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

Appendix 6 – Air Quality Modelling Report following Consultation and with COVID-19 impacts

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This document is **not** a formal submission, but a draft and unfinished document, prepared ahead of the consultation and submitted so that JAQU can have sight of Greater Manchester's approach to the components that will make up the Full Business Case and provide feedback as work on the measure progresses.

The document and the work within it will therefore be subject to change. Furthermore, once the document is finished it will be subject to formal approval and governance by all 10 Greater Manchester authorities before it can constitute the final formal submission.

Contents

1 Executive Summary

1.1 The Secretary of State has instructed many local authorities across the UK to take quick action to reduce harmful nitrogen dioxide (NO2) levels, and has issued a direction under the Environment Act 1995 to many local authorities undertake feasibility studies to identify measures for reducing NO2 concentrations to within legal limit values in the "shortest possible time". In Greater Manchester (GM) this is being delivered via the Greater Manchester Clean Air Plan.

1.2 GM has been directed by the Government to introduce a charging Clean Air Zone (CAZ) Class C across the region. Certain vehicle types will pay a daily charge for driving inside the zone if they do not comply with emissions standards in the Government's CAZ Framework. Non-compliant vehicles that will be charged are: Buses, Coaches, Minibuses, Hackney Carriages and PHVs (Private Hire Vehicles), HGVs (Heavy Goods Vehicles) and LGVs (Light Goods Vehicles).

1.3 GM has been working to develop the detail of the GM CAZ and associated package of supporting funds, discounts and exemptions for impacted vehicle owners. Following the consultation in late 2020 GM has developed a Post-Consultation Package, which incorporates a Class C CAZ proposed to open in May 2022. This modelling report is based on the Clean Air Plan Policy[1] following consultation, which takes account of the consultation from 2020, and also the impacts of COVID-19 on GM and the CAP.

1.4 Throughout this process GM has used best practice methodology and assumptions to understand the effects of the measures, which have been reviewed and approved by the Joint Air Quality Unit (JAQU) and their Technical Independent Review Panel (TIRP). GM has continued to work closely with Government, including most recently updates to incorporate the impacts of Covid-19 to the Clean Air Plan in accordance with national guidance. GM's proposed approach to updating the modelling was approved by JAQU on 4th May 2021[2]. Updates include a representation of Covid-19 impacts on vehicle fleet and also local investment in electric buses.

1.5 The updated modelling predicts there to be exceedances in all districts with the exception of Oldham and Wigan in the Do Minimum scenarios for 2023. By 2025, exceedances are only predicted in Manchester, Salford, and Bury, which is consistent with the Consultation modelling scenarios. Modelling has not yet been updated for the pre-2023 scenario, but it is expected that all GM authorities would be in exceedance in 2022 without the CAP.

1.6 For the Post-Consultation Package, in 2023 when the GM CAP is fully opened with all measures in place, the proposed scheme is predicted to reduce the number of exceedances from 71 down to 5. These are located at:

[1] Supplied as Appendix 1 to the 25th June 2021 GMCA report 'Greater Manchester Clean Air Plan'
[2] See Appendix C

- A34 John Dalton St & Bridge St, Manchester (2 exceedances);
- A58 Bolton Road, Bury (2 exceedances); and
- A57 Regent Road, Salford (1 exceedance).

1.7 However, by 2024 with an extra year of natural fleet turnover, the associated additional improvement to vehicle emissions means that there are no exceedances predicted in GM as a result of the reduction in vehicle emissions produced by the GM CAP.

1.8 Therefore, 2024 is the first year of compliance with the legal limits for nitrogen dioxide within Greater Manchester. This is the same as produced by the Consultation Option, and meets the requirements of the Ministerial Direction for such compliance to be achieved by 2024 at the latest. Compliance is achieved three years earlier than predicted without the GM CAP in place. Achieving compliance in Greater Manchester is not possible sooner with the other options that have been suggested.

1.9 Note that a category C CAZ does not apply charges to M1 (or M1 Special Purpose) group of vehicles with a body-type of 'motorcaravan'. However, there is a lack of parity between this classification of vehicle and vehicles with a body type of 'motorcaravan[1]' that have a vehicle type approval of N1 or N2, which are currently liable for a charge under the GM CAZ scheme. To ensure the principle of parity of treatment of all vehicles with body type of 'motorcaravan' it is recommended therefore that that a consultation is held on the inclusion of motorhomes classified as M1 Special Purpose in the GM Clean Air Zone.

2 Introduction

2.1 Purpose of this Report

2.1.1 This report sets out the results of modelling carried out in May 2021 to forecast air quality in Greater Manchester (GM) in future years, taking into account the impacts of Covid-19, new investment in buses, and reflecting the revised GM Clean Air Plan (CAP) Policy post-consultation.

2.1.2 The report documents changes that have been made to the modelling methodology to reflect the impacts of the Covid-19 pandemic on factors that influence air quality, and other changes that have been made to reflect the newest evidence on investment in ultra low emission buses, as well as any other methodological changes that have been made to the 'Do Minimum' modelling methodology.

2.1.3 The report sets out how the GM CAP Policy following consultation has been represented in the modelling suite, and any relevant methodological changes to the 'Do Something' modelling methodology.

2.1.4 Finally, the report sets out the results of the Do Minimum and Do Something modelling, in other words, the forecast air quality with and without the GM CAP. To date, the modelling has been conducted for 2023 and 2025, with results interpolated for 2024.

2.2 Background to the GM CAP

2.2.1 The Secretary of State has instructed many local authorities across the UK to take quick action to reduce harmful Nitrogen Dioxide (NO_2) levels, issuing a direction under the Environment Act 1995 to many local authorities to undertake feasibility studies to identify measures for reducing NO_2 concentrations to within legal limit values in the "shortest possible time". In Greater Manchester, the 10 local authorities, the Greater Manchester Combined Authority (GMCA) and Transport for Greater Manchester (TfGM), collectively referred to as "Greater Manchester" or "GM", have worked together to develop a Clean Air Plan to tackle NO_2 Exceedances at the Roadside, referred to as the "GM CAP", in response to such a direction.

2.2.2 The core goal of the GM Clean Air Plan is to eliminate concentrations of NO_2 at locations within Greater Manchester identified through the target determination process that exceed the legal Limit Value (40 µg/m^3) in the "shortest possible time" in line with Government guidance.

2.2.3 GM has been directed by the Government to implement the local plan for NO_2 compliance, that includes a charging Clean Air Zone (CAZ) Class C across the region and certain additional measures. Certain vehicle types will pay a daily charge for driving inside such a zone if they do not comply with emissions standards in the Government's CAZ Framework[3]. Non-compliant vehicles that will be charged are: Buses, Coaches, Minibuses, Hackney

[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/863730/clean-air-zone-framework-feb2020.pdf

Carriages and PHVs (Private Hire Vehicles), HGVs (Heavy Goods Vehicles) and LGVs (Light Goods Vehicles).

2.2.4 A category C CAZ does not apply charges to M1 (or M1 Special Purpose) group of vehicles with a body-type of 'motorcaravan'. However, there is a lack of parity between this classification of vehicle and vehicles with a body type of 'motorcaravan[1]' that have a vehicle type approval of N1 or N2, which are currently liable for a charge under the GM CAZ scheme. To ensure the principle of parity of treatment of all vehicles with body type of 'motorcaravan' it is recommended, therefore, that that a consultation is held on the inclusion of motorhomes classified as M1 Special Purpose in the GM Clean Air Zone.

2.3 GM CAP Policy following consultation

2.3.1 This modelling report is based on the GM CAP Policy following consultation[4], which takes account of the consultation in late 2020, and also the impacts of Covid-19 on GM and the GM CAP.

2.3.2 The anticipated implementation date of the Category C Charging Clean Air Zone is Monday 30th May 2022, with LGVs, minibuses, coaches and GM-licensed hackney carriages and private hire vehicles proposed to be eligible for a temporary exemption from charges to 31st May 2023.

2.3.3 The boundary will cover the whole of Greater Manchester[5], excluding the strategic Road Network (SRN) which is managed by Highways England. The daily charges remain the same as proposed at consultation.

2.3.4 The support funds have changed in many cases from those within the policy for consultation. Feedback from the consultation and the impact of Covid-19 on GM has been used to better understand the requirements of those businesses, individuals and organisations who most need the support to upgrade. As a result, the proposed funding offered per vehicle has been increased for private hire vehicles, coaches, HGVs and larger vans whilst remaining the same for other vehicle types. There are also more options for replacement and retrofit for hackney carriages, PHVs, minibuses and vans.

[4] Supplied as Appendix 1 to the June 2021 GMCA report 'Greater Manchester Clean Air Plan'

[5] It is now proposed to include, in addition to the roads consulted on, the A575 and A580 at Worsley and a further consultation is proposed to take place on that.

3 Methodology

3.1 Overview of the modelling process

3.1.1 The GM CAP is underpinned by an evidence base derived from data collection, research, analysis and modelling. The results of that analysis were summarised in the report 'Data, Evidence and Modelling: Consultation Summary Report', and set out in detail in a series of Technical Reports and Technical Notes. All published materials can be found at https://cleanairgm.com/technical-documents.

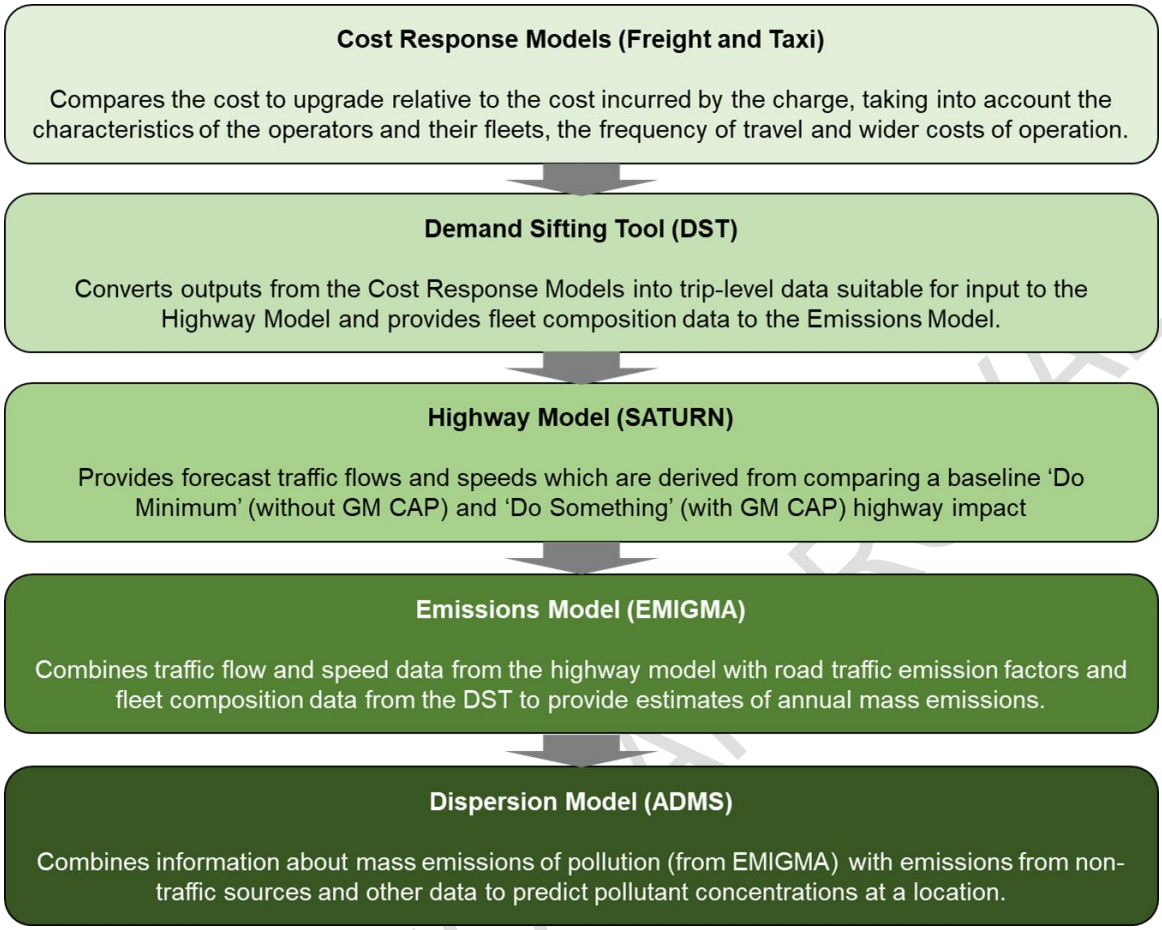
3.1.2 This section sets out a brief overview of the modelling approach followed to assess the air quality impacts of the GM CAP proposal. It sets out how the modelling approach has been updated to reflect the impacts of Covid-19 in line with JAQU guidance and changes to the GM CAP Policy following public consultation.

3.1.3 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.

3.1.4 The modelling process provides a forecast of NO_2 concentrations in the baseline, if no action is taken, and then allows GM to test the impact of different policies and proposals on vehicle fleets, traffic and emissions. Using these modelling tools, GM forecasts NOx emissions and NO_2 concentrations under a range of scenarios for years 2023 and 2025. NO_2 concentrations for interim years and beyond 2025 are interpolated from the results in modelled years. Further modelling will be carried out to assess NOx emissions and NO_2 concentrations for 2022, the opening year of the CAZ; this has not yet been completed.

3.1.5 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 Technical Reports T1-4 and AQ1-3 (Option for Consultation); these reports will be updated to support the Full Business Case.

Figure 3-1 Overview of the Modelling Process



3.2 Changes to the modelling approach between OBC and consultation

3.2.1 Since the submission of the OBC, the modelling process has been refined to reflect an improved evidence base and collaboration with Government and stakeholders. As a result, there were several modelling updates which have impacted both the 'Do Minimum' and 'Do Something modelling scenarios which formed the Option for Consultation. Technical Note 24 sets out the updated approach to modelling the 'Do Minimum' scenario, whilst the various improvements that have been made to the 'Do Something' scenario are set out in Technical Note 29 and T4: Local Plan Transport Model Forecasting Report - Consultation Option January 2020.

3.3 Reflecting the delayed launch date

3.3.1 Due to the Covid-19 pandemic, the anticipated launch date of the CAZ has been delayed from 2021 to 2022. Within the modelling suite, the years 2021, 2023 and 2025 can be directly modelled, with interim years estimated via an interpolation process. GM has agreed an approach to representing the 2022 launch date with JAQU[6] and this report presents results from the 2023 and 2025 models only, with interpolated results for 2024.

