2008_8568_DW	Manchester	20,347	966	157	363	35	2,455	673	13,732	1,476	488	186	-157	3	0	45	12	357	39
3272_8542_DW	Manchester	6,418	344	56	128	12	654	179	4,444	477	-1,017	9	-56	-20	-2	-65	-18	-772	-88
3752_7895_DW	Salford	19,743	902	149	1,025	99	2,556	704	11,867	1,268	383	172	-149	-52	-5	134	37	224	21
3786_1233_DW	Salford	34,441	1,642	268	1,095	105	3,720	1,018	23,767	2,563	903	286	-268	391	38	293	81	77	05
3964_4732_DW	Salford	41,421	1,948	316	1,093	105	5,643	1,540	27,480	2,948	04	315	-316	1	0	13	5	-13	-1
6013_6014_DW	Salford	26,533	1,296	211	670	64	3,177	869	18,148	1,946	1,164	297	-211	0	0	130	35	820	87
6024_16008	Manchester	8,361	413	68	215	21	1,183	323	5,423	583	-3,368	-132	-68	-75	-7	-557	-145	-2,142	-226
6024_8570_DW	Manchester	13,294	644	104	352	34	1,601	439	8,939	960	-594	72	-104	46	4	-135	-39	-391	-45
Jct288	Salford	14,087	599	97	717	69	1,979	542	8,905	955	-397	76	-97	-4	0	0	0	-330	-40

5.4.16 Overall, the majority of the exceedance sites are predicted to be compliant as a result of bus upgrades, with A34 Quay Street and Great Bridgewater Street needing supporting LTM measures. However, for all of GM to become compliant the A57 Regent Road, Salford also requires the taxi measure to be in place, in addition to the improvement from bus and the A57 LTM measures.

5.4.17 It should also be noted that unlike the bus and LTM measures, which only affect very specific routes or locations, the GM taxi measure will lead to improvements at the most roads across GM. This has the benefit of improving the resilience of the GM CAP, because there is uncertainty inherent in all modelling and the margins of compliance are forecast to be low in some locations.

5.4.18 Furthermore, the scale of improvement predicted by the taxi measure modelling assumptions is expected to under-predict the levels of improvement delivered if owners took up options for upgrading to hybrid or electric vehicles.

6 Benchmark CAZ Scenario Model Results

6.1 Modelling Assumptions for the Benchmark CAZ Scenario

6.1.1 The Benchmark CAZ scenario has been modelled for both 2025 and 2026, because the exact opening date is not expected to be until July 2026 at the earliest. Both appraisal scenario years assume that the CAZ is fully operational on the 1st January, and with all behavioural responses for upgrade having taken place in advance of this date. For the 2025 scenario this is not considered feasible because the CAZ opening date is later than 2025. For 2026 the modelled outputs are considered to be over-estimates of the theoretical responses because the CAZ isn't due to be live before July 2026, and therefore the impact on the CAZ modelled reductions to NO_2 concentrations is likely to be an over-prediction.

6.1.2 The Benchmark CAZ scenario has applied a charging CAZ C scheme, which including daily penalty charges for non-compliant vehicles entering the regional centre IRR boundary. A CAZ C covers non-compliant buses, taxis, HGVs and vans, but private cars are not in-scope and unaffected.

6.1.3 It should be noted that a bus which has been fitted with the government CVRAS accredited bus retrofit equipment is considered to be a compliant vehicle, based on the approach set out by JAQU and other cities in which CAZs are now operational. By 2025, there will be no non-compliant buses operating in GM as a result of the GM bus franchising conditions, however many of the buses in operation will still be retrofitted Euro V vehicles. Because these buses are not subject to a CAZ charge, it is assumed that no changes to their planned operational pattern or services would occur for this modelled scenario.

6.1.4 Unlike the Investment-led Plan, the Benchmark CAZ scenario does not assume that all taxis are required to upgrade to a compliant vehicle in response to a GM emissions standard licensing condition, rather the disincentive of the CAZ charge encourages the upgrade response.

6.1.5 The CAZ Benchmark operational assumptions, such as the boundary, charges, and class were developed in conjunction with JAQU. For details of the modelled methodology and the behavioural responses rates as a result of the CAZ charges, refer to the T4 report.

6.2 Summary Results for the Benchmark CAZ Scenario

6.2.1 Table 6-1 shows the number of sites remaining in exceedance of legal limits in 2025 and 2026 under the Do Minimum scenario and with the Benchmark CAZ scenario, by local authority. The location of the predicted exceedances is presented in Figure 6-1 and Figure 6-2 for 2025 and 2026, respectively.

6.2.2 The results show:

2025

- without action, there are predicted to be 26 non-compliant sites across Greater in 2025;
- under the Benchmark CAZ scenario, five exceedances are removed (four in Manchester and one in Salford) leaving 21 in GM and Salford becomes compliant; and
- the exceedances in Bury and Stockport remain.

2026

- without action, there are predicted to be 17 non-compliant sites across Greater in 2026;
- under the Benchmark CAZ scenario, one exceedance in Manchester is removed leaving 16 in GM; and
- the exceedance in Stockport remains.

Table 6-1: Number of sites remaining in exceedance of legal limits for NO_2 concentrations by year, Greater Manchester, by local authority for the Benchmark CAZ scenario

	2025		2026	
	Do Minimum	**Benchmark CAZ**	**Do Minimum**	**Benchmark CAZ**
Bolton	0	0	0	0
Bury	2	2	0	0
Manchester	21	17	15	14
Oldham	0	0	0	0
Rochdale	0	0	0	0
Salford	1	0	0	0
Stockport	2	2	2	2
Tameside	0	0	0	0
Trafford	0	0	0	0
Wigan	0	0	0	0
GM Total	**26**	**21**	**17**	**16**

6.2.3 GM aims to deliver compliance in the shortest possible time in a way that takes into account the need to minimise human exposure. Table 6-2 demonstrates the benefits being delivered in terms of reduced concentrations including at sites remaining in exceedance in 2025 and 2026. This also shows that the number of sites close to exceedance reduces as a result of the CAZ Benchmark. Health benefits continue to be delivered by reductions in NO_2 concentrations even below the Limit Values.

6.2.4 With action, there are still sites that are non-compliant in 2025 and 2026, but there is an increase in the number of sites predicted to have concentrations less than 35 µg/m^3.

Table 6-2: Number of modelled sites by scale of NO_2 exceedance by year, Greater Manchester – Benchmark CAZ

Scenario	Compliant sites		Non-compliant sites				Change in no. of sites in exceedance
	Very compliant (below 35 µg/m^3)	Compliant but close (35 to 40 µg/m^3)	Non-compliant (40 to 45 µg/m^3)	Very non-compliant (45 to 50 µg/m^3)	Extremely non-compliant (> 50 µg/m^3)	Total non-compliant (> 40 µg/m^3)	
2025							
Do minimum	2419	95	19	7	0	**26**	na
Benchmark CAZ	2426	93	16	5	0	**21**	**-5**
2026							
Do minimum	2467	56	12	5	0	**17**	na
Benchmark CAZ	2473	51	12	4	0	**16**	**-1**

Figure 6-1: Exceedance Points in the Benchmark CAZ Scenario – 2025

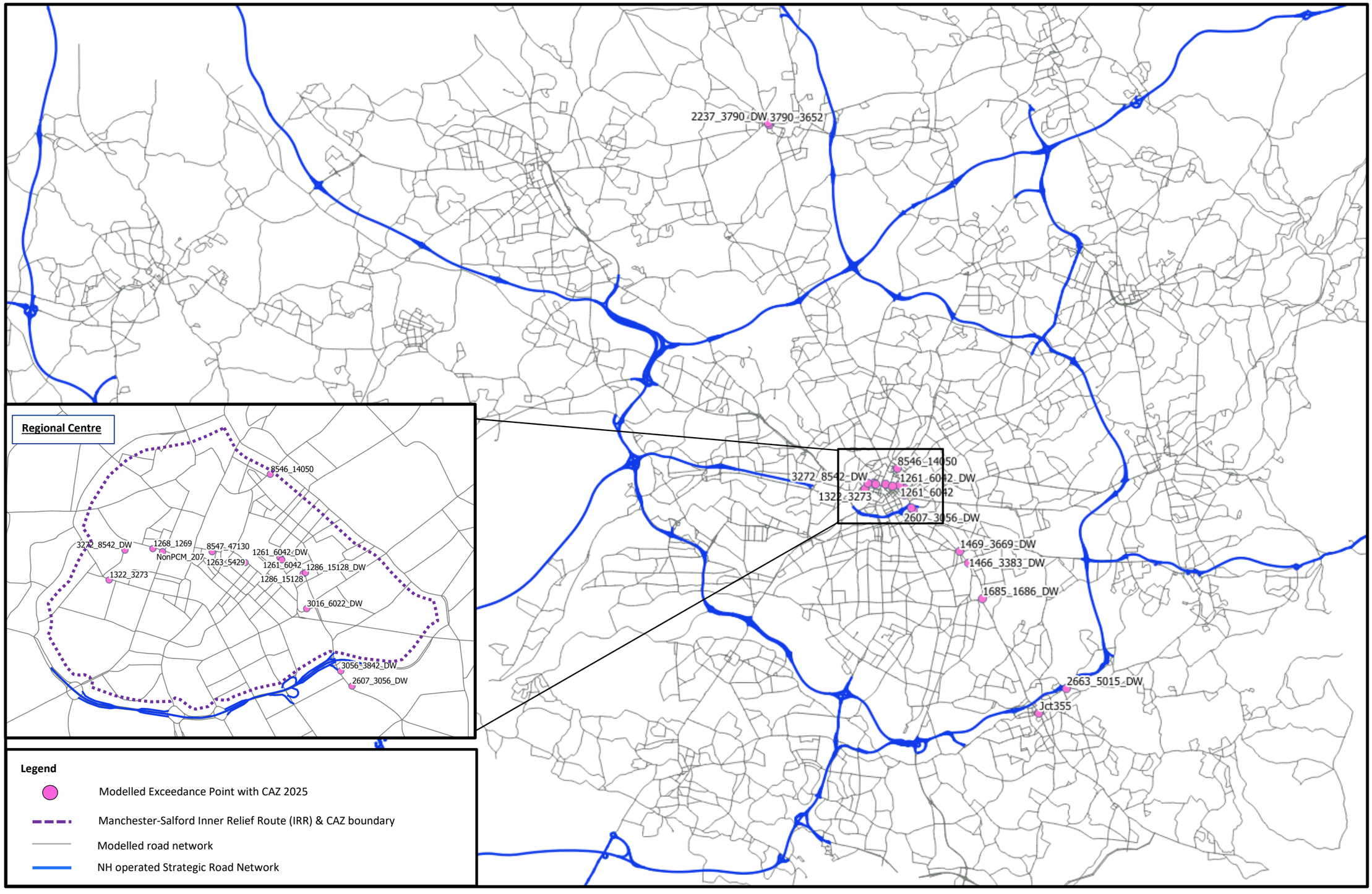
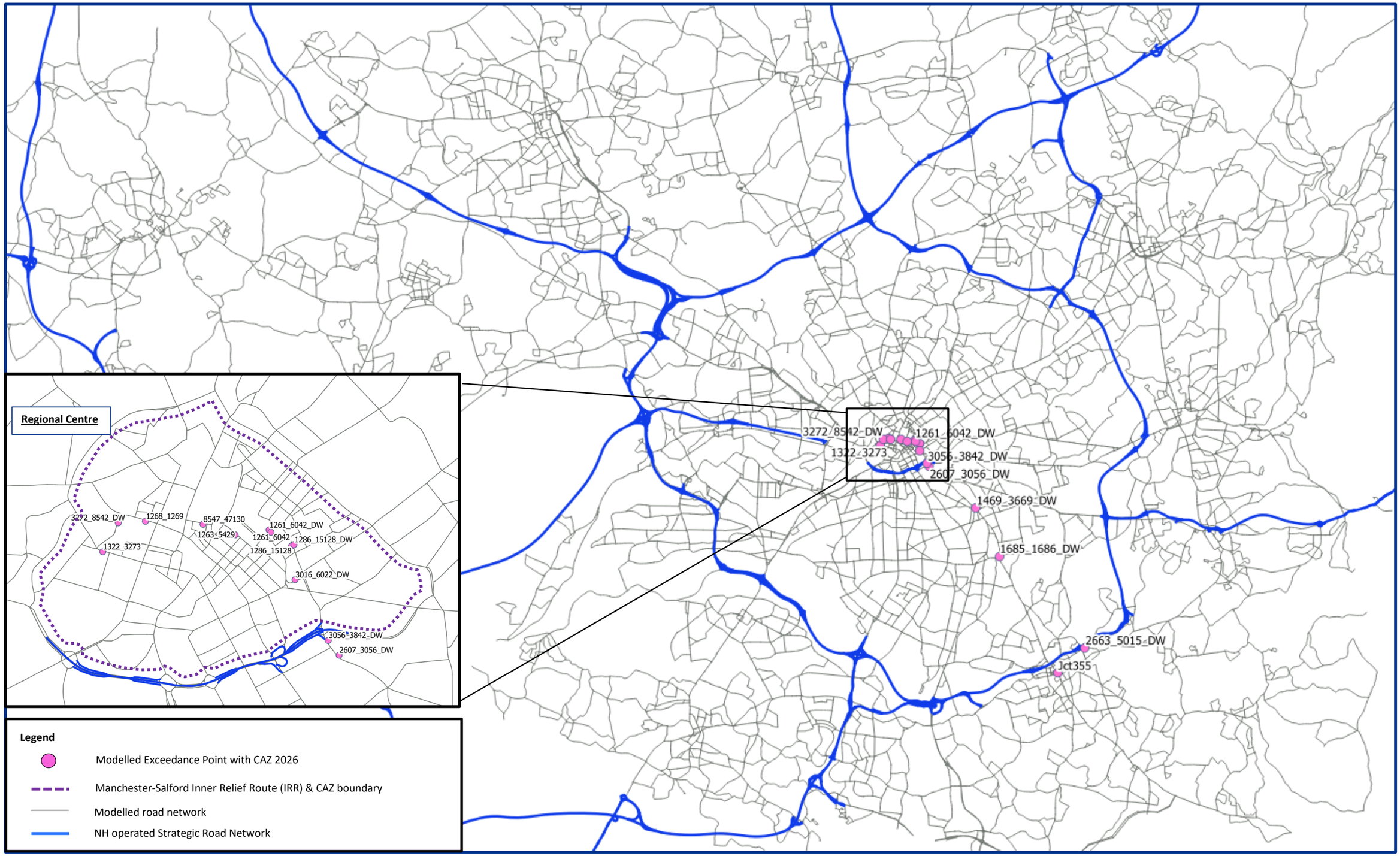


Figure 6-2: Exceedance Points in the Benchmark CAZ Scenario – 2026



6.3 Detailed Discussion of Transport and Air Quality Impacts for the Benchmark CAZ scenario

6.3.1 This section considers the modelled impacts of the Benchmark CAZ scenario with reference to the key exceedance points identified earlier, examining the changes to traffic and emissions by vehicle type.

6.3.2 The air quality and source apportionment data for 2025 and 2026 are provided in Table 6-3 and Table 6-5, whilst the impacts on the traffic flows are provided in Table 6-4 and Table 6-6.

2025

6.3.3 With the Benchmark CAZ scenario in effect, there are predicted to be 21 exceedances remaining in 2025, 12 located inside the CAZ boundary. There are also six exceedances along the A6 bus corridor between Manchester and Stockport, two in Bury (which are on opposite sides of the same section of the A58 Bolton Road dual carriageway) and another at the B6104 Carrington Road, Stockport.

6.3.4 The sites in Bury and Stockport are separated by a significant distance from the GM regional centre, and traffic is less likely to be travelling to the IRR as a destination. Therefore, these sites are not impacted by the CAZ, and would need to be tackled by a different measure.

6.3.5 Of the Manchester regional centre sites which are still non-compliant with the CAZ in effect, there are five sites with concentrations above 45 µg/m^3. The maximum improvement occurs at A34 Quay St which reduces to 46.4 µg/m^3 following an improvement due to the CAZ of -1.8 µg/m^3. Other notable exceedances that improve are at Gartside Street, King Street and York Street and are all approximately 44 µg/m^3 having received reductions of between -1.8 to -1.5 µg/m^3.

6.3.6 The maximum concentration is Portland Street at 48.1 µg/m^3, which at this section is a bus and taxi only route. The impacts of the CAZ on taxi emissions will not be captured in this location, because the Saturn model cannot differentiate between private car and taxi demand, so taxis flows are excluded.

6.3.7 Of the total change in emissions due to the Benchmark CAZ, typically c55% of the NO_x reduction come from LGVs upgrading to become compliant (130 to 450 veh/day), and c35% from HGVs upgrading to become compliant (10 to 35 veh/day), with the remainder due to taxi upgrades and some minor changes to overall vehicle flows.

6.3.8 Of the sites that become compliant as a result of the Benchmark CAZ, Great Bridgewater Street receives an improvement of -2.2 µg/m^3, whilst A57 Regent Road reduces by -0.8 µg/m^3.

6.3.9 At A57 Regent, the total change in emissions due to the Benchmark CAZ, 57% of the NO_x reduction come from LGVs upgrading to become compliant (580veh/day), and 40% from HGVs upgrading to become compliant (50 veh/day), with the remainder due to taxi upgrades.

2026

6.3.10 The pattern of impacts from the Benchmark CAZ in 2026 is very similar to that in 2025, although the magnitude of change is smaller as there are less non-compliant vehicles that would be in-scope for a CAZ charge and would therefore potentially upgrade. Also, the A58 Bolton St, Bury and the A57 Regent Road, Salford are not in exceedance in 2026 in the Do Minimum scenario.

6.3.11 With the Benchmark CAZ scenario in effect, there are predicted to be 16 exceedances remaining in 2025, 10 located inside the CAZ boundary. There are also five exceedances along the A6 bus corridor between Manchester and Stockport, and another at the B6104 Carrington Road, Stockport.

6.3.12 The sites in Stockport are separated by a significant distance from the GM regional centre, and traffic is less likely to be travelling to the IRR as a destination. Therefore, these sites are not impacted by the CAZ, and would need to be tackled by a different measure.

6.3.13 Of the Manchester regional centre sites which are still non-compliant with the CAZ in effect, there are four sites with concentrations above 45 $\mu g/m^3$. The maximum improvement occurs at A34 Quay Street which reduces to 44.9 $\mu g/m^3$ following an improvement due to the CAZ of -1.3 $\mu g/m^3$. Other notable exceedances that improve are at Gartside Street, King Street and York Street having received reductions of between -1.3 to -1.0 $\mu g/m^3$.

6.3.14 The maximum concentration is Portland Street at 47.2 $\mu g/m^3$, which at this section is a bus and taxi only route. The impacts of the CAZ on taxi emissions will not be captured in this location, because the Saturn model cannot differentiate between private car and taxi demand, so taxis flows are excluded.

6.3.15 Of the total change in emissions due to the Benchmark CAZ, typically c60% of the NO_x reduction come from LGVs upgrading to become compliant (100 to 360veh/day), and c35% from HGVs upgrading to become compliant (10 to 25 veh/day), with the remainder due to taxi upgrades and some minor changes to overall vehicle flows.

6.3.16 Of the sites that become compliant as a result of the Benchmark CAZ, Great Bridgewater Street receives the largest improvement of -1.7 $\mu g/m^3$.

6.3.17 Both the 2025 and 2026 Benchmark CAZ scenarios have been modelled as operational for the full year, so the modelled impact on NO_2 in 2025 is greater because there are less non-compliant vehicles forecast to be in the fleet in 2026 as a result of natural year-on-year fleet turnover. However, the viable CAZ opening date is not until July 2026, and therefore the impacts of the CAZ on NO_2 concentrations are likely significantly overstated.

6.3.18 Extrapolation of the concentrations beyond 2025/26 is not straightforward due to the assumptions made about the GM bus fleet for the Do Minimum & CAZ Benchmark scenario modelling. Additionally, as described previously, the impact of a charging CAZ is reduced each year into the future. The Do Minimum modelled scenarios based on the 2025 bus fleet indicates that GM is not predicted to become fully compliant with the legal limit for NO_2 until after 2029. The worst-case locations under the CAZ Benchmark are not significantly impacted by CAZ measures, so the first year of compliance under the CAZ Benchmark scenario is also dependent on the Stockpot depot being electrified, and operational with electric buses serving the A6 corridor to Piccadilly bus station. It is currently anticipated that the Zero Emission Bus Depot in Stockport would be delivered and available for use during late 2028 / early 2029, meaning the first year of compliance would be 2029 in both the Do Minimum and CAZ Benchmark scenarios.

6.3.19 It should be noted that the number of AADT flows responding as upgrading, is not directly comparable to the total number of unique vehicles affected, as some vehicles are likely to travel along the link more than once per day (e.g a return trip) or on multiple links along overall routes (e.g. through Salford into Manchester regional centre).

6.3.20 There is also the likely minor effect that some vehicles have been reassigned onto these routes from equivalent ‘rat-running’ routes, due to slight reductions in overall demand (and modelled trip delays or ‘congestion’) hence the gap between the reduced non-compliant flows and increased compliant flows, particularly for cars and LGVs, is relatively small.

Table 6-3: Predicted annual mean NO_2 concentrations and source apportionment at key compliance sites on the Greater Manchester road network – With Benchmark CAZ 2025

Point ID	Census ID	Road name	Local Authority	Annual mean NO_2 conc ($\mu g/m^3$)	BG[32] NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	Traffic Flow (veh per day)	NOx contribution by vehicle type (%)					Change in Annual mean NO_2 conc ($\mu g/m^3$)
										Bus	Taxi	HGV	LGV	Car	
2237_3790_DW	38354	A58 Bolton St	Bury	**42.4**	20.1	14.4	61.2	28.0	80,642	8%	6%	19%	25%	41%	0.0
3790_3652	38354	A58 Bolton St	Bury	**40.7**	20.1	14.4	58.1	26.3	80,642	8%	6%	19%	25%	41%	0.0
3016_6022_DW	46165	A6 Whitworth St	Manchester	**47.8**	30.0	20.3	61.9	27.5	6,788	79%	2%	2%	5%	12%	-1.7
1322_3273	27975	A34 Quay St	Manchester	**46.4**	33.2	22.1	57.1	24.3	14,098	30%	5%	15%	18%	32%	-1.8
1261_6042	77003	Portland St	Manchester	**48.1**	33.2	22.1	56.7	26.0	1,023	100%	0%	0%	0%	0%	-0.1
1261_6042_DW	77003	Portland St	Manchester	**47.7**	33.2	22.1	55.7	25.5	1,023	100%	0%	0%	0%	0%	-0.1
1286_15128	70158	A6 Piccadilly	Manchester	**47.3**	33.2	22.1	55.4	25.2	3,583	90%	1%	3%	2%	4%	-0.4
3272_8542_DW	N/A	Gartside St	Manchester	**44.7**	33.2	22.1	50.0	22.6	6,391	45%	5%	3%	13%	35%	-1.5
8547_47130	N/A	King St	Manchester	**43.9**	33.2	22.1	49.4	21.9	21,540	26%	6%	6%	18%	44%	-1.8
1263_5429	N/A	New York St	Manchester	**43.7**	33.2	22.1	48.0	21.5	9,680	28%	6%	3%	19%	44%	-1.6
1286_15128_DW	70158	A6 Piccadilly	Manchester	**44.6**	33.2	22.1	48.8	22.4	3,583	90%	1%	3%	2%	4%	-0.3
1469_3669_DW	28695	A6 Stockport Rd	Manchester	**43.8**	22.9	16.1	55.8	27.7	28,277	56%	4%	4%	11%	25%	-0.3
1268_1269	27974	A34 Bridge St	Manchester	**42.8**	33.2	22.1	47.9	20.7	11,883	55%	4%	3%	10%	28%	-0.9
2607_3056_DW	26157	A6 Ardwick Green	Manchester	**42.6**	30.0	20.3	45.5	22.2	33,405	41%	4%	4%	20%	32%	-0.4
3056_3842_DW	26157	A6 London Rd	Manchester	**42.4**	30.0	20.3	45.4	22.1	34,746	40%	4%	4%	19%	33%	-0.5
1685_1686_DW	73778	A6 Stockport Rd	Manchester	**42.6**	21.8	15.5	54.9	27.1	27,844	55%	3%	8%	12%	21%	-0.2
NonPCM_207	N/A	A34 Bridge St	Manchester	**41.3**	33.2	22.1	43.9	19.2	11,883	55%	4%	3%	10%	28%	-0.8
1324_3276_DW	N/A	Great Bridgewater St	Manchester	39.6	27.6	18.9	50.6	20.6	10,792	8%	6%	23%	24%	40%	-2.2
8547_47130_DW	N/A	King St	Manchester	40.2	33.2	22.1	40.1	18.1	21,540	26%	6%	6%	18%	44%	-1.5
8546_14050	57427	A664 Shudehill	Manchester	**40.7**	33.2	22.1	43.3	18.6	10,808	53%	4%	6%	10%	27%	-0.9
1466_3383_DW	7946	A6 Stockport Rd	Manchester	**41.0**	22.9	16.1	49.5	24.9	25,100	55%	4%	4%	11%	26%	-0.2
Jct262	N/A	Portland St	Manchester	40.3	30.0	20.3	42.8	20.0	4,637	89%	1%	1%	5%	5%	-0.4
1269_3272	27974	A34 Bridge St	Manchester	39.8	33.2	22.1	42.1	17.7	12,633	59%	3%	6%	10%	21%	-0.8
1349_2993_DW	73792	A57 Regent Rd	Salford	40.4	23.2	16.3	52.2	24.1	56,859	1%	6%	17%	30%	46%	-0.8
Jct355	N/A	A6 Wellington Rd South	Stockport	**44.8**	22.4	15.9	60.0	29.0	24,781	40%	4%	9%	19%	29%	-0.1
2663_5015_DW	N/A	B6104 Carrington Rd	Stockport	**43.8**	17.9	13.0	66.8	30.8	18,030	40%	2%	24%	18%	15%	0.0
Jct490	N/A	Vernon St	Bolton	40.0	24.3	17.0	48.3	23.0	10,337	13%	6%	7%	34%	41%	0.2
1996_14524_DW	36632	A62 Bottom o' th' Moor	Oldham	40.2	24.4	17.0	47.4	23.2	33,666	29%	5%	9%	22%	35%	0.0
2210_14216_DW	17322	A664 Edinburgh Way	Rochdale	39.3	17.0	12.4	63.0	26.9	34,582	0%	4%	41%	26%	29%	0.0
1695_14478_DW	99618	A635 Manchester Rd	Tameside	37.6	24.5	17.0	43.5	20.5	46,661	0%	6%	18%	33%	43%	0.0
7606_17100_DW	N/A	B5214 Trafford Blvd	Trafford	38.8	18.3	13.3	54.5	25.5	28,908	36%	4%	20%	10%	29%	0.0
3103_3435_DW	N/A	King St West	Wigan	40.0	27.5	18.8	47.2	21.2	7,202	77%	1%	9%	5%	8%	0.0

[32] BG = Background

Table 6-4: Predicted impact on traffic flows at key compliance points on the Greater Manchester road network – With Benchmark CAZ 2025