[6] For details of GM's proposed methodology, see Appendix D and for JAQU's letter of approval see Appendix C to this report.

3.4 Reflecting the impacts of the Covid-19 pandemic in the modelling approach

3.4.1 To understand the wider impacts of COVID-19 the GM CAP team have undertaken an assessment of the possible impacts of COVID-19 to inform a number of technical briefing note for decision makers. The results of this assessment are set out in an Impacts of Covid-19 Report[7].

3.4.2 GM have been in regular liaison with JAQU's technical team to agree methodology, seek guidance and inputs and share early results emerging from the pandemic throughout 2020 and 2021. JAQU supplied written guidance, set out in **Table 3-1**, to inform local authorities how to consider Covid-19 impacts, what sensitivity testing they would like local authorities to carry out and how to consider Covid-19 within economic appraisal and distributional impact assessments. This has been reflected within GM's work programme.

3.4.3 JAQU has approved GM's methodology to assess Covid-19 impacts and reflect those impacts within the modelling and analysis process.

3.4.4 There remains considerable uncertainty with regards to the potential impacts of COVID-19 on travel patterns and services. However, it is already clear that, as a result of the pandemic, vehicle owners will not be starting from the same position as had been previously assumed in terms of their fleets.

3.4.5 Capital investment in replacement vehicles has been delayed and as a result the fleet on GM's roads is older and more non-compliant than would otherwise have been the case, worsening emissions. In particular, the car and taxi fleets are estimated to be up to a year older as a result of the pandemic, and these lost upgrades are not expected to be recovered by 2025. LGV upgrades have also been delayed, but the current sales trajectory suggests that much of this delay will have been recovered by 2025.

3.4.6 As a result, the modelling has been updated to reflect an older and more non-compliant fleet of cars, taxis and LGVs in the 'Do Minimum' and 'Do Something' scenarios.

3.4.7 A change has been applied to the cost modelling process such that those non-compliant LGVs and taxis - hackney carriage and PHV - that would have upgraded to a compliant vehicle without the pandemic but have not done so are assumed not to upgrade as a result of the GM CAP.

3.4.8 Overall, the delay to fleet upgrades has the effect of worsening emissions from those vehicle fleets and brings more taxis and LGVs in scope for charging than previously assumed. Sensitivity testing identified the age of the fleet as the most impactful factor, so by incorporating changes within the

[7] Supplied as Appendix 5 to the June 2021 GMCA report 'Greater Manchester Clean Air Plan'

core scenario at this stage GM is less sensitive to the impacts of the pandemic.

3.4.9 In terms of the vehicles in scope for the scheme, bus and commercial vehicle traffic has largely returned to pre-pandemic levels (taxi and coach travel remain suppressed). Therefore, it is reasonable to assume that the prior assumptions about traffic volumes for these vehicle types remain valid.

3.4.10 Uncertainty remains around car traffic. Although there is some evidence that, for example, commuter traffic may not return to pre-pandemic levels, GM has taken the conservative approach of assuming that car traffic volumes remain as previously forecast. This is in line with JAQU guidance. Sensitivity testing carried out at OBC suggested that GM was not highly sensitive to small changes in car traffic; further sensitivity testing will be carried out at FBC.

3.4.11 Any other possible impacts of the pandemic that have been identified by GM as plausible and potentially impactful will be considered via sensitivity testing, reflecting JAQU's guidance and continued uncertainty as to the longer-term impacts of the pandemic.

Table 3-1: Covid-19 related JAQU guidance and GM's response

Date received	JAQU guidance	GM response (all approved by JAQU)
26/05/2020	Requesting sensitivity testing of the 'with measures' scenarios wherein the natural fleet turnover is 'paused' at the level of the previous year; and a second sensitivity test applying a 0% upgrade in response to a CAZ scenario.	GM has conducted sensitivity testing of the impact of a one-year-older fleet. GM agreed with JAQU that a 0% upgrade response test would not be informative in the GM CAP context, as it would be essentially a near Do Minimum position. Instead, GM has conducted a number of sensitivity tests of the assumed behavioural responses. The results of these tests are summarised in the Report: Impacts of Covid-19 on the GM CAP
17/07/2020	Guidance on considering the possible effect of Covid-19 on the economic analysis of the plan, including the value for money assessment, distributional impact and the development of Clean Air Fund bids.	GM has undertaken sensitivity testing of the possible effects of Covid-19 on the value for money assessment, based on a methodology as agreed with JAQU. GM has also carried out a review of the distributional impacts assessment and produced supporting analysis of the impact of the pandemic on each vehicle type in scope for charging under the proposed GM CAZ C.
22/02/2021	Ministerial guidance on the approach to be taken by local authorities in representing the impacts of Covid-19 on their Clean Air Plans (see **Appendix A**). This guidance sets out a Red/Amber/Green (RAG) rating determining whether local authorities are able to apply the results of sensitivity testing of a given factor within their central scenario i.e. whether Covid-related changes to assumptions can be incorporated within the core modelling scenario, or whether they should be considered as sensitivity tests.	GM has conducted a review of the JAQU guidance and considered an approach to revising the modelling methodology in accordance with this guidance and reflecting both (i) sensitivity testing determining which factors could impact the GM CAP and (ii) locally collected evidence on the extent to which these impacts are being realised as a result of the pandemic. GM's approach to revising the local modelling methodology to represent the impacts of Covid-19 is set out in this note, alongside a supporting discussion of the impact of Covid-19 on uncertainty and how this will be reflected within the core scenario and sensitivity testing. (See **Appendix A, Annex 1** for description of RAG rating)

3.5 Other changes to the modelling approach since consultation

3.5.1 GM has reviewed the assumptions underpinning the highway assignment modelling including bus services and fleet, taxi upgrade assumptions, traffic volumes and composition and future schemes.

3.5.2 Since the previous review of bus services, a fleet of zero emission buses has been deployed on routes in the city centre and further zero emission buses are funded and planned to be in operation from 2023. The highway model will be updated to reflect these new buses, operating on the following services:

- 111, 43 (Chorlton to Manchester City Centre, Manchester Airport to Manchester City Centre) – from 2020.
- Manchester Metroshuttle Free Bus Services (within the City Centre) – from 2023.
- Vantage services (operating through Salford to Manchester City Centre, including along the A34 Bridge St/John Dalton St) – from 2023.

3.5.3 In addition, following the feedback from consultation, evidence of the impact of Covid-19 on the trade, research and stakeholder engagement with the taxi trade, GM has revised its assumption about the proportion of taxis that will upgrade to ZEC, rather than a compliant Euro 6 vehicle, to make it more conservative. It is possible that future regulatory reform, licensing policy, or the impact of investment in charging infrastructure will mean that more taxis than forecast upgrade to ZEC.

3.5.4 The values of time and distance that are used in the Saturn model assignments have been updated based on values of time, GDP growth rates and vehicle operating costs derived from the latest TAG data book, July 2020. This produced modest changes in the assignment parameters and minor changes in routing.

3.6 Considering modelling uncertainty

3.6.1 GM have followed Government guidance in terms of considering modelling uncertainties. A discussion of uncertainty in the modelling of the Option for Consultation is set out in the Analytical Assurance Statement[8].

[8] Available at https://assets.ctfassets.net/tlpgbvy1k6h2/H7Az0lK4HE78gzyZz0YPy/8a0c304567c41293ac6262d291777405/Analytical_Assurance_Statement.pdf

3.6.2 GM have considered the impacts of Covid-19 on the GM CAP, as set out in the 'Impacts of Covid-19 on the GM CAP Report'[9] and have specifically considered the impact on uncertainty, in line with Government guidance. At the time of writing, the UK is still operating under pandemic-related restrictions on activity and travel. It is therefore too early to say with certainty what the impacts of Covid-19 will be post-pandemic on behaviour, travel patterns, businesses and the economy. The Government's guidance on reflecting the impacts of Covid-19 within the modelling is set out in Appendix A and GM's proposed approach to representing the impact of Covid-19 in core modelling scenarios is set out in Appendix D. This includes a discussion of uncertainty, as section 7 of Appendix D; concluding that there is greater uncertainty as a result of the pandemic, with some aspects potentially worsening air quality and others potentially providing air quality improvements. Overall, Appendix D concludes that it is very unlikely that any improvements to air quality would be of a sufficient scale to mean that action was no longer required.

3.6.3 In order to achieve compliance in the shortest possible time, GM needs to progress the modelling underpinning the GM CAP based on a set of reasonable assumptions about the medium-to-long term impacts of the pandemic. GM has supplied in this report its best estimates of what is likely to happen based on the available evidence.

3.6.4 Nonetheless, uncertainty remains and as a result, sensitivity testing is planned and underway to consider the possible impacts of delayed development plans, increased homeworking, changes to GDP, impacts on public transport, and changes to vehicle purchasing costs and the affordability, feasibility or appeal of upgrade as a result of the pandemic. Sensitivity testing will also be conducted to assess the possible impact of other factors affecting certainty, unrelated to the pandemic.

3.6.5 If the sensitivity testing identifies any potential issues with the plan as it stands, this will indicate that adaptive planning is required and GM will need to work with JAQU to agree mechanisms to facilitate this. Adaptations could include reviewing the charge levels; funding offers; or eligibility criteria for funding, with the aim of further encouraging upgrade if it appears that more people are choosing to stay and pay than forecast. GM could also review permanent discounts and exemptions if it becomes apparent that non-compliant vehicles constitute a greater proportion of the on-the-road fleet than expected.

[9] Supplied as Appendix 5 to the June GMCA Report 'Greater Manchester Clean Air Plan'

3.6.6 Once the plan is in place, monitoring will be required to ensure that the policy and proposals contained in the GM CAP remain appropriate throughout the lifetime of the interventions. GM will ensure that the Monitoring and Evaluation Plan sets out to address issues where uncertainty remains as to post-pandemic conditions (or for other reasons), as identified in the sensitivity testing, and for example in terms of vehicle fleets, travel patterns and the provision of bus services. If the monitoring reveals issues with the performance of the measures that form the plan, again, an adaptive planning approach will be required, such that GM and JAQU can agree any changes to the plan that would make it more effective.

3.7 Summary of changes to the modelling approach since consultation

3.7.1 In summary, GM has made the following changes to the modelling process since consultation:

- Representation of delayed CAZ launch date of 2022;
- Apply a delay to normal fleet upgrades to the private car, van, and taxi fleets;
- Apply a change to the cost modelling process such that those non-compliant LGVs and taxis - hackney carriage and PHV - that would have upgraded to a compliant vehicle without the pandemic but have not done so are assumed not to upgrade as a result of the GM CAP;
- Update to bus fleet reflecting current deployment of zero emission buses;
- Revision of assumptions about taxi upgrade to ZEC; and
- Updates to assumed values of time and distance, reflecting latest Government guidance.

4 Representation of the proposed final GM CAP Policy within the modelling approach

4.1.1 The following changes have been made to the package as modelled to reflect the post-Consultation proposed final GM CAP Policy and how this has changed from the Policy for Consultation.

4.2 CAZ Charges

4.2.1 No changes to CAZ charges from the Option for Consultation. Assumed CAZ charges are:

- £60 daily charge – HGV, Bus, Coach;
- £10 daily charge – LGV, Minibus; and
- £7.50 daily charge – Taxi (Hackney & PHV)[10].

4.3 Temporary Exemptions

4.3.1 Temporary exemptions have been extended to end May 2023 for LGVs, minibuses and coaches. Within the modelling, charges assumed to apply to those vehicle types for 2023 (where they are directly modelled).

4.3.2 All GM licensed taxis (Hackneys & PHVs) will be temporarily exempt from the CAZ charge until the end of May 2023, whereas previously only WAV taxis were proposed to be exempt. This will affect the modelling of earlier years but does not impact on the modelling for 2023, 2024 and 2025 as presented here.

Grant Levels

4.3.3 Updated grant levels as modelled are discussed in **Tables 4-1 and 4-2**. It is not possible to reflect the full range of grant options available to vehicle owners within the models, and therefore the tables set out the simplified representation of the grant offer as modelled.

4.3.4 Constraints have been applied within the modelling to reflect the total amount of funding available for each vehicle type. It is not possible to perfectly replicate the funding totals and therefore the constraints applied mean that somewhat less funding is applied within the modelling than will be available in practice. Therefore, the models slightly under-estimate uptake of funds and potentially the total upgrade response for LGVs. This was considered more cautious and appropriate than allowing the funding uptake within the modelling to exceed the total funding allocation.

[10] Note – the package modelling includes an assumption of a discount in PHV charges for use more the 5 days per week, where the CAZ charge is capped at the 5 day charge. This proposal has now been removed from the policy, but remains within the package modelling. Removing this discount from the modelling, would support a further increase in PHV upgrade response, but analysis shows that the impact would be very small.

Table 4-1: Grant and Retrofit Offers for Commercial Vehicles to be applied in the Cost Response Models

	Option for Consultation	Revised Grant Level
Mode:	**LGV**	
Euro 6 Grant	£3,500 all LGVs	£3,500 1.6t, £4,500 3.5t
Retrofit Grant	n/a	£5,000
Mode:	**HGV**	
7.5t	£2,500	£5,000
18t	£3,500	£7,000
26t	£4,500	£9,000
32t	£5,500	£12,000
44t	£4,500	£6,500
Retrofit		Up to £16,000 (off model calculation assumes £3m allocation)

Table 4-2: Grant and Retrofit Offers for Taxis to be applied in the Cost Response Models

	Option for Consultation	Revised Grant Level
Mode:	**PHV**	
Grant Euro 6	£3,000	£3,000
Grant EV	£3,000	£6,000
Retrofit	n/a	n/a
Mode:	**Hackney (WAV)**	
	London Style	**WAV**
Grant Euro 6	n/a	£5,000
Grant EV	£10,000	£10,000
Retrofit	£5,000	£5,000 (WAV only)
Mode:	**Hackney (Non-WAV)**	
	Non-London	**Non-WAV**
	n/a	As Revised PHV

4.3.5 Measures to promote the increased uptake of electric vehicles have been modelled using the taxi cost response model to assess the behavioural responses to the CAP and the introduction of incentives for operators to upgrade their vehicles. For the Consultation modelling it was estimated that approximately 15% of taxi and private hire car drivers who operate a compliant vehicle would either purchase an electric vehicle or choose to lease an electric vehicle. A more pessimistic assumption based on the revised behavioural model has been adopted for the latest forecasts, assuming that 3% of taxi drivers would upgrade to an electric vehicle. The air quality impacts of this assumption have been modelled post assignment by reducing the compliant taxi flows that are output from the Saturn model (and that are input to EMIGMA) by 3%, based on the assumption that electric vehicles generate zero emissions at the exhaust.

4.3.6 The forecast behavioral responses generated due to the updated package modelling are presented in **Appendix B**.

5 Emissions in the Do Minimum and Do Something scenarios

5.1 Modelled scenarios

5.1.1 This section sets out the results of emissions modelling. Modelling has been undertaken for the following scenarios:

- **Do Minimum**, which represents what is forecast to happen in the absence of the CAP proposals; and
- **Final GM CAP Policy** – the Do Something, which represents what is forecast to happen when the GM CAP is introduced.

5.2 Mass Emissions Outputs

5.2.1 Summary results from the EMIGMA modelling for the tests are presented below in **Table 5-1**, which shows modelled mass NOx emission totals for 2023 and 2025 for Greater Manchester as-a-whole, disaggregated by vehicle type.

5.2.2 The results indicate that the CAP is forecast to deliver reductions in mass NOx emissions of approximately 20% relative to the Do Minimum in 2023 and 15% in 2025. These figures are similar to the results for the Consultation Option modelling, which forecast that the Consultation proposals would deliver reductions in NOx of about 22% (relative to the consultation Do Minimum) in 2023 and 17% in 2025.

5.2.3 It should be noted that overall emissions in post-Consultation Do Minimum are approximately 3% greater than the Do Minimum scenario used for the Consultation in 2023 as a result of the increased age of the car, LGV and taxi fleets due to Covid-19. This total mass emissions value also includes a reduction in emissions associated with new electric buses, but these emission improvements are confined to specific bus route corridors.

Table 5-1 Mass NOx Emission Totals from EMIGMA Modelling (Greater Manchester, Tonnes per Year, with Percentage Changes Relative to the Do Minimum)

2023						
Scenario	**Car**	**LGV**	**HGV**	**Taxi**	**Bus**	**Total**
Do-Minimum	2,799	1,887	796	357	484	6,324
Final Post-Consultation Package	2,803	1,475	378	316	106	5,078
% Change (DM)	0.1%	-21.9%	-52.5%	-11.6%	-78.0%	-19.7%
2025						
Scenario	**Car**	**LGV**	**HGV**	**Taxi**	**Bus**	**Total**
Do-Minimum	2,412	1,610	523	294	344	5,183
Final Post-Consultation Package	2,412	1,287	312	271	106	4,389
% Change (DM)	0.0%	-20.1%	-40.4%	-7.9%	-69.0%	-15.3%

Notes:

Taxis comprise Private Hire Vehicles and Hackney Carriages combined

% Changes for the Final Post-Consultation Package are relative to the Do Minimum

Totals may not sum due to rounding

6 Air Quality in the Do Minimum and Do Something scenarios

6.1 Overview

6.1.1 This section sets out the results of air quality modelling for the Do Minimum and Do Something scenarios.

6.2 Air quality in the Do Minimum scenario

6.2.1 **Table 6-1** summarises the Consultation modelling results, and the updated modelling post-Consultation incorporating the impacts of Covid-19 results for the Do Minimum years of 2023 and 2025, 2021 model results have not yet been completed. The location of the predicted exceedances in each year are shown in **Figures 6-1 and 6-2** with the spatial pattern closely resembling that in the Consultation modelling.

6.2.2 There is an increase in the number of points of exceedance in 2023 from the Consultation model Do Minimum (from 69 to 71). This is primarily associated with the wider road network outside of the regional centre where car and van emissions have increased due to an older fleet profile due to Covid-19, leading to increases in NO_2 concentrations of typically 0.5 µg/m^3 up to 1.0 µg/m^3. However, on the route corridors where the new electric buses will operate there are improvements, with a reduction in exceedances inside the Inner Ring Road (IRR) on these routes.

6.2.3 By 2025, the number of exceedances reduces due to the natural upgrade of the vehicle fleet, which is expected to continue despite the depressive effect of Covid-19 on some markets, and which has been accounted for where relevant. Compared with the Consultation Do Minimum scenario, there has been a decrease in the overall number of exceedances (from 12 to 11). This is because the most persistent exceedances which still remain are predominantly associated with bus routes, and a proportion of these will now have electric buses in operation.

6.2.4 There are predicted to be exceedances in all districts with the exception of Oldham and Wigan in the Do Minimum scenarios for 2023[11]. By 2025, exceedances are only predicted in Manchester, Salford, and Bury, which is consistent with the Consultation modelling scenarios.

6.2.5 The updated modelling shows results consistent with the methodological modelling alterations described previously. The locations where car and van flows are greatest have an increased number of exceedances, typically sites classed as ‘Other Locations’. Those sites in the IRR where bus contributions are most significant have a decreased number of exceedances due to the presence of electric buses. The last points of exceedance (11 in total) in 2025 still remain at:

[11] Note that analysis carried out based upon the Do Minimum modelling as at consultation suggested that all local authorities would remain non-compliant in 2022. Updated analysis for 2022 has not yet been completed.

- Inside the IRR, including the A34 Bridge St /John Dalton St;
- A57 Regent Rd, Salford;
- A6 Chapel St, Salford; and
- A58 Bolton Road, Bury.

Table 6-1: Predicted annual mean NO_2 concentrations at points on the Greater Manchester road network – 2021 (Consultation Option version only), 2023 and 2025 without further action ('Do Minimum')

Consultation Option Data – Do Minimum

Road classification[12]	Compliant sites		Non-compliant sites			
	Very compliant (below 35 µg/m³)	Compliant but marginal (35 to 40 µg/m³)	Non-compliant (>40 to 45 µg/m³)	Very non-compliant (>45 to 50 µg/m³)	Extremely non-compliant (>50 µg/m³)	Total non-compliant (>40 µg/m³)
2021						
Inside Manchester-Salford Inner Relief Route (IRR)	150	72	29	19	5	**53**
Urban centres	170	48	14	5	0	**19**
Other locations	1,531	365	100	25	6	**131**
Total	**1,851**	**485**	**143**	**49**	**11**	**203**
2023						
Inside IRR	205	39	21	9	1	**31**
Urban centres	213	20	4	0	0	**4**
Other locations	1,869	150	30	4	0	**34**
Total	**2,287**	**209**	**55**	**13**	**1**	**69**
2025						
Inside IRR	240	27	8	0	0	**8**
Urban centres	233	4	0	0	0	**0**
Other locations	1,990	78	4	0	0	**4**
Total	**2,463**	**109**	**12**	**0**	**0**	**12**

Post-Consultation including Covid-19 Data – Do Minimum

Road classification[3]	Compliant sites		Non-compliant sites			
	Very compliant (below 35 µg/m³)	Compliant but marginal (35 to 40 µg/m³)	Non-compliant (>40 to 45 µg/m³)	Very non-compliant (>45 to 50 µg/m³)	Extremely non-compliant (>50 µg/m³)	Total non-compliant (>40 µg/m³)
2021						
Inside Manchester-Salford Inner Relief Route (IRR)	n/a	n/a	n/a	n/a	n/a	n/a
Urban centres	n/a	n/a	n/a	n/a	n/a	n/a
Other locations	n/a	n/a	n/a	n/a	n/a	n/a
Total	n/a	n/a	n/a	n/a	n/a	n/a
2023						
Inside IRR	209	37	21	8	0	**29**
Urban centres	210	23	4	0	0	**4**
Other locations	1,847	145	31	7	0	**38**
Total	**2,266**	**205**	**56**	**15**	**0**	**71**
2025						
Inside IRR	245	23	7	0	0	**7**
Urban centres	233	4	0	0	0	**0**
Other locations	1,991	35	4	0	0	**4**
Total	**2,469**	**62**	**11**	**0**	**0**	**11**

n/a: Results for 2021 are not available for the Post-Consultation modelling

Note: The total number of predicted points and distribution of those points changes between 2021 and 2023/2025 due to planned changes to the road network.

12 "Inside Inner Relief Route" is the area encircled by the Inner Relief Route. "Urban centres" are areas that met a definition used for the purposes of air quality modelling for OBC Option testing. "Other locations" are roads outside of Urban centres and the Inner Relief Route.

Figure 6-1: Do Minimum Exceedances in 2023, updated modelling post-consultation and with Covid-19 impacts

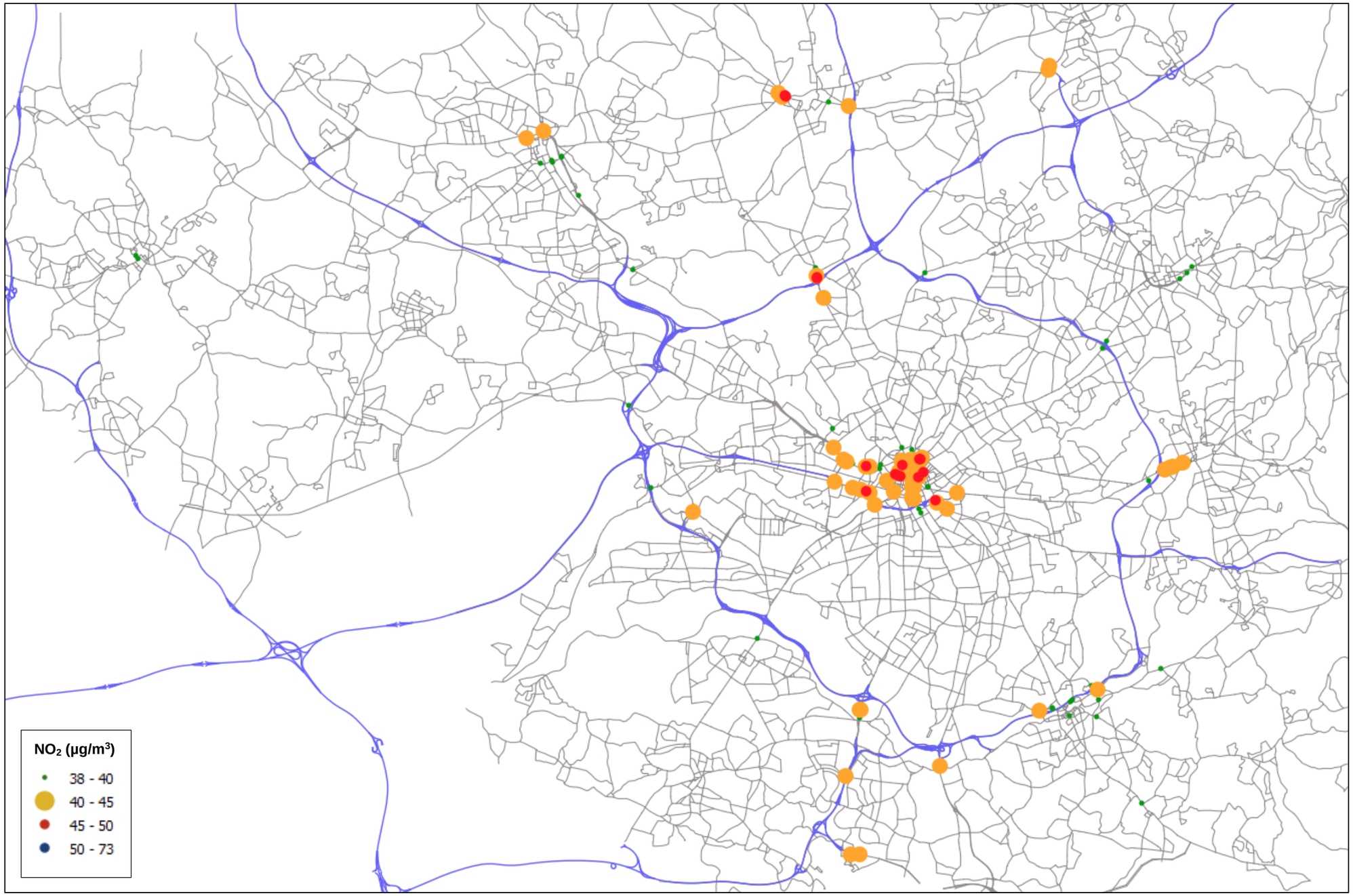
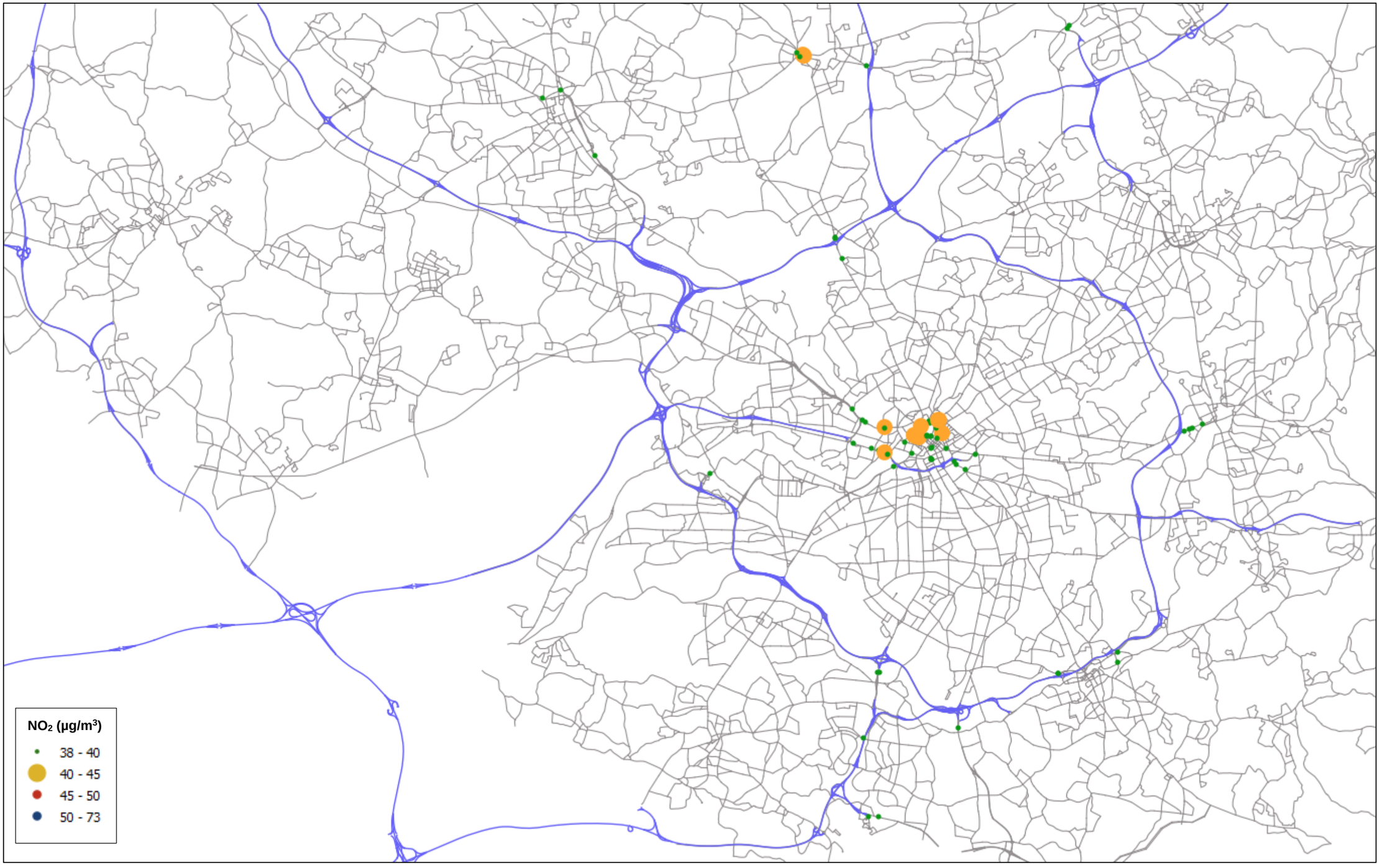


Figure 6-2: Do Minimum Exceedances in 2025, updated modelling post-consultation and with Covid-19 impacts



6.3 Air quality with the final GM CAP Policy

6.3.1 The section summarises the Consultation Option results and the Final Post-Consultation GM CAP Policy, including the impacts of Covid-19, for 2023 and 2025. The exceedances in 2023 are shown in **Figure 6-3**, there are no exceedances remaining in 2025.