Point ID	Local Authority	Do Min ; Total AADT Flows (no. veh per day)									Benchmark CAZ: Change in AADT Flows (no. veh per day) from Do Min.								
		All Vehicles	Taxi (comp)	Taxi (non-comp)	HGV (comp)	HGV (non-comp)	LGV (comp)	LGV (non-comp)	Car (comp)	Car (non-comp)	All Vehicles	Taxi (comp)	Taxi (non-comp)	HGV (comp)	HGV (non-comp)	LGV (comp)	LGV (non-comp)	Car (comp)	Car (non-comp)
2237_3790_DW	Bury	80,638	3,908	639	1,639	158	9,248	2,559	55,532	5,951	4	5	-2	0	0	27	-29	1	2
3790_3652	Bury	80,638	3,908	639	1,639	158	9,248	2,559	55,532	5,951	4	5	-2	0	0	27	-29	1	2
3016_6022_DW	Manchester	6,809	316	51	48	05	613	168	4,586	493	-21	49	-42	7	-5	138	-124	-40	-5
1322_3273	Manchester	14,103	714	118	287	28	1,818	498	9,458	1,016	-5	94	-95	28	-27	355	-379	17	1
1261_6042	Manchester	1,023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1261_6042_DW	Manchester	1,023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1286_15128	Manchester	3,588	186	33	54	05	346	95	1,898	194	-5	23	-26	5	-5	58	-73	12	5
3272_8542_DW	Manchester	6,418	344	56	128	12	654	179	4,444	477	-26	45	-45	10	-12	131	-135	-17	-3
8547_47130	Manchester	21,601	1,087	177	379	37	2,316	634	14,960	1,608	-62	138	-145	34	-36	457	-491	-13	-6
1263_5429	Manchester	9,726	501	82	187	18	1,146	314	6,528	701	-46	64	-67	18	-18	227	-241	-26	-3
1286_15128_DW	Manchester	3,588	186	33	54	05	346	95	1,898	194	-5	23	-26	5	-5	58	-73	12	5
1469_3669_DW	Manchester	28,272	1,375	223	459	44	2,944	806	19,512	2,096	5	46	-49	0	-5	206	-192	5	-7
1268_1269	Manchester	11,868	551	90	168	16	1,160	318	7,650	820	15	77	-73	16	-16	247	-249	12	1
2607_3056_DW	Manchester	33,431	1,478	239	559	54	4,495	1,230	21,884	2,333	-27	91	-86	12	-12	321	-326	-15	-12
3056_3842_DW	Manchester	34,845	1,549	250	566	54	4,507	1,234	23,056	2,461	-99	95	-97	12	-13	297	-341	-37	-15
1685_1686_DW	Manchester	27,865	1,359	224	499	48	3,122	856	18,818	2,016	-22	32	-40	3	-3	157	-169	0	-1
NonPCM_207	Manchester	11,868	551	90	168	16	1,160	318	7,650	820	15	77	-73	16	-16	247	-249	12	1
1324_3276_DW	Manchester	10,810	562	93	314	30	1,509	413	7,023	748	-18	72	-74	30	-30	283	-300	1	-1
8547_47130_DW	Manchester	21,601	1,087	177	379	37	2,316	634	14,960	1,608	-62	138	-145	34	-36	457	-491	-13	-6
8546_14050	Manchester	10,814	562	91	181	17	964	264	6,931	746	-6	75	-73	19	-17	189	-202	4	-1
1466_3383_DW	Manchester	25,110	1,241	203	500	48	2,651	726	17,069	1,823	-10	47	-47	6	-4	196	-188	-17	-4
Jct262	Manchester	4,639	162	28	86	8	650	178	1,690	176	-2	21	-22	8	-8	142	-135	-3	-4
1269_3272	Manchester	12,643	620	102	195	19	1,231	337	8,170	876	-10	83	-82	17	-18	255	-259	-4	-1
1349_2993_DW	Salford	56,847	2,522	406	2,378	229	8,141	2,223	36,649	3,932	12	76	-76	50	-47	575	-587	22	-1
Jct355	Stockport	24,755	1,116	182	1,055	102	3,237	885	15,734	1,674	26	10	-9	-4	-2	50	-37	19	-1
2663_5015_DW	Stockport	18,005	673	110	1,675	162	3,567	980	9,346	994	26	2	0	1	0	26	-4	3	-2
Jct490	Bolton	10,338	464	76	156	15	1,695	465	6,598	704	-1	-2	0	1	0	-7	-1	7	2
1996_14524_DW	Oldham	33,683	1,542	252	917	88	4,612	1,265	22,092	2,370	-16	17	-5	-3	-2	2	-9	-21	4
2210_14216_DW	Rochdale	34,575	1,536	248	2,100	202	4,884	1,338	21,750	2,332	6	2	-2	-1	0	2	0	7	-1
1695_14478_DW	Tameside	46,661	2,078	337	2,315	223	6,972	1,916	29,274	3,142	0	7	-5	6	-4	37	-29	-9	-2
7606_17100_DW	Trafford	28,908	1,373	224	1,715	166	2,234	613	19,675	2,093	0	1	-1	-1	0	0	0	-2	3
3103_3435_DW	Wigan	7,198	291	49	321	31	801	220	3,904	415	4	6	0	-1	0	-28	-7	31	2

Table 6-5: Predicted annual mean NO_2 concentrations and source apportionment at key compliance sites on the Greater Manchester road network – With Benchmark CAZ 2026

Point ID	Census ID	Road name	Local Authority	Annual mean NO_2 conc ($\mu g/m^3$)	BG[33] NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	Traffic Flow (veh per day)	NOx contribution by vehicle type (%)					Change in Annual mean NO_2 conc ($\mu g/m^3$)
										Bus	Taxi	HGV	LGV	Car	
2237_3790_DW	38354	A58 Bolton St	Bury	39.9	19.6	14.1	56.2	25.8	80,769	9%	6%	19%	25%	40%	-0.1
3790_3652	38354	A58 Bolton St	Bury	38.5	19.6	14.1	53.5	24.4	80,769	9%	6%	19%	25%	40%	0.0
3016_6022_DW	46165	A6 Whitworth St	Manchester	**47.0**	29.4	19.9	60.8	27.1	6,894	80%	1%	2%	5%	11%	-0.4
1322_3273	27975	A34 Quay St	Manchester	**44.9**	32.5	21.7	54.3	23.2	14,129	32%	4%	15%	18%	31%	-1.3
1261_6042	77003	Portland St	Manchester	**47.6**	32.5	21.7	56.5	25.9	1,033	100%	0%	0%	0%	0%	0.0
1261_6042_DW	77003	Portland St	Manchester	**47.2**	32.5	21.7	55.5	25.5	1,033	100%	0%	0%	0%	0%	0.0
1286_15128	70158	A6 Piccadilly	Manchester	**46.7**	32.5	21.7	54.8	25.0	3,611	90%	1%	3%	2%	4%	-0.2
3272_8542_DW	N/A	Gartside St	Manchester	**43.4**	32.5	21.7	47.8	21.7	6,435	47%	5%	3%	13%	33%	-1.0
8547_47130	N/A	King St	Manchester	**42.4**	32.5	21.7	46.7	20.8	21,674	28%	6%	6%	18%	42%	-1.3
1263_5429	N/A	New York St	Manchester	**42.2**	32.5	21.7	45.6	20.5	9,791	30%	6%	3%	19%	42%	-1.2
1286_15128_DW	70158	A6 Piccadilly	Manchester	**43.9**	32.5	21.7	48.2	22.2	3,611	90%	1%	3%	2%	4%	-0.2
1469_3669_DW	28695	A6 Stockport Rd	Manchester	**42.4**	22.3	15.8	53.2	26.6	28,244	59%	3%	3%	11%	24%	-0.2
1268_1269	27974	A34 Bridge St	Manchester	**41.6**	32.5	21.7	46.0	19.9	11,942	57%	4%	3%	10%	27%	-0.7
2607_3056_DW	26157	A6 Ardwick Green	Manchester	**41.0**	29.4	19.9	42.8	21.0	33,373	43%	4%	3%	19%	31%	-0.3
3056_3842_DW	26157	A6 London Rd	Manchester	**40.7**	29.4	19.9	42.5	20.8	34,667	43%	4%	4%	18%	32%	-0.4
1685_1686_DW	73778	A6 Stockport Rd	Manchester	**41.2**	21.2	15.1	52.5	26.1	27,869	57%	3%	8%	11%	20%	-0.1
NonPCM_207	N/A	A34 Bridge St	Manchester	40.1	32.5	21.7	42.3	18.5	11,942	57%	4%	3%	10%	27%	-0.7
1324_3276_DW	N/A	Great Bridgewater St	Manchester	37.7	27.0	18.6	46.5	19.1	10,725	6%	6%	25%	24%	39%	-1.7
8547_47130_DW	N/A	King St	Manchester	38.9	32.5	21.7	38.0	17.2	21,674	28%	6%	6%	18%	42%	-1.1
8546_14050	57427	A664 Shudehill	Manchester	40.3	32.5	21.7	46.8	19.4	10,851	49%	3%	15%	11%	23%	0.0
1466_3383_DW	7946	A6 Stockport Rd	Manchester	39.6	22.3	15.8	47.3	23.9	25,117	58%	4%	4%	11%	24%	-0.2
Jct262	N/A	Portland St	Manchester	39.7	29.4	19.9	42.2	19.7	4,619	90%	1%	1%	4%	4%	-0.3
1269_3272	27974	A34 Bridge St	Manchester	38.8	32.5	21.7	40.8	17.1	12,691	61%	3%	7%	9%	20%	-0.6
1349_2993_DW	73792	A57 Regent Rd	Salford	37.9	22.7	16.0	47.2	21.9	56,856	1%	6%	16%	30%	46%	-0.7
Jct355	N/A	A6 Wellington Rd South	Stockport	**43.5**	21.9	15.5	57.5	27.9	24,859	43%	4%	8%	18%	28%	0.0
2663_5015_DW	N/A	B6104 Carrington Rd	Stockport	**41.6**	17.5	12.7	61.8	28.9	18,014	43%	2%	22%	18%	15%	-0.5
Jct490	N/A	Vernon St	Bolton	37.8	23.7	16.6	43.9	21.1	10,320	6%	6%	7%	38%	44%	-0.2
1996_14524_DW	36632	A62 Bottom o' th' Moor	Oldham	38.3	23.9	16.7	43.8	21.6	33,687	31%	5%	8%	22%	34%	0.0
2210_14216_DW	17322	A664 Edinburgh Way	Rochdale	37.2	16.7	12.2	58.3	25.0	34,719	0%	4%	42%	26%	28%	0.0
1695_14478_DW	99618	A635 Manchester Rd	Tameside	35.4	24.1	16.8	39.0	18.6	46,716	0%	6%	17%	34%	43%	0.0
7606_17100_DW	N/A	B5214 Trafford Blvd	Trafford	37.0	17.9	13.0	50.7	24.0	28,953	39%	4%	19%	10%	29%	0.0
3103_3435_DW	N/A	King St West	Wigan	39.3	27.2	18.6	45.9	20.7	7,192	79%	1%	8%	5%	7%	0.0

[33] BG = Background

Table 6-6: Predicted impact on traffic flows at key compliance points on the Greater Manchester road network – With Benchmark CAZ 2026

Point ID	Local Authority	Do Min ; Total AADT Flows (no. veh per day)									Benchmark CAZ: Change in AADT Flows (no. veh per day) from Do Min.								
		All Vehicles	Taxi (comp)	Taxi (non-comp)	HGV (comp)	HGV (non-comp)	LGV (comp)	LGV (non-comp)	Car (comp)	Car (non-comp)	All Vehicles	Taxi (comp)	Taxi (non-comp)	HGV (comp)	HGV (non-comp)	LGV (comp)	LGV (non-comp)	Car (comp)	Car (non-comp)
2237_3790_DW	Bury	80,745	4,187	373	1,675	107	9,883	1,961	57,133	4,417	24	3	-1	1	0	15	-20	24	2
3790_3652	Bury	80,745	4,187	373	1,675	107	9,883	1,961	57,133	4,417	24	3	-1	1	0	15	-20	24	2
3016_6022_DW	Manchester	6,899	350	31	53	03	670	130	4,761	368	-4	20	-25	4	-3	99	-96	-1	-1
1322_3273	Manchester	14,131	765	68	295	19	1,925	376	9,761	755	-3	46	-55	18	-19	278	-285	15	-2
1261_6042	Manchester	1,033	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1261_6042_DW	Manchester	1,033	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1286_15128	Manchester	3,610	194	21	56	04	364	71	1,946	172	1	24	-17	3	-4	56	-54	-3	-4
3272_8542_DW	Manchester	6,403	371	33	130	08	690	135	4,558	353	33	29	-26	9	-8	102	-101	27	2
8547_47130	Manchester	21,707	1,170	103	392	25	2,466	481	15,477	1,187	-33	79	-83	24	-25	364	-371	-19	-2
1263_5429	Manchester	9,804	545	48	193	12	1,226	238	6,769	521	-13	37	-39	12	-12	178	-183	-5	-1
1286_15128_DW	Manchester	3,610	194	21	56	04	364	71	1,946	172	1	24	-17	3	-4	56	-54	-3	-4
1469_3669_DW	Manchester	28,281	1,476	131	465	30	3,150	615	20,044	1,551	-37	25	-29	-6	-4	141	-150	-10	-3
1268_1269	Manchester	11,917	594	53	170	11	1,234	241	7,901	609	25	46	-43	15	-11	197	-187	5	3
2607_3056_DW	Manchester	33,383	1,585	139	568	36	4,792	935	22,431	1,730	-10	50	-49	8	-8	237	-248	-2	3
3056_3842_DW	Manchester	34,685	1,652	145	575	37	4,774	932	23,584	1,810	-18	56	-55	8	-9	223	-254	9	4
1685_1686_DW	Manchester	27,873	1,458	131	515	33	3,303	646	19,351	1,505	-4	20	-22	2	-2	117	-128	11	0
NonPCM_207	Manchester	11,917	594	53	170	11	1,234	241	7,901	609	25	46	-43	15	-11	197	-187	5	3
1324_3276_DW	Manchester	10,726	598	55	328	21	1,605	313	7,118	571	-1	42	-43	20	-21	222	-227	-3	8
8547_47130_DW	Manchester	21,707	1,170	103	392	25	2,466	481	15,477	1,187	-33	79	-83	24	-25	364	-371	-19	-2
8546_14050	Manchester	10,825	606	53	191	12	1,033	201	7,118	546	25	44	-43	14	-12	154	-153	19	1
1466_3383_DW	Manchester	25,107	1,332	118	516	33	2,823	551	17,509	1,369	10	25	-26	2	-3	147	-143	4	5
Jct262	Manchester	4,638	181	18	90	6	705	138	1,661	163	-19	5	-14	3	-6	84	-105	29	-11
1269_3272	Manchester	12,669	669	60	200	13	1,307	255	8,413	650	22	49	-48	13	-13	191	-196	23	1
1349_2993_DW	Salford	56,881	2,699	238	2,446	156	8,655	1,681	37,739	2,900	-25	46	-44	37	-32	429	-446	-15	0
Jct355	Stockport	24,866	1,200	107	1,097	70	3,486	673	16,200	1,255	-6	8	-5	1	-1	9	-33	14	1
2663_5015_DW	Stockport	18,048	725	65	1,709	109	3,782	743	9,659	754	-34	-2	-1	-2	0	20	-3	-40	-5
Jct490	Bolton	10,314	497	44	160	10	1,815	354	6,747	521	6	-2	0	1	0	8	1	-2	-1
1996_14524_DW	Oldham	33,692	1,653	148	934	60	4,907	959	22,747	1,736	-5	14	-3	-1	-1	11	-4	-23	2
2210_14216_DW	Rochdale	34,721	1,647	146	2,174	139	5,238	1,020	22,443	1,732	-2	1	-1	1	0	-3	-1	5	-3
1695_14478_DW	Tameside	46,718	2,220	198	2,393	153	7,404	1,447	30,148	2,349	-2	2	-3	4	-3	13	-22	12	-4
7606_17100_DW	Trafford	28,958	1,485	130	1,760	112	2,362	461	20,235	1,590	-4	0	0	-1	0	0	0	-2	-1
3103_3435_DW	Wigan	7,198	316	29	330	21	855	167	3,985	319	-5	3	1	0	0	-12	-2	1	4

7 Conclusions

7.1 There have been a number of best practice updates to assumptions used in the prediction of future year traffic and emissions forecasts applied. Most notably these include:

- electric buses operating on certain routes serving the regional centre, and updates to bus fleets and services patterns to reflect the situation in 2025 with the implementation of GM Bus Franchising;
- incorporation of the impacts of Covid-19 slowing natural rates of vehicle turnover due to reduced new vehicle sales;
- the configuration of the road network expected to be in operation in 2025, most notably in the regional centre based on the CCTS programme; and
- JAQU guidance on representing the emissions from retrofitted buses, because testing has indicated variable performance, and no reliable improvement from the original vehicle.

7.2 Whilst levels of NO_2 are below the Limit Value across much of the road network, in 2021 it was predicted that 224 sites would have been non-compliant. The 2021 modelling represents what would have been expected without Covid-19 and the associated travel restrictions. It should be recognised that 2021 has been impacted by Covid-19 with a range of lockdowns restricting travel and therefore road traffic, which are not represented in the modelling. It is expected that the near term influence of Covid-19 will gradually reduce as restrictions are removed and economic recovery takes place. This means that there is considered to be greater uncertainty in the model predictions for 2021 compared with the 2025 and 2026 forecast years.

7.3 There were predicted to be exceedances in all 10 districts in the Do Minimum scenario for 2021. Over time into 2025, the significant emissions improvements associated with the electric bus fleet and the natural replacement of older more polluting vehicles with newer models means that by 2025, exceedances are only predicted in Manchester, Salford, Bury and Stockport, with 26 exceedances forecast.

7.4 In 2025, the majority of exceedances are inside the IRR in Manchester where 16 are located, the other remaining points of exceedance are at:

- A57 Regent Road, Salford
- A58 Bury Bridge, Bury (x2)
- A6 corridor between Stockport and the IRR (x6)
- B6104 Carrington Road, Stockport

7.5 By 2026, exceedances are only predicted in Manchester and Stockport, with 21 exceedances forecast. Beyond the IRR where 15 of the remaining exceedances are located in Manchester, the other last points of exceedance in 2026 are at:

- A6 corridor between Stockport and the IRR (x5)
- B6104 Carrington Road, Stockport

7.6 In response GM has developed both an Investment-led Plan (ILP) scenario, and a Benchmark CAZ scenario.

7.7 The ILP has applied a series of measures aimed at reducing emissions and smoothing traffic flows to deliver compliance in 2025. The following measures have been targeted at the last exceedances:

- Bus fleet upgrade
  - Upgrade services operated by retrofit Euro V buses to OEM Euro VI; then
  - Upgrade bus services operated by retrofit Euro V buses or OEM Euro VI to ZEB
- GM Taxi Emissions Standards and Clean Taxi Fund
- Local Traffic Management Measures

7.8 It should be noted that the taxi modelling applies a number of pessimistic assumptions, relating to upgrade to electric models and the proportion of taxi movements in the regional centre. Therefore, it is expected that the modelled response will underestimate the level of improvement that would occur under the Investment-led Plan taxi measure.

7.9 The results for the ILP show:

- without action, there are predicted to be 26 non-compliant sites across Greater in 2025;
- with the inclusion of the Bus measures the exceedances in Bury and Stockport are removed, with only two sites in Manchester and one in Salford remaining non-compliant;
- the taxi measure further reduces concentrations, but the exceedances at A34 Quay Street and Great Bridgewater Street (Manchester) and the A57 Regent Road (Salford) are not yet removed; and
- with the inclusion of the local traffic management measures at A57 Regent Road and the A34 Quay Street area, GM achieves compliance in 2025 by removal of the last three exceedances, as a result of the ILP.

7.10 The Benchmark CAZ scenario has applied a charging CAZ C scheme, which incurs daily charges for non-compliant vehicles entering the regional centre IRR boundary. A CAZ C covers non-compliant buses, taxis, HGVs and vans, but private cars are not in-scope and unaffected.

7.11 The Benchmark CAZ C scenario has been modelled for both 2025 and 2026, because the earliest viable opening date is not expected to be until July 2026. The impact of the CAZ on modelled reductions to NO_2 concentrations even for 2026 is therefore likely to be an over-prediction, because the modelling assumes a full calendar year of operation, not a mid-year commencement.

7.12 It should be noted that a bus which has been retrofitted is considered to be a compliant vehicle, based on the approach set out by JAQU and other CAZ cities which are now live. Because these buses are not subject to a CAZ charge, it is assumed that no changes to their planned operational pattern or services would occur for this modelled CAZ scenario.

7.13 The Benchmark CAZ results show:

2025

- without action, there are predicted to be 26 non-compliant sites across Greater in 2025, in Manchester, Salford, Bury and Stockport;
- under the Benchmark CAZ scenario, five exceedances are removed leaving 21, primarily inside the CAZ IRR boundary in Manchester, although Salford becomes compliant
- the exceedances in Bury and Stockport still remain in 2025

2026

- without action, there are predicted to be 17 non-compliant sites across Greater in 2026, in Manchester and Stockport;
- under the Benchmark CAZ scenario, one exceedance is removed leaving 14 in Manchester
- the two exceedances in Stockport remain in 2026

7.14 In summary, the ILP uses a package of targeted measures and is predicted to deliver compliance at all locations in GM in 2025. The Benchmark CAZ scenario does not deliver compliance in the Regional Centre or wider GM in either 2025 or 2026 and would require further additional measures to be applied, which are outside the scope of the JAQU benchmark test guidance[34].

[34] Options Appraisal Package Guidance, JAQU, 2017

7.15 This appraisal is based on a variety of models which inherently contain uncertainty in their input data and modelling assumptions, which are discussed in the *Analytical Assurance Statement*. Sensitivity testing has been undertaken, to evaluate how this uncertainty may affect the results and conclusions.

7.16 A range of sensitivity tests have been undertaken, notably examining assumptions relating to fleet age, travel demand and emissions factors.

7.17 Of these sensitivity tests, those with a greater likelihood of being applicable generally reduce concentrations by more than those which increase concentrations. These tests provide reassurance that the Investment-led Plan is more likely to achieve compliance than the core scenario assumptions forecast set out herein. Further analysis of these influences is considered in the Sensitivity Testing Report.

7.18 Delay to Queens Road depot and M602 speed limit as set out in section **Error! Reference source not found.**, in the process of preparing the *A ppraisal Report* and supporting material, a risk identified in the December 2023 submission “Delays to bus depot electrification” has materialised and there is now a delivery delay in the electrification of Queens Road depot. This was due to take place by January 2025, which was the assumed delivery date in the modelling of the Investment-led plan.

7.19 In addition, National Highways also advised that the temporary speed limit on the M602 (which forms part of the Strategic Route Network) also in the Investment led plan modelling assumptions is to be removed.

7.20 The implications of these issues are addressed in the *Supplementary Appraisal Report*, included as part of this evidence submission documentation. Therefore, this report and associated documentation should be read in conjunction with the *Supplementary Appraisal Report*, which considers the implications of these issues on the date of compliance, includes updated air quality modelling results and provides a comparative appraisal of the Investment-led plan and the CAZ Benchmark.

Appendix A - Air Quality Model Verification

A.1 A total of 314 monitoring sites were reviewed for the model verification process and of these a number of sites were discounted for a variety of reasons including low data capture, inappropriate location (e.g. bus stop), unidentified location, or co-location with a continuous analyser site. There were 194 sites used for the model verification, 147 for roadside predictions and 47 for background mapping adjustment. The monitoring data for all sites are provided in the files issued to JAQU with the AQ3 document. These files contain the model verification performance by site, including background concentrations and verification zone. Sites which were excluded from the verification process are detailed in Table A-6.

A.2 Initially, the Defra background maps were compared with background monitoring sites. Of those sites reported as background type locations by the local authorities, only those sites with very low modelled road component NOx were used in the verification process. These monitoring sites were grouped as 'Zone 2', and the Defra background maps were found to under-estimate the measured Total NO_x and Total NO_2 concentrations by a factor of 1.30. The background NO_x and NO_2 maps were therefore uplifted by this adjustment factor, and used in the modelling process.

A.3 There are 16 continuous analyser sites in GM, of which nine were suitable for roadside verification and four for background verification. Three are background sites, but with a road component which meant they were not considered suitable for either grouping. Where the diffusion tube data was used for verification, road NO_x was back calculated using the Defra NOx to NO_2 calculator v6.1, with calculated f-NO_2 from the dispersion modelling input for each site.

A.4 The air quality modelling outputs were converted to NO_2 and then compared to the monitoring data. Only monitoring sites with data capture greater than 75% in the calendar year 2016 were used in the verification process.

A.5 The initial modelling applied the canyon module to the entire GM modelled road network. The results were then reviewed spatially for patterns of model performance, and each site checked locally. The canyon model input files were produced by CERC on behalf of TfGM. These initial model outputs were reviewed, and it was considered that the canyon module was performing poorly in areas which were not significantly built up, potentially due the relatively longer length of less homogenous road links, and additionally compromising model run times over the very large study area.

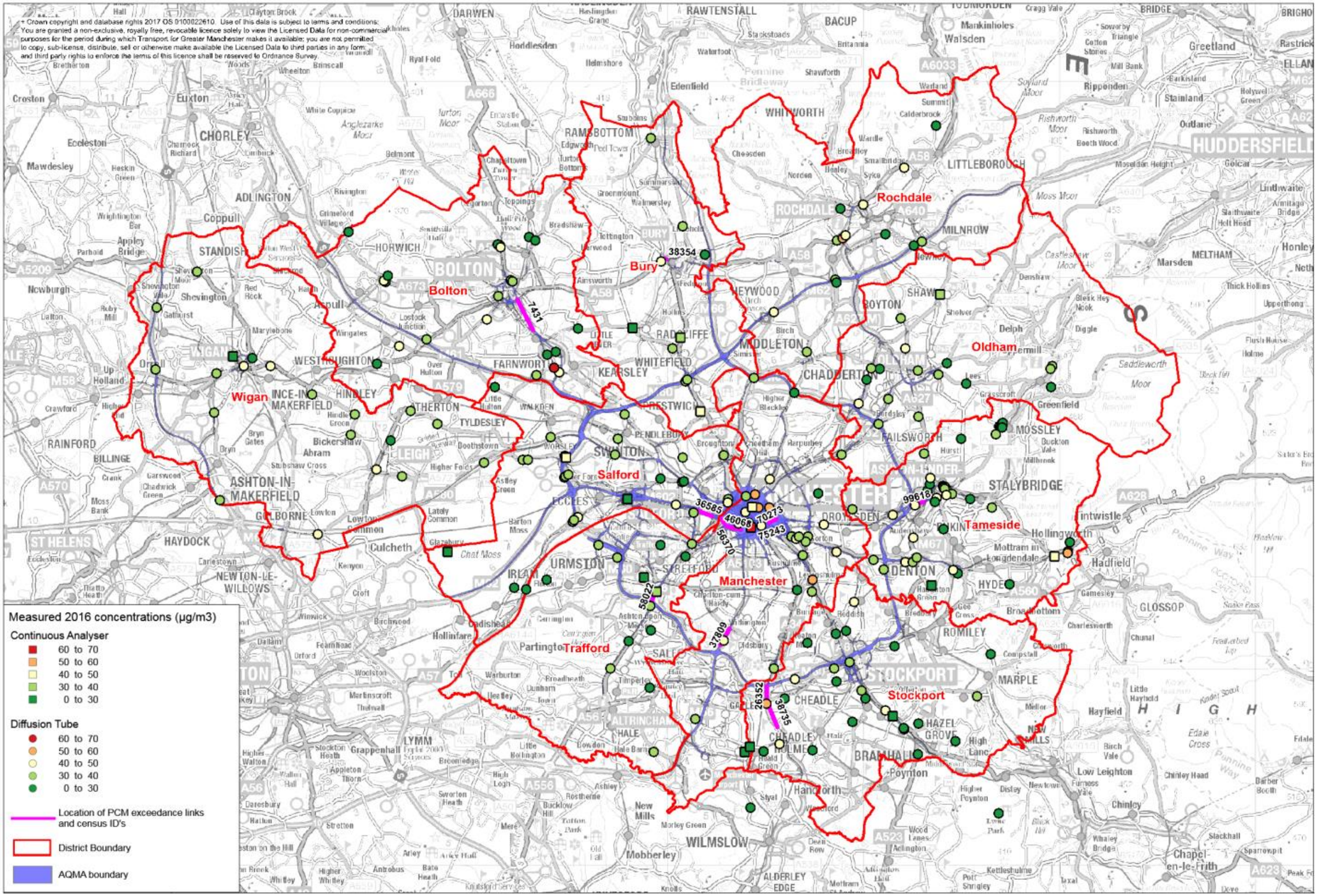
A.6 A zonal approach to model verification was considered necessary, to refine the spatial performance of the model, including application of the canyon module. The study area was split into three zones:

- the area of central Manchester inside the Inner Relief Route (IRR) where there is a predominance of tall buildings (Zone 5),
- the A57/A628 at Mottram (where operated by National Highways) which is very narrow and congested (Zone 4) [35]; and
- the remainder of GM (Zone 1).

A.7 The canyon module was used in Zone 4 and 5, but not in Zone 1. A total of 118 sites were used in the verification process for Zone 1 (remainder of GM outside the Manchester city centre Inner Ring Road). Twenty one sites were included for Zone 4 (A57/A628 Mottram) and eight sites were included for Zone 5 (sites within the Manchester-Salford Inner Relief Route). These sites are presented separately in Figure A-1.

[35] The GM CAP does not include the roads forming the Strategic Road Network operated by National Highways (formerly known as Highways England). Therefore, this report does provide any outputs for roads on the Strategic Road Network which are contained in Verification Zone 4.

Figure A-1: GM Air Quality Constraints Plan with AQMA based on data available for Target Determination Process



A.8 The results for all monitoring sites prior to adjustment (but with the canyon module applied in Zone 4 and 5 locations) are presented in Table A-1. These show that the study area showed a slight systematic bias of under prediction (fractional bias of 0.27) with an RMSE of 12.5 µg/m3. Analysis was undertaken to address the overall under prediction, and refine the model performance.

A.9 The verification process was applied following guidance in LAQM.TG(16) which is consistent with the updated guidance published in 2022[36] to adjust Road NO_x, with a further adjustment applied to Road NO_2, and the resulting model performance for the three zones considered are presented in Table A-1.