6.3.2 With the Final Post-Consultation GM CAP Policy, in 2023 when the GM CAP is fully opened with all measures in place, the proposed scheme is predicted to reduce the number of exceedances from 71 down to 5. These are located at the:

- A34 John Dalton St & Bridge St, Manchester (2 exceedances)
- A58 Bolton Road, Bury (2 exceedances)
- A57 Regent Road, Salford (1 exceedance)

6.3.3 However, in 2024 with an extra year of natural fleet turnover, the additional improvement means that there are no exceedances predicted in GM as a result of the reduction in vehicle emissions produced by the CAP. The 2024 concentrations are calculated by linear interpolation of the 2023 and 2025 model years.

6.3.4 Therefore, 2024 is the first year of compliance within Greater Manchester. This is the same year as produced by the Consultation Option, and meets the requirements of the Ministerial Direction for the local plan for NO_2 compliance by 2024 at the latest. This is three years earlier than the year of compliance predicted without the GM CAP in place. Achieving compliance in Greater Manchester is not possible sooner with the other options that have been suggested.

6.3.5 The points of compliance with the highest concentrations are the A58 Bolton Road, Bury and A57 Regent Road, Salford which in 2024 are both 40.3 µg/m^3 [13]. These sites have received an improvement of 4.8 ug/m^3 and 4.3 µg/m^3, respectively. **Table 6-2** shows the number of sites by local authority, and **Table 6-3** shows the number of sites by scale of exceedance with the Consultation Option and Final GM CAP Policy.

[13] Noting that values under 40.5 are considered to be compliant.

Table 6-2: Number of sites remaining in exceedance of legal limits for NO2 concentrations by year, Greater Manchester, by local authority

Consultation Option Data

LA	2021		2023		2024 (Interpolated)		2025	
	Do Min	Cons. Option	Do Min	Cons. Option	Do Min	Cons. Option	Do Min	Cons. Option
Bolton	13	6	1	0	1	0	0	0
Bury	16	7	8	1	4	0	1	0
Manchester	76	22	39	4	20	0	9	0
Oldham	9	1	0	0	0	0	0	0
Rochdale	5	2	2	0	2	0	0	0
Salford	36	10	11	0	4	0	2	0
Stockport	21	5	3	0	0	0	0	0
Tameside	13	5	4	0	0	0	0	0
Trafford	7	0	1	0	0	0	0	0
Wigan	7	0	0	0	0	0	0	0
GM Total	**203**	**58**	**69**	**5**	**31**	**0**	**12**	**0**

Final GM CAP Policy Data

LA	2021		2023		2024 (Interpolated)		2025	
	Do Min	Final Package	Do Min	Final Package	Do Min	Final Package	Do Min	Final Package
Bolton	n/a	n/a	2	0	1	0	0	0
Bury	n/a	n/a	9	2	6	0	2	0
Manchester	n/a	n/a	38	2	18	0	7	0
Oldham	n/a	n/a	0	0	0	0	0	0
Rochdale	n/a	n/a	2	0	2	0	0	0
Salford	n/a	n/a	12	1	6	0	2	0
Stockport	n/a	n/a	3	0	1	0	0	0
Tameside	n/a	n/a	4	0	1	0	0	0
Trafford	n/a	n/a	1	0	0	0	0	0
Wigan	n/a	n/a	0	0	0	0	0	0
GM Total	n/a	n/a	**71**	**5**	**35**	**0**	**11**	**0**

n/a: Results for 2021 are not yet available for the Post-Consultation modelling

Table 6-3: Number of sites by scale of exceedance by year, Greater Manchester road network - 2021, 2023 and 2025

Consultation Option Data

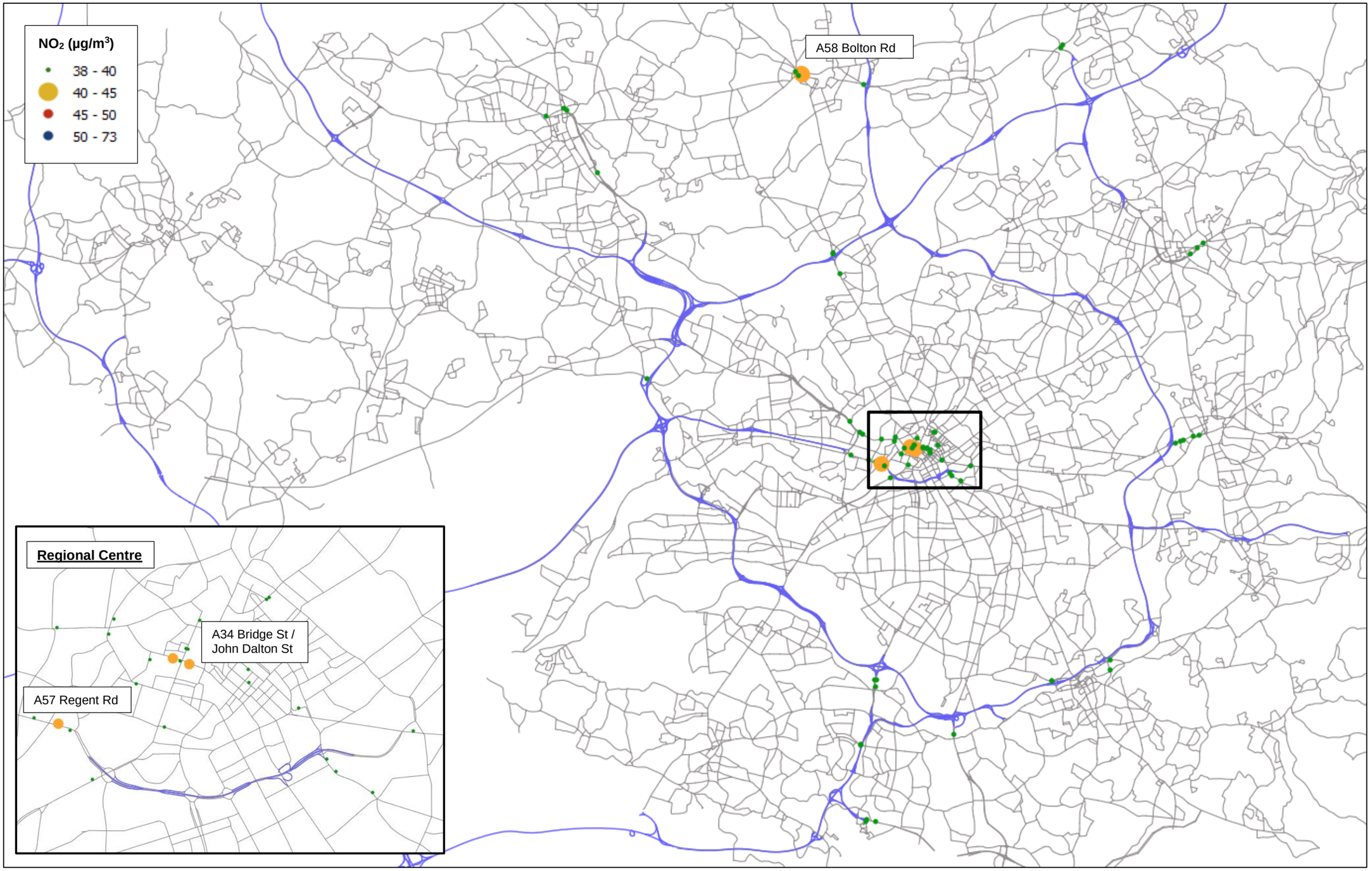
Scheme Option	Compliant sites		Non-compliant sites			
	Very compliant (below 35 µg/m^3)	Compliant but marginal (35 to 40 µg/m^3)	Non-compliant (>40 to 45 µg/m^3)	Very non-compliant (>45 to 50 µg/m^3)	Extremely non-compliant (>50 µg/m^3)	Total non-compliant (>40 µg/m^3)
2021						
Do Minimum	1,851	485	143	49	11	**203**
Consultation Option	2,266	216	52	5	0	**57**
2023						
Do Minimum	2,287	209	55	13	1	**69**
Consultation Option	2,486	33	5	0	0	**5**
2025						
Do Minimum	2,463	109	12	0	0	**12**
Consultation Option	2,522	9	0	0	0	**0**

Final GM CAP Policy Data

Scheme Option	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						
Do Minimum	n/a	n/a	n/a	n/a	n/a	n/a
Final Post-Consultation Package	n/a	n/a	n/a	n/a	n/a	n/a
2023						
Do Minimum	2266	205	56	15	0	**71**
Final Post-Consultation Package	2471	66	5	0	0	**5**
2025						
Do Minimum	2469	62	11	0	0	**11**
Final Post-Consultation Package	2,526	16	0	0	0	**0**

n/a: Results for 2021 are not yet available for the Post-Consultation modelling

Figure 6-3: Final Post-Consultation Package 2023 Exceedances



7 Summary & Conclusions

7.1.1 This report sets out the changes to, and results of, modelling to forecast air quality in GM, taking into account the impacts of COVID-19, new investment in ultra low emission buses, and reflecting the revised GM CAP Final Policy based on the outcomes of the consultation.

7.1.2 These changes to the modelling apply the assumptions, methodology and sensitivity tests developed in agreement with JAQU based on the extant JAQU guidance for assessing the impact of Covid-19 provided to GM.

7.1.3 The report sets out the results of the Do Minimum and Do Something modelling scenarios, in other words, the forecast air quality with and without the GM CAP, and also compares these with the air quality modelling results for the Option for Consultation. The modelling has been conducted for 2023 and 2025, with results interpolated for 2024.

7.1.4 The impact of Covid-19 is expected to slow the natural turnover of vehicle fleet, as a result of lost new vehicle sales for cars, LGVs and taxis during 2020/21. This has the effect of increasing vehicle emissions in the future worsening air quality predictions, and also increases the number of non-compliant LGVs and taxis in-scope for the CAZ charge. In contrast the investment in electric buses will reduce emissions in both the Do Minimum and Do Something scenarios, along the specific route corridors of operation.

7.1.5 The results of the air quality modelling show that there is a slight increase in the number of points of exceedance in 2023 from the Consultation model Do Minimum (from 69 to 71), and a decrease in 2025 (from 12 to 11). There is a worsening on the general road network where car and LGV emissions have increased due to an older fleet resulting from delayed investment due to Covid-19. However, on the route corridors where the new electric buses will operate there are improvements, with a reduction in exceedances inside the IRR on these routes.

7.1.6 The reason that there is a slight decrease in 2025 versus an increase in 2023 is because the most persistent exceedances which still remain in 2025 are predominantly associated with bus routes, and a proportion of these will now have electric buses in operation.

7.1.7 There are predicted to be exceedances in all districts with the exception of Oldham and Wigan in the Do Minimum scenarios for 2023[14]. By 2025, exceedances are only predicted in Manchester, Salford, and Bury, which is consistent with the Consultation modelling scenarios. Modelling has not yet been updated for the pre-2023 scenario, but it is expected that all GM authorities would be in exceedance in 2022 without the CAP.

[14] The scale and distribution of exceedances remains similar to the forecast as set out in the OBC. The OBC sets out the options appraisal process which determined that a GM-wide CAZ C with supporting measures was the best performing option to achieve compliance in the shortest possible time, and that measures involving local CAZs did not achieve compliance as quickly. See OBC documentation at Technical Documents | Clean Air Greater Manchester (cleanairgm.com)

7.1.8 The key last points of exceedance (11 in total) in 2025 still remain at:

- Inside the IRR, including the A34 Bridge St /John Dalton St;
- A57 Regent Rd, Salford;
- A6 Chapel St, Salford; and
- A58 Bolton Road, Bury.

7.1.9 For the Final Post-Consultation Package, in 2023 when the GM CAP is fully opened with all measures in place the proposed scheme is predicted to reduce the number of exceedances from 71 down to 5. These are located at:

- A34 John Dalton St & Bridge St, Manchester (2 exceedances);
- A58 Bolton Road, Bury (2 exceedances); and
- A57 Regent Road, Salford (1 exceedance).

7.1.10 However, in 2024 with an extra year of natural fleet turnover, the additional improvement means that there are no exceedances predicted in GM as a result of the reduction in vehicle emissions produced by the CAP.

7.1.11 Therefore, 2024 is the first year of compliance within Greater Manchester. This is the same year as produced by the Consultation Option, and meets the requirements of the Ministerial Direction for the local plan for NO_2 compliance by 2024 at the latest. This is three years earlier than the year of compliance predicted without the GM CAP in place. Achieving compliance in Greater Manchester is not possible sooner with the other options that have been suggested.

7.1.12 Analysis has been conducted assessing the proposed discounts and exemptions, derived from the updated analysis. A report setting out the results of this analysis is supplied as Appendix E.