Table A-1: Modelled verification results for roadside locations

Annual mean conc. bands (µg/m^3)	No adjustm't: All roadside sites	No adjustm't: Zone 1	Zone 1	No adjustm't: Zone 4	Zone 4	No adjustm't: Zone 5	Zone 5
No. sites	147	118	118	21	21	8	8
Mod NO_x Rd v Mon NO_x Rd Factor	n/a	n/a	1.98	n/a	2.003	n/a	1.494
Mod NO_2 Rd v Mon NO_2 Rd Factor	n/a	n/a	1.002	n/a	0.981	n/a	0.936
RMSE	12.5	10.9	8.3	20.0	12.1	8.5	7.0
Fractional Bias	0.27	0.26	0.07	0.39	0.03	0.12	0.02
Correlation Coefficient	0.68	0.55	0.52	0.70	0.70	0.80	0.78
No. sites within ±25%	78	64	94	7	17	7	7

Note: Zone 2 was used for background verification and Zone 3 was not used.

A.10 The results show that the RMSE is improved and the fractional bias reduced compared to the overall dataset for each of the three zones. The number of sites within ± 25% of monitored concentrations in each zone is improved or remains the same. Each outlier site was reviewed to determine whether it should be excluded, but it was considered these should remain to describe

[36] Local Air Quality Management Technical Guidance TG(22) https://laqm.defra.gov.uk/technical-guidance/, Defra, 2022

the spread of the data. These verification factors were applied to the model results.

A.11 The model performance at each monitoring site is provided below by verification zone in Table A-3 to Table A-5, and the modelled road NOx and total NO_2 (pre- and post- adjustment) are provided for each zone in Graph 1 to 9.

A.12 The continuous analysers were highly variable in their response, possibly relating to variations in f-NO_2, amongst other factors. Therefore, the performance of continuous analysers was also considered separately to diffusion tubes. A separate approach, using just the continuous analyser data to produce the road NO_x adjustment factor, and then both continuous analysers and diffusion tubes to produce a total NO_2 adjustment factor was applied to Zone 1 (Zone 4 and five only contained one continuous analyser and this method was not considered appropriate). The model performance using this approach is summarised in Table A-2.

A.13 Overall, the RMSE and number of outliers sites were poorer using this approach, whilst the Fractional Bias and Correlation Coefficient were slightly better. The test was not considered to significantly improve overall model performance, and therefore this approach has not been applied. This is discussed further in the separate *Sensitivity Testing Report*.

Table A-2: Modelled verification results for roadside locations – Continuous Analyser for NOx Rd Adjustment Test

Annual mean concentration bands (µg/m^3)	**No adjustment: Zone 1**	**Zone 1**
No. sites	CM: 7 DT: 111	118
Mod NO_x Rd v Mon NO_x Rd Factor	n/a	2.200
Mod Total NO_2 v Mon Total NO_2 Factor	n/a	0.984
RMSE	10.9	8.4
Fractional Bias	0.26	0.04
Correlation Coefficient	0.55	0.51
No. sites within ±25%	64	92

Table A-3: Verification Results: Zone 1

Ref.	X	Y	Measured NOx Conc	Measured NO_2 Conc	DC %	Md f-NO_2	Background NOx	Background NO_2	Mod Total NO_2	Mon/Mod Total NO_2	Mod Road NOx	Mon Road NOx	Mon/Mod Road NOx	Mod Road NO_2	Mon Road NO_2	Mon/Mod Road NO_2	Adjusted Modelled NOx (Roads)	Adjusted Modelled NO_2 (Roads)	Adjusted Modelled NO_2 (Total)
SalfordSA33	372597	400725	55.3	31.5	100%	0.24	21.2	15.2	23.0	-27%	14.5	34.1	2.4	7.8	16.3	2.1	28.7	13.94	29.10
SalfordSA55	372850	400733	70.6	37.9	92%	0.25	21.2	15.2	26.0	-31%	18.3	49.4	2.7	10.8	22.7	2.1	36.2	17.25	32.41
Wigan 54	370612	400586	61.7	33.9	100%	0.24	20.2	14.5	19.2	-43%	10.2	41.5	4.1	4.7	19.4	4.1	20.2	10.05	24.52
MMLR_018_1215	399196	395942	45.5	26.5	100%	0.23	18.0	13.1	26.0	-2%	22.3	27.4	1.2	12.9	13.3	1.0	44.2	20.52	33.65
MMLR_020_1215	398451	396636	75.4	39.1	100%	0.24	18.1	13.2	29.5	-25%	23.2	57.3	2.5	16.4	26.0	1.6	45.9	21.47	34.63
MMLR_056_1215	399049	396280	22.3	15.2	100%	0.24	16.7	12.2	13.7	-10%	2.9	5.7	2.0	1.5	3.0	2.0	5.8	3.03	15.23
MMLR_065_1215	398825	396336	52.4	29.8	100%	0.25	18.1	13.2	21.7	-27%	17.5	34.3	2.0	8.5	16.7	2.0	34.6	16.83	29.99
MMLR_010_1215	398357	395315	46.6	27.4	100%	0.27	17.9	13.0	17.0	-38%	7.6	28.7	3.8	4.0	14.4	3.6	15.1	7.83	20.85
MMLR_021_1215	398147	396837	73.1	38.4	100%	0.25	18.1	13.2	24.2	-37%	21.3	55.0	2.6	11.1	25.2	2.3	42.2	20.05	33.20
MMLR_022_1215	397449	397210	54.8	31.3	83%	0.25	21.1	15.0	22.5	-28%	9.0	33.8	3.7	7.4	16.2	2.2	17.9	8.99	24.04
MMLR_006_1215	395369	395062	49.5	29.4	100%	0.24	26.3	18.2	21.8	-26%	11.1	23.2	2.1	3.6	11.2	3.1	22.0	10.63	28.84
TamesideT 20	394609	395102	79.8	41.8	100%	0.23	26.6	18.4	27.7	-34%	18.4	53.2	2.9	9.3	23.4	2.5	36.4	16.78	35.19
MMLR_003_1215	395526	395405	36.6	23.5	100%	0.27	26.3	18.2	22.7	-4%	7.5	10.4	1.4	4.5	5.3	1.2	14.9	7.63	25.84
MMLR_004_1215	394885	395408	45.4	27.7	100%	0.26	26.6	18.4	23.0	-17%	9.6	18.8	2.0	4.6	9.3	2.0	19.0	9.45	27.86
MMLR_005_1215	395127	395435	56.3	32.6	83%	0.25	26.3	18.2	23.0	-29%	7.1	30.0	4.2	4.8	14.4	3.0	14.1	7.05	25.26
MMLR_007_1215	395619	395230	48.5	29.3	92%	0.27	26.3	18.2	26.3	-10%	14.2	22.2	1.6	8.1	11.1	1.4	28.0	13.82	32.02
Wigan 14	366880	403255	66.4	36.4	100%	0.26	20.5	14.7	22.9	-37%	9.3	45.9	4.9	8.2	21.7	2.7	18.4	9.34	24.05
Wigan 28	366423	399893	73.4	38.6	92%	0.22	22.9	16.2	19.5	-50%	13.4	50.5	3.8	3.3	22.4	6.8	26.5	12.62	28.81
Wigan 61	364025	403080	64.7	35.5	100%	0.25	20.1	14.5	27.9	-21%	24.3	44.5	1.8	13.5	21.0	1.6	48.1	22.53	36.99
Wigan 71	368244	402562	67.8	36.9	100%	0.25	20.8	14.9	25.1	-32%	10.7	47.1	4.4	10.3	22.0	2.1	21.3	10.64	25.52
Wigan 114	365115	400259	71.3	40.1	100%	0.27	28.9	19.8	28.6	-29%	16.4	42.4	2.6	8.7	20.2	2.3	32.5	15.88	35.71
Trafford22	377054	390078	63.3	35.6	83%	0.26	23.8	16.8	29.5	-17%	19.3	39.5	2.0	12.7	18.7	1.5	38.3	18.22	35.06
Bolton41	366296	406568	85.2	43.4	92%	0.24	21.7	15.5	22.0	-49%	10.3	63.5	6.2	6.5	27.9	4.3	20.3	10.04	25.56
Bolton60	373288	405062	59.1	34.2	92%	0.25	28.1	19.4	26.7	-22%	12.1	31.0	2.6	7.4	14.8	2.0	23.9	11.62	31.01
Rochdale2A	388537	409942	61.5	33.3	92%	0.22	19.9	14.3	35.4	6%	47.7	41.6	0.9	21.1	19.0	0.9	94.4	37.38	51.70

Ref.	X	Y	Measured NOx Conc	Measured NO_2 Conc	DC %	Md f-NO_2	Background NOx	Background NO_2	Mod Total NO_2	Mon/Mod Total NO_2	Mod Road NOx	Mon Road NOx	Mon/Mod Road NOx	Mod Road NO_2	Mon Road NO_2	Mon/Mod Road NO_2	Adjusted Modelled NOx (Roads)	Adjusted Modelled NO_2 (Roads)	Adjusted Modelled NO_2 (Total)
Rochdale6A	385414	408319	91.8	44.6	100%	0.23	19.0	13.7	39.9	-10%	59.3	72.8	1.2	26.2	30.9	1.2	117.5	45.02	58.76
BURY	380637	406972	59.0	30.0	94%	0.24	25.0	17.6	24.5	-18%	10.0	34.0	3.4	7.0	12.4	1.8	19.8	9.77	27.32
BuryBU6	379658	410888	74.5	40.8	100%	0.25	29.1	20.0	37.2	-9%	28.2	45.4	1.6	17.2	20.8	1.2	55.8	24.99	44.97
Rochdale12A	392072	415685	85.8	43.3	92%	0.24	19.5	14.1	23.7	-45%	18.7	66.3	3.6	9.6	29.3	3.0	37.0	17.61	31.67
Rochdale11A	389969	413814	89.1	46.8	100%	0.24	35.9	23.7	35.6	-24%	26.1	53.2	2.0	11.9	23.2	1.9	51.7	22.63	46.31
Wigan 35	357132	398669	73.5	39.0	92%	0.25	19.7	14.2	27.4	-30%	27.0	53.9	2.0	13.2	24.8	1.9	53.4	24.68	38.83
Wigan 52	362138	396947	83.4	41.7	100%	0.23	18.5	13.4	26.2	-37%	20.3	64.9	3.2	12.8	28.3	2.2	40.1	18.76	32.15
BUR1	378195	407477	64.0	28.0	95%	0.26	26.4	18.3	39.2	40%	28.2	37.6	1.3	20.9	9.7	0.5	55.8	25.33	43.65
Bolton48	375402	407462	48.5	28.7	75%	0.23	24.2	17.1	23.6	-18%	12.7	24.3	1.9	6.5	11.7	1.8	25.1	12.05	29.13
Bolton62	374193	405460	163.3	66.1	92%	0.21	25.0	17.5	33.0	-50%	17.8	138.3	7.8	15.5	48.5	3.1	35.3	16.04	33.57
Wigan 115	353845	405360	58.9	32.6	75%	0.25	17.0	12.5	25.8	-21%	26.1	41.9	1.6	13.4	20.1	1.5	51.6	24.22	36.70
Trafford24	379260	385811	52.4	30.7	92%	0.28	21.0	15.0	28.0	-9%	8.7	31.4	3.6	13.0	15.7	1.2	17.2	8.88	23.86
STK5	391483	387636	58.0	25.0	99%	0.21	28.0	19.2	35.1	40%	23.8	30.0	1.3	15.9	5.8	0.4	47.1	20.45	39.67
StockportSK 7	392063	386969	99.5	47.7	100%	0.22	23.5	16.6	22.3	-53%	23.6	76.0	3.2	5.8	31.1	5.4	46.6	20.74	37.29
StockportSK28	385700	386220	86.3	43.7	100%	0.21	26.7	18.6	30.5	-30%	22.7	59.6	2.6	11.9	25.1	2.1	45.0	19.78	38.37
BuryBU8	380753	412622	56.7	32.0	100%	0.21	24.3	17.2	27.5	-14%	16.2	32.4	2.0	10.3	14.9	1.4	32.1	14.73	31.88
Wigan 53	353896	408519	62.7	33.9	92%	0.25	15.5	11.5	24.1	-29%	25.4	47.2	1.9	12.7	22.4	1.8	50.3	23.74	35.24
Wigan 81	355979	410362	56.0	30.5	100%	0.24	14.7	10.9	13.0	-57%	7.0	41.3	5.9	2.1	19.6	9.3	13.8	7.10	18.00
Bolton43	365500	409885	83.3	44.1	83%	0.26	27.0	18.5	26.0	-41%	12.4	56.4	4.6	7.4	25.5	3.4	24.5	12.02	30.55
Wigan 43	356833	403150	70.5	37.1	100%	0.23	19.9	14.3	29.7	-20%	29.5	50.6	1.7	15.4	22.8	1.5	58.4	25.77	40.08
Wigan 23	361835	404090	66.2	36.3	100%	0.26	20.3	14.5	17.2	-52%	14.8	45.9	3.1	2.7	21.7	8.1	29.4	14.50	29.04
Wigan 33	359726	405534	79.3	41.8	92%	0.24	25.2	17.6	29.5	-29%	18.1	54.0	3.0	11.9	24.2	2.0	35.9	16.90	34.47
Wigan 51	358787	405931	49.2	29.9	75%	0.23	39.0	25.0	33.6	12%	15.0	10.2	0.7	8.6	4.9	0.6	29.8	13.51	38.55
StockportSK 4	396469	390800	22.5	15.7	100%	0.24	19.7	14.2	16.8	7%	6.6	2.8	0.4	2.6	1.5	0.6	13.1	6.67	20.89
StockportSK25	395770	388655	54.4	30.6	100%	0.19	23.3	16.5	24.9	-19%	9.9	31.1	3.2	8.4	14.1	1.7	19.5	9.22	25.69
TamesideT 18	391967	395521	97.3	49.3	100%	0.25	27.4	18.8	39.0	-21%	39.0	69.9	1.8	20.1	30.5	1.5	77.2	33.16	51.99

Ref.	X	Y	Measured NOx Conc	Measured NO_2 Conc	DC %	Md f-NO_2	Background NOx	Background NO_2	Mod Total NO_2	Mon/Mod Total NO_2	Mod Road NOx	Mon Road NOx	Mon/Mod Road NOx	Mod Road NO_2	Mon Road NO_2	Mon/Mod Road NO_2	Adjusted Modelled NOx (Roads)	Adjusted Modelled NO_2 (Roads)	Adjusted Modelled NO_2 (Total)
TamesideT 19	392478	395505	73.8	39.5	75%	0.22	28.7	19.6	36.5	-7%	22.3	45.1	2.0	16.9	19.8	1.2	44.2	19.50	39.13
TamesideT 24	390475	395621	72.3	39.3	100%	0.25	25.8	17.9	28.6	-27%	13.5	46.6	3.4	10.7	21.4	2.0	26.8	12.96	30.90
TamesideT 48	392699	395741	49.5	30.1	92%	0.28	28.7	19.6	26.9	-11%	13.9	20.8	1.5	7.3	10.4	1.4	27.6	13.65	33.28
TamesideT 10	392515	396749	78.4	41.4	100%	0.23	27.1	18.7	29.8	-28%	19.6	51.3	2.6	11.1	22.7	2.0	38.9	17.83	36.51
MAN73	388604	396043	82.8	43.6	100%	0.23	31.6	21.4	39.5	-9%	17.5	51.2	2.9	18.1	22.2	1.2	34.6	15.76	37.14
StockportSK19	389479	393464	79.9	42.5	100%	0.23	30.3	20.6	42.1	-1%	20.2	49.7	2.5	21.5	21.9	1.0	40.0	18.06	38.69
Rochdale7A	388602	411924	67.9	36.7	100%	0.23	23.8	16.7	28.3	-23%	28.9	44.1	1.5	11.6	20.0	1.7	57.1	24.99	41.73
Rochdale8A	388929	412091	106.6	51.2	92%	0.24	23.2	16.4	32.3	-37%	34.0	83.4	2.5	15.8	34.7	2.2	67.3	29.14	45.58
Rochdale9A	389058	412214	88.2	45.2	100%	0.23	26.9	18.6	40.6	-10%	41.6	61.3	1.5	22.0	26.5	1.2	82.4	33.88	52.52
Rochdale15A	392977	411907	60.7	32.8	75%	0.22	18.3	13.3	28.7	-13%	32.4	42.4	1.3	15.4	19.5	1.3	64.1	27.74	41.05
BUR2	381651	403221	111.0	42.0	99%	0.23	24.7	17.3	30.4	-28%	18.7	86.3	4.6	13.1	24.7	1.9	37.1	17.12	34.42
BuryBU5	380294	406411	62.1	35.5	92%	0.27	25.0	17.6	23.8	-33%	11.9	37.0	3.1	6.2	18.0	2.9	23.6	11.82	29.38
M60	374810	400854	129.0	46.0	94%	0.24	20.2	14.5	36.3	-21%	47.6	108.8	2.3	21.8	31.5	1.4	94.1	38.36	52.88
SalfordSA04	377451	401828	51.7	30.4	83%	0.21	28.5	19.6	22.8	-25%	7.8	23.2	3.0	3.2	10.8	3.4	15.5	7.42	27.02
SalfordSA28	377289	401010	56.6	32.9	100%	0.24	28.5	19.6	27.7	-16%	19.7	28.1	1.4	8.1	13.3	1.6	39.0	17.96	37.56
SalfordSA31	374024	401905	57.5	32.5	100%	0.25	20.8	14.9	29.6	-9%	23.9	36.7	1.5	14.6	17.6	1.2	47.2	22.06	36.98
SalfordSA38	377788	403063	54.7	31.0	100%	0.23	21.5	15.3	20.4	-34%	11.1	33.2	3.0	5.1	15.7	3.1	21.9	10.71	25.99
TamesideT 26	394948	401826	39.5	24.8	100%	0.28	23.9	16.8	20.0	-19%	5.6	15.6	2.8	3.2	8.0	2.5	11.2	5.80	22.62
TamesideT 32	396970	402416	50.4	29.2	100%	0.25	20.0	14.4	25.0	-14%	7.7	30.4	3.9	10.6	14.8	1.4	15.3	7.77	22.17
TamesideT 33	397011	402592	45.8	27.6	100%	0.26	23.1	16.3	18.7	-32%	5.0	22.6	4.5	2.4	11.3	4.7	9.9	5.13	21.47
TamesideT 34	397066	402586	47.6	28.5	100%	0.26	23.1	16.3	22.9	-20%	10.0	24.5	2.5	6.5	12.1	1.9	19.7	9.92	26.26
TamesideT 35	397068	402535	79.6	41.8	100%	0.25	23.1	16.3	22.0	-47%	8.1	56.4	7.0	5.7	25.5	4.5	16.0	8.05	24.39
TamesideT 37	396727	402072	73.5	39.9	100%	0.28	20.0	14.4	24.0	-40%	10.9	53.5	4.9	9.6	25.5	2.7	21.6	11.06	25.46
TamesideT SPEC	394193	399264	69.3	37.3	100%	0.16	33.7	22.6	28.0	-25%	16.5	35.6	2.2	5.5	14.7	2.7	32.6	13.61	36.17
TamesideT 15	395403	398729	48.1	29.6	92%	0.26	34.9	23.1	29.9	1%	11.2	13.2	1.2	6.8	6.5	1.0	22.1	10.70	33.81
TamesideT 27	396174	398218	51.4	31.1	100%	0.27	31.2	21.1	27.3	-12%	7.6	20.2	2.7	6.2	10.0	1.6	15.0	7.53	28.63

Ref.	X	Y	Measured NOx Conc	Measured NO_2 Conc	DC %	Md f-NO_2	Background NOx	Background NO_2	Mod Total NO_2	Mon/Mod Total NO_2	Mod Road NOx	Mon Road NOx	Mon/Mod Road NOx	Mod Road NO_2	Mon Road NO_2	Mon/Mod Road NO_2	Adjusted Modelled NOx (Roads)	Adjusted Modelled NO_2 (Roads)	Adjusted Modelled NO_2 (Total)
TamesideT 40	394063	399307	65.2	36.6	100%	0.21	33.7	22.6	26.4	-28%	8.0	31.4	3.9	3.9	14.0	3.6	15.9	7.44	30.01
TamesideT 41	394117	399259	62.1	34.7	100%	0.17	33.7	22.6	26.5	-24%	12.4	28.4	2.3	4.0	12.2	3.1	24.6	10.66	33.23
TamesideT 42	394494	399011	55.5	33.1	100%	0.26	33.7	22.6	27.1	-18%	11.0	21.8	2.0	4.6	10.5	2.3	21.9	10.57	33.14
TamesideT 43	394210	398926	86.2	46.4	100%	0.27	36.1	23.7	32.7	-30%	16.4	50.1	3.1	9.0	22.7	2.5	32.4	15.34	39.01
TamesideT 14	393697	398794	72.5	40.6	100%	0.26	34.7	22.9	33.8	-17%	22.0	37.9	1.7	10.9	17.7	1.6	43.6	20.08	43.02
Bolton3	370747	407923	95.0	49.1	92%	0.26	29.7	20.3	33.9	-31%	12.1	65.3	5.4	13.6	28.8	2.1	23.9	11.65	31.95
Bolton66	371441	411600	75.8	40.4	92%	0.24	25.9	18.1	32.2	-20%	19.3	49.9	2.6	14.2	22.3	1.6	38.3	17.69	35.79
StockportSK16	391569	391226	48.3	28.9	100%	0.23	26.7	18.5	29.0	0%	13.2	21.6	1.6	10.5	10.4	1.0	26.0	12.38	30.91
StockportSK11	391082	387936	82.6	43.4	83%	0.24	28.0	19.2	40.4	-7%	20.6	54.6	2.6	21.1	24.2	1.1	40.9	18.79	38.01
StockportSK15	389886	388961	65.3	37.0	100%	0.26	29.7	20.2	29.4	-20%	14.1	35.6	2.5	9.2	16.8	1.8	28.0	13.45	33.70
MAN87A	387019	396563	65.4	37.1	100%	0.26	30.4	20.6	29.2	-21%	17.5	35.1	2.0	8.6	16.4	1.9	34.6	16.29	36.92
MAN75	387363	394618	107.3	51.5	100%	0.21	33.4	22.4	40.8	-21%	23.8	73.9	3.1	18.4	29.2	1.6	47.1	20.07	42.43
TRF2	379411	394013	76.0	33.0	98%	0.27	27.4	18.9	31.5	-5%	27.0	48.6	1.8	12.6	14.1	1.1	53.5	24.66	43.56
BuryBU1	384376	404918	63.0	35.2	92%	0.26	22.3	15.9	31.4	-11%	33.5	40.7	1.2	15.5	19.4	1.2	66.4	29.77	45.64
TamesideT 13	392583	398433	79.2	42.9	100%	0.25	33.6	22.3	38.5	-10%	35.6	45.7	1.3	16.2	20.6	1.3	70.4	30.04	52.33
TamesideT 16	391421	397973	89.0	46.1	100%	0.25	27.1	18.7	26.7	-42%	14.4	61.9	4.3	8.0	27.4	3.4	28.5	13.74	32.44
TamesideT 17	389069	398245	64.3	36.2	100%	0.24	29.1	19.9	30.0	-17%	12.2	35.2	2.9	10.2	16.3	1.6	24.2	11.61	31.47
TamesideT 25	393051	401037	52.2	30.4	100%	0.24	24.0	16.9	25.0	-18%	11.8	28.2	2.4	8.1	13.5	1.7	23.3	11.36	28.23
TamesideT 30	393419	399691	75.6	41.6	100%	0.25	33.3	22.2	28.6	-31%	13.4	42.3	3.2	6.4	19.4	3.0	26.4	12.62	34.82
MAN37	382828	391491	89.0	46.3	100%	0.28	21.7	15.5	32.4	-30%	24.3	67.3	2.8	16.9	30.8	1.8	48.1	22.97	38.44
OldhamOL11	393783	405097	57.8	34.1	92%	0.25	34.4	22.9	27.7	-19%	14.9	23.4	1.6	4.8	11.2	2.3	29.6	13.91	36.80
CW	393884	409183	79.0	34.0	94%	0.26	23.2	16.4	23.5	-31%	10.7	55.8	5.2	7.0	17.6	2.5	21.3	10.65	27.08
SalfordSA34	375362	397800	90.6	45.6	100%	0.25	21.3	15.2	37.6	-18%	49.0	69.3	1.4	22.4	30.4	1.4	97.0	40.11	55.32
SalfordSA42	374697	399854	75.1	39.1	100%	0.24	18.8	13.6	40.5	4%	62.0	56.3	0.9	26.9	25.4	0.9	122.8	47.80	61.41
SalfordSA50	375396	397805	84.7	43.7	100%	0.25	21.3	15.2	26.7	-39%	26.0	63.4	2.4	11.5	28.5	2.5	51.5	23.85	39.06
SalfordSA51	375213	397661	71.9	37.7	100%	0.22	21.3	15.2	39.2	4%	38.4	50.6	1.3	24.0	22.5	0.9	76.1	31.58	46.79

Ref.	X	Y	Measured NOx Conc	Measured NO_2 Conc	DC %	Md f-NO_2	Background NOx	Background NO_2	Mod Total NO_2	Mon/Mod Total NO_2	Mod Road NOx	Mon Road NOx	Mon/Mod Road NOx	Mod Road NO_2	Mon Road NO_2	Mon/Mod Road NO_2	Adjusted Modelled NOx (Roads)	Adjusted Modelled NO_2 (Roads)	Adjusted Modelled NO_2 (Total)
SalfordSA52	375148	397588	65.6	35.2	100%	0.22	21.3	15.2	31.0	-12%	26.2	44.3	1.7	15.8	20.0	1.3	51.8	22.93	38.14
SalfordSA53	374757	399891	68.6	36.5	100%	0.24	18.8	13.6	25.7	-30%	24.8	49.8	2.0	12.1	22.9	1.9	49.2	22.66	36.27
StockportSK20	386921	389529	90.9	47.9	100%	0.28	24.7	17.3	34.4	-28%	33.0	66.1	2.0	17.1	30.6	1.8	65.2	30.28	47.59
MAN74	385401	390096	67.1	38.0	100%	0.28	27.3	18.8	28.4	-25%	14.6	39.9	2.7	9.6	19.2	2.0	28.9	14.27	33.07
StockportSK12	385031	388288	110.2	54.5	100%	0.26	26.5	18.4	38.1	-30%	24.9	83.7	3.4	19.6	36.0	1.8	49.3	22.93	41.37
SalfordSA14	382833	401035	61.6	35.5	100%	0.28	26.9	18.6	25.3	-29%	12.7	34.7	2.7	6.6	16.9	2.5	25.2	12.55	31.19
SalfordSA17	380741	400863	68.8	38.1	100%	0.24	28.8	19.7	21.2	-44%	2.6	40.0	15.1	1.6	18.4	11.9	5.2	2.66	22.34
SalfordSA25	381304	398014	57.4	33.6	100%	0.25	32.8	21.9	30.1	-10%	15.3	24.5	1.6	8.2	11.7	1.4	30.3	14.26	36.16
SalfordSA44	380412	398439	71.9	40.7	100%	0.28	35.5	23.4	34.1	-16%	24.5	36.5	1.5	10.7	17.4	1.6	48.5	22.52	45.88
Oldham OL24	389720	403629	87.1	44.9	92%	0.23	29.0	19.8	35.0	-22%	30.7	58.0	1.9	15.2	25.1	1.7	60.7	26.12	45.95
MAN28	387960	397429	77.0	41.0	100%	0.21	33.8	22.5	39.0	-5%	16.3	43.2	2.7	16.5	18.5	1.1	32.2	14.30	36.76
MAN86A	387161	396850	64.3	36.7	100%	0.27	30.4	20.6	27.9	-24%	12.2	33.9	2.8	7.3	16.1	2.2	24.2	11.79	32.42
MAN36	385199	399743	74.9	40.1	92%	0.20	34.0	22.6	31.4	-22%	16.5	40.9	2.5	8.8	17.5	2.0	32.7	14.35	36.96
MAN88A	386535	396700	104.2	52.7	100%	0.26	32.6	21.8	31.0	-41%	18.5	71.6	3.9	9.2	30.8	3.4	36.6	17.11	38.95
MAN89A	386717	396829	62.0	35.7	100%	0.25	32.6	21.8	25.7	-28%	7.6	29.4	3.9	3.9	13.9	3.6	15.0	7.38	29.22

Table A-4: Verification Results: Zone 4

Ref.	X	Y	Measured NOx Conc	Measured NO_2 Conc	DC %	Md f-NO_2	Background NOx	Background NO_2	Mod Total NO_2	Mon/Mod Total NO_2	Mod Road NOx	Mon Road NOx	Mon/Mod Road NOx	Mod Road NO_2	Mon Road NO_2	Mon/Mod Road NO_2	Adjusted Modelled NOx (Roads)	Adjusted Modelled NO_2 (Roads)	Adjusted Modelled NO_2 (Total)
MMLR_026_1215	400948	395800	89.3	45.1	75%	0.27	16.2	11.9	21.7	-52%	19.0	73.2	3.8	9.8	33.3	3.4	38.1	18.40	30.27
TamesideT 11	400416	396062	174.8	62.8	100%	0.18	17.1	12.5	33.8	-46%	50.1	157.8	3.1	21.3	50.4	2.4	100.4	35.85	48.31
TamesideT 21	400430	395961	123.9	56.1	100%	0.25	16.2	11.9	31.0	-45%	39.8	107.7	2.7	19.1	44.3	2.3	79.7	34.06	45.93
MMLR_024_1215	400102	395940	110.5	48.7	100%	0.21	16.2	11.9	38.3	-21%	61.9	94.4	1.5	26.4	36.8	1.4	124.1	44.15	56.02
MMLR_025_1215	400364	396006	139.2	59.6	92%	0.23	17.1	12.5	33.3	-44%	44.9	122.2	2.7	20.9	47.2	2.3	90.0	36.49	48.95
MMLR_036_1215	400622	395977	33.5	20.6	83%	0.23	16.2	11.9	14.0	-32%	4.0	17.3	4.3	2.1	8.7	4.2	8.0	4.07	15.94
MMLR_044_1215	400490	396118	103.7	46.5	100%	0.20	17.1	12.5	32.2	-31%	44.5	86.7	1.9	19.8	34.0	1.7	89.1	33.99	46.45
MMLR_051_1215	400493	395915	97.4	47.3	92%	0.25	16.2	11.9	31.6	-33%	41.1	81.2	2.0	19.8	35.5	1.8	82.3	35.14	47.01
MMLR_054_1215	400022	395909	102.1	46.1	100%	0.21	16.2	11.9	38.1	-17%	61.4	86.0	1.4	26.2	34.3	1.3	123.0	43.86	55.73
MMLR_057_1215	399876	395861	91.6	43.3	100%	0.21	18.0	13.1	47.0	9%	85.6	73.6	0.9	33.9	30.2	0.9	171.5	55.42	68.56
MMLR_067_1215	400701	395902	28.8	18.4	100%	0.24	16.2	11.9	14.0	-24%	4.0	12.6	3.2	2.1	6.5	3.1	8.0	4.12	15.99
TAM1	399719	395805	162.0	49.0	95%	0.21	18.0	13.1	34.2	-30%	47.6	144.0	3.0	21.0	35.9	1.7	95.3	36.06	49.19
MMLR_012_1215	398901	395501	96.2	47.5	100%	0.26	17.9	13.0	27.7	-42%	29.6	78.3	2.6	14.7	34.4	2.3	59.4	26.75	39.77
MMLR_013_1215	399291	395634	153.5	58.9	100%	0.19	18.0	13.1	46.4	-21%	87.5	135.5	1.5	33.3	45.7	1.4	175.4	53.51	66.64
MMLR_014_1215	399315	395639	297.2	89.5	92%	0.19	18.0	13.1	51.8	-42%	106.8	279.1	2.6	38.7	76.4	2.0	214.0	61.79	74.92
MMLR_015_1215	399305	395625	201.8	69.9	100%	0.19	18.0	13.1	35.3	-49%	52.2	183.7	3.5	22.2	56.8	2.6	104.7	37.32	50.45
MMLR_016_1215	399300	395652	89.8	42.6	92%	0.20	18.0	13.1	26.4	-38%	28.3	71.8	2.5	13.3	29.4	2.2	56.8	23.82	36.95
MMLR_019_1215	399691	395821	84.9	41.0	100%	0.20	18.0	13.1	45.6	11%	80.9	66.8	0.8	32.4	27.9	0.9	162.0	53.19	66.32
MMLR_050_1215	400744	395786	72.1	37.9	100%	0.25	16.2	11.9	30.9	-19%	39.2	55.9	1.4	19.0	26.0	1.4	78.5	33.97	45.84
MMLR_064_1215	399413	395738	231.2	75.7	100%	0.19	18.0	13.1	44.1	-42%	79.8	213.1	2.7	31.0	62.6	2.0	159.8	50.08	63.21
MMLR_069A_1215	399718	395804	126.3	53.7	83%	0.20	18.0	13.1	36.8	-31%	54.7	108.2	2.0	23.7	40.5	1.7	109.6	40.04	53.17

Table A-5: Verification Results: Zone 5

Ref.	X	Y	Measured NOx Conc	Measured NO_2 Conc	DC %	Md f-NO_2	Background NOx	Background NO_2	Mod Total NO_2	Mon/Mod Total NO_2	Mod Road NOx	Mon Road NOx	Mon/Mod Road NOx	Mod Road NO_2	Mon Road NO_2	Mon/Mod Road NO_2	Adjusted Modelled NOx (Roads)	Adjusted Modelled NO_2 (Roads)	Adjusted Modelled NO_2 (Total)
SalfordSA39	383041	398555	88.4	46.8	100%	0.22	50.5	30.9	47.1	1%	38.7	37.9	1.0	16.2	15.9	1.0	57.9	21.43	52.32
SalfordSA27	383080	398743	70.2	39.8	92%	0.24	50.5	30.9	38.3	-4%	16.1	19.7	1.2	7.4	8.9	1.2	24.0	10.08	40.96
MAN1	384238	397278	232.0	66.0	78%	0.15	47.2	29.4	53.1	-20%	70.9	184.8	2.6	23.7	36.6	1.5	105.9	29.59	58.96
MAN9A/B	384602	398304	103.3	51.9	100%	0.20	50.8	31.2	35.7	-31%	10.0	52.5	5.3	4.5	20.7	4.6	14.9	6.19	37.35
MAN24	383958	398058	86.4	45.3	100%	0.18	50.5	30.9	49.2	9%	47.8	35.9	0.8	18.3	14.4	0.8	71.5	23.70	54.58
MAN29A	384120	397501	184.2	66.2	100%	0.13	47.2	29.4	60.6	-9%	111.5	137.0	1.2	31.2	36.8	1.2	166.5	37.88	67.24
MAN72	384760	397383	70.6	40.0	100%	0.24	47.2	29.4	34.5	-14%	11.0	23.4	2.1	5.2	10.6	2.1	16.4	7.11	36.48
MAN82	384239	397278	154.7	61.9	100%	0.15	47.2	29.4	53.7	-13%	73.8	107.5	1.5	24.4	32.6	1.3	110.3	30.38	59.75

Table A-6: Excluded Sites

Reference	Reason to exclude
MAN8	No data
Oldham OL31	
SalfordSA59	
SalfordSA60	
OldhamOL14	
M60J18_009_1215	Only 6 months of data
M60J18_010_1215	
M60J18_011_1215	
M60J18_017_1215	
M60J18_020c_1215	
M60J18_012_1215	
M60J18_021_1215	
M60J18_013_1215	
M60J18_014_1215	
M62J20J25_015_0116	
M62J20J25_016_0116	
M62J20J25_017_0116	
M62J20J25_018_0116	
M62J20J25_019_0116	
M62J20J25_020_0116	
M62J20J25_021_0116	
M62J20J25_022_0116	
M62J20J25_023_0116	
M62J20J25_024_0116	
M62J20J25_033_0116	
M60J18_001_1215	
M60J18_002_1215	

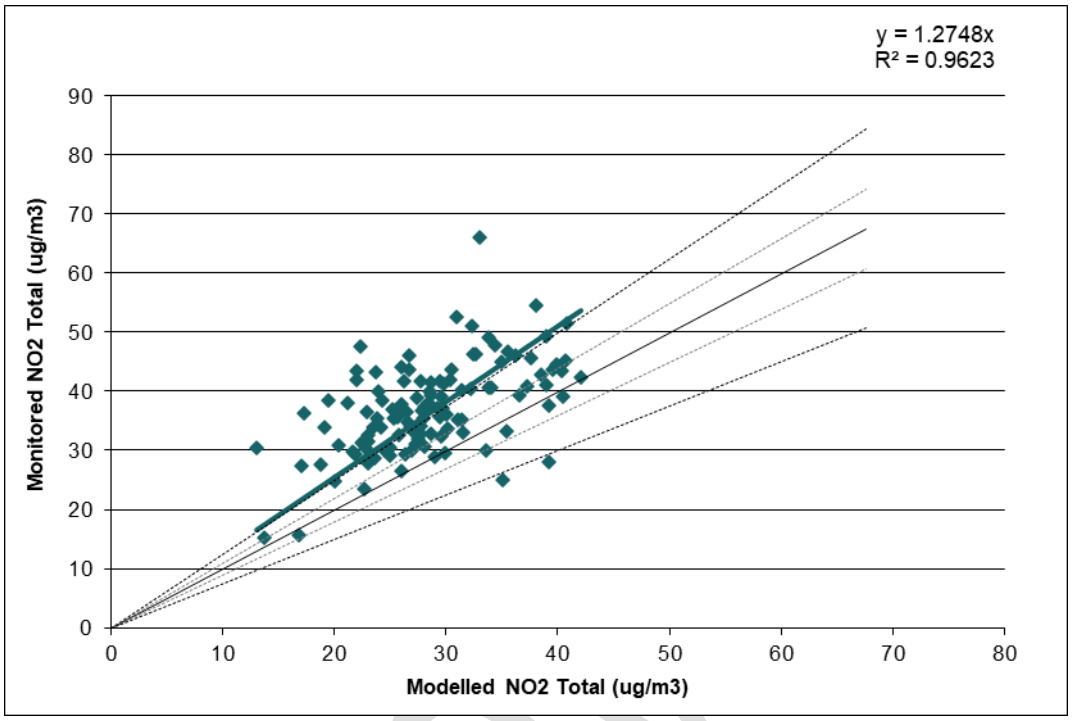
Reference	Reason to exclude
M60J18_003_1215	
M60J18_004_1215	
M60J18_005_1215	
M60J18_007_1215	
M60J18_008_1215	
M60J18_016_1215	
M60J18_018_1215	
M60J18_006_1215	
M60J18_015_1215	
M60J18_019_1215	
M62J20J25_035a_0116	
MAN59	
MAN59	
MAN59	
MAN82	
MAN83	
MAN84	
MAN90	
MAN91	
MAN92	Co-located with a CM
OldhamOL20	
OldhamOL21	
Oldham OL22	
SalfordSA20	
SalfordSA21	
SalfordSA22	
SalfordSA23	
SalfordSA24	

Reference	Reason to exclude
SalfordSA29	
StockportSK22	
StockportSK22	
StockportSK22	
TamesideT 9	
TamesideT 12	
TamesideT 45	
TamesideT 46	
TamesideT 47	
Trafford19	
Trafford 19a	
Trafford20	
Trafford 20a	
Trafford 25	
Trafford 25A	
Wigan 47	
Wigan 48	
Wigan 49	
MAN77	BG site - in narrow canyon with local combustion sources nearby
TamesideT 1	Location could not be identified
Bolton14	
Trafford 15	
Trafford18	
Trafford23	
MMLR_002_1215	BG sites that include a road contribution and not used in the Defra map comparison process
MMLR_063_1215	
Wigan 116	

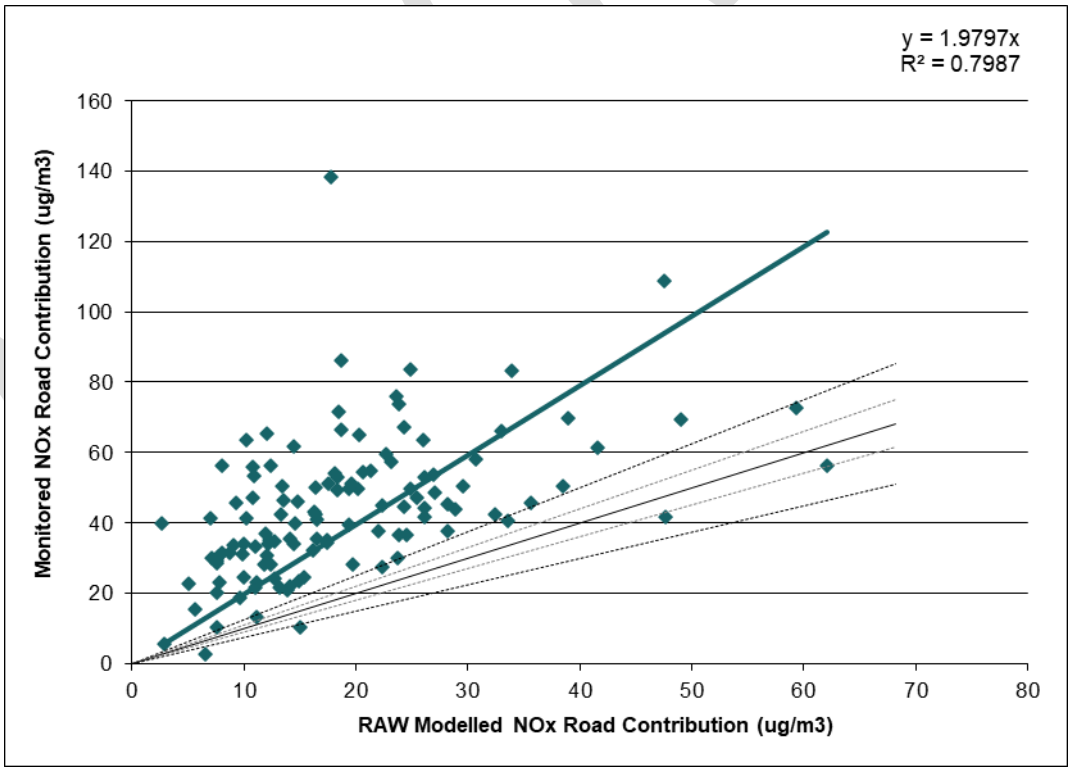
Reference	Reason to exclude
Bolton63	
SalfordSA02	
SalfordSA01	
TamesideT 3	
TamesideT 23	
Bolton16	
Bolton65	
StockportSK29	
StockportSK 1	
StockportSK18	
MAN79	
MAN80	
MAN81	
StockportSK 3	
TRAF	
Trafford5	
Trafford9	
Trafford19	
Trafford13	
Trafford21	
Rochdale4A	
Rochdale5A	
OldhamOL10	
TamesideT 22	
TamesideT 29	
ECCL	
SalfordSA23	
SalfordSA54	

Reference	Reason to exclude
StockportSK17	
StockportSK21	
StockportSK27	
StockportSK 6	
MAN77	
SalfordSA13	
SalfordSA26	
SalfordSA37	
OldhamOL17	
Oldham OL23	
MAN14	
MAN26A/B	
MAN78	
MAN3	
MAN71	Behind ADMS canyon wall in city centre
MAN88	

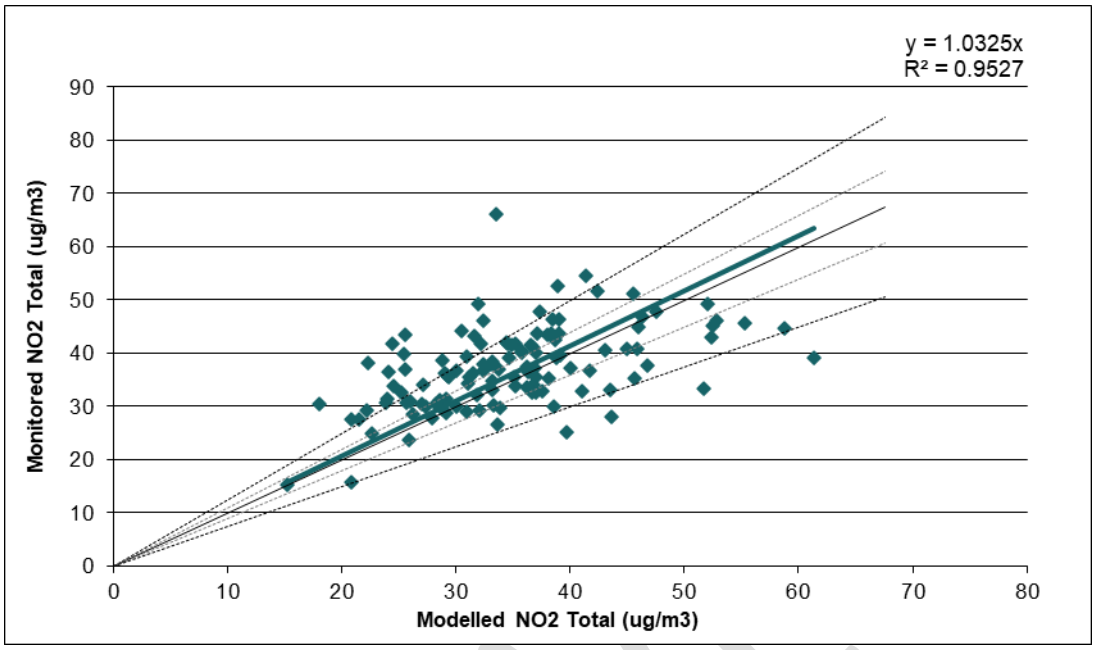
Graph A-1: Modelled vs Monitored Total NO_2 for Zone 1 (Unadjusted)



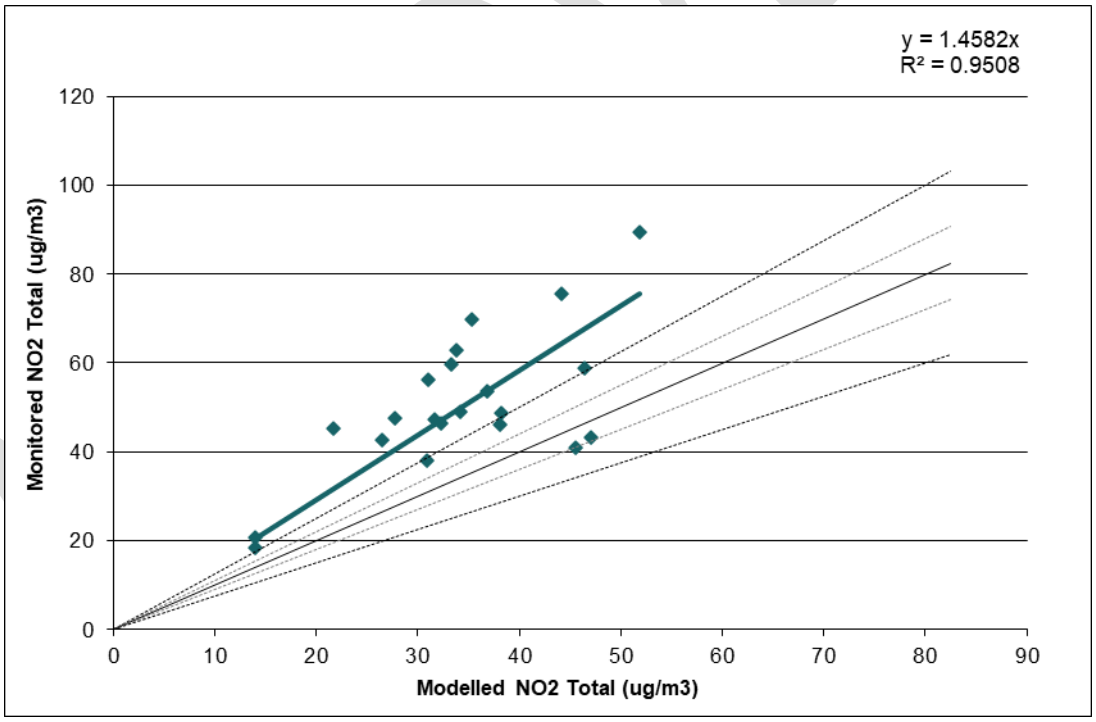
Graph A-2: Modelled vs Monitored Road NOx for Zone 1 (Unadjusted)



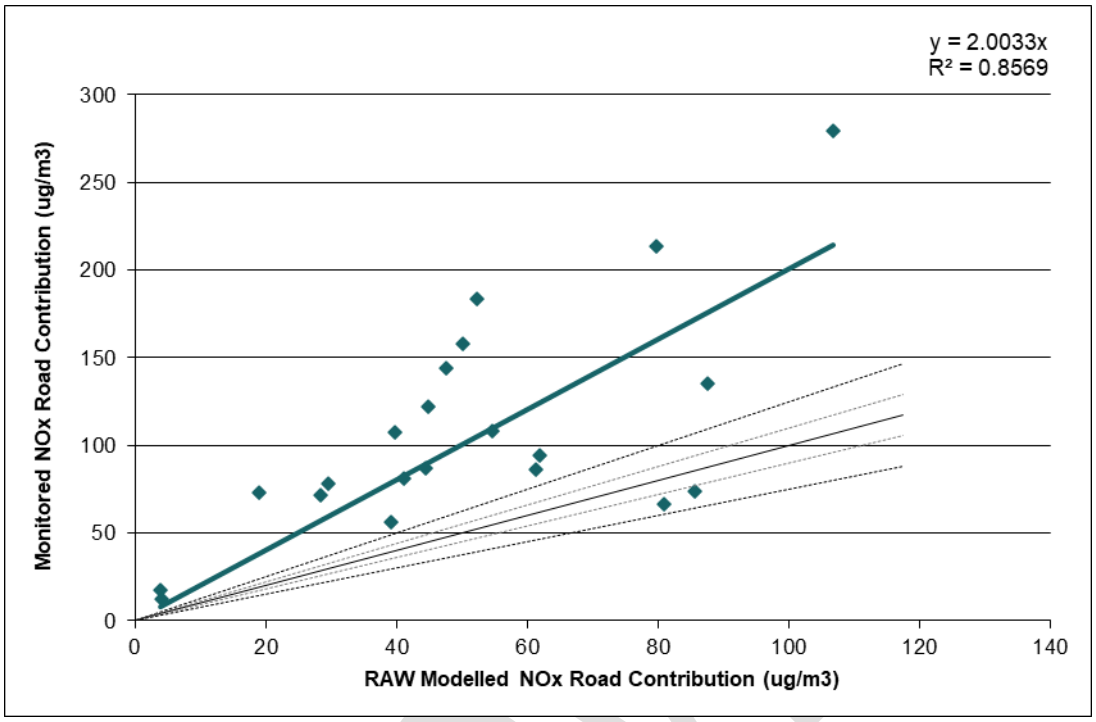
Graph A-3: Modelled vs Monitored Total NO_2 for Zone 1 (Adjusted)



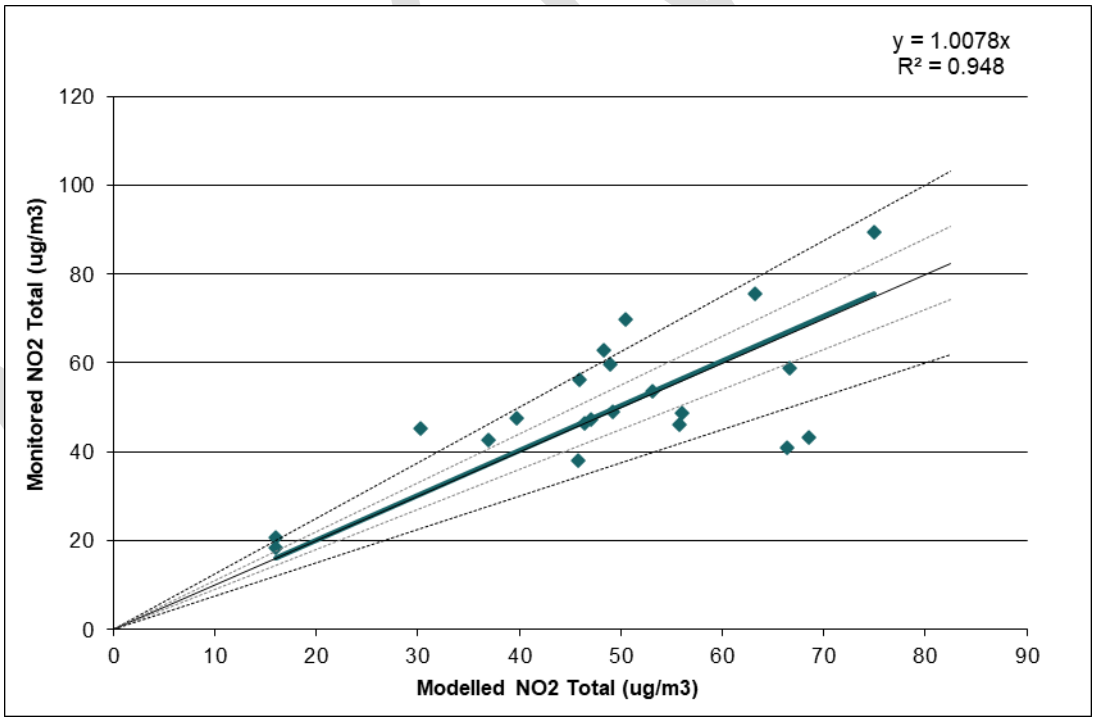
Graph A-4: Modelled vs Monitored Total NO_2 for Zone 4 (Unadjusted)



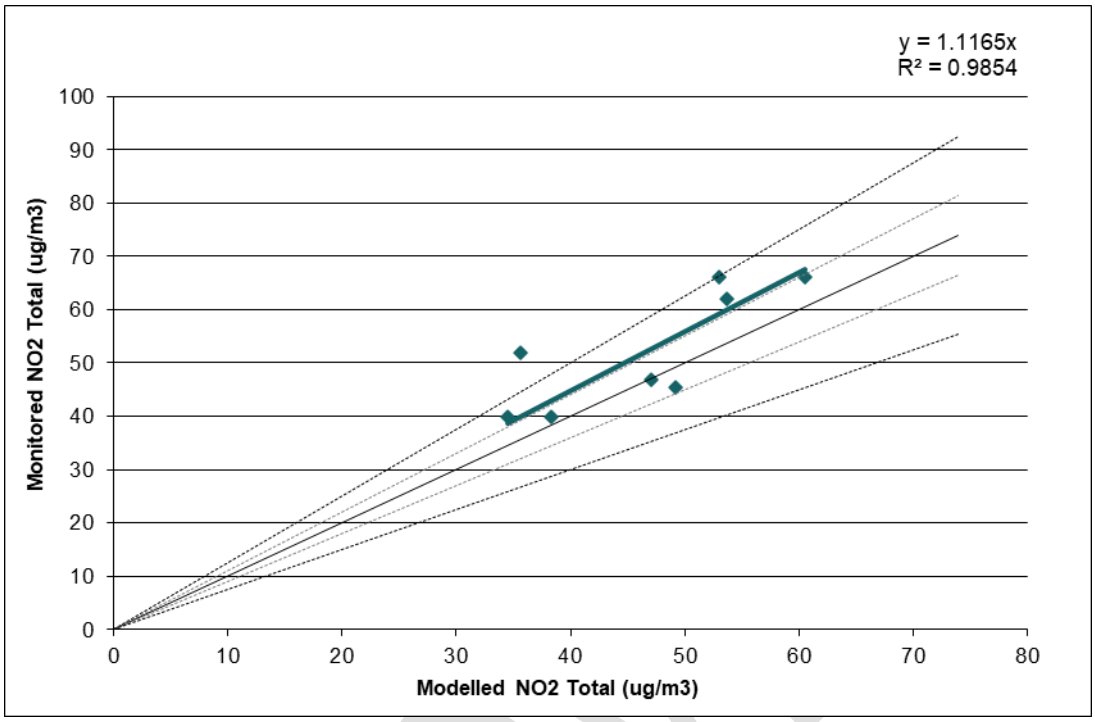
Graph A-5: Modelled vs Monitored Road NOx for Zone 4 (Unadjusted)



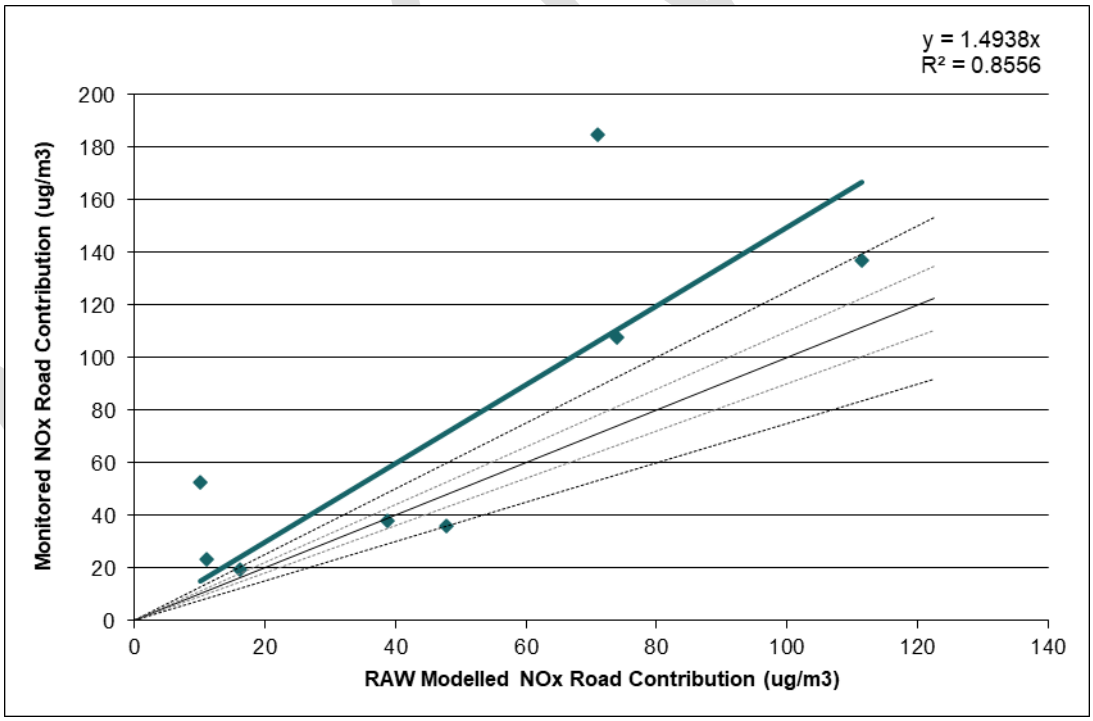
Graph A-6: Modelled vs Monitored Total NO_2 for Zone 4 (Adjusted)



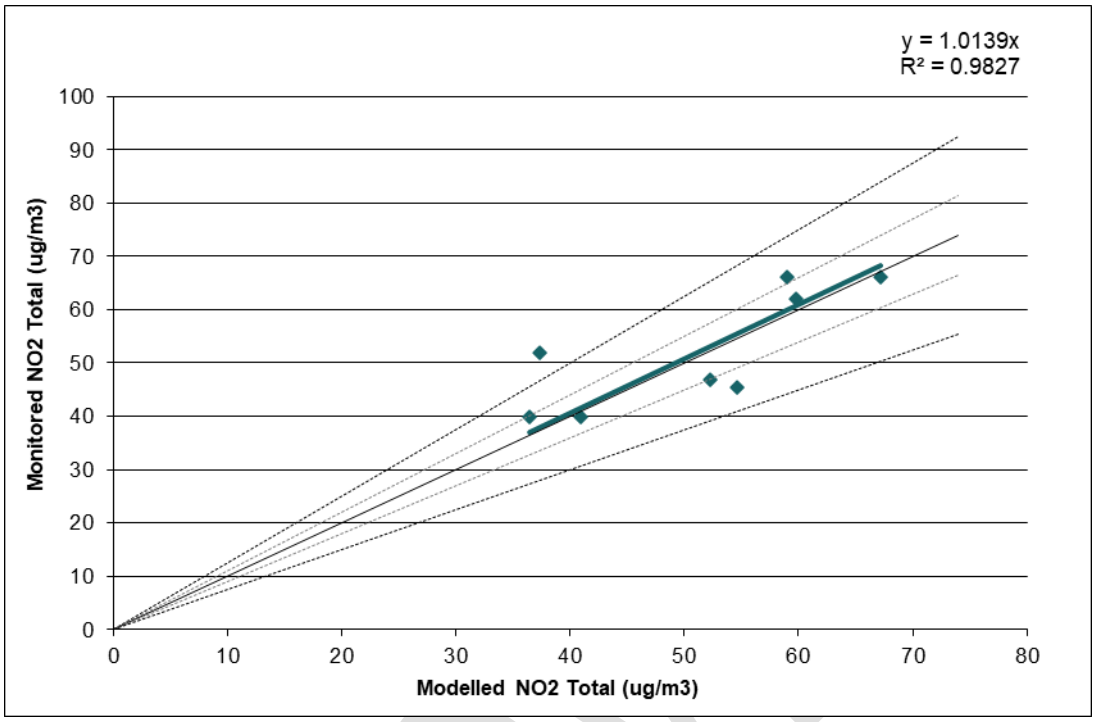
Graph A-7: Modelled vs Monitored Total NO_2 for Zone 5 (Unadjusted)



Graph A-8: Modelled vs Monitored Road NOx for Zone 5 (Unadjusted)



Graph A-9: Modelled vs Monitored Total NO_2 for Zone 5 (Adjusted)



Appendix B – Full Model Results for 2021 Target Determination Exceedances

The results for 2021 are provided for information purposes only and should not be compared with measured concentrations from 2021 which would include the impacts of travel restrictions due to Covid-19.