Appendix A: JAQU's guidance to local authorities, February 2021

Department for Transport

Department for Environment Food & Rural Affairs

Cllr Andrew Western
Trafford Council,
Trafford Town Hall,
Talbot Road,
Stretford,
M32 0TH

22 February 2021

Dear Andrew,

The Government is implementing the 2017 Air Quality Plan to ensure that compliance with roadside nitrogen dioxide concentrations is achieved in the shortest possible time. Due to the impacts of Covid-19, we are now operating in an environment of considerable uncertainty. Despite these uncertainties we must continue to deliver cleaner air. The future impact of the pandemic on traffic levels and nitrogen dioxide emissions/concentrations will be difficult to predict. Roadside nitrogen dioxide levels will be impacted in the short term by how quickly local traffic flows re-start and in the longer term by several factors (e.g. fleet evolution, home working, modal shift, etc). Analysis and modelling can provide an indication of possible outcomes, however, given the considerable uncertainty we must accept that there is a risk of putting in place clean air measures that overachieve, however, this is preferable to inaction which leads to poor air quality.

JAQU officials have been working with Local Authorities to review the impacts of Covid-19 on their delivery plans and NO_2 levels. Based on these conversations, the data LAs have supplied to us, discussions with our expert panel and our internal review of evidence, we are now in a position to confirm next steps as to how Covid-19 impacts can be applied to central scenarios.

LAs will be able to apply some, but not all, of the results of sensitivity tests to central scenarios, depending on the level of uncertainty associated with underlying assumptions and the impact of the result on the plan. JAQU (with TIRP steer) have RAG rated the sensitivity tests that LAs have discussed with us in **Annex 1**.

LAs can use the test results as follows:

- **"Green"** rated – results can be used to influence central scenario modelling due to a higher level of confidence in the evidence (lower level of uncertainty) and/or small impact on outcomes.
- **"Amber"** rated – results may be used to influence central scenario modelling if the LA has appropriate supporting evidence. The degree of change brought about by these results will also play a factor. JAQU will require the LA to make a strong case for their inclusion, which will be assessed by JAQU and TIRP, with

a recommendation given to Ministers as to whether JAQU supports inclusion of this impact in their core modelling.

- **"Red"** rated – due to the high level of uncertainty with these tests, LAs will not be able to use the results to influence central scenario modelling, however results can be included in business cases to indicate degree of shift possible within the plan.

LAs must note that the evidence required to support Covid-19 assumptions is expected to be of at least the same level of robustness as evidence included in plans as standard. Where evidence does not achieve the required standard the results from the sensitivity tests cannot be applied to the central scenario modelling but may be included as a sensitivity test in the business case submission. LAs that include Covid-19 impacts in the central scenarios will be expected to include KPIs to monitor and evaluate these in their Monitoring & Evaluation plan.

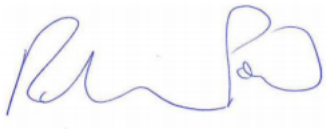
The steps for LAs who intend to apply Covid-19 impacts to their plans are set out in **Annex 2**. The process has been designed to minimise additional delays and provide a swift decision that will enable Local Authorities to proceed in finalising their plans and implementing their measures. LAs will be expected to proceed with applying any approved Covid-19 impacts following a single TIRP and JAQU recommendation and direction or letter (as appropriate). LAs will be expected to agree a timeline with JAQU officials on the submission of their sensitivity test results by 1st March 2021. After TIRP review it is anticipated that should any further modelling be required that an LA should complete this within a maximum of 8 weeks and be done in parallel to current work.

Please do not hesitate to contact your account manager if you have any questions.

Yours sincerely,

RACHEL MACLEAN

PARLIAMENTARY UNDER SECRETARY OF STATE FOR TRANSPORT



REBECCA POW

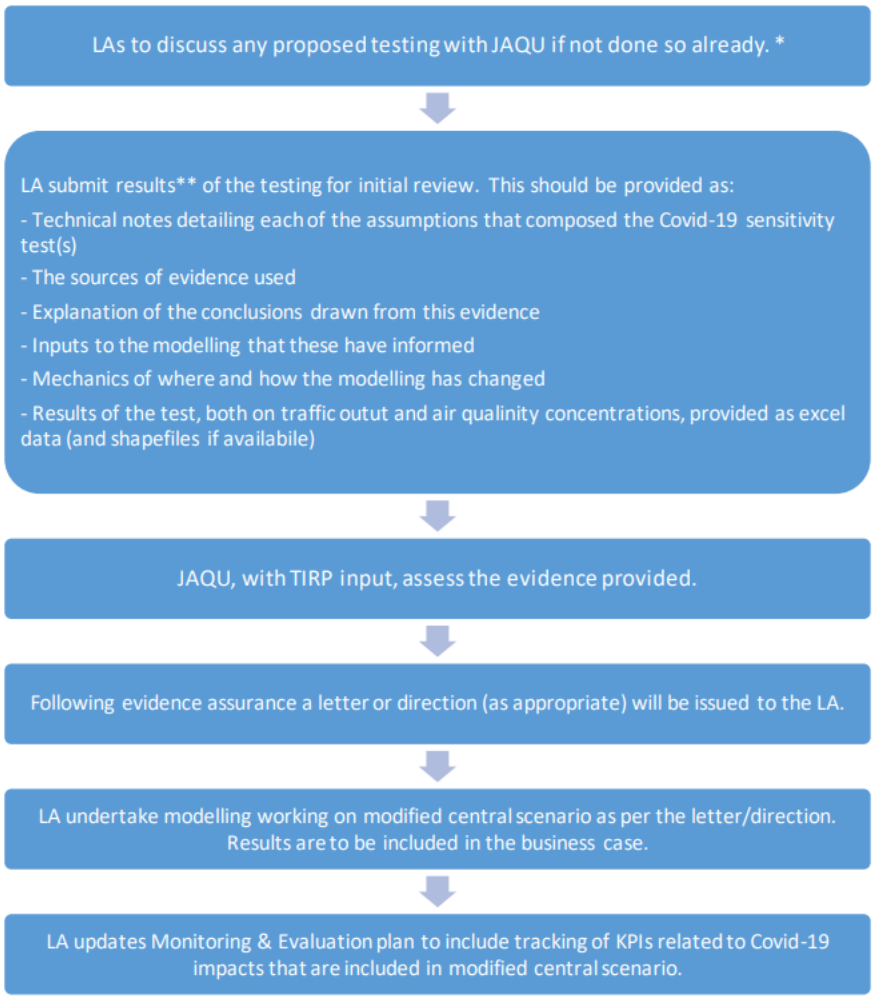
PARLIAMENTARY UNDER SECRETARY OF STATE FOR ENVIRONMENT AND RURAL AFFAIRS

Annex 1: RAG rating for sensitivity tests

Test & RAG status	Justification for categorisation and guidance on what evidence to include
Impacts of a CAZ implementation delay	• Robust evidence within LAs of any delay to CAZ go-live. • Delays simple to model.
Green recovery/measures	• Robust evidence as some LAs have developed measures that have been agreed and in places already implemented through other funding initiatives. • Impact of these tends to be highly localised (single roads, junctions, etc.)
Delayed development plans (new residential or commercial developments /infrastructure, etc.)	• Robust evidence as planning already in progress for these schemes. The original assumed demand for such schemes was known to the LA. • Only schemes of significant size will have a high impact, but most large schemes will have been considered already by LA modelling.
Fleet upgrade delay impacts	• Delay simple to model and national data readily available. • LA may have evidence to support such a delay derived from observed purchasing trends throughout 2020. • Fleet upgrade could be influenced by economic performance depending on timing of CAZ and length/depth of recession.
Reduction in CAZ charges	• LAs set these responses in their modelling based on either locally gathered surveys, central gov estimates or a literature review of similar schemes during plan development. • JAQU does not want to rule out (by putting in red) that an LA may be able to bring together a body of evidence that indicates an adjustment to these assumed response levels is warranted. • Note: JAQU central assumptions will not be updated at this time in respect to Covid-19.
Increased Stay & Pay response	• LAs set these responses in their modelling based on either locally gathered surveys, central gov estimates or a literature review of similar schemes during plan development. • JAQU does not want to rule out (by putting in red) that the LA is able to bring together a body of evidence that indicates an adjustment to these assumed response levels is warranted. • JAQU central assumptions will not be updated at this time in respect to Covid-19.
LGV/HGV change response	• Trend in goods vehicle trips and GDP growth tend to mirror each other.

	• LAs may be able to adequately source bespoke local evidence to warrant a change. Changes to this response would be inspired by local understanding of the types of businesses serviced in the CAZ area and the adaptation/ survival of those businesses post-Covid. • Note: JAQU central assumptions will not be updated at this time in respect to Covid-19.
Increased homeworking	• Level of continued homeworking post-Covid is highly speculative.
Shopping/Leisure trips (increase due to home working and/or reduction due to online shopping)	• Level of shopping and leisure trips post-Covid is highly speculative.
GDP impacts (reduced employment)	• GDP performance is highly speculative.
Impacts on public transport/modal shift (reduction in demand/capacity/supply)	• Short term aversion to public transport is driven primarily by the immediate threat of transmission of the virus so there is an expectation that this does not impact longer term behaviour. • Model limitations used in LA plans may prevent adequate modelling of these impacts (i.e. economic impact and social distancing; change in transport mode preference due to perceived fear of virus, cost of mode, etc.).
Change in car ownership assumptions	• We do not support inclusion of changes of these factors in central scenario modelling. • These factors are highly speculative (based on long term behaviours & GDP, as well as international factors). • Subcategory/consequence of GDP - wider economic, employment forecasting would need to be taken into account. Driven by length and depth of long/short term recession. Also dependent on price of oil/level of subsidy.
Changes to vehicle purchase costs/pricing (fare)	• Speculative (long term behaviours & GDP). • Subcategory/consequence of GDP - wider economic, employment forecasting would need to be taken into account. Dependent on price of oil/level of subsidy/fare.

Annex 2: Steps for LAs to follow



*LAs that have not submitted a baseline at IES stage should include green-rated tests in their baseline.

**Data needed: In addition to those items explained above, if LAs have tested a potential revised package of measures on top of the sensitivity test baseline, this should be provided for review.

***If they wish, LAs are welcome to update Monitoring & Evaluation plans to track KPIs associated with Covid-19 impacts that informed sensitivity tests but were not taken forward into the modified central scenario.

Appendix B: Output Behavioural Responses

The estimated behavioural response for the Final GM CAP Policy 'Do Something' scenario for each of the core modelled modes are presented below for the 2025 forecast year.

LGV (Trips)

	2023	2025
a) Pay Charge	17.8%	16.1%
b) Change Mode (to Car)	3.7%	0.0%
c) Cancel Trip	0.0%	0.0%
d) Upgrade Vehicle	78.6%	83.9%

HGV (Trips)

	2023	2025
Pay Charge	4.9%	1.9%
Change mode (to LGV)	0.0%	0.0%
Cancel Trip	0.0%	0.0%
Upgrade Vehicle	95.1%	98.1%

PHV (Trips)

	2023	2025
a) Pay Charge	19.1%	18.3%
b) Change Mode	0.0%	0.0%
c) Cancel Trip	0.1%	0.0%
d) Upgrade Vehicle	80.7%	81.7%

Hackneys (Trips)

	2023	2025
a) Pay Charge	14.7%	18.6%
b) Change Mode	0.0%	0.0%
c) Cancel Trip	0.0%	0.0%
d) Upgrade Vehicle	85.3%	81.4%

Appendix C: JAQU's approval of GM's proposed methodology for incorporating Covid-19 impacts with the modelling (May 2021)

Department for Environment Food & Rural Affairs

Department for Transport

Simon Warburton
Transport Strategy Director
TfGM
2 Piccadilly Place
Manchester M1 3BG

4 May 2021

Dear Simon,

The Government is implementing the 2017 UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations to ensure that compliance with legal nitrogen dioxide limits is achieved in the shortest possible time. As described in Minister Pow and Minister Maclean's joint letter dated 22 February 2021, due to the impacts of Covid-19, we are now operating in an environment of considerable uncertainty. Despite these uncertainties we must continue to deliver cleaner air.

Thank you for supplying the results of your sensitivity testing on the impacts of Covid-19 on your local plan. JAQU officials have reviewed the documents and considered the evidence provided along with advice from the Technical Independent Review Panel (TIRP). On this basis, JAQU will support the following impacts being included in your baseline modelling that you presented in "Proposed Approach to representing covid-19 in core modelling":

- Fleet Upgrade Delay
- Change in Implementation Year (2022)
- Green Recovery Measures
- Stay and Pay Changes (with outputs of "Option b" of Table 5.1 also presented, see Annex 1)

More detailed TIRP feedback can be found in Annex 1.

Due to the high level of uncertainty associated with the following impacts, JAQU will not support inclusion in your baseline modelling of the following elements, however they can be included in the business case as sensitivity tests to indicate the degree of shift possible within the plan:

- Delayed development plans

- Increased homeworking
- GDP impacts
- Impacts on Public Transport
- Changes to vehicle purchasing costs

Should you wish to monitor these aspects you are welcome to include additional KPIs in your Monitoring and Evaluation plan, however, you are not required to do so.

The application of the approved impacts to baseline modelling must be completed within 8 weeks from the date of this letter and be done in parallel to current work.

JAQU and the TIRP will review the outputs of these adjustments to baseline modelling, and the outputs to the post-consultation package modelling, in June.

Please do not hesitate to contact your account manager if you have any questions.