Table B-1: Predicted annual mean NO_2 concentrations and source apportionment at exceedance links on the Greater Manchester road network - Do Minimum – 2021

Point ID	Rd Link ID	x	y	Census ID	Road name	Local Authority	PCM / LA	Annual mean NO_2 conc ($\mu g/m^3$)	BG NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	AADT	NOx contribution by vehicle type (%)					Change NO_2 conc ($\mu g/m^3$)
														Bus	Taxi	HGV	LGV	Car	
2119_2564_DW	2119_2564	371207	409524	17905	A673	Bolton	PCM	43.0	28.2	19.5	53.5	23.5	26,909	28%	6%	9%	20%	38%	na
2799_3775_DW	2799_3775	371869	409735	8030	A666	Bolton	PCM	43.9	28.2	19.5	52.9	24.4	20,922	0%	7%	13%	33%	48%	na
2799_3118_DW	2799_3118	371751	409800	58048	A673	Bolton	PCM	45.6	28.2	19.5	60.1	26.1	27,027	0%	6%	32%	26%	36%	na
2650_2653_DW	2653_2650	372915	407622	7431	A666	Bolton	PCM	44.6	26.5	18.4	55.0	26.2	65,659	0%	6%	9%	43%	42%	na
2649_2650_DW	2650_2649	372622	408297	7431	A666	Bolton	PCM	41.6	25.0	17.5	49.7	24.1	66,904	0%	6%	8%	43%	43%	na
1986_2053_DW	1986_2053	372038	408749	74518	A575	Bolton	PCM	42.9	25.0	17.5	60.6	25.4	21,588	40%	4%	12%	17%	27%	na
2053_12949_DW	2053_12949	371997	408820	74518	A575	Bolton	PCM	42.4	28.4	19.5	55.0	22.9	15,288	56%	3%	4%	14%	23%	na
3064_15148_DW	3064_15148	371642	408705	7921	A579	Bolton	PCM	43.2	28.4	19.5	56.4	23.7	26,085	37%	5%	11%	16%	32%	na
2648_6404_DW	2648_6404	372355	408934	47988	A579	Bolton	PCM	45.5	25.0	17.5	61.2	28.0	34,619	8%	6%	16%	32%	38%	na
2407_6761_DW	2407_6761	374740	405143	73087	A667	Bolton	PCM	42.2	18.9	13.7	64.7	28.5	38,122	13%	6%	24%	19%	38%	na
NonPCM_307	6404_2648	372340	408924	N/A	A579 BRADFORD STREET	Bolton	LA	45.2	25.0	17.5	60.3	27.7	34,619	8%	6%	16%	32%	38%	na
Jct490	2113_2119	371155	409546	N/A		Bolton	LA	49.1	28.2	19.5	70.8	29.6	9,756	32%	4%	7%	26%	31%	na
Jct491	2490_14486	371909	409019	N/A		Bolton	LA	40.9	28.2	19.5	51.4	21.5	15,267	57%	3%	4%	13%	23%	na
4912_2244	4912_2244	381959	410596	73198	A58	Bury	PCM	41.9	22.9	16.3	57.8	25.6	23,320	10%	4%	32%	28%	27%	na
2244_2756_DW	2244_2756	381848	410697	N/A	B6221 WASH LANE	Bury	LA	42.3	22.9	16.3	59.7	26.0	19,469	0%	5%	43%	21%	31%	na
2244_4913_DW	2244_4913	381968	410627	73198	A58	Bury	PCM	49.2	22.9	16.3	77.9	33.0	23,884	9%	6%	23%	23%	39%	na
2552_3975_DW	2552_3975	380966	411188	N/A	B6222 MOORGATE	Bury	LA	42.0	21.8	15.6	62.3	26.4	24,706	7%	5%	39%	17%	32%	na
2243_4639_DW	2243_4639	381310	410749	16556	A58	Bury	PCM	43.1	22.9	16.3	60.7	26.9	27,736	20%	4%	15%	30%	31%	na
3790_3652	3790_2237	379874	410937	38354	A58	Bury	PCM	51.3	23.0	16.3	85.3	35.1	78,578	14%	6%	19%	23%	38%	na
2237_3790_DW	3790_2237	379830	410975	38354	A58	Bury	PCM	53.6	23.0	16.3	90.6	37.3	78,578	14%	6%	19%	23%	38%	na
3652_6021	3790_2237	379755	410929	38354	A58	Bury	PCM	48.4	23.0	16.3	76.5	32.2	78,578	14%	6%	19%	23%	38%	na
3089_5572_DW	3089_5572	379629	411052	N/A	B6214 CROSTONS ROAD	Bury	LA	46.5	24.9	17.5	66.3	29.0	45,794	17%	6%	14%	23%	39%	na
3089_5572	3089_5572	379597	411059	N/A	B6214 CROSTONS ROAD	Bury	LA	41.8	24.9	17.5	54.0	24.3	45,794	17%	6%	14%	23%	39%	na
4939_3424	4939_3424	380899	404868	17924	A56	Bury	PCM	46.2	18.1	13.2	76.9	33.0	22,758	7%	5%	29%	24%	36%	na
3424_4940_DW	3424_4940	380920	404881	17924	A56	Bury	PCM	52.1	18.1	13.2	95.8	38.9	19,861	8%	5%	36%	18%	33%	na
1742_9011_DW	1742_9011	381149	404182	46572	A56	Bury	PCM	45.6	21.8	15.5	72.6	30.1	36,845	17%	5%	27%	19%	32%	na
2483_2951_DW	2483_2951	380856	405206	17924	A56	Bury	PCM	45.4	19.2	13.9	72.4	31.5	45,479	9%	6%	24%	22%	39%	na
NonPCM_69	3424_4939	380931	404841	N/A	A56 BURY NEW ROAD	Bury	LA	51.7	18.1	13.2	94.0	38.6	42,619	7%	5%	33%	21%	34%	na
Jct495	3424_7436	380909	404951	N/A		Bury	LA	46.2	18.1	13.2	77.7	33.0	40,719	5%	6%	22%	26%	40%	na
1268_1269	1268_1269	383558	398278	27974	A34	Manchester	PCM	57.3	38.5	25.0	125.0	32.3	9,641	78%	2%	3%	6%	11%	na
1356_4539_DW	1356_4539	383054	398617	99519	A6042	Manchester	PCM	42.6	38.5	25.0	42.2	17.6	26,229	0%	7%	22%	26%	45%	na
1269_3272	1269_3272	383423	398312	27974	A34	Manchester	PCM	43.8	38.5	25.0	57.8	18.8	5,908	84%	1%	3%	4%	8%	na
1322_3273	1322_3273	383249	398058	27975	A34	Manchester	PCM	49.0	38.5	25.0	56.7	24.0	15,564	0%	8%	11%	24%	56%	na
1324_3276_DW	1324_3276	383489	397693	N/A	GREAT BRIDGEWATER STREET	Manchester	LA	49.3	32.0	21.5	71.5	27.8	9,252	12%	6%	24%	25%	33%	na
3272_8542_DW	3272_8542	383361	398267	N/A	GARTSIDE STREET	Manchester	LA	42.2	38.5	25.0	39.7	17.2	5,171	0%	9%	11%	18%	62%	na
1324_8570	1324_8570	383385	397701	7922	A6143	Manchester	PCM	42.5	32.0	21.5	50.1	21.0	14,123	8%	6%	20%	29%	38%	na
1312_5801_DW	1312_5801	383778	399163	36577	A56	Manchester	PCM	43.8	27.4	18.9	59.1	24.9	22,924	18%	4%	25%	24%	28%	na
1309_2291	1309_2291	384105	399123	17935	A665	Manchester	PCM	43.6	28.6	19.6	59.6	24.0	30,987	14%	5%	19%	26%	36%	na
2353_45005_DW	2353_45005	384492	398898	75248	A664	Manchester	PCM	40.7	38.8	25.3	38.7	15.4	6,875	76%	1%	9%	5%	9%	na
2353_45005	2353_45005	384467	398922	75248	A664	Manchester	PCM	42.6	38.8	25.3	45.1	17.3	6,875	76%	1%	9%	5%	9%	na
1472_1511_DW	1472_1511	385939	397630	27403	A635	Manchester	PCM	41.7	32.5	21.7	45.4	20.0	26,863	6%	4%	32%	28%	30%	na
1341_2939_DW	1341_2939	385618	397656	75239	A635	Manchester	PCM	47.4	32.5	21.7	63.1	25.7	24,549	7%	4%	42%	20%	27%	na
1341_2939	1341_2939	385616	397633	75239	A635	Manchester	PCM	41.0	32.5	21.7	44.7	19.3	24,549	7%	4%	42%	20%	27%	na
2608_4852_DW	2608_4852	385272	397130	26157	A6	Manchester	PCM	45.2	32.5	21.7	52.4	23.5	35,979	17%	6%	6%	30%	40%	na
2607_2608_DW	2607_2608	385142	397223	26157	A6	Manchester	PCM	41.8	32.5	21.7	43.7	20.0	35,873	16%	6%	6%	31%	40%	na
2607_3056_DW	2607_3056	384957	397311	26157	A6	Manchester	PCM	48.9	34.9	23.1	59.7	25.8	35,873	21%	6%	7%	26%	39%	na

Point ID	Rd Link ID	x	y	Census ID	Road name	Local Authority	PCM / LA	Annual mean NO_2 conc ($\mu g/m^3$)	BG NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	AADT	NOx contribution by vehicle type (%)					Change NO_2 conc ($\mu g/m^3$)
														Bus	Taxi	HGV	LGV	Car	
2286_1286_DW	2286_1286	384598	398032	N/A	AUBURN STREET	Manchester	LA	42.6	38.8	25.3	44.2	17.3	6,752	12%	5%	29%	17%	37%	na
1242_1243	1242_1243	384483	398343	70154	A62	Manchester	PCM	52.0	38.8	25.3	114.3	26.7	1,446	100%	0%	0%	0%	0%	na
2293_6119_DW	2293_6119	384344	398215	N/A		Manchester	LA	43.3	38.8	25.3	59.3	18.1	2,354	100%	0%	0%	0%	0%	na
5429_8559_DW	5429_8559	384266	398150	N/A	NEW YORK STREET	Manchester	LA	41.3	38.8	25.3	40.9	16.1	6,180	38%	5%	4%	18%	35%	na
1338_2904_DW	1338_2904	384418	396982	N/A	B5117 OXFORD ROAD	Manchester	LA	40.6	33.1	22.1	52.1	18.5	2,562	100%	0%	0%	0%	0%	na
1338_4532_DW	1338_4532	384338	397135	75242	A34	Manchester	PCM	41.2	34.9	23.1	49.1	18.2	3,814	98%	0%	0%	0%	2%	na
2006_3292	2006_3292	384110	397858	56529	A5103	Manchester	PCM	44.0	34.9	23.1	66.6	20.9	5,699	88%	1%	1%	5%	4%	na
1336_16404	1336_16404	384137	397465	17929	A34	Manchester	PCM	44.9	34.9	23.1	72.7	21.8	4,671	94%	1%	1%	1%	4%	na
1336_16404_DW	1336_16404	384153	397473	17929	A34	Manchester	PCM	44.4	34.9	23.1	70.4	21.3	4,671	94%	1%	1%	1%	4%	na
1268_46301	1268_46301	383702	398229	7947	A34	Manchester	PCM	54.2	38.5	25.0	109.1	29.2	8,506	76%	1%	8%	7%	8%	na
8547_47130_DW	8547_47130	383976	398274	N/A	KING STREET	Manchester	LA	45.6	38.5	25.0	51.6	20.6	20,385	22%	6%	8%	20%	43%	na
8547_47130	8547_47130	383973	398256	N/A	KING STREET	Manchester	LA	49.5	38.5	25.0	62.9	24.4	20,385	22%	6%	8%	20%	43%	na
1259_1243	1259_1243	384409	398297	N/A	PICCADILLY	Manchester	LA	40.8	38.8	25.3	48.3	15.6	1,308	100%	0%	0%	0%	0%	na
2289_12835	2289_12835	384282	398507	70153	A6	Manchester	PCM	47.0	38.8	25.3	69.8	21.7	9,252	81%	2%	1%	4%	12%	na
3261_1302	3261_1302	384528	398779	75246	A665	Manchester	PCM	43.1	38.8	25.3	43.6	17.8	14,154	0%	6%	29%	25%	40%	na
8546_14050	8546_14050	384384	398801	57427	A664	Manchester	PCM	49.5	38.8	25.3	79.9	24.2	7,924	76%	2%	4%	4%	15%	na
5806_1304	5806_1304	384250	398668	57427	A664	Manchester	PCM	41.9	38.8	25.3	51.0	16.6	2,702	85%	1%	6%	4%	5%	na
2290_3027	2290_3027	384038	398775	48035	A6042	Manchester	PCM	43.6	38.8	25.3	58.6	18.4	2,923	93%	1%	2%	2%	2%	na
2290_3027_DW	2290_3027	384055	398767	48035	A6042	Manchester	PCM	45.7	38.8	25.3	68.4	20.5	2,923	93%	1%	2%	2%	2%	na
1305_2290_DW	1305_2290	384091	398691	N/A	WITHY GROVE	Manchester	LA	48.1	38.8	25.3	80.9	22.8	2,923	94%	0%	1%	2%	2%	na
1307_1317	1307_1317	383757	398717	36551	A6	Manchester	PCM	48.2	38.5	25.0	78.4	23.2	4,347	88%	1%	2%	5%	4%	na
1307_1317_DW	1307_1317	383771	398733	36551	A6	Manchester	PCM	44.7	38.5	25.0	62.0	19.6	4,347	88%	1%	2%	5%	4%	na
3056_3842	3056_3842	384855	397401	26157	A6	Manchester	PCM	40.0	34.9	23.1	36.8	16.9	37,568	19%	6%	8%	26%	41%	na
3056_3842_DW	3056_3842	384880	397418	26157	A6	Manchester	PCM	48.1	34.9	23.1	57.5	25.1	37,568	19%	6%	8%	26%	41%	na
3033_2293	3033_2293	384317	398195	N/A	PARKER STREET	Manchester	LA	48.6	38.8	25.3	87.8	23.3	2,494	100%	0%	0%	0%	0%	na
1261_6042_DW	1261_6042	384451	398215	77003	A6	Manchester	PCM	41.5	38.8	25.3	52.1	16.2	1,257	100%	0%	0%	0%	0%	na
1261_6042	1261_6042	384466	398201	77003	A6	Manchester	PCM	41.6	38.8	25.3	52.5	16.3	1,257	100%	0%	0%	0%	0%	na
3016_6022_DW	3016_6022	384639	397855	46165	A6	Manchester	PCM	43.8	34.9	23.1	59.8	20.7	7,263	63%	3%	5%	8%	20%	na
1302_8546	1302_8546	384428	398838	75248	A664	Manchester	PCM	44.6	38.8	25.3	59.3	19.3	7,819	68%	1%	15%	6%	9%	na
1302_8546_DW	1302_8546	384414	398854	75248	A664	Manchester	PCM	41.4	38.8	25.3	46.6	16.1	7,819	68%	1%	15%	6%	9%	na
2893_5074	2892_2890	384158	397155	75243	A57M	Manchester	PCM	41.6	34.9	23.1	42.6	18.5	59,118	0%	6%	12%	38%	44%	na
5409_5430_DW	5409_5430	384209	398072	N/A	CHARLOTTE STREET	Manchester	LA	42.2	38.8	25.3	40.0	17.0	12,697	1%	8%	6%	25%	59%	na
1263_5429	1263_5429	384207	398182	N/A	BACK GEORGE STREET	Manchester	LA	47.0	38.8	25.3	58.2	21.7	6,180	41%	5%	4%	17%	34%	na
2283_8544_DW	2283_8544	383791	398603	27992	A56	Manchester	PCM	50.6	38.5	25.0	88.4	25.6	4,347	82%	1%	4%	7%	5%	na
1267_1985	1267_1985	383672	398364	16536	A56	Manchester	PCM	49.4	38.5	25.0	69.3	24.4	8,498	49%	4%	8%	15%	25%	na
1267_1985_DW	1267_1985	383687	398358	16536	A56	Manchester	PCM	48.3	38.5	25.0	65.4	23.3	8,498	49%	4%	8%	15%	25%	na
1985_2283	1985_2283	383717	398477	16536	A56	Manchester	PCM	40.9	38.5	25.0	42.2	15.9	7,768	58%	3%	5%	14%	20%	na
1985_2283_DW	1985_2283	383734	398471	16536	A56	Manchester	PCM	42.2	38.5	25.0	46.4	17.2	7,768	58%	3%	5%	14%	20%	na
1685_1686_DW	1685_1686	387382	394221	73778	A6	Manchester	PCM	41.8	25.5	17.8	57.2	24.0	27,693	36%	5%	13%	17%	29%	na
1469_3669_DW	1469_3669	386578	395884	28695	A6	Manchester	PCM	42.5	26.4	18.3	56.2	24.2	27,642	35%	5%	7%	16%	36%	na
1684_4312_DW	1684_4312	387763	393475	73778	A6	Manchester	PCM	41.6	27.3	18.8	50.8	22.8	34,028	22%	6%	9%	20%	43%	na
4373_5121_DW	4373_5121	382333	389181	48339	A560	Manchester	PCM	42.1	19.9	14.3	60.9	27.8	33,775	3%	6%	28%	24%	39%	na
1846_2423	1846_2423	381858	388161	26047	M56	Manchester	PCM	43.1	20.5	14.8	59.9	28.4	13,734	16%	7%	6%	26%	45%	na
1846_2423_DW	1846_2423	381865	388177	26047	M56	Manchester	PCM	46.3	20.5	14.8	68.0	31.6	13,734	16%	7%	6%	26%	45%	na
2855_2218_DW	2856_2855	382356	390128	7701	A5103	Manchester	PCM	45.5	19.5	14.1	69.3	31.4	104,159	0%	7%	14%	29%	50%	na
2844_2848	2855_2847	382344	390388	7701	A5103	Manchester	PCM	46.2	19.5	14.1	70.5	32.1	126,947	2%	7%	15%	27%	49%	na
2847_2855_DW	2855_2847	382389	390376	7701	A5103	Manchester	PCM	46.8	19.5	14.1	71.6	32.7	126,947	2%	7%	15%	27%	49%	na
14951_17000_DW	14951_17000	381833	385986	N/A	THORLEY LANE	Manchester	LA	40.3	34.2	22.4	40.4	17.9	17,158	12%	6%	25%	22%	36%	na
7634_8756_DW	7634_8756	382361	385549	N/A	RINGWAY ROAD WEST	Manchester	LA	44.7	39.0	24.9	44.7	19.8	32,606	0%	5%	30%	22%	44%	na

Point ID	Rd Link ID	x	y	Census ID	Road name	Local Authority	PCM / LA	Annual mean NO_2 conc ($\mu g/m^3$)	BG NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	AADT	NOx contribution by vehicle type (%)					Change NO_2 conc ($\mu g/m^3$)
														Bus	Taxi	HGV	LGV	Car	
12800_14480_DW	12800_14480	382038	385547	N/A	OUTWOOD LANE	Manchester	LA	46.3	39.0	24.9	48.5	21.4	33,596	0%	7%	26%	17%	50%	na
NonPCM_184	1336_16404	384110	397517	N/A	A34 OXFORD STREET	Manchester	LA	46.1	34.9	23.1	79.6	23.0	4,671	94%	1%	1%	1%	4%	na
NonPCM_207	4530_1268	383624	398258	N/A	A34 BRIDGE STREET	Manchester	LA	55.6	38.5	25.0	114.9	30.6	13,962	22%	6%	10%	24%	39%	na
NonPCM_216	5408_5432	384079	397954	N/A	GEORGE STREET	Manchester	LA	41.1	34.9	23.1	47.9	18.0	10,114	57%	4%	2%	11%	26%	na
Jct254	14490_5406	384292	398620	N/A		Manchester	LA	43.6	38.8	25.3	53.4	18.4	5,751	65%	3%	7%	7%	18%	na
Jct262	2006_3292	384156	397878	N/A		Manchester	LA	46.9	34.9	23.1	80.7	23.8	5,699	88%	1%	1%	5%	4%	na
Jct280	1402_5407	383617	397503	N/A		Manchester	LA	41.0	32.0	21.5	45.2	19.5	26,502	13%	8%	8%	24%	48%	na
Jct282	1275_1279	384116	398263	N/A		Manchester	LA	47.5	38.8	25.3	58.5	22.3	8,090	33%	5%	7%	18%	36%	na
Jct285	8546_14050	384363	398784	N/A		Manchester	LA	48.2	38.8	25.3	74.5	23.0	7,924	76%	2%	4%	4%	15%	na
Jct526	1275_1279	384116	398262	N/A		Manchester	LA	47.5	38.8	25.3	58.5	22.3	8,090	33%	5%	7%	18%	36%	na
3911_4112	3911_4112	389383	403282	99617	A663	Oldham	PCM	42.5	22.8	16.1	57.3	26.4	40,957	6%	6%	15%	25%	47%	na
1996_14524_DW	1996_14524	393502	405226	36632	A62	Oldham	PCM	45.6	27.4	18.9	60.9	26.7	32,550	18%	6%	14%	25%	37%	na
N14523_14524	14523_14524	393312	405043	36632	A62	Oldham	PCM	43.6	27.4	18.9	53.1	24.7	52,001	0%	7%	15%	31%	47%	na
1975_2466_DW	14523_7556	392991	404790	N/A	WATERLOO STREET	Oldham	LA	41.4	23.7	16.7	52.4	24.8	51,650	0%	7%	13%	32%	48%	na
7556_14523_DW	7556_14523	393092	404851	36632	A62	Oldham	PCM	44.3	26.1	18.2	56.3	26.2	24,557	0%	7%	18%	26%	48%	na
1295_1703	1295_1703	390482	402513	77008	A62	Oldham	PCM	43.8	23.7	16.6	60.7	27.2	36,602	8%	6%	21%	27%	37%	na
3914_5661_DW	3914_5661	390653	402743	6606	A62	Oldham	PCM	41.4	23.7	16.6	54.6	24.8	36,982	6%	5%	28%	29%	32%	na
3914_5661	3914_5661	390627	402753	6606	A62	Oldham	PCM	42.8	23.7	16.6	58.0	26.1	36,982	6%	5%	28%	29%	32%	na
1433_1615_DW	1433_1615	389260	401329	73781	A62	Oldham	PCM	41.1	21.6	15.4	62.8	25.7	17,341	29%	3%	30%	23%	15%	na
2202_2205_DW	2202_2205	389446	413627	27469	A680	Rochdale	PCM	41.9	28.9	19.8	48.0	22.2	23,648	7%	6%	20%	29%	38%	na
2210_14216_DW	2210_14216	388664	411856	17322	A664	Rochdale	PCM	49.9	19.0	13.8	90.6	36.1	34,283	0%	4%	43%	25%	28%	na
14220_14221	14220_14221	389004	412157	26586	A58	Rochdale	PCM	42.2	21.0	15.0	61.1	27.1	45,240	10%	6%	25%	23%	37%	na
2210_4463_DW	2210_4463	388729	411971	26586	A58	Rochdale	PCM	49.1	19.0	13.8	90.8	35.3	45,241	9%	4%	40%	20%	27%	na
2210_4463	2210_4463	388741	411950	26586	A58	Rochdale	PCM	42.2	19.0	13.8	68.5	28.4	45,241	9%	4%	40%	20%	27%	na
1345_1346_DW	1345_1346	380555	398426	56535	A5186	Salford	PCM	42.1	27.6	18.9	51.7	23.2	13,688	18%	5%	27%	19%	31%	na
1345_1346	1345_1346	380537	398426	56535	A5186	Salford	PCM	41.0	27.6	18.9	48.5	22.1	13,688	18%	5%	27%	19%	31%	na
1364_1366	1364_1366	381428	399804	17245	A576	Salford	PCM	42.7	26.2	18.1	56.7	24.6	30,838	24%	6%	15%	16%	39%	na
5249_7952	5249_7952	381205	399532	58028	A576	Salford	PCM	42.2	26.2	18.1	54.2	24.0	34,184	17%	7%	13%	19%	44%	na
5249_7952_DW	5249_7952	381224	399526	58028	A576	Salford	PCM	41.3	26.2	18.1	52.0	23.2	34,184	17%	7%	13%	19%	44%	na
2672_14311_DW	2299_14311	381434	399244	6161	A6	Salford	PCM	42.0	26.2	18.1	53.7	23.9	51,091	28%	6%	12%	16%	38%	na
14311_2299_DW	2299_14311	381488	399165	6161	A6	Salford	PCM	50.5	26.2	18.1	80.1	32.3	51,091	28%	6%	12%	16%	38%	na
3964_4732	3964_4732	382882	397222	99516	A56	Salford	PCM	41.0	26.5	18.4	50.0	22.6	35,268	5%	5%	27%	27%	35%	na
3964_4732_DW	3964_4732	382871	397244	99516	A56	Salford	PCM	46.8	26.5	18.4	65.5	28.4	35,268	5%	5%	27%	27%	35%	na
1867_4574_DW	1867_4574	382129	397840	36585	A57	Salford	PCM	49.1	26.5	18.4	71.3	30.7	48,955	2%	5%	27%	26%	39%	na
1232_1257	1232_1257	381738	398808	6161	A6	Salford	PCM	42.6	25.0	17.4	60.6	25.2	40,461	40%	4%	13%	14%	28%	na
1349_1867_DW	1349_1867	382371	397772	48023	A57	Salford	PCM	47.2	26.5	18.4	65.4	28.8	46,152	2%	6%	25%	27%	40%	na
3786_1233_DW	3968_1233	381517	398259	27751	A5063	Salford	PCM	41.4	25.0	17.4	52.5	24.0	33,582	4%	7%	21%	22%	46%	na
1349_2993_DW	1349_2993	382580	397716	73792	A57	Salford	PCM	50.9	26.5	18.4	75.3	32.6	52,832	2%	6%	24%	29%	40%	na
1349_2993	1349_2993	382574	397693	73792	A57	Salford	PCM	41.8	26.5	18.4	51.3	23.4	52,832	2%	6%	24%	29%	40%	na
5505_5507_DW	5505_5507	382099	398640	56160	A6	Salford	PCM	45.6	27.1	18.7	68.6	26.9	29,051	48%	4%	9%	13%	26%	na
3969_6612_DW	3969_6612	381512	398031	6562	A57	Salford	PCM	46.8	25.0	17.4	66.3	29.4	50,879	2%	6%	23%	29%	40%	na
4575_6612_DW	4575_6612	381692	397971	36585	A57	Salford	PCM	41.5	24.1	16.9	52.4	24.6	49,528	2%	6%	15%	35%	43%	na
3850_7895_DW	3850_7895	382754	398553	17926	A6	Salford	PCM	43.6	27.1	18.7	60.6	24.9	31,999	39%	5%	10%	17%	30%	na
4575_7897_DW	4575_7897	381821	397932	36585	A57	Salford	PCM	41.6	24.1	16.9	52.7	24.7	49,529	2%	6%	16%	33%	43%	na
3752_4897_DW	3752_4897	382876	398556	70151	A6	Salford	PCM	42.1	27.1	18.7	57.4	23.4	23,952	48%	4%	10%	14%	24%	na
3752_7895_DW	3752_7895	382815	398555	17926	A6	Salford	PCM	41.3	27.1	18.7	54.6	22.6	23,952	46%	4%	10%	15%	25%	na
12947_1223_DW	12947_1223	381649	398952	6161	A6	Salford	PCM	41.3	25.0	17.4	54.2	23.9	24,276	23%	7%	5%	20%	45%	na
12945_14431_DW	12945_14431	381917	398711	56160	A6	Salford	PCM	49.7	25.0	17.4	82.6	32.3	35,687	40%	5%	8%	15%	31%	na
1232_12945_DW	1232_12945	381825	398784	56160	A6	Salford	PCM	50.6	25.0	17.4	89.9	33.2	35,696	45%	3%	16%	13%	22%	na