Yours sincerely,

ANDREW JACKSON
HEAD OF THE JOINT AIR QUALITY UNIT

Annex 1: TIRP feedback report on "Proposed approach to representing Covid 19 in core modelling"

From meeting of 27.4.2021

Section	Commentary	Agree with proposed changes?
3: 2022 model year	Very detailed explanation of method, thanks. It is fortunate that 2021 and 2023 both exist to allow an interpolation between two years with close proximity. Please highlight any risks around this approach and include them in the final reporting.	Yes, agree with proposed changes.
4: Fleet Upgrade Delay	Have examined the current position (what delay has occurred as of Jan 2021) and the current evidence base is well presented. A key assumption is that over the next 12 months there won't either be a "catch up" or indeed further delays, however the proposed approach represents a relatively neutral position. The sensitivities already explored (no upgrade delay and 1 year delay) provide useful benchmarks to the potential scale of impact. Please include these sensitivities the post-modelling AAS. The panel query whether wider TfGM plans (or the changes to plans that may have been precipitated due to covid) could play a part in the upgrade delay	Yes, agree with proposed changes.

	or any further delay or "catch up".	
5: adjusting behavioural responses	Speculation is impossible to avoid here however, option c of table 5.1 does follow evidentially from the fleet upgrade evidence presented in section 4. These pieces of evidence build the new construct in option c. Acknowledge that c is the more cautionary approach (in terms of impact on air quality) however it is difficult to decide which is the likelier to occur as neither b nor c have definitive evidence. Please consider whether it is feasible to perform both options to illustrate the scale of the difference between these two sensitivities.	If b were to be followed instead of c, how much of a difference in the transport outputs (extrapolated loosely through to emissions) would this make? Please include reference to this in reporting if c is selected.
7: adaptation to AAS	Thanks, these points are thoughtful and detailed. To what extent will these revisions affect work that's being done? Table provided illustrates vulnerabilities but does not specify whether action can/will be taken. If no action can feasibly be taken that is okay.	n/a
Further comments	GM have done a very good job in terms of capturing all the uncertainty.	n/a

Appendix D: GM's proposed approach to representing the impact of Covid 19 in core modelling scenarios

See separate document

Appendix E: Note 38: Discounts & Exemptions – updated with final GM CAP Policy

See separate document

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

Appendix 6D - GM's proposed approach to representing the impact of Covid 19 in core modelling scenarios

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Version Status:	DRAFT FOR APPROVAL	**Prepared by:**	Transport for Greater Manchester on behalf of the 10 Local Authorities of Greater Manchester
Date:	20 June 2021		

Contents

1 Introduction and context

1.1 Covid-19 Impacts on CAP Modelling

1.1.1 This Technical Note sets out GM's proposed approach to developing assumptions based on appropriate emerging evidence and projections of the Covid recovery. In response to JAQU's guidance of 22nd February 2021, it sets out how GM proposes to reflect Covid-19 impacts in GM's central Do Minimum and Do Something scenarios.

1.1.2 The definition of a preferred set of assumptions will then be based on the approach set out herein, for necessary GM governance and approvals, as well as agreement with JAQU. These preferred assumptions will then be used to define the modelling required for the FBC submissions. Wherever possible, these have been informed by central government guidance and the most recent available evidence.

1.2 Background

1.2.1 Greater Manchester (GM) district authorities have been mandated by the Government to to take quick action to reduce harmful Nitrogen Dioxide (NO2) levels, issuing a direction under the Environment Act 1995 to undertake feasibility studies to identify measures for reducing NO2 concentrations to within legal limit values in the "shortest possible time". In Greater Manchester, the 10 local authorities, the Greater Manchester Combined Authority (GMCA) and Transport for Greater Manchester (TfGM), collectively referred to as "Greater Manchester" or "GM", have worked together to develop a Clean Air Plan to tackle NO2 Exceedances at the Roadside, referred to as GM CAP.

1.2.2 The GM CAP is underpinned by a programme of transport, emissions and air quality modelling to identify the scale of the poor air quality challenge and to test the effectiveness of these specific measures and packages of measures in combination. This process is described in the following reports:

- Local Plan Transport Modelling Tracking Table (T1), which is a live document, that is intended to demonstrate that the modelling requirements for the study are being met;
- Local Plan Transport Highway Model Validation Report (T2), which explains in detail how the road traffic model was validated against real-world data in the base year (2016);
- Local Plan Transport Modelling Methodology Report (T3), which describes the approach taken to forecast traffic in 2021 and beyond to 2023 and 2025; and
- Local Plan Air Quality Modelling Tracker Table (AQ1) and Methodology Report (AQ2), which provides an overview of the air quality modelling process and evidence base.

1.2.3 These reports were published at OBC and were updated in January 2020 to support the consultation process.

1.2.4 The results of the analysis carried out at OBC were presented in the Strategic and Economic cases of the OBC and associated appendices, and in the following reports:

- Local Plan Transport Model Forecasting Report (T4), which describes the transport modelling process and results for the Greater Manchester Clean Air Plan Project; and
- Local Plan Air Quality Modelling Report (AQ3), which provides details of modelled NOx and NO_2 concentrations for the base and forecast years, including comparisons with measured concentrations for the base year.

1.2.5 Revised versions of the Local Plan Transport Model Forecasting Report (T4) and Local Plan Air Quality Modelling Report (AQ3) were produced in January 2020 setting out the process applied to testing of the Package for Consultation, and the results of that modelling.

1.2.6 The appraisal of the economic impacts and value for money of the GM CAP was presented in the Economic case of the OBC, and the methodology for this analysis is described in the following reports:

- E1 – Economic Appraisal Methodology Report;
- E2 – Economic Appraisal Model; and
- E3 – Distributional Impacts Report.

1.2.7 These reports were updated in November 2020 and submitted with the Interim Full Business Case, based on a pre-Covid 19 modelling position.

1.2.8 Final revisions of the Technical and Economic Reports will be carried out and submitted with the Full Business Case (FBC). These will apply the proposed revisions to the methodology as set out in note 'Proposed approach to representing the impacts of Covid 19 in the core scenario for the GM CAP' as well as any changes to the proposed package of measures post-Consultation.

1.2.9 GM decided to proceed with consultation on the basis of the Package for Consultation, based on pre-Covid 19 assumptions and modelling, and to include questions about the Covid 19 impact in that Consultation. The Consultation closed in December 2020. Analysis of the results of that Consultation is now underway and will be reported to the GMCA and ten local authorities in summer 2021, alongside a report summarising the modelled impact of the proposed changes on compliance. Any implications of the Consultation on the package of measures or modelling process have not yet been considered.

1.3 <u>Overview of the modelling process</u>

1.3.1 The modelling for the study is being undertaken using the CAP modelling suite as illustrated below in Figure 1-1:

Figure 1-1 CAP Modelling Suite

1.3.2 The modelling system consists of five components:

- The demand sifting tool, which 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 highway (Saturn) model, 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.
- The emissions model, which uses TfGM's EMIGMA (Emissions Inventory for Greater Manchester) 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.
- 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.

1.3.3 The purpose of the modelling is to identify the preferred option for delivering air quality compliance in the shortest possible time, and to provide supporting analyses for the development of the business case submissions.

1.4 Analysis of Covid 19 Impacts on the GM CAP

1.4.1 Since the modelling for the Consultation Option was undertaken, the onset of the Covid 19 pandemic and the associated restrictions to travel and the economy have impacted on a range of the assumptions used within the modelling approach for the CAP. In response, GM undertook a programme of modelling and analysis to assess the impact of the pandemic on the GM CAP. This programme included:

- A review of risks and assumptions;
- Scenario planning and brainstorming exercise, carried out with TfGM's Strategy team to incorporate considerations beyond the GM CAP;
- Monitoring of real-world conditions;
- Impacts assessments by vehicle type and distributional impacts;
- Research, data collection and Consultation; and
- Sensitivity testing of transport, AQ and economic models, based on indicative or hypothetical scenarios and applying JAQU's guidance.

1.4.2 The results of this analysis have been fed back to GM's ten local authorities and to JAQU and are set out in a series of Technical Notes supplied to JAQU. A report setting out the impact of the proposed changes on the Do Minimum position, alongside modelling of the impact of the post-Consultation package on achieving compliance in the shortest possible time will be available in early summer 2021.

1.4.3 GM's analysis suggested that the following key factors were both plausible and potentially impactful:

- Vehicle upgrades slow, with fewer new vehicles entering the fleet and older vehicles remaining in the fleet for longer;
- A sustained increase in working from home reduces commute traffic, particularly in peak periods;
- Bus mileage may reduce if patronage does not recover to pre-pandemic levels, unless subsidies are maintained to prevent this;
- Businesses may be less able to upgrade in response to the GM CAP, due to having exhausted their reserves, taken on debt, suffered shutdowns and so on; and/or
- Availability of compliant vehicles may be constrained, and/or prices may rise.

2 JAQU guidance and GM's response to it

2.1 Interaction with JAQU

2.1.1 Following the OBC submission in March 2019, technical discussions concerning the behavioural, traffic and air quality modelling recommenced in April 2019 on a regular fortnightly basis. Additional technical documentation was provided to JAQU in the form of a series of technical notes. The revised methodology as set out in these notes was approved by JAQU in November 2019, and reflected in the updated Technical Reports submitted in January 2020.

2.1.2 The economic appraisal methodology was updated and agreed with JAQU in spring 2020, reflected in updated Economic Reports submitted as appendices to the Interim FBC in November 2020.

2.1.3 Following the start of the first national lockdown in March 2020, GM held several technical discussions throughout 2020 and 2021 with JAQU to consider the impact of the pandemic on the GM CAP.

2.1.4 GM have submitted a number of draft technical notes to JAQU as part of this process[1], as set out in Table 2-1 below. It is intended that an updated version of the analysis contained in these notes will be set out in a report to GM's ten local authorities in summer 2021, superseding the notes.

[1] Note that two further notes, CV13 and CV14, were planned but not submitted and the planned contents of note CV6 (an initial assessment of Covid 19 impacts on Analytical Assurance) have been incorporated in this note.

Table 2-1: GM CAP Covid 19 Technical Notes

Number	Title
CV1	Sensitivity test of a delay in fleet upgrade resulting from the Covid 19 pandemic
CV2	Covid 19 Related Sensitivity Testing: Zero Upgrade Test Considerations
CV3	Sensitivity test of increased working from home resulting from the Covid 19 pandemic
CV4	Sensitivity testing of Covid 19 impacts on behavioural responses
CV5	Sensitivity testing of Covid 19 impacts on bus
CV7	Review of Covid 19 impact on modelling methodology as set out in T3
CV8	Review of Covid 19 impact on modelling methodology as set out in T4
CV9	Review of Covid 19 impact modelling methodology as set out in AQ2 and AQ3
CV10	Covid 19 Impacts – HGV
CV11	Covid 19 Impacts – LGV
CV12	Covid 19 Impacts – Coach & Minibus
CV15	Summary data note - Monitoring traffic conditions during the pandemic
CV16	Specialised Goods Vehicle Counts (2020)

2.2 JAQU guidance and GM response

2.2.1 JAQU have supplied three sets of modelling-related guidance to local authorities, as set out in Table 2-2, which also sets out GM's actions in response to that guidance.

Table 2-2: Covid 19 related JAQU guidance and GM response

Date received	JAQU guidance	GM response
26/05/2020	Requesting sensitivity testing of (i) the 'with measures' scenarios wherein the natural fleet turnover is 'paused' at the level of the previous year; and (ii) a second sensitivity test applying a 0% upgrade in response to a CAZ scenario.	GM has conducted sensitivity testing of the impact of a one-year-older fleet, supplied as *Note CV1 – Sensitivity test of a delay in fleet upgrade.* GM agreed with JAQU that a 0% upgrade response test would not be informative in the GM CAP context, as it would be essentially a near Do Minimum position, as set out in *Note CV2 – Zero upgrade test considerations.* Instead, GM has conducted a number of sensitivity tests of the assumed behavioural responses, set out in *Note CV4 – Sensitivity test of Covid 19 impacts on behavioural responses.*
17/07/2020	Guidance on considering the possible effect of Covid 19 on the economic analysis of the plan, including the value for money assessment, distributional impact and the development of Clean Air Fund bids.	GM has undertaken sensitivity testing of the possible effects of Covid 19 on the value for money assessment, based on a methodology as agreed by email on 30/11/2020. GM has also carried out a review of the distributional impacts assessment and produced supporting analysis of the impact of the pandemic on each vehicle type in scope for charging under the proposed GM CAZ C.
22/02/2021	Ministerial guidance on the approach to be taken by local authorities in representing the impacts of Covid 19 on their Clean Air Plans (see Appendix One on page 53 of this document). This guidance sets out a Red/Amber/Green (RAG) rating determining whether local authorities are able to apply the results of sensitivity testing of a given factor within their central scenario ie: whether Covid-related changes to assumptions can be incorporated within the core modelling scenario, or whether they should be considered as sensitivity tests.	GM has conducted a review of the JAQU guidance and considered an approach to revising the modelling methodology in accordance with this guidance and reflecting both (i) sensitivity testing determining which factors could impact the GM CAP and (ii) locally collected evidence on the extent to which these impacts are being realised as a result of the pandemic. GM's proposed approach to revising the local modelling methodology to represent the impacts of Covid 19 is set out in this note, alongside a supporting discussion of the impact of Covid 19 on uncertainty and how this will be reflected within the core scenario and sensitivity testing.

2.2.2 On 22nd February 2021, JAQU provided GM with Ministerial guidance on the approach to be taken by local authorities in representing the impacts of Covid 19 on their Clean Air Plans (see Appendix One for details). This guidance sets out a Red/Amber/Green (RAG) rating determining whether local authorities are able to apply the results of sensitivity testing of a given factor within their central scenario. The RAG rating is defined as follows:

- "Green" rated – results can be used to influence central scenario modelling due to a higher level of confidence in the evidence (lower level of uncertainty) and/or small impact on outcomes.
- "Amber" rated – results may be used to influence central scenario modelling if the LA has appropriate supporting evidence. The degree of change brought about by these results will also play a factor. JAQU will require the LA to make a strong case for their inclusion, which will be assessed by JAQU and TIRP, with a recommendation given to Ministers as to whether JAQU supports inclusion of this impact in their core modelling.
- "Red" rated – due to the high level of uncertainty with these tests, LAs will not be able to use the results to influence central scenario modelling, however results can be included in business cases to indicate degree of shift possible within the plan.

2.3 Tables 2-3, 2-4 and 2-5 below set out JAQU's guidance for local authorities and GM's response to that guidance. To inform GM's response, GM has reviewed the assumptions underpinning each stage of the modelling process. A summary of the results of that review is set out in Technical Notes CV7, 8 and 9.

2.4 JAQU's guidance states that "LAs must note that the evidence required to support Covid-19 assumptions is expected to be of at least the same level of robustness as evidence included in plans as standard." Where changes are proposed to the methodology for the core scenario, the rationale for their inclusion is set out in Sections 3 to 5.

2.5 Note that GM carried out a series of indicative sensitivity tests exploring the impact of potential changes to factors affecting the GM CAP as a result of Covid 19, based on the Do Minimum and GM CAP Policy for Consultation modelling as set out the Technical Reports submitted in January 2020. Further Covid-related sensitivity testing, as set out below, will be carried out on the final post-Consultation modelling and will be submitted as appendices to the FBC, alongside any other sensitivity testing required to assess the robustness of the Plan.