Point ID	Rd Link ID	x	y	Census ID	Road name	Local Authority	PCM / LA	Annual mean NO_2 conc ($\mu g/m^3$)	BG NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	AADT	NOx contribution by vehicle type (%)					Change NO_2 conc ($\mu g/m^3$)
														Bus	Taxi	HGV	LGV	Car	
3850_14502_DW	3850_14502	382685	398551	17926	A6	Salford	PCM	47.5	27.1	18.7	74.7	28.8	31,990	45%	4%	11%	14%	25%	na
5505_14310_DW	5505_14310	382293	398539	56160	A6	Salford	PCM	43.6	27.1	18.7	61.8	24.9	29,051	48%	4%	8%	13%	27%	na
1216_14503_DW	1216_14503	382565	398546	17926	A6	Salford	PCM	52.6	27.1	18.7	96.1	33.9	31,995	48%	3%	15%	13%	20%	na
1216_14503	1216_14503	382567	398523	17926	A6	Salford	PCM	46.0	27.1	18.7	70.8	27.3	31,995	48%	3%	15%	13%	20%	na
5179_5182_DW	5179_5182	374598	400597	74618	A572	Salford	PCM	45.2	15.8	11.6	73.2	33.6	33,321	3%	7%	15%	29%	47%	na
1579_17017_DW	1579_17017	377344	400951	37363	A580	Salford	PCM	43.4	19.2	13.9	67.3	29.5	37,828	9%	5%	26%	23%	37%	na
1589_14316_DW	1589_14316	378317	399184	7292	A576	Salford	PCM	40.9	24.8	17.3	59.8	23.6	18,424	40%	3%	29%	11%	18%	na
NonPCM_147	4951_4554	375357	397837	N/A	A57 LIVERPOOL ROAD	Salford	LA	43.9	16.7	12.3	70.9	31.7	17,481	20%	6%	7%	28%	39%	na
NonPCM_219	2993_1202	382678	397661	N/A	A57 REGENT ROAD	Salford	LA	46.7	26.5	18.4	66.3	28.4	52,831	2%	5%	38%	25%	31%	na
Jct205	4554_4951	375367	397806	N/A		Salford	LA	42.0	16.7	12.3	65.0	29.7	17,481	20%	6%	7%	28%	39%	na
Jct290	1216_7959	382540	398554	N/A		Salford	LA	45.5	27.1	18.7	68.9	26.8	5,098	0%	6%	24%	31%	39%	na
1859_14054_DW	1859_14054	389505	390884	N/A	B6167 LANCASHIRE HILL	Stockport	LA	41.5	25.8	18.0	50.1	23.5	17,636	13%	7%	8%	25%	47%	na
3620_5931_DW	3620_5931	390351	390720	37920	A626	Stockport	PCM	47.9	25.9	18.0	71.3	29.9	32,241	0%	4%	39%	26%	30%	na
2663_5015	2663_5015	390347	391028	N/A	B6104 CARRINGTON ROAD	Stockport	LA	41.5	20.5	14.7	63.4	26.8	16,715	19%	3%	41%	20%	18%	na
2663_5015_DW	2663_5015	390344	391047	N/A	B6104 CARRINGTON ROAD	Stockport	LA	48.1	20.5	14.7	84.6	33.4	16,715	19%	3%	41%	20%	18%	na
5021_6254_DW	5021_6254	390116	391212	37920	A626	Stockport	PCM	44.1	20.5	14.7	65.7	29.4	28,950	0%	4%	31%	36%	29%	na
1860_4172	1860_4172	389421	390671	58254	A560	Stockport	PCM	41.7	25.8	18.0	51.3	23.7	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	na
1859_1860	1859_1860	389494	390731	58254	A560	Stockport	PCM	42.4	25.8	18.0	52.8	24.4	9,646	30%	5%	6%	23%	36%	na
1678_2967	1678_2967	388831	390418	27983	A5145	Stockport	PCM	41.9	22.3	15.8	56.2	26.1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	na
2669_14483_DW	2669_14483	389208	390259	N/A	CHESTERGATE	Stockport	LA	40.7	25.8	18.0	65.2	22.7	1,283	100%	0%	0%	0%	0%	na
3426_4162_DW	3426_4162	390357	390129	27384	A626	Stockport	PCM	41.3	25.9	18.0	50.7	23.3	31,187	8%	6%	17%	23%	45%	na
5160_6071_DW	5160_6071	392018	392010	27296	A560	Stockport	PCM	41.1	26.0	18.0	49.8	23.2	32,471	0%	7%	23%	24%	47%	na
1924_8878_DW	1924_8878	392443	391754	27296	A560	Stockport	PCM	42.7	21.6	15.4	66.0	27.4	33,237	10%	5%	36%	14%	35%	na
3973_14181_DW	3973_14181	388375	390354	58034	A5145	Stockport	PCM	46.7	22.3	15.8	70.6	30.9	25,738	12%	5%	22%	25%	36%	na
3973_14181	3973_14181	388376	390333	58034	A5145	Stockport	PCM	43.7	22.3	15.8	61.8	27.9	25,738	12%	5%	22%	25%	36%	na
2430_3710_DW	2430_3710	385097	388122	38735	A34	Stockport	PCM	42.4	20.5	14.7	58.7	27.7	64,596	0%	7%	15%	27%	51%	na
2887_2430_DW	2887_2430	385044	388518	26352	A34	Stockport	PCM	45.5	20.5	14.7	66.1	30.8	37,814	1%	7%	16%	26%	51%	na
2184_14428_DW	2184_14428	391822	387266	99018	A6	Stockport	PCM	44.1	20.9	15.0	68.7	29.1	33,913	13%	6%	28%	17%	36%	na
6055_14428_DW	6055_14428	391767	387344	99018	A6	Stockport	PCM	42.1	20.9	15.0	62.8	27.1	33,913	12%	6%	27%	18%	37%	na
NonPCM_273	6205_6055	391720	387414	N/A	A6 LONDON ROAD	Stockport	LA	42.6	20.9	15.0	66.0	27.6	33,913	15%	5%	31%	17%	32%	na
Jct355	1850_1864	389388	390175	N/A		Stockport	LA	43.0	25.8	18.0	62.9	25.0	20,841	22%	5%	15%	23%	35%	na
Jct539	3426_4162	390301	390159	N/A		Stockport	LA	41.9	25.9	18.0	52.5	24.0	31,187	8%	6%	17%	23%	45%	na
7637_2941_DW	7637_2941	393180	398661	99618	A635	Tameside	PCM	46.8	27.3	18.8	66.1	28.1	27,940	17%	5%	25%	23%	30%	na
2941_5978_DW	7638_5978	393398	398690	37451	A635	Tameside	PCM	43.1	27.3	18.8	51.9	24.3	52,654	0%	7%	16%	31%	46%	na
1695_14478_DW	1695_14478	392753	398494	99618	A635	Tameside	PCM	48.0	26.9	18.5	66.8	29.5	45,767	3%	6%	24%	30%	37%	na
1695_14478	1695_14478	392761	398476	99618	A635	Tameside	PCM	41.7	26.9	18.5	50.5	23.2	45,767	3%	6%	24%	30%	37%	na
3813_3812_DW	3813_3812	392978	398478	74561	A6017	Tameside	PCM	43.4	26.9	18.5	54.4	24.9	32,809	8%	6%	16%	29%	41%	na
7638_3813	7638_3813	393112	398511	74561	A6017	Tameside	PCM	42.8	27.3	18.8	53.6	24.0	30,503	10%	6%	22%	23%	40%	na
1695_5659	1695_5659	392588	398416	99618	A635	Tameside	PCM	41.2	26.9	18.5	48.6	22.7	47,136	3%	6%	20%	32%	39%	na
1695_5659_DW	1695_5659	392582	398435	99618	A635	Tameside	PCM	47.6	26.9	18.5	64.5	29.1	47,136	3%	6%	20%	32%	39%	na
5655_5656_DW	5655_5656	392042	398069	76074	A6140	Tameside	PCM	42.9	26.9	18.5	55.7	24.4	20,732	0%	4%	43%	25%	28%	na
3812_14478	3812_14478	392855	398516	74561	A6017	Tameside	PCM	42.0	26.9	18.5	51.8	23.5	40,853	5%	5%	26%	29%	34%	na
3812_14478_DW	3812_14478	392847	398534	99618	A635	Tameside	PCM	48.0	26.9	18.5	67.9	29.5	40,853	5%	5%	26%	29%	34%	na
3761_5653_DW	3761_5653	390802	395630	99512	A57	Tameside	PCM	41.3	20.0	14.4	59.8	26.9	19,651	7%	5%	28%	27%	33%	na
Jct449	3227_8517	391912	395574	N/A		Tameside	LA	41.7	21.7	15.4	56.2	26.2	18,573	2%	7%	9%	34%	48%	na
2305_5949_DW	2305_5949	380182	395145	36578	A56	Trafford	PCM	41.1	31.1	20.9	43.3	20.2	30,480	17%	7%	11%	20%	44%	na
1382_3622_DW	1382_3622	380628	395827	56499	A56	Trafford	PCM	41.1	31.1	20.9	43.6	20.3	34,757	15%	7%	9%	24%	45%	na
7603_7606_DW	7603_7606	376675	396960	N/A	B5214 TRAFFORD BOULEVARD	Trafford	LA	45.0	21.2	15.2	75.2	29.8	21,453	20%	5%	29%	14%	32%	na
7606_17100_DW	7606_17100	376759	397007	N/A	B5214 TRAFFORD BOULEVARD	Trafford	LA	45.5	21.2	15.2	78.2	30.4	28,938	30%	4%	27%	12%	27%	na

Point ID	Rd Link ID	x	y	Census ID	Road name	Local Authority	PCM / LA	Annual mean NO_2 conc ($\mu g/m^3$)	BG NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	AADT	NOx contribution by vehicle type (%)					Change NO_2 conc ($\mu g/m^3$)
														Bus	Taxi	HGV	LGV	Car	
NonPCM_324	2833_2349	378901	392774	N/A	A56 CROSS STREET	Trafford	LA	44.1	20.6	14.8	64.4	29.2	45,576	7%	7%	15%	25%	46%	na
Jct225	3529_8101	377585	395102	N/A		Trafford	LA	41.5	20.7	14.8	55.9	26.7	8,213	0%	9%	7%	22%	62%	na
Jct231	3304_3529	377588	395133	N/A		Trafford	LA	42.3	20.7	14.8	58.0	27.4	6,246	0%	6%	37%	20%	38%	na
3492_3511_DW	3492_3511	358611	405310	8566	A577	Wigan	PCM	41.0	31.0	20.8	44.8	20.3	23,477	8%	6%	23%	25%	39%	na
3431_7687_DW	3431_7687	358110	405811	N/A	MARKET STREET	Wigan	LA	40.6	31.0	20.8	57.8	19.9	2,098	100%	0%	0%	0%	0%	na
3103_3435_DW	3103_3435	358085	405595	N/A	KING STREET WEST	Wigan	LA	47.0	31.0	20.8	82.6	26.3	7,508	81%	1%	8%	4%	7%	na
3396_3466_DW	3396_3466	358002	405379	8568	A49	Wigan	PCM	41.3	31.0	20.8	50.1	20.5	18,110	51%	4%	10%	11%	25%	na
3103_8156	3103_8156	358146	405514	N/A		Wigan	LA	42.7	31.0	20.8	59.6	21.9	8,260	56%	2%	21%	11%	10%	na
3431_3463	3431_3463	358038	405924	N/A	NEW MARKET STREET	Wigan	LA	40.8	31.0	20.8	51.7	20.0	12,133	61%	3%	8%	10%	19%	na
Jct485	3103_3435	358163	405546	N/A	KING STREET WEST	Wigan	LA	41.3	31.0	20.8	56.1	20.5	7,508	81%	1%	8%	4%	7%	na

Table B-2: Predicted annual mean NO_2 concentrations and source apportionment at exceedance links on the Greater Manchester road network – Approved GM CAP – 2021

Point ID	Rd Link ID	x	y	Census ID	Road name	Local Authority	PCM / LA	Annual mean NO_2 conc ($\mu g/m^3$)	BG NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	AADT	NOx contribution by vehicle type (%)					Change NO_2 conc ($\mu g/m^3$)
														Bus	Taxi	HGV	LGV	Car	
2119_2564_DW	2119_2564	371207	409524	17905	A673	Bolton	PCM	38.9	28.2	19.5	40.2	19.4	26,966	10%	8%	3%	27%	51%	-4.1
2799_3775_DW	2799_3775	371869	409735	8030	A666	Bolton	PCM	41.6	28.2	19.5	45.4	22.1	20,910	0%	7%	4%	36%	53%	-2.3
2799_3118_DW	2799_3118	371751	409800	58048	A673	Bolton	PCM	42.5	28.2	19.5	49.3	23.0	27,044	0%	6%	20%	31%	43%	-3.1
2650_2653_DW	2653_2650	372915	407622	7431	A666	Bolton	PCM	43.1	26.5	18.4	50.2	24.7	65,623	0%	6%	2%	47%	45%	-1.5
2649_2650_DW	2650_2649	372622	408297	7431	A666	Bolton	PCM	40.4	25.0	17.5	45.9	22.9	66,859	0%	6%	2%	46%	46%	-1.2
1986_2053_DW	1986_2053	372038	408749	74518	A575	Bolton	PCM	37.3	25.0	17.5	41.7	19.8	21,577	21%	6%	6%	26%	42%	-5.6
2053_12949_DW	2053_12949	371997	408820	74518	A575	Bolton	PCM	37.0	28.4	19.5	37.2	17.5	15,349	33%	5%	2%	23%	37%	-5.4
3064_15148_DW	3064_15148	371642	408705	7921	A579	Bolton	PCM	38.6	28.4	19.5	41.3	19.1	26,089	24%	6%	5%	22%	43%	-4.6
2648_6404_DW	2648_6404	372355	408934	47988	A579	Bolton	PCM	42.6	25.0	17.5	51.2	25.0	34,580	1%	7%	5%	40%	47%	-2.9
2407_6761_DW	2407_6761	374740	405143	73087	A667	Bolton	PCM	37.9	18.9	13.7	50.0	24.2	38,122	7%	7%	10%	26%	50%	-4.3
NonPCM_307	6404_2648	372340	408924	N/A	A579 BRADFORD STREET	Bolton	LA	42.4	25.0	17.5	50.9	24.9	34,580	1%	7%	5%	40%	47%	-2.8
Jct490	2113_2119	371155	409546	N/A		Bolton	LA	44.2	28.2	19.5	52.7	24.7	9,757	6%	6%	3%	38%	46%	-4.9
Jct491	2490_14486	371909	409019	N/A		Bolton	LA	35.1	28.2	19.5	32.8	15.6	15,329	32%	6%	2%	22%	39%	-5.8
4912_2244	4912_2244	381959	410596	73198	A58	Bury	PCM	37.3	22.9	16.3	42.8	21.0	23,313	2%	6%	13%	40%	39%	-4.6
2244_2756_DW	2244_2756	381848	410697	N/A	B6221 WASH LANE	Bury	LA	37.7	22.9	16.3	44.2	21.4	19,436	0%	7%	19%	30%	44%	-4.6
2244_4913_DW	2244_4913	381968	410627	73198	A58	Bury	PCM	44.1	22.9	16.3	58.4	27.8	23,897	1%	8%	8%	31%	52%	-5.1
2552_3975_DW	2552_3975	380966	411188	N/A	B6222 MOORGATE	Bury	LA	38.4	21.8	15.6	49.7	22.8	24,718	5%	6%	27%	22%	40%	-3.6
2243_4639_DW	2243_4639	381310	410749	16556	A58	Bury	PCM	39.4	22.9	16.3	48.2	23.1	27,772	10%	5%	7%	38%	39%	-3.7
3790_3652	3790_2237	379874	410937	38354	A58	Bury	PCM	47.6	23.0	16.3	70.6	31.3	78,590	6%	7%	12%	29%	46%	-3.7
2237_3790_DW	3790_2237	379830	410975	38354	A58	Bury	PCM	49.6	23.0	16.3	74.5	33.4	78,590	6%	7%	12%	29%	46%	-4.0
3652_6021	3790_2237	379755	410929	38354	A58	Bury	PCM	44.9	23.0	16.3	63.3	28.7	78,590	6%	7%	12%	29%	46%	-3.5
3089_5572_DW	3089_5572	379629	411052	N/A	B6214 CROSTONS ROAD	Bury	LA	42.7	24.9	17.5	53.1	25.2	45,804	9%	8%	6%	29%	49%	-3.8
3089_5572	3089_5572	379597	411059	N/A	B6214 CROSTONS ROAD	Bury	LA	38.5	24.9	17.5	43.3	21.0	45,804	9%	8%	6%	29%	49%	-3.3
4939_3424	4939_3424	380899	404868	17924	A56	Bury	PCM	41.2	18.1	13.2	58.7	28.0	22,763	1%	7%	10%	33%	49%	-5.0
3424_4940_DW	3424_4940	380920	404881	17924	A56	Bury	PCM	46.4	18.1	13.2	72.1	33.2	19,858	2%	7%	18%	26%	47%	-5.7
1742_9011_DW	1742_9011	381149	404182	46572	A56	Bury	PCM	40.9	21.8	15.5	55.8	25.4	36,845	9%	6%	18%	25%	42%	-4.7
2483_2951_DW	2483_2951	380856	405206	17924	A56	Bury	PCM	40.4	19.2	13.9	54.7	26.5	45,477	1%	8%	8%	30%	53%	-5.0
NonPCM_69	3424_4939	380931	404841	N/A	A56 BURY NEW ROAD	Bury	LA	46.4	18.1	13.2	72.0	33.2	42,621	2%	7%	14%	29%	48%	-5.3
Jct495	3424_7436	380909	404951	N/A		Bury	LA	40.8	18.1	13.2	58.1	27.7	40,717	1%	7%	6%	34%	52%	-5.4
1268_1269	1268_1269	383558	398278	27974	A34	Manchester	PCM	46.2	38.5	25.0	61.6	21.2	9,631	59%	3%	2%	12%	23%	-11.1
1356_4539_DW	1356_4539	383054	398617	99519	A6042	Manchester	PCM	40.1	38.5	25.0	33.9	15.1	26,178	0%	8%	9%	31%	53%	-2.5
1269_3272	1269_3272	383423	398312	27974	A34	Manchester	PCM	35.3	38.5	25.0	26.1	10.3	5,888	66%	3%	2%	10%	19%	-8.5
1322_3273	1322_3273	383249	398058	27975	A34	Manchester	PCM	47.3	38.5	25.0	50.5	22.3	15,555	0%	9%	3%	27%	61%	-1.7
1324_3276_DW	1324_3276	383489	397693	N/A	GREAT BRIDGEWATER STREET	Manchester	LA	44.9	32.0	21.5	54.3	23.4	9,276	5%	7%	10%	34%	44%	-4.4
3272_8542_DW	3272_8542	383361	398267	N/A	GARTSIDE STREET	Manchester	LA	40.8	38.5	25.0	35.1	15.8	5,190	0%	10%	4%	20%	67%	-1.4
1324_8570	1324_8570	383385	397701	7922	A6143	Manchester	PCM	40.3	32.0	21.5	42.7	18.8	14,114	3%	6%	13%	34%	44%	-2.2
1312_5801_DW	1312_5801	383778	399163	36577	A56	Manchester	PCM	40.0	27.4	18.9	46.1	21.0	22,928	11%	5%	17%	31%	36%	-3.8
1309_2291	1309_2291	384105	399123	17935	A665	Manchester	PCM	38.9	28.6	19.6	42.9	19.3	31,019	2%	7%	7%	35%	49%	-4.7
2353_45005_DW	2353_45005	384492	398898	75248	A664	Manchester	PCM	35.7	38.8	25.3	23.4	10.4	6,876	65%	2%	6%	9%	16%	-5.0
2353_45005	2353_45005	384467	398922	75248	A664	Manchester	PCM	36.9	38.8	25.3	26.9	11.6	6,876	65%	2%	6%	9%	16%	-5.7
1472_1511_DW	1472_1511	385939	397630	27403	A635	Manchester	PCM	37.6	32.5	21.7	32.6	15.9	26,861	1%	6%	11%	40%	42%	-4.1
1341_2939_DW	1341_2939	385618	397656	75239	A635	Manchester	PCM	42.1	32.5	21.7	44.2	20.4	24,557	2%	5%	21%	31%	41%	-5.3
1341_2939	1341_2939	385616	397633	75239	A635	Manchester	PCM	36.8	32.5	21.7	31.6	15.1	24,557	2%	5%	21%	31%	41%	-4.2
2608_4852_DW	2608_4852	385272	397130	26157	A6	Manchester	PCM	42.3	32.5	21.7	42.6	20.5	35,978	5%	7%	3%	37%	49%	-2.9
2607_2608_DW	2607_2608	385142	397223	26157	A6	Manchester	PCM	39.2	32.5	21.7	35.7	17.5	35,873	4%	7%	2%	38%	49%	-2.6
2607_3056_DW	2607_3056	384957	397311	26157	A6	Manchester	PCM	45.6	34.9	23.1	47.9	22.5	35,872	8%	7%	3%	32%	49%	-3.3
2286_1286_DW	2286_1286	384598	398032	N/A	AUBURN STREET	Manchester	LA	40.5	38.8	25.3	37.0	15.3	6,734	14%	6%	20%	19%	42%	-2.1

Point ID	Rd Link ID	x	y	Census ID	Road name	Local Authority	PCM / LA	Annual mean NO_2 conc ($\mu g/m^3$)	BG NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	AADT	NOx contribution by vehicle type (%)					Change NO_2 conc ($\mu g/m^3$)
														Bus	Taxi	HGV	LGV	Car	
1242_1243	1242_1243	384483	398343	70154	A62	Manchester	PCM	40.9	38.8	25.3	52.9	15.6	1,446	100%	0%	0%	0%	0%	-11.1
2293_6119_DW	2293_6119	384344	398215	N/A		Manchester	LA	30.2	38.8	25.3	12.2	4.9	2,354	100%	0%	0%	0%	0%	-13.1
5429_8559_DW	5429_8559	384266	398150	N/A	NEW YORK STREET	Manchester	LA	36.6	38.8	25.3	25.3	11.3	6,185	9%	7%	1%	28%	54%	-4.7
1338_2904_DW	1338_2904	384418	396982	N/A	B5117 OXFORD ROAD	Manchester	LA	28.1	33.1	22.1	13.0	6.0	2,562	100%	0%	0%	0%	0%	-12.5
1338_4532_DW	1338_4532	384338	397135	75242	A34	Manchester	PCM	30.4	34.9	23.1	15.5	7.4	3,824	84%	1%	0%	2%	12%	-10.8
2006_3292	2006_3292	384110	397858	56529	A5103	Manchester	PCM	31.3	34.9	23.1	19.4	8.2	5,712	55%	3%	2%	21%	18%	-12.7
1336_16404	1336_16404	384137	397465	17929	A34	Manchester	PCM	31.4	34.9	23.1	20.5	8.3	4,673	76%	2%	1%	5%	16%	-13.5
1336_16404_DW	1336_16404	384153	397473	17929	A34	Manchester	PCM	31.3	34.9	23.1	20.1	8.2	4,673	76%	2%	1%	5%	16%	-13.1
1268_46301	1268_46301	383702	398229	7947	A34	Manchester	PCM	45.1	38.5	25.0	60.8	20.0	8,502	62%	2%	8%	12%	15%	-9.1
8547_47130_DW	8547_47130	383976	398274	N/A	KING STREET	Manchester	LA	42.1	38.5	25.0	39.1	17.1	20,389	7%	8%	4%	26%	55%	-3.5
8547_47130	8547_47130	383973	398256	N/A	KING STREET	Manchester	LA	45.6	38.5	25.0	47.9	20.6	20,389	7%	8%	4%	26%	55%	-3.9
1259_1243	1259_1243	384409	398297	N/A	PICCADILLY	Manchester	LA	30.1	38.8	25.3	11.9	4.8	1,309	100%	0%	0%	0%	0%	-10.7
2289_12835	2289_12835	384282	398507	70153	A6	Manchester	PCM	38.4	38.8	25.3	34.9	13.1	9,258	63%	4%	1%	9%	24%	-8.6
3261_1302	3261_1302	384528	398779	75246	A665	Manchester	PCM	39.9	38.8	25.3	32.9	14.6	14,178	0%	7%	10%	32%	51%	-3.2
8546_14050	8546_14050	384384	398801	57427	A664	Manchester	PCM	41.1	38.8	25.3	43.5	15.9	7,929	60%	4%	2%	7%	27%	-8.4
5806_1304	5806_1304	384250	398668	57427	A664	Manchester	PCM	35.4	38.8	25.3	27.8	10.2	2,700	77%	1%	7%	6%	8%	-6.5
2290_3027	2290_3027	384038	398775	48035	A6042	Manchester	PCM	30.7	38.8	25.3	13.2	5.5	2,918	70%	3%	3%	9%	15%	-12.9
2290_3027_DW	2290_3027	384055	398767	48035	A6042	Manchester	PCM	31.3	38.8	25.3	14.9	6.1	2,918	70%	3%	3%	9%	15%	-14.4
1305_2290_DW	1305_2290	384091	398691	N/A	WITHY GROVE	Manchester	LA	33.8	38.8	25.3	22.4	8.5	2,918	80%	2%	1%	7%	10%	-14.3
1307_1317	1307_1317	383757	398717	36551	A6	Manchester	PCM	37.6	38.5	25.0	34.7	12.6	4,346	75%	2%	1%	12%	10%	-10.6
1307_1317_DW	1307_1317	383771	398733	36551	A6	Manchester	PCM	35.5	38.5	25.0	27.9	10.5	4,346	75%	2%	1%	12%	10%	-9.2
3056_3842	3056_3842	384855	397401	26157	A6	Manchester	PCM	37.4	34.9	23.1	29.3	14.4	37,556	5%	8%	4%	32%	51%	-2.6
3056_3842_DW	3056_3842	384880	397418	26157	A6	Manchester	PCM	44.8	34.9	23.1	46.0	21.8	37,556	5%	8%	4%	32%	51%	-3.3
3033_2293	3033_2293	384317	398195	N/A	PARKER STREET	Manchester	LA	31.8	38.8	25.3	17.1	6.6	2,494	100%	0%	0%	0%	0%	-16.8
1261_6042_DW	1261_6042	384451	398215	77003	A6	Manchester	PCM	35.2	38.8	25.3	28.7	10.0	1,257	100%	0%	0%	0%	0%	-6.3
1261_6042	1261_6042	384466	398201	77003	A6	Manchester	PCM	35.3	38.8	25.3	29.1	10.1	1,257	100%	0%	0%	0%	0%	-6.3
3016_6022_DW	3016_6022	384639	397855	46165	A6	Manchester	PCM	39.6	34.9	23.1	43.6	16.6	7,282	53%	4%	4%	11%	28%	-4.2
1302_8546	1302_8546	384428	398838	75248	A664	Manchester	PCM	38.0	38.8	25.3	34.1	12.8	7,829	55%	3%	15%	10%	17%	-6.6
1302_8546_DW	1302_8546	384414	398854	75248	A664	Manchester	PCM	35.8	38.8	25.3	27.1	10.5	7,829	55%	3%	15%	10%	17%	-5.6
2893_5074	2892_2890	384158	397155	75243	A57M	Manchester	PCM	39.9	34.9	23.1	37.1	16.9	59,169	0%	6%	3%	42%	49%	-1.7
5409_5430_DW	5409_5430	384209	398072	N/A	CHARLOTTE STREET	Manchester	LA	40.2	38.8	25.3	33.4	15.0	12,696	1%	9%	2%	26%	62%	-2.0
1263_5429	1263_5429	384207	398182	N/A	BACK GEORGE STREET	Manchester	LA	40.9	38.8	25.3	35.6	15.6	6,184	10%	7%	2%	27%	54%	-6.1
2283_8544_DW	2283_8544	383791	398603	27992	A56	Manchester	PCM	40.1	38.5	25.0	42.0	15.1	4,346	67%	3%	3%	16%	11%	-10.5
1267_1985	1267_1985	383672	398364	16536	A56	Manchester	PCM	42.2	38.5	25.0	40.4	17.2	8,510	16%	7%	6%	27%	44%	-7.2
1267_1985_DW	1267_1985	383687	398358	16536	A56	Manchester	PCM	41.3	38.5	25.0	38.1	16.3	8,510	16%	7%	6%	27%	44%	-7.0
1985_2283	1985_2283	383717	398477	16536	A56	Manchester	PCM	36.3	38.5	25.0	27.0	11.3	7,766	40%	5%	2%	22%	31%	-4.6
1985_2283_DW	1985_2283	383734	398471	16536	A56	Manchester	PCM	37.3	38.5	25.0	29.7	12.3	7,766	40%	5%	2%	22%	31%	-4.9
1685_1686_DW	1685_1686	387382	394221	73778	A6	Manchester	PCM	37.3	25.5	17.8	42.1	19.5	27,702	20%	6%	9%	24%	40%	-4.5
1469_3669_DW	1469_3669	386578	395884	28695	A6	Manchester	PCM	38.2	26.4	18.3	42.0	19.9	27,654	18%	7%	3%	22%	50%	-4.3
1684_4312_DW	1684_4312	387763	393475	73778	A6	Manchester	PCM	37.8	27.3	18.8	38.6	19.0	34,039	5%	8%	3%	27%	57%	-3.8
4373_5121_DW	4373_5121	382333	389181	48339	A560	Manchester	PCM	38.5	19.9	14.3	49.2	24.2	33,791	1%	8%	9%	30%	52%	-3.6
1846_2423	1846_2423	381858	388161	26047	M56	Manchester	PCM	41.2	20.5	14.8	53.6	26.4	13,727	2%	8%	2%	33%	55%	-1.9
1846_2423_DW	1846_2423	381865	388177	26047	M56	Manchester	PCM	44.1	20.5	14.8	60.4	29.4	13,727	2%	8%	2%	33%	55%	-2.2
2855_2218_DW	2856_2855	382356	390128	7701	A5103	Manchester	PCM	42.6	19.5	14.1	59.5	28.6	104,155	0%	8%	4%	32%	56%	-2.9
2844_2848	2855_2847	382344	390388	7701	A5103	Manchester	PCM	43.6	19.5	14.1	61.2	29.5	126,950	0%	8%	5%	31%	56%	-2.6
2847_2855_DW	2855_2847	382389	390376	7701	A5103	Manchester	PCM	44.4	19.5	14.1	62.9	30.3	126,950	0%	8%	5%	31%	56%	-2.4
14951_17000_DW	14951_17000	381833	385986	N/A	THORLEY LANE	Manchester	LA	37.5	34.2	22.4	31.9	15.1	17,161	6%	7%	14%	28%	46%	-2.8
7634_8756_DW	7634_8756	382361	385549	N/A	RINGWAY ROAD WEST	Manchester	LA	43.5	39.0	24.9	40.6	18.6	32,608	0%	5%	23%	24%	48%	-1.2
12800_14480_DW	12800_14480	382038	385547	N/A	OUTWOOD LANE	Manchester	LA	43.6	39.0	24.9	39.4	18.7	33,593	0%	9%	8%	21%	62%	-2.7