Table 2-3: "Green-rated" factors and GM's proposed approach to representing them

Factor	JAQU commentary	To be applied in GM?	GM commentary
Impacts of a CAZ implementation delay	Robust evidence within LAs of any delay to CAZ go-live. Delays simple to model.	**Yes**	The pandemic has resulted in a delay to the proposed launch date of the GM CAZ to spring 2022. GM has fully developed versions of the modelling suite for the years 2021, 2023 and 2025. It is not possible to produce a 2022 version of the modelling suite without imposing significant delay and cost. Therefore, GM proposes to apply the following approach: 1. Development of 2022 versions of the Demand Sifting Tool and cost models; and 2. Application of an interpolation process between 2021 and 2023 to estimate emissions and compliance by site in 2022. Further detail is supplied in Section 3.
Green recovery/measures	Robust evidence as some LAs have developed measures that have been agreed and in places already implemented through other funding initiatives. Impact of these tends to be highly localised (single roads, junctions, etc.)	**Yes**	Since the previous review of bus services, a fleet of zero emission buses has been deployed on routes in the city centre. The highway model will be updated to reflect these new buses. Several temporary road schemes have been put in place during the pandemic. Although it is possible that they may continue, or that other schemes could be introduced which affect traffic patterns or the road network, the GM CAP team is not currently aware of any new funded and approved schemes of this nature and therefore no new schemes will be represented in the highway modelling.

Factor	JAQU commentary	To be applied in GM?	GM commentary
Delayed development plans (new residential or commercial developments /infrastructure, etc.)	Robust evidence as planning already in progress for these schemes. The original assumed demand for such schemes was known to the LA. Only schemes of significant size will have a high impact, but most large schemes will have been considered already by LA modelling.	**As sensitivity test only**	There are a number of road schemes assumed to be in the reference case road network modelling programmed to open in 2023 or 2025 that have been delayed during the GM CAP development. These are: • Western Gateway Infrastructure Scheme (WGIS); • M60 Junction (Jn) 24-27 smart motorway scheme; and • M60 Jn 1-4 smart motorway scheme. A test of the potential impacts of excluding these schemes on vehicle routing has been undertaken, indicating that these cannot be screened out based on relevant national government guidance scoping criteria (Design Manual for Roads and Bridges - LA 105 - Air quality, Nov 2019). However, it is not anticipated that the changes to traffic flows will materially alter air quality at key locations for consideration of the GM CAP. Therefore, a test of the Consultation Option model, excluding the Full WGIS and M60 Jn 24-27 and Jn 1-4 smart motorway schemes (those elements of the WGIS scheme that have been built will be included) will be undertaken as a sensitivity test but changes will not be applied in the core scenario.

Table 2-4: "Amber-rated" factors and GM's proposed approach to representing them

Factor	JAQU commentary	To be applied in GM?	GM commentary
Fleet upgrade delay impacts	Delay simple to model and national data readily available. LA may have evidence to support such a delay derived from observed purchasing trends throughout 2020. Fleet upgrade could be influenced by economic performance depending on timing of CAZ and length/depth of recession.	**Yes**	GM considers that there is now credible evidence that some vehicle fleets will experience sustained delay impacts throughout the lifetime of the Plan. As a result, GM is proposing to apply alterations to the without-scheme fleet upgrade assumptions for private cars, vans and taxis (Hackney and PHV). GM is not proposing to apply alterations to the fleets for HGV or bus. Further information about the changes proposed is set out in Section 4.
Reduction in CAZ charges	LAs set these responses in their modelling based on either locally gathered surveys, central gov estimates or a literature review of similar schemes during plan development. JAQU does not want to rule out (by putting in red) that an LA may be able to bring together a body of evidence that indicates an adjustment to these assumed response levels is warranted. Note: JAQU central assumptions will not be updated at this time in respect to Covid-19.	**No**	This is not considered relevant as GM models behavioural responses to charges using cost models rather than based on survey data, central government estimates or literature review of similar schemes. GM is reviewing the proposed CAZ charges in response to Consultation feedback. If any changes to the charge levels are proposed, this will be represented in the Do Something modelling, applying the same process and behavioural response assumptions as before.
Increased Stay & Pay response	LAs set these responses in their modelling based on either locally gathered surveys, central gov estimates or a literature review of similar schemes during plan development. JAQU does not want to rule out (by putting in red) that the LA is able to bring together a body of evidence that indicates an adjustment to these assumed response levels is warranted.	**Partially and as a sensitivity test**	GM's evidence does suggest that businesses may be less able to upgrade in response to the CAZ, as set out in Technical Notes CV10, 11 and 12 and discussed in Tables 7-1 and 7-2.

Factor	JAQU commentary	To be applied in GM?	GM commentary
	JAQU central assumptions will not be updated at this time in respect to Covid-19.		As a result of the proposed alterations to normal (without scheme) fleet upgrades, there will be more non-compliant vehicles in scope for the CAZ at launch. In order to prevent the cost models predicting implausibly high change responses, a minor change to how the cost models will be applied is proposed, set out in Section 5. Beyond this proposed change, GM does not consider that there is sufficient certainty in terms of how the impact on businesses may affect their behavioural responses to the scheme to allow for changes to be made to the core scenario. It is therefore proposed that a series of sensitivity tests are carried out to reflect plausible impacts on the affordability of or ability to upgrade.
LGV/HGV change response	Trend in goods vehicle trips and GDP growth tend to mirror each other. LAs may be able to adequately source bespoke local evidence to warrant a change. Changes to this response would be inspired by local understanding of the types of businesses serviced in the CAZ area and the adaptation/ survival of those businesses post Covid. Note: JAQU central assumptions will not be updated at this time in respect to Covid-19.	**No**	GM is not proposing to change it's assumptions in terms of freight trip volumes. The proposed approach to reflecting pandemic impacts in behavioural responses is set out in Section 5.

Table 2-5: "Red-rated" factors and GM's proposed approach to representing them

Factor	JAQU commentary	To be applied in GM?	GM commentary
Increased homeworking	Level of continued homeworking post-Covid is highly speculative	**As sensitivity test**	Unprecedented numbers of workers have been asked to work from home during the pandemic. Business surveys suggest that a sizeable minority of companies, particularly larger businesses, are planning to maintain some of the changes made post-pandemic. However, given that the recommendation for workers to work from home where possible remains in place at the time of writing, it is too early to draw conclusions as to the scale or nature of any sustained change post-pandemic. GM's analysis suggests that an increase of up to around 10% points in the number of commuters working from home on an average day is plausible and will carry out sensitivity testing accordingly.
Shopping/Leisure trips (increase due to home working and/or reduction due to online shopping)	Level of shopping and leisure trips post-Covid is highly speculative	**No**	GM does not consider that there is any clear evidence as to what the impact could be.
GDP impacts (reduced employment)	GDP performance is highly speculative	**Partially as a sensitivity test**	GDP and related traffic assumptions are derived from Government guidance and GM has taken the view that it would not be appropriate to represent possible recessionary impacts without revised national guidance. Sensitivity testing of the impact of reduced traffic will be carried out, which is one possible impact of a recession.

Factor	JAQU commentary	To be applied in GM?	GM commentary
Impacts on public Transport / modal shift (reduction in demand / capacity/ Supply)	Short term aversion to public transport is driven primarily by the immediate threat of transmission of the virus so there is an expectation that this does not impact longer term behaviour. Model limitations used in LA plans may prevent adequate modelling of these impacts (i.e. economic impact and social distancing; change in transport mode preference due to perceived fear of virus, cost of mode, etc.).	**As sensitivity test**	Modelled bus services in the forecast year models are based on 2019 service patterns and flows and on operator specific fleet, derived from the levels recorded in TfGM's Punctuality and Reliability Monitoring Survey (PRMS) and the Greater Manchester Bus Route Mapping system. It is understood that future bus funding from central government CBSSG is to be set with the intention of maintaining existing levels of service provision. Whilst there are typically minor variations in routes and service frequencies over time, an overall trend of mileage reduction should not be anticipated or represented within the CAP. Indicative sensitivity tests of reduced bus mileage have been carried out and can be repeated if considered necessary.
Change in car ownership assumptions	We do not support inclusion of changes of these factors in central scenario modelling. These factors are highly speculative (based on long term behaviours & GDP, as well as international factors). Subcategory/consequence of GDP - wider economic, employment forecasting would need to be taken into account. Driven by length and depth of long/short term recession. Also dependent on price of oil/level of subsidy.	**No**	GM does not consider that changes in car ownership as a result of the pandemic are sufficiently likely to be represented in the modelling.

Factor	JAQU commentary	To be applied in GM?	GM commentary
Changes to vehicle purchase costs / pricing (fare)	Speculative (long term behaviours & GDP). Subcategory/consequence of GDP - wider economic, employment forecasting would need to be taken into account. Dependent on price of oil/level of subsidy/fare.	**As sensitivity test**	GM is concerned that it is possible that constraints on the availability of compliant vehicles may lead to price increases in some markets – this was a source of uncertainty pre-Covid, given the number of similar schemes being implemented across the country, and may be exacerbated by the pandemic given evidence that production of new vehicles was lower than expected in 2020. In particular, GM is concerned about media reports of increases in the price of second-hand vans. There is currently no robust evidence on which to base any changes to the core scenario however. GM will continue to monitor the situation, and will carry out sensitivity testing on the impact of price increases on behavioural responses.

3 Approach to modelling a 2022 start date

3.1 Background

3.1.1 The modelling tools developed to support the assessment of the Option for Consultation were based on three forecast year models representing the impacts of the introduction of GM CAP in 2021, 2023, and 2025. At the time of preparation, the proposed opening date of GM CAP was 2021.

3.1.2 Following recent updates to the project, the opening year of the scheme has now changed to 2022. To reflect this, further consideration has been undertaken on how this change will be reflected within the modelling suite.

3.2 Representing a 2022 start date in the Cost Response models

3.2.1 To reflect a 2022 forecast year, the Cost Response Models will be updated to reflect a 2022 opening year scenario. This will reflect a number of updates to the model inputs & assumptions. In particular, this will comprise:

- Do minimum fleet profiles to be updated to reflect a 2022 modelled year;
- 2022 specific input assumptions to be updated to reflect the change in forecast year; and
- The cost model will then forecast a 2022 with GM CAP behavioural responses based on the 2022 input parameters, which would then be applied in the Demand Sifting Tool.

3.2.2 The Cost Response Models also provide inputs to several other CAP calculations and will generate 2022 forecasts for the following:

- Fund uptake assumptions;
- Inputs to the Vehicle Finance model;
- CAZ operating costs; and
- CAZ revenues.

3.3 Representing a 2022 start date in the Demand Sifting Tool

3.3.1 The Demand Sifting Tool (DST) provides the linkage between the Cost Response models and the highway modelling (GM SATURN) and forms a key part of the modelling suite which assess the impacts on air quality of the GM CAP. The tool brings together the do minimum traffic demand (split by compliant and non-compliant vehicles) and applies the forecast behavioural responses from the Cost Response Models to generate the forecast with GMCAP demand, accounting for the impacts of both CAZ and Funds.

3.3.2 As the air quality modelling is not proposing to develop bespoke 2022 forecasts, an interpolation process will be prepared, to understand the impacts on air quality. This will include preparing a 2021 and 2023 forecast model run with 2022 GM CAP assumptions, using interpolation processes to forecast the intermediate year estimates for air quality.

3.3.3 For the DST, this will include model runs using 2021 and 2023 versions of the model, with the 2022 GM CAP scheme assumptions. These will generate 2021 and 2023 with CAP demand forecasts for application in the GM highway model.

3.4 Representing a 2022 start date in the air quality modelling

3.4.1 Using the relevant scenarios which allow consistent inclusion of relevant charges by vehicle type, the outputs from the DST will be put through the highway, emissions and air quality modelling process. The air quality concentrations for the 2022 scenarios will be derived using linear interpolation between the NO_2 outputs of the 2021 and 2023 scenarios.

3.4.2 This process will generate 2022 forecasts to support the following:

- Provision of a monitoring baseline;
- Calculation of emissions benefits for economic appraisal;
- Calculation of fleet upgrade costs and savings for the economic appraisal;
- Estimate of Do Minimum exceedances;
- Estimate of compliance by site; and
- Estimate of human exposure benefits.

4 Rationale and evidence for proposed changes to fleet upgrade delay impacts

4.1 Background

4.1.1 Sales of new cleaner vehicles lead to a natural turnover of on-road fleet, as the replaced vehicles pass onto the second-hand market, with the oldest most polluting vehicles gradually cycled 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.

4.1.2 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 may now be optimistic, as lower sales reduce the rate of vehicle upgrades and also impacts on the second-hand market. Indicative testing of this effect is described in Notes CV1 and CV4.

4.1.3 It is also recognised that the vehicle sales have been impacted to differing extents by vehicle type and fuel, with commercial vehicle sales having been more resilient than those for the private car and taxi market.

4.1.4 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.

4.1.5 Indicative sensitivity testing of a range of potential Covid 19 impacts has been undertaken, based on JAQU guidance. This indicated that the impacts of slowed fleet upgrade is the effect of Covid 19 most likely lead to significant changes to NO_2 concentrations of the suite of tests.

4.2 Buses

4.2.1 As a result of the engagement with bus operators undertaken throughout the development of the GM CAP, operators have been aware of, and preparing for, the CAP for some time. Government funding for retrofit of appropriate vehicles has been secured, and operators have made successful applications for these funds. Bus operators are already responding to the CAZ and so it is not considered likely that the bus fleet will renew more slowly than expected in the Do Minimum scenario. Additionally, there are a number of routes where electric buses are newly operating which were not captured in the Consultation Option modelling, and these will be captured within the updated modelling process.

4.2.2 With the CAP in operation, it is assumed that all non-compliant bus fleet will become Euro VI compliant vehicles, and there is no reason to alter this assumption.