Point ID	Rd Link ID	x	y	Census ID	Road name	Local Authority	PCM / LA	Annual mean NO_2 conc ($\mu g/m^3$)	BG NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	AADT	NOx contribution by vehicle type (%)					Change NO_2 conc ($\mu g/m^3$)
														Bus	Taxi	HGV	LGV	Car	
NonPCM_184	1336_16404	384110	397517	N/A	A34 OXFORD STREET	Manchester	LA	30.7	34.9	23.1	18.6	7.7	4,673	76%	2%	1%	5%	16%	-15.4
NonPCM_207	4530_1268	383624	398258	N/A	A34 BRIDGE STREET	Manchester	LA	45.0	38.5	25.0	57.0	19.9	13,958	16%	7%	4%	28%	46%	-10.6
NonPCM_216	5408_5432	384079	397954	N/A	GEORGE STREET	Manchester	LA	34.2	34.9	23.1	25.0	11.2	10,122	17%	8%	1%	23%	52%	-6.9
Jct254	14490_5406	384292	398620	N/A		Manchester	LA	38.4	38.8	25.3	34.0	13.1	5,751	51%	4%	6%	11%	28%	-5.2
Jct262	2006_3292	384156	397878	N/A		Manchester	LA	32.6	34.9	23.1	23.0	9.5	5,712	55%	3%	2%	21%	18%	-14.3
Jct280	1402_5407	383617	397503	N/A		Manchester	LA	39.0	32.0	21.5	38.7	17.5	26,505	6%	9%	3%	27%	55%	-2.0
Jct282	1275_1279	384116	398263	N/A		Manchester	LA	42.2	38.8	25.3	38.5	16.9	8,096	8%	8%	3%	28%	54%	-5.3
Jct285	8546_14050	384363	398784	N/A		Manchester	LA	40.2	38.8	25.3	40.4	14.9	7,929	60%	4%	2%	7%	27%	-8.0
Jct526	1275_1279	384116	398262	N/A		Manchester	LA	42.2	38.8	25.3	38.4	16.9	8,096	8%	8%	3%	28%	54%	-5.3
3911_4112	3911_4112	389383	403282	99617	A663	Oldham	PCM	39.8	22.8	16.1	48.4	23.7	40,946	3%	7%	5%	29%	56%	-2.7
1996_14524_DW	1996_14524	393502	405226	36632	A62	Oldham	PCM	41.3	27.4	18.9	46.1	22.4	32,560	4%	8%	5%	33%	50%	-4.3
N14523_14524	14523_14524	393312	405043	36632	A62	Oldham	PCM	41.3	27.4	18.9	45.8	22.5	51,985	0%	8%	5%	35%	53%	-2.3
1975_2466_DW	14523_7556	392991	404790	N/A	WATERLOO STREET	Oldham	LA	39.4	23.7	16.7	45.8	22.7	51,651	0%	7%	4%	36%	53%	-2.0
7556_14523_DW	7556_14523	393092	404851	36632	A62	Oldham	PCM	42.1	26.1	18.2	49.0	24.0	24,565	0%	8%	6%	30%	55%	-2.2
1295_1703	1295_1703	390482	402513	77008	A62	Oldham	PCM	40.1	23.7	16.6	48.0	23.5	36,587	2%	7%	8%	35%	47%	-3.7
3914_5661_DW	3914_5661	390653	402743	6606	A62	Oldham	PCM	37.6	23.7	16.6	42.4	21.0	36,968	1%	7%	10%	40%	43%	-3.8
3914_5661	3914_5661	390627	402753	6606	A62	Oldham	PCM	38.9	23.7	16.6	45.1	22.2	36,968	1%	7%	10%	40%	43%	-3.9
1433_1615_DW	1433_1615	389260	401329	73781	A62	Oldham	PCM	36.3	21.6	15.4	46.1	20.9	17,340	17%	3%	25%	32%	22%	-4.8
2202_2205_DW	2202_2205	389446	413627	27469	A680	Rochdale	PCM	40.2	28.9	19.8	42.4	20.4	23,651	4%	7%	13%	34%	43%	-1.7
2210_14216_DW	2210_14216	388664	411856	17322	A664	Rochdale	PCM	45.9	19.0	13.8	73.7	32.1	34,289	0%	5%	30%	31%	34%	-4.0
14220_14221	14220_14221	389004	412157	26586	A58	Rochdale	PCM	37.7	21.0	15.0	46.2	22.7	45,240	2%	7%	9%	31%	50%	-4.5
2210_4463_DW	2210_4463	388729	411971	26586	A58	Rochdale	PCM	44.4	19.0	13.8	71.1	30.6	45,240	5%	5%	30%	26%	34%	-4.7
2210_4463	2210_4463	388741	411950	26586	A58	Rochdale	PCM	38.0	19.0	13.8	53.7	24.3	45,240	5%	5%	30%	26%	34%	-4.2
1345_1346_DW	1345_1346	380555	398426	56535	A5186	Salford	PCM	38.5	27.6	18.9	40.2	19.6	13,674	9%	7%	12%	28%	45%	-3.6
1345_1346	1345_1346	380537	398426	56535	A5186	Salford	PCM	37.8	27.6	18.9	38.4	18.8	13,674	9%	7%	12%	28%	45%	-3.2
1364_1366	1364_1366	381428	399804	17245	A576	Salford	PCM	38.8	26.2	18.1	43.6	20.6	30,825	11%	7%	10%	21%	51%	-3.9
5249_7952	5249_7952	381205	399532	58028	A576	Salford	PCM	37.7	26.2	18.1	39.9	19.6	34,176	3%	9%	5%	25%	58%	-4.5
5249_7952_DW	5249_7952	381224	399526	58028	A576	Salford	PCM	36.9	26.2	18.1	38.0	18.7	34,176	3%	9%	5%	25%	58%	-4.4
2672_14311_DW	2299_14311	381434	399244	6161	A6	Salford	PCM	37.7	26.2	18.1	39.9	19.6	51,110	10%	8%	4%	23%	55%	-4.3
14311_2299_DW	2299_14311	381488	399165	6161	A6	Salford	PCM	44.4	26.2	18.1	56.6	26.3	51,110	10%	8%	4%	23%	55%	-6.1
3964_4732	3964_4732	382882	397222	99516	A56	Salford	PCM	38.6	26.5	18.4	42.5	20.3	35,254	3%	6%	17%	32%	41%	-2.4
3964_4732_DW	3964_4732	382871	397244	99516	A56	Salford	PCM	44.1	26.5	18.4	55.8	25.7	35,254	3%	6%	17%	32%	41%	-2.7
1867_4574_DW	1867_4574	382129	397840	36585	A57	Salford	PCM	45.3	26.5	18.4	57.2	26.9	48,958	1%	6%	11%	33%	48%	-3.8
1232_1257	1232_1257	381738	398808	6161	A6	Salford	PCM	36.6	25.0	17.4	40.5	19.2	40,443	17%	7%	7%	23%	46%	-6.0
1349_1867_DW	1349_1867	382371	397772	48023	A57	Salford	PCM	43.5	26.5	18.4	52.5	25.2	46,118	0%	7%	9%	34%	50%	-3.7
3786_1233_DW	3968_1233	381517	398259	27751	A5063	Salford	PCM	38.2	25.0	17.4	42.2	20.8	33,552	1%	8%	7%	28%	57%	-3.2
1349_2993_DW	1349_2993	382580	397716	73792	A57	Salford	PCM	47.3	26.5	18.4	61.4	28.9	52,858	0%	7%	9%	35%	49%	-3.6
1349_2993	1349_2993	382574	397693	73792	A57	Salford	PCM	38.8	26.5	18.4	41.8	20.4	52,858	0%	7%	9%	35%	49%	-3.0
5505_5507_DW	5505_5507	382099	398640	56160	A6	Salford	PCM	37.6	27.1	18.7	40.2	18.9	29,032	19%	7%	5%	23%	46%	-8.0
3969_6612_DW	3969_6612	381512	398031	6562	A57	Salford	PCM	43.5	25.0	17.4	54.5	26.1	50,880	0%	7%	9%	35%	49%	-3.3
4575_6612_DW	4575_6612	381692	397971	36585	A57	Salford	PCM	39.1	24.1	16.9	44.8	22.2	49,532	0%	6%	4%	40%	49%	-2.4
3850_7895_DW	3850_7895	382754	398553	17926	A6	Salford	PCM	36.4	27.1	18.7	36.6	17.8	31,920	9%	8%	4%	29%	51%	-7.2
4575_7897_DW	4575_7897	381821	397932	36585	A57	Salford	PCM	39.1	24.1	16.9	44.9	22.2	49,533	0%	7%	5%	39%	50%	-2.5
3752_4897_DW	3752_4897	382876	398556	70151	A6	Salford	PCM	34.4	27.1	18.7	32.2	15.7	23,869	12%	7%	5%	28%	47%	-7.7
3752_7895_DW	3752_7895	382815	398555	17926	A6	Salford	PCM	34.0	27.1	18.7	31.2	15.3	23,869	11%	7%	5%	29%	47%	-7.3
12947_1223_DW	12947_1223	381649	398952	6161	A6	Salford	PCM	36.6	25.0	17.4	39.2	19.2	24,310	4%	9%	2%	27%	59%	-4.7
12945_14431_DW	12945_14431	381917	398711	56160	A6	Salford	PCM	41.7	25.0	17.4	51.2	24.3	35,664	9%	8%	4%	26%	54%	-8.0
1232_12945_DW	1232_12945	381825	398784	56160	A6	Salford	PCM	43.8	25.0	17.4	61.3	26.4	35,673	28%	5%	14%	20%	33%	-6.8
3850_14502_DW	3850_14502	382685	398551	17926	A6	Salford	PCM	39.5	27.1	18.7	44.9	20.8	31,911	19%	7%	6%	25%	43%	-8.0

Point ID	Rd Link ID	x	y	Census ID	Road name	Local Authority	PCM / LA	Annual mean NO_2 conc ($\mu g/m^3$)	BG NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	AADT	NOx contribution by vehicle type (%)					Change NO_2 conc ($\mu g/m^3$)
														Bus	Taxi	HGV	LGV	Car	
5505_14310_DW	5505_14310	382293	398539	56160	A6	Salford	PCM	35.6	27.1	18.7	34.9	16.9	29,032	13%	8%	4%	25%	50%	-8.0
1216_14503_DW	1216_14503	382565	398546	17926	A6	Salford	PCM	44.9	27.1	18.7	62.2	26.2	31,916	29%	5%	13%	21%	32%	-7.7
1216_14503	1216_14503	382567	398523	17926	A6	Salford	PCM	39.4	27.1	18.7	46.4	20.7	31,916	29%	5%	13%	21%	32%	-6.6
5179_5182_DW	5179_5182	374598	400597	74618	A572	Salford	PCM	42.7	15.8	11.6	64.2	31.0	33,324	1%	8%	4%	33%	54%	-2.5
1579_17017_DW	1579_17017	377344	400951	37363	A580	Salford	PCM	39.2	19.2	13.9	52.9	25.3	37,834	4%	7%	11%	31%	48%	-4.2
1589_14316_DW	1589_14316	378317	399184	7292	A576	Salford	PCM	34.7	24.8	17.3	38.8	17.4	18,424	23%	4%	26%	17%	29%	-6.2
NonPCM_147	4951_4554	375357	397837	N/A	A57 LIVERPOOL ROAD	Salford	LA	39.6	16.7	12.3	55.8	27.3	17,484	3%	7%	2%	36%	51%	-4.3
NonPCM_219	2993_1202	382678	397661	N/A	A57 REGENT ROAD	Salford	LA	43.4	26.5	18.4	54.6	25.1	52,858	1%	5%	26%	30%	38%	-3.3
Jct205	4554_4951	375367	397806	N/A		Salford	LA	38.1	16.7	12.3	52.3	25.9	17,484	3%	7%	2%	36%	51%	-3.9
Jct290	1216_7959	382540	398554	N/A		Salford	LA	39.0	27.1	18.7	45.3	20.3	5,088	0%	7%	7%	38%	48%	-6.5
1859_14054_DW	1859_14054	389505	390884	N/A	B6167 LANCASHIRE HILL	Stockport	LA	39.2	25.8	18.0	42.9	21.2	17,623	3%	8%	3%	30%	56%	-2.3
3620_5931_DW	3620_5931	390351	390720	37920	A626	Stockport	PCM	45.0	25.9	18.0	60.3	27.0	32,252	0%	5%	28%	31%	36%	-2.9
2663_5015	2663_5015	390347	391028	N/A	B6104 CARRINGTON ROAD	Stockport	LA	36.0	20.5	14.7	44.7	21.3	16,733	8%	4%	25%	33%	29%	-5.5
2663_5015_DW	2663_5015	390344	391047	N/A	B6104 CARRINGTON ROAD	Stockport	LA	41.5	20.5	14.7	58.4	26.8	16,733	8%	4%	25%	33%	29%	-6.6
5021_6254_DW	5021_6254	390116	391212	37920	A626	Stockport	PCM	41.3	20.5	14.7	56.1	26.6	28,956	0%	5%	20%	42%	33%	-2.8
1860_4172	1860_4172	389421	390671	58254	A560	Stockport	PCM	38.8	25.8	18.0	42.0	20.8	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	-2.9
1859_1860	1859_1860	389494	390731	58254	A560	Stockport	PCM	39.7	25.8	18.0	44.1	21.7	9,643	10%	6%	4%	31%	49%	-2.7
1678_2967	1678_2967	388831	390418	27983	A5145	Stockport	PCM	39.0	22.3	15.8	46.8	23.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	-2.9
2669_14483_DW	2669_14483	389208	390259	N/A	CHESTERGATE	Stockport	LA	33.6	25.8	18.0	39.3	15.6	1,282	100%	0%	0%	0%	0%	-7.1
3426_4162_DW	3426_4162	390357	390129	27384	A626	Stockport	PCM	38.5	25.9	18.0	41.8	20.5	31,197	2%	8%	7%	28%	55%	-2.8
5160_6071_DW	5160_6071	392018	392010	27296	A560	Stockport	PCM	38.9	26.0	18.0	42.9	21.0	32,480	0%	8%	11%	27%	54%	-2.2
1924_8878_DW	1924_8878	392443	391754	27296	A560	Stockport	PCM	39.5	21.6	15.4	54.2	24.1	33,251	6%	6%	28%	17%	42%	-3.2
3973_14181_DW	3973_14181	388375	390354	58034	A5145	Stockport	PCM	43.9	22.3	15.8	60.3	28.1	25,731	8%	6%	14%	29%	43%	-2.8
3973_14181	3973_14181	388376	390333	58034	A5145	Stockport	PCM	41.0	22.3	15.8	52.8	25.2	25,731	8%	6%	14%	29%	43%	-2.7
2430_3710_DW	2430_3710	385097	388122	38735	A34	Stockport	PCM	40.5	20.5	14.7	52.2	25.7	64,584	0%	8%	5%	31%	57%	-1.9
2887_2430_DW	2887_2430	385044	388518	26352	A34	Stockport	PCM	43.5	20.5	14.7	59.0	28.7	37,810	0%	8%	5%	29%	58%	-2.0
2184_14428_DW	2184_14428	391822	387266	99018	A6	Stockport	PCM	38.8	20.9	15.0	50.0	23.8	33,921	3%	8%	14%	24%	51%	-5.3
6055_14428_DW	6055_14428	391767	387344	99018	A6	Stockport	PCM	37.2	20.9	15.0	46.4	22.3	33,921	3%	8%	13%	24%	51%	-4.9
NonPCM_273	6205_6055	391720	387414	N/A	A6 LONDON ROAD	Stockport	LA	37.8	20.9	15.0	49.1	22.8	33,921	9%	7%	18%	23%	44%	-4.8
Jct355	1850_1864	389388	390175	N/A		Stockport	LA	36.5	25.8	18.0	40.4	18.5	20,846	5%	7%	6%	33%	50%	-6.5
Jct539	3426_4162	390301	390159	N/A		Stockport	LA	39.0	25.9	18.0	43.1	21.0	31,197	2%	8%	7%	28%	55%	-2.9
7637_2941_DW	7637_2941	393180	398661	99618	A635	Tameside	PCM	43.1	27.3	18.8	52.5	24.3	27,945	12%	6%	14%	30%	39%	-3.7
2941_5978_DW	7638_5978	393398	398690	37451	A635	Tameside	PCM	41.4	27.3	18.8	46.2	22.6	52,651	0%	7%	6%	35%	52%	-1.7
1695_14478_DW	1695_14478	392753	398494	99618	A635	Tameside	PCM	44.8	26.9	18.5	55.2	26.3	45,750	1%	7%	10%	37%	46%	-3.2
1695_14478	1695_14478	392761	398476	99618	A635	Tameside	PCM	39.0	26.9	18.5	41.8	20.5	45,750	1%	7%	10%	37%	46%	-2.7
3813_3812_DW	3813_3812	392978	398478	74561	A6017	Tameside	PCM	40.5	26.9	18.5	45.0	22.0	32,804	2%	7%	6%	35%	50%	-2.9
7638_3813	7638_3813	393112	398511	74561	A6017	Tameside	PCM	39.4	27.3	18.8	42.4	20.6	30,488	2%	7%	10%	29%	52%	-3.4
1695_5659	1695_5659	392588	398416	99618	A635	Tameside	PCM	38.8	26.9	18.5	41.1	20.3	47,119	1%	7%	8%	39%	46%	-2.4
1695_5659_DW	1695_5659	392582	398435	99618	A635	Tameside	PCM	44.8	26.9	18.5	54.6	26.3	47,119	1%	7%	8%	39%	46%	-2.8
5655_5656_DW	5655_5656	392042	398069	76074	A6140	Tameside	PCM	39.3	26.9	18.5	43.4	20.7	20,711	0%	5%	23%	34%	38%	-3.6
3812_14478	3812_14478	392855	398516	74561	A6017	Tameside	PCM	39.1	26.9	18.5	42.6	20.6	40,839	3%	6%	13%	36%	42%	-2.9
3812_14478_DW	3812_14478	392847	398534	99618	A635	Tameside	PCM	44.7	26.9	18.5	55.9	26.2	40,839	3%	6%	13%	36%	42%	-3.3
3761_5653_DW	3761_5653	390802	395630	99512	A57	Tameside	PCM	37.2	20.0	14.4	46.4	22.9	19,648	2%	6%	11%	36%	44%	-4.1
Jct449	3227_8517	391912	395574	N/A		Tameside	LA	39.3	21.7	15.4	48.5	23.9	18,578	0%	7%	3%	37%	52%	-2.4
2305_5949_DW	2305_5949	380182	395145	36578	A56	Trafford	PCM	38.6	31.1	20.9	35.8	17.7	30,474	4%	9%	4%	26%	57%	-2.5
1382_3622_DW	1382_3622	380628	395827	56499	A56	Trafford	PCM	38.5	31.1	20.9	35.4	17.6	34,766	2%	9%	3%	30%	57%	-2.6
7603_7606_DW	7603_7606	376675	396960	N/A	B5214 TRAFFORD BOULEVARD	Trafford	LA	37.5	21.2	15.2	47.7	22.3	21,453	5%	8%	13%	23%	51%	-7.5
7606_17100_DW	7606_17100	376759	397007	N/A	B5214 TRAFFORD BOULEVARD	Trafford	LA	38.3	21.2	15.2	50.8	23.1	28,936	19%	7%	13%	19%	42%	-7.2
NonPCM_324	2833_2349	378901	392774	N/A	A56 CROSS STREET	Trafford	LA	40.7	20.6	14.8	52.8	25.8	45,591	1%	8%	5%	30%	55%	-3.4

Point ID	Rd Link ID	x	y	Census ID	Road name	Local Authority	PCM / LA	Annual mean NO_2 conc ($\mu g/m^3$)	BG NOx conc ($\mu g/m^3$)	BG NO_2 conc ($\mu g/m^3$)	Road NOx contrib ($\mu g/m^3$)	Road NO_2 contrib ($\mu g/m^3$)	AADT	NOx contribution by vehicle type (%)					Change NO_2 conc ($\mu g/m^3$)
														Bus	Taxi	HGV	LGV	Car	
Jct225	3529_8101	377585	395102	N/A		Trafford	LA	39.5	20.7	14.8	49.4	24.6	8,214	0%	10%	2%	23%	66%	-2.0
Jct231	3304_3529	377588	395133	N/A		Trafford	LA	40.0	20.7	14.8	50.8	25.2	6,241	0%	8%	12%	27%	53%	-2.3
3492_3511_DW	3492_3511	358611	405310	8566	A577	Wigan	PCM	37.9	31.0	20.8	35.0	17.1	23,426	2%	7%	11%	31%	50%	-3.1
3431_7687_DW	3431_7687	358110	405811	N/A	MARKET STREET	Wigan	LA	28.8	31.0	20.8	18.7	8.0	2,098	100%	0%	0%	0%	0%	-11.8
3103_3435_DW	3103_3435	358085	405595	N/A	KING STREET WEST	Wigan	LA	37.7	31.0	20.8	44.0	16.9	7,510	71%	2%	6%	8%	13%	-9.3
3396_3466_DW	3396_3466	358002	405379	8568	A49	Wigan	PCM	34.6	31.0	20.8	28.6	13.8	18,108	18%	7%	5%	21%	49%	-6.7
3103_8156	3103_8156	358146	405514	N/A		Wigan	LA	35.6	31.0	20.8	35.0	14.9	8,287	37%	4%	22%	20%	18%	-7.1
3431_3463	3431_3463	358038	405924	N/A	NEW MARKET STREET	Wigan	LA	33.7	31.0	20.8	28.7	12.9	12,126	41%	5%	5%	17%	33%	-7.1
Jct485	3103_3435	358163	405546	N/A	KING STREET WEST	Wigan	LA	34.3	31.0	20.8	32.2	13.5	7,510	71%	2%	6%	8%	13%	-7.0

Appendix C – Review of 2023 CAP monitoring data

C.1 This appendix considers the CAP DT monitoring data from 2023 against the exceedances forecast by the GM CAP modelling.

C.2 Whilst at earlier stages of the project the GM CAP had modelled forecasts for 2023, there have been a number of significant revisions to the model assumptions since that make direct comparisons unreliable, and 2023 scenarios have not been produced recently. The main alterations are described below.

Variable Performance of Retrofitted Bus Emissions

C.3 The variable performance of emissions from retrofit buses were not understood or included in any of the 2023 scenario model runs. JAQU remote sensing monitoring has demonstrated significant variability in the emissions from retrofitted buses, both between buses of the same model, and also for the same unique buses operating at different times past the same point. JAQU guidance sets out a method to uplift retrofitted bus emissions for NOx and f-NO2 to reflect this issue. However, this does not accommodate the increased variability and range of emissions observed, and how this could impact locations differentially.

C.4 During 2023 approximately 50% of the GM bus fleet were retrofitted Euro V vehicles, with a limited number of retrofitted Euro IV also in operation. At this point in time GM bus operations were under private ownership, and the bus types operating on specific routes were not under GM control. Analysis of which buses were operating on specific routes has been undertaken for a sample from May 2023, but operators are understood to change the vehicles serving specific routes regularly to meet their own operational objectives. Given the potential impact of the variability of bus emissions between retrofitted and OEM models, and also between buses of the same model, this increases the uncertainty in comparisons for 2023.

Modelled Road Network

C.5 The city centre transport strategy (CCTS) includes a number of substantial schemes, which are aimed at reducing trips into and through the regional centre. These completed schemes have been coded into the Saturn traffic assignment modelling for 2025, but the construction programme means they were at different stages of implementation during 2023, either:

- in final planning design, pre-construction phase;
- under construction (with associated traffic management in place altering traffic flows and routing);
- fully opened or opened mid-2023; or
- a combination of these phases.

C.6 This means that the operational road network does not correspond to the coded model scenarios available. Traffic flows, speeds and routing are impacted across various locations, especially close to and around the regional centre. Further details of the schemes are presented in the T3 report.

Meteorology

C.7 The sensitivity testing undertaken earlier in the project shows that the GM CAP modelled concentrations are sensitive to assumptions about meteorological conditions. This is consistent with the analysis from the JAQU guidance, that whilst inter-annual changes in meteorology may not have a large impact on the overall distribution of roadside NO2 concentrations in a local area, it can have a significant impact for particular road links[37]. The GM CAP modelling uses a base year meteorological dataset of 2016. Statistical analysis of the influence of meteorological conditions in 2023 has not been undertaken at this stage.

Location of Monitoring

C.8 A separate issue is that the JAQU guidance requires that the compliance point is defined as a modelled output point 4m back from the road edge and 2m high. Diffusion tubes are typically deployed by attaching the equipment to available street furniture, free from the localised obstructions which would alter air flow and associated measured concentrations.

C.9 The specification of the location where the Limit Values apply is less restrictive, and doesn't limit the distance back from the road, but with a minimum height of 1.5m.

C.10 For the GM CAP monitoring survey, monitoring sites were sought that met the JAQU guidance as closely as possible, but is restricted by the availability of street furniture, which means that it is rarely exactly comparable, and often closer to the road that 4m or lower than 2m to avoid the influence of signage of air flow (but could also be further back or higher up). These distance and height factors will also influence the dispersion and therefore the measured concentrations, compared to the targeted model output point.

Overview of CAP DT monitoring for 2023

C.11 The initial CAP survey of 55 sites started in January 2018, extended to 222 sites in June 2019 as project developed. For the monitoring and evaluation process, JAQU guidance requires monitoring at all modelled Target Determination exceedances, and the survey was designed and commissioned targeting 3 sites per exceeding link, leading to 432 sites for 2022.

[37] JAQU, Supplementary Note on Sensitivity Testing, 2018

C.12 In order to be cost efficient, the approved cost profile identified that where low concentrations were recorded in 2022 sites were decommissioned to leave approximately 250 sites in 2023.

C.13 GM uses Staffordshire Scientifics Services (20% TEA in water) tubes for LAQM monitoring, and the same equipment has been used for the CAP. The national bias adjustment factors issued by Defra are applied, 0.86 for 2023 data.

C.14 Table C-1 shows a summary of the CAP diffusion tube monitoring up to 2023. The full datasets are available at www.cleanairgm.com.

C.15 This shows a decrease in the number of reported exceedances in 2023, compared to 2022 and pre-Covid (i.e. 2019). There are exceedances recorded by the CAP survey in 8 districts, but none in Trafford or Rochdale. Across the survey as a whole there is a general reduction in measured concentrations, of typically 1 to 2 µg/m^3. This is consistent with the rate of year-on-year reduction that is forecast by the modelling.

C.16 Figures C-1 & C-2 shows the measured concentrations in 2023 in the CAP diffusion tube survey across the whole of GM and just in the regional centre, with the Target Determination exceedance links for the 2021 modelled Do Minimum scenario marked in red. Figures C-3 & C4 are the same but with only sites measured as in exceedance presented.

C.17 These show that there are a number of sites that are well below the nitrogen dioxide annual mean standard of 40 µg/m^3, which may in part be related to sites being further back than 4m or upwind of the road.

C.18 It would be expected that overall, many of the Target Determination road links should not be recording exceedances in 2023. This is because concentrations would be expected to reduce from the 2021 modelled forecast (which was produced before Covid-19, and did not account for the impacts of the travel restrictions and the wider impacts on the economy) to 2023.

C.19 The monitoring shows there are 33 road links where exceedances have been recorded in 2023. Exceedances are also recorded on the Strategic Road Network (SRN), operated by National Highways.

C.20 In the regional centre, one area of discrepancy is around the A34 Quay Street and Great Bridgewater Street. The modelling indicates that these are some of the last areas of exceedance, but the monitoring has not identified exceedances. These locations are influenced by the Deansgate Phase 2 scheme, which was not opened in 2023, and is expected to re-route traffic onto the alternative routes in the traffic model in 2025. They are also in locations influenced by complex street canyons which is another source of modelling uncertainty.

C.21 At the north end of Deansgate, the pedestrian scheme was opened in 2023 and hence very low concentrations are now being recorded.

C.22 In order to better understand the influence of the uncertainty that is introduced as a result of the retrofitted bus operations, Figure C-5 & C-6 shows the proportion of bus movements that were by retrofitted buses, rather than OEM versions. This was a sample for May 2023, but shows how widespread and prevalent retrofitted buses are across GM. Given how the source apportionment presented earlier in this report shows that buses are a significant contributor to exceedances, especially in the regional centre and on the A6 corridor towards Stockport, this means that there is possibility of significant variability in measured concentrations. Generally, the higher measured concentrations are located on roads with a greater proportion of retrofitted bus movements.

C.23 However, as GM bus franchising comes into effect over Q4 2023 to Q2 2024, GM will be able to specify which buses operate on specific routes. Whilst retrofitted buses will still comprise a substantial proportion of total movements, they can be operated on routes where risk of air quality exceedance is lower, and there is greater headroom below the standard.

Table C-1: Summary of GM CAP Diffusion Tube Monitoring by District from 2018 to 2023

District	No. Sites						No. Exceedances						Maximum NO_2 Conc (ug/m^3)					
	2018	2019	2020	2021	2022	2023	2018	2019	2020	2021	2022	2023	2018	2019	2020	2021	2022	2023
Bolton	5	14	14	14	32	19	1	4	1	2	4	2	54	64	46	48	44	43
Bury	5	16	16	16	37	19	2	10	0	2	7	3	48	61	38	44	46	43
Manchester	20	91	91	91	159	109	14	65	8	25	48	39	71	76	50	56	65	59
Oldham	na	9	9	9	19	13	na	5	0	1	5	1	na	54	39	45	45	42
Rochdale	na	12	12	12	15	6	na	4	1	1	1	0	na	61	49	45	41	39
Salford	5	27	27	27	60	32	1	16	0	7	13	4	47	67	40	45	45	43
Stockport	10	19	19	19	47	24	6	15	2	3	8	7	62	75	46	52	51	50
Tameside	5	14	14	14	32	19	4	6	4	4	8	7	56	56	43	48	48	47
Trafford	5	14	14	14	18	4	1	3	0	0	0	0	47	47	35	37	35	34
Wigan	na	6	6	6	13	3	na	1	0	0	1	1	na	45	31	33	45	47
Total	**55**	**222**	**222**	**222**	**432**	**248**	**29**	**129**	**16**	**45**	**95**	**64**	**-**	**-**	**-**	**-**	**-**	**-**

Figure C-1: GM CAP Diffusion Tube Monitoring Concentrations – 2023: All Sites

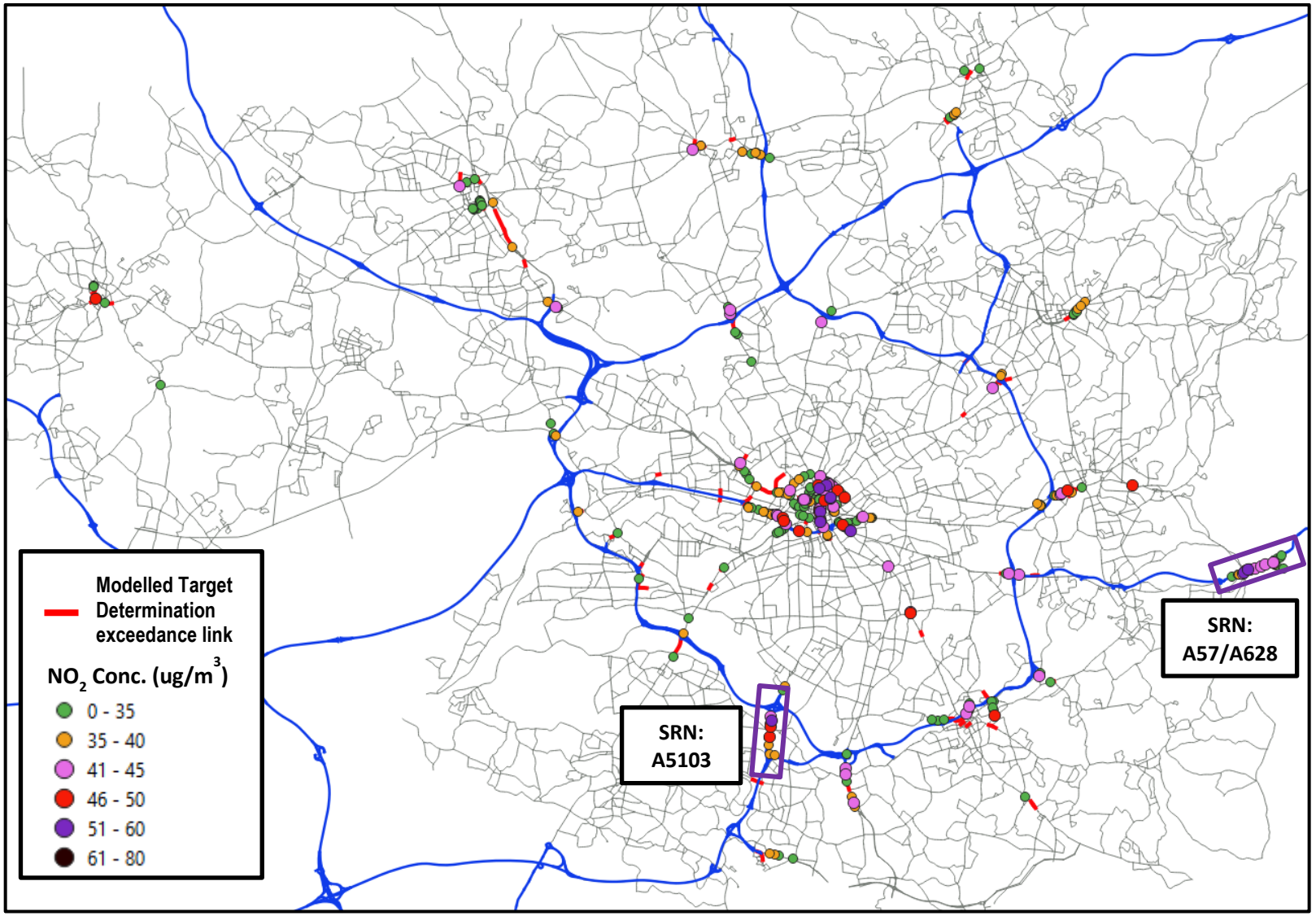


Figure C-2: GM CAP Diffusion Tube Monitoring Concentrations – 2023: All Sites in the Regional Centre

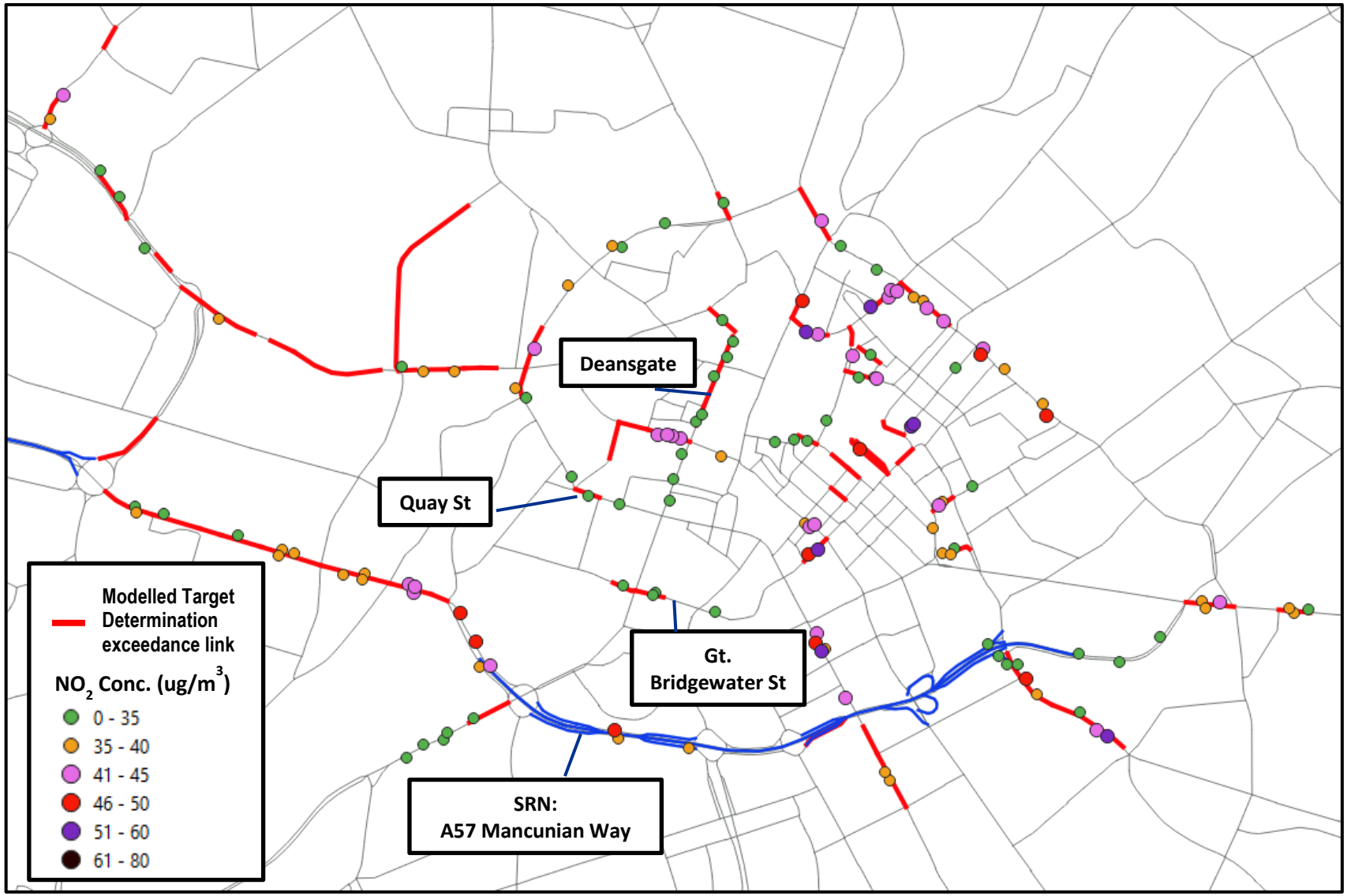


Figure C-3: GM CAP Diffusion Tube Monitoring Concentrations – 2023: Exceedances Only

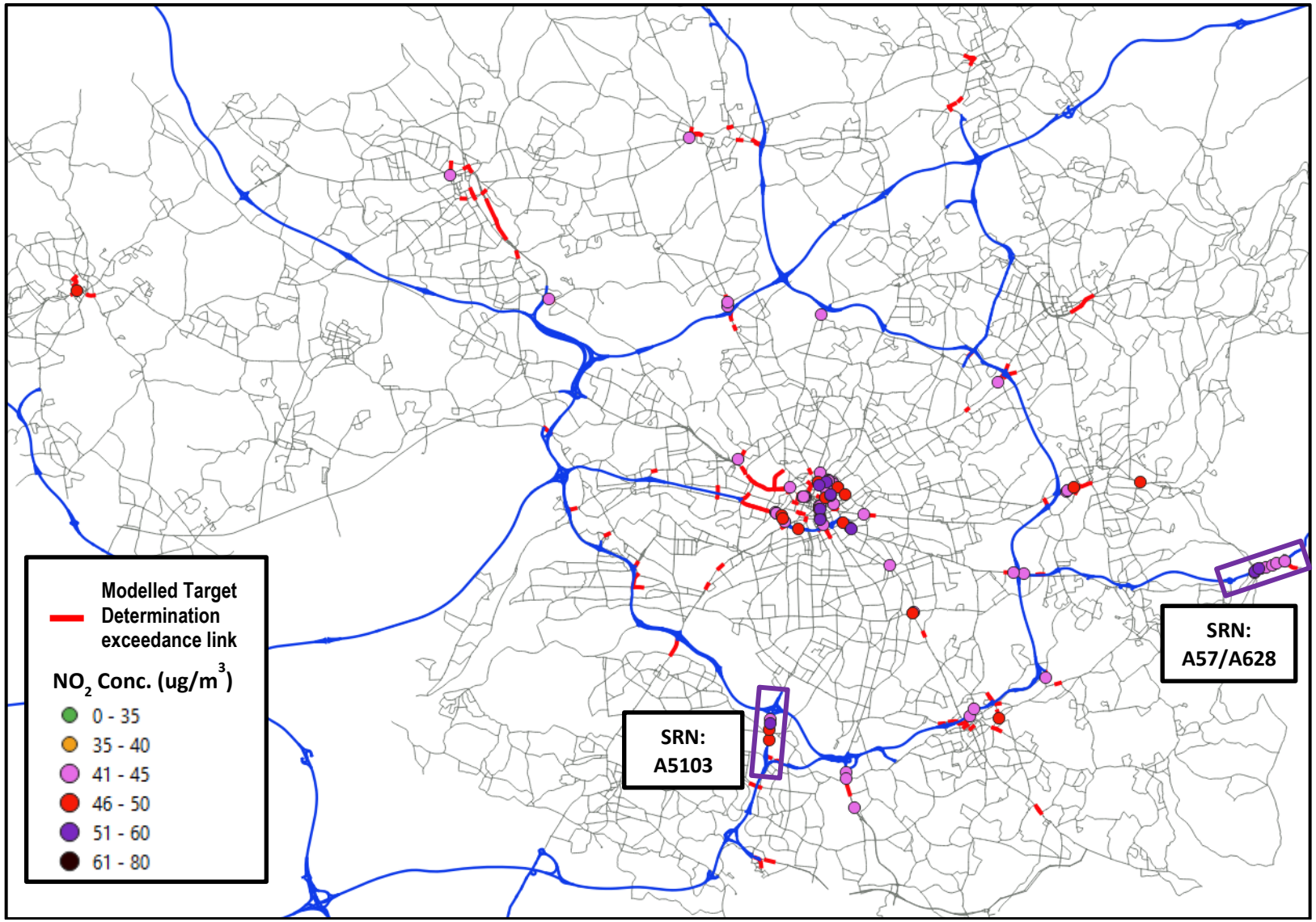


Figure C-4: GM CAP Diffusion Tube Monitoring Concentrations – 2023: Exceedances Only in the Regional Centre

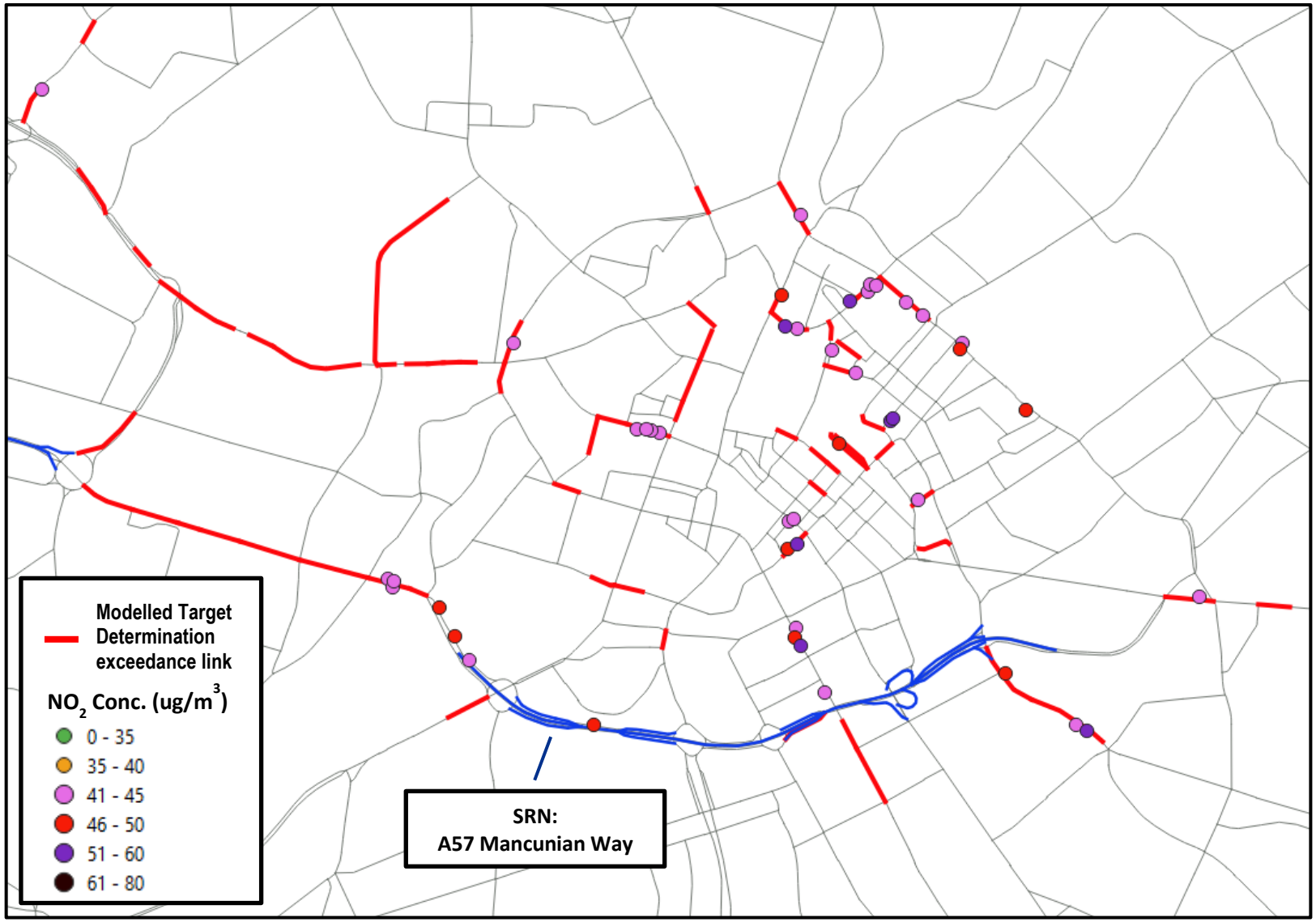


Figure C-5: Proportion of Bus Movements Operated by a Retrofitted Vehicle

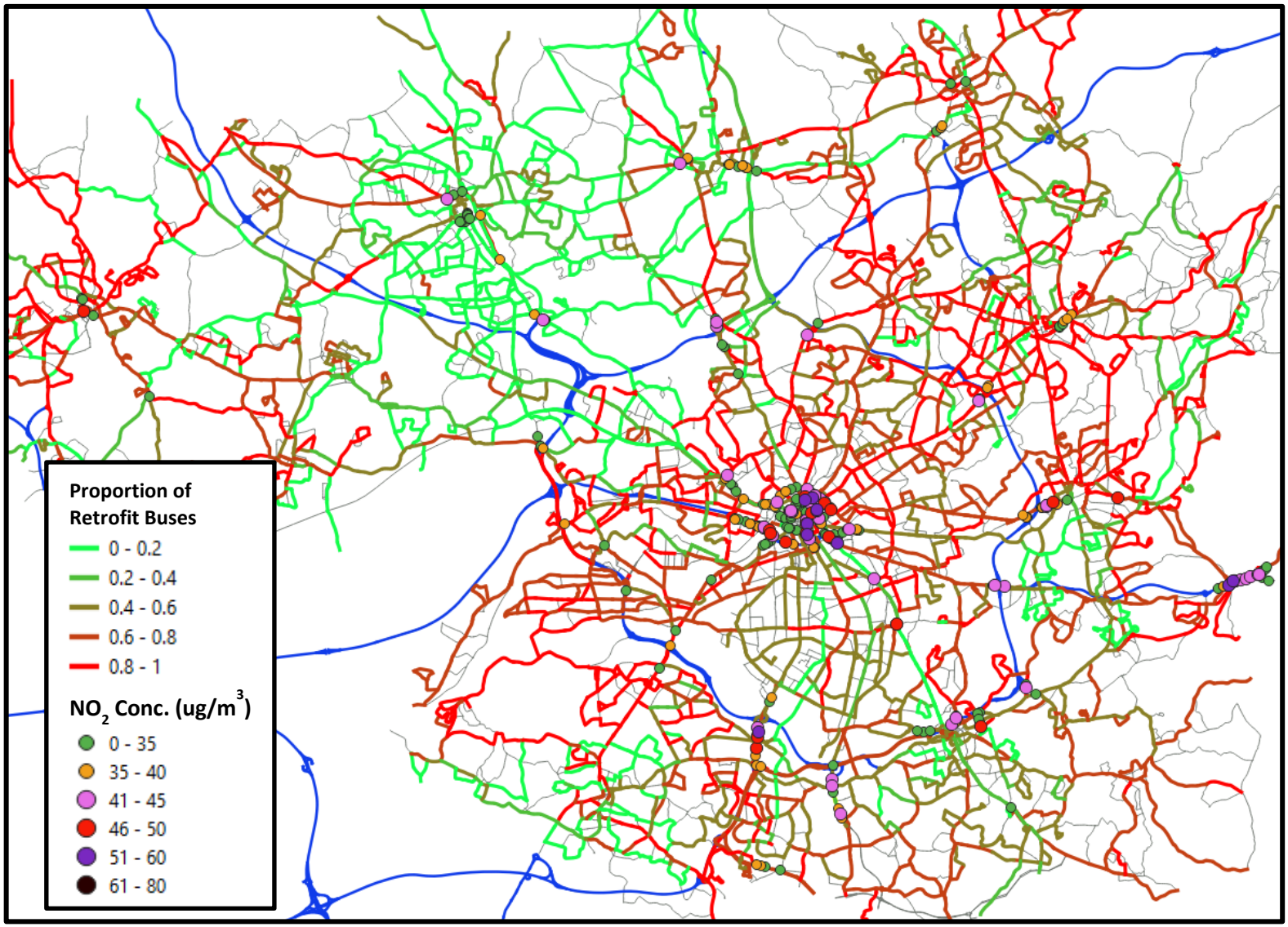
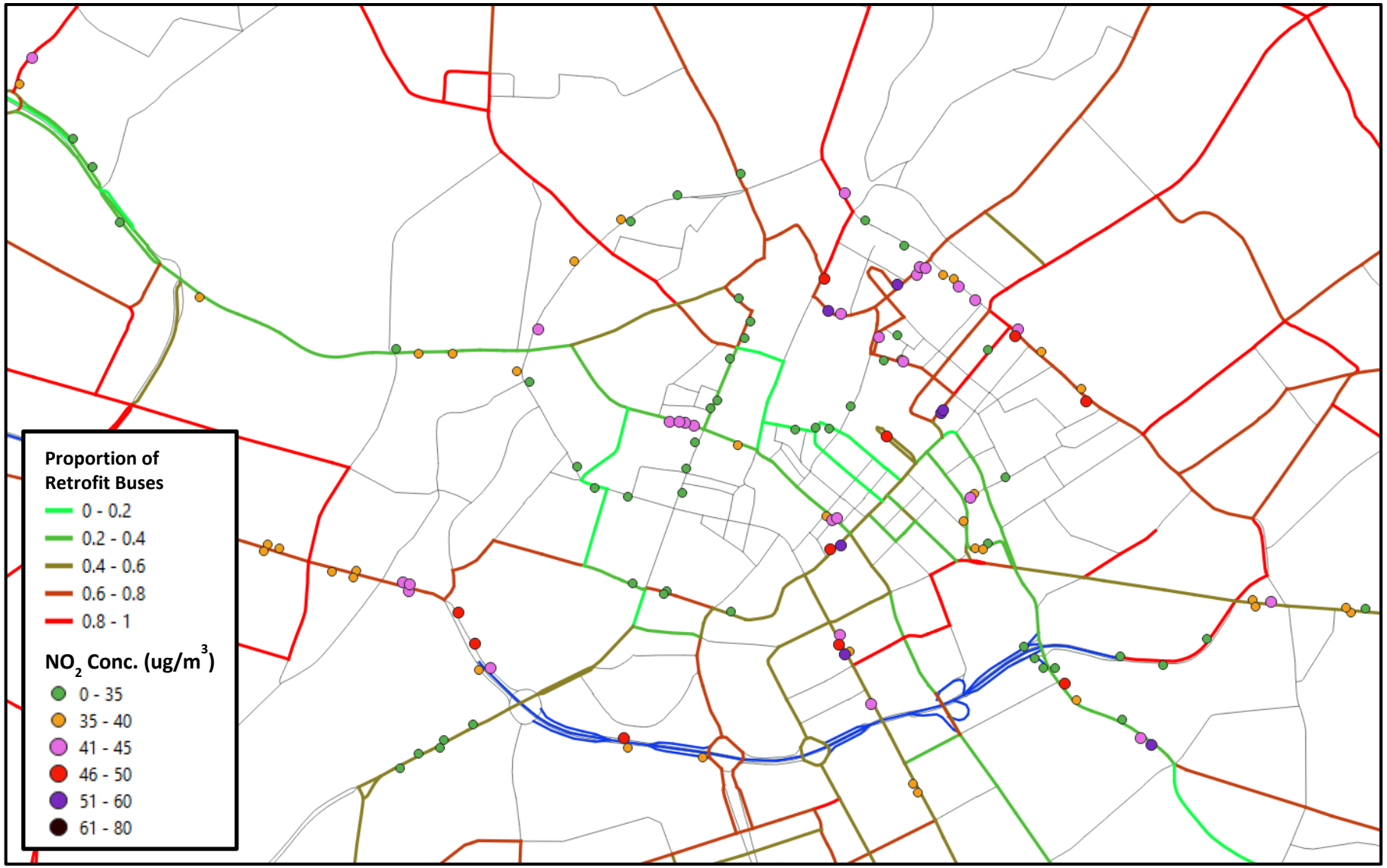


Figure C-6: Proportion of Bus Movements Operated by a Retrofitted Vehicle in the Regional Centre



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