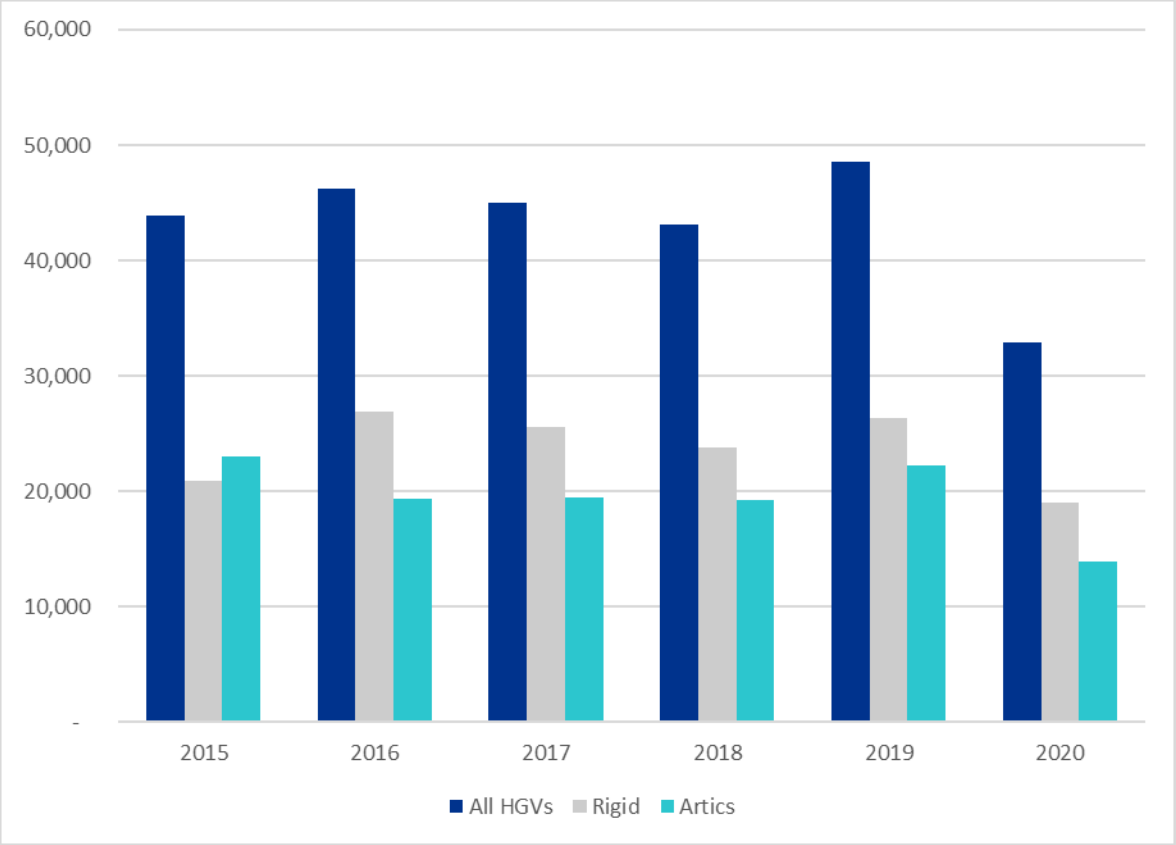
4.2.3 GM is not therefore proposing to apply any delay to the business-as-usual fleet upgrade for buses as a result of Covid 19.

4.3 HGVs

4.3.1 A review of HGV sales shows that whilst there has been a reduction in 2020, this was in part a consequence of increased atypical sales in 2019 due to regulatory changes coming the following year, as shown in Figure 4-1. This effect would be expected to impact 2020 sales before the impacts of Covid 19.

4.3.2 Total 2019/20 sales, which account for a 2-year structural sales shift altering investment cycles, fall within 1% of pre-existing 2016-2018 trends.

Figure 4-1 Annual HGV Registrations 2015-2020



Source: https://www.smmt.co.uk/vehicle-data/heavy-goods-vehicle-registrations/

4.3.3 Additionally, analysis of traffic count data for HGVs from March 2020 onwards indicates that these vehicles were less impacted than cars and vans, with movements returning to pre-Covid levels by late summer 2020. This would also suggest that the HGV market has been less severely impacted than cars and vans, although it is recognised that distribution patterns within different industry or commodity sectors may have varied.

4.3.4 It is therefore not proposed that fleet renewal projection rates for HGVs are altered from those used in the Consultation Option scenarios methodology.

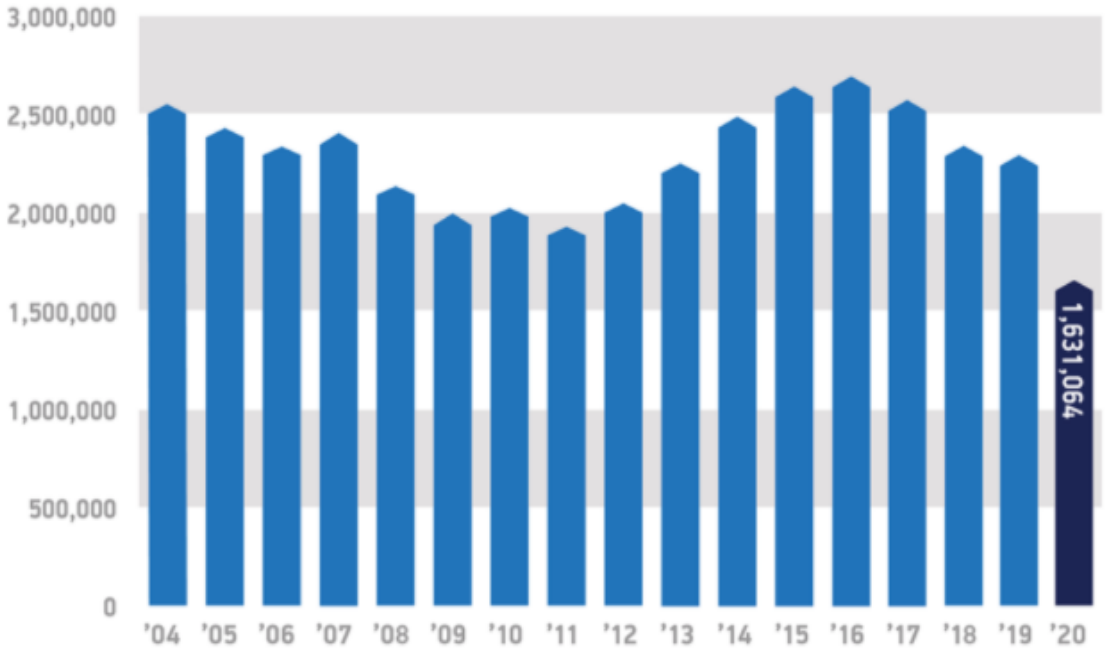
4.4 Private cars and vans

4.4.1 Evidence of reduced vehicle sales since March 2020 is available on a monthly basis[2], and projections of sales recovery have been published recently by the SMMT[3] for cars and light commercial vehicles in 2021/22, along with patterns in the second hand used car market. These will be used to calculate the number of cumulative lost sales between 2020 and the forecast years of 2021, 2023 and 2025 by vehicle type, which can be applied to the roll-over model used for vehicle fleet projection.

4.4.2 The SMMT projections suggest a rate of recovery of vehicle sales that in 2021/22 leads to lower annual sales than in the years preceding Covid 19. For the GM CAP 2023 and 2025 forecast model years, these SMMT sales projection trends will be extrapolated, and the rate of projected recovery will at some point lead to sales above those recorded pre-Covid.

4.4.3 Further analysis of the pre-Covid sales patterns for private cars, shows that sales have been falling year-on-year since 2016 (Figure 4-2). It is therefore not considered reasonable that vehicles sales per year should be forecast to exceed those in the pre-Covid reference level.

Figure 4-2 Annual Car Registrations 2004-2020

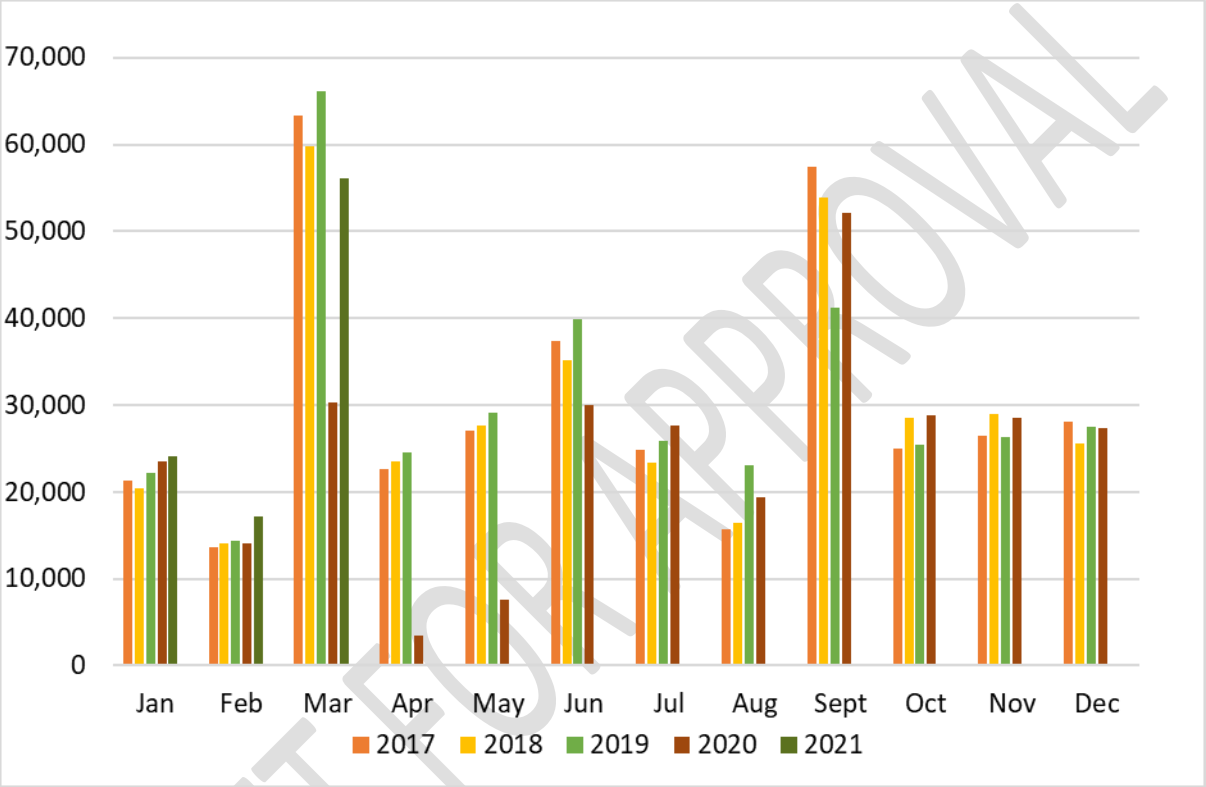


Source: https://www.smmt.co.uk/vehicle-data/car-registrations/

[2] https://www.smmt.co.uk/vehicle-data/
[3] https://www.smmt.co.uk/wp-content/uploads/sites/2/WEBSUM-SMMT-CARLCV-MARKET-OUTLOOK-Q1-REVISED-03032021.pdf

4.4.4 Sales of vans have been stable since 2016, and were more resilient during the pandemic after the initial national lockdown. Furthermore, sales in January and February 2021 were greater than those recorded historically indicating strong market demand and that supply of new vehicles isn't unduly restricted at this stage (Figure 4-3). It is therefore considered reasonable that vehicles sales per year could be forecast to exceed those in the pre-Covid reference level.

Figure 4-3 Monthly Van Registrations 2017-2021



Source: https://www.smmt.co.uk/vehicle-data/lcv-registrations/

4.4.5 Using these vehicle sales data sources and SMMT sale predictions, the following approach to incorporating the impacts of Covid 19 into the modelling is proposed, as set out in Table 4-1. The typical pre-Covid sales have been set at those recorded in 2019.

4.4.6 The SMMT predictions for 2021/22 have then been extrapolated forward to 2025. The difference between the predicted annual sales (or actual for 2020) than typical pre-Covid levels have been summed cumulatively, and are reported as the equivalent of typical sales each year.

4.4.7 Because car sales are limited to the pre-Covid level of 1,945,000 vehicles, the rate of lost vehicle sales is equivalent to 62% (or approx.7 months) of a year's worth of renewal from 2023 onwards. For vans, where sales have been more resilient, the rate of lost vehicle sales is equivalent to 28% of a year's worth of renewal in 2023, reducing to 7% in 2025, because sales have been extrapolated to levels above those in 2019.

4.4.8 These lost renewal rates will then be applied into the fleet roll over model, for each year, creating a slightly older fleet profile for use in the behavioural response and emissions modelling.

Table 4-1 Predicted Car and Van Fleet Renewal Delays

Data Source	Year	**Cars sold**	Lost sales/ yr [1]	Cumul -ative lost sales	Lost % of annual sales		**Vans sold**	Lost sales/ yr [2]	Cumul -ative lost sales	Lost % of annual sales
Actual	2016	2317					376			
Actual	2017	2179					362			
Actual	2018	2010					357			
Actual	2019	1945	typical sales per yr				366	typical sales per yr		
Actual (during pandemic)	2020	1338	-607	-607	**-31%**		293	-73	-73	**-20%**
SMMT prediction	*2021*	*1543*	-402	-1009	**-52%**		*344*	-22	-95	**-26%**
SMMT prediction	*2022*	*1777*	-168	-1177	**-61%**		*353*	-13	-108	**-30%**
SMMT extrapolation	*2023*	*1923*	-22	-1199	**-62%**		*373*	7	-101	**-28%**
SMMT extrapolation	*2024*	*1945*	0	-1199	**-62%**		*393*	27	-74	**-20%**
SMMT extrapolation	*2025*	*1945*	0	-1199	**-62%**		*413*	47	-27	**-7%**

1. Limit to typical 2019 sales level
2. Allow SMMT extrapolated recovery, above typical historical rate of sale

4.4.9 Separately, there are a range of confounding factors which affect how emissions would be altered, since the way that new vehicles are used on the road is not necessarily linearly-related to sales themselves. For example, generally newer vehicles drive more miles per annum than older vehicles, as do vehicles purchased for primarily business use rather than private use. Range anxiety concerns with battery-electric vehicles (BEV) also mean that are often purchased as second cars or for shorter local trips. These effects cannot be quantified or represented in the modelling process.

4.4.10 The current split between diesel, petrol and electric car mileage for each forecast year is based on projections from the Department for Transport, which have been updated in the Consultation Option. The trend in a switch from diesel cars towards petrol and electric powered vehicles is represented in this modelling process following JAQU guidance, and assumptions will be reviewed against available evidence. However, whilst the reduction in new and used vehicle sales is related to the impacts of Covid 19, the influence of Covid 19 altering projected rates of fuel switch is not clear or at this stage considered a first order impact.

4.5 Hackney Carriages and Private Hire Vehicles (PHVs)

4.5.1 Taxis are considered to be one of the groups most impacted by the Covid 19 pandemic, as business and recreational trips have been curtailed by the travel restrictions imposed on GM. Analysis of sales data for Hackney Carriages indicates that the taxi sector has been heavily impacted by Covid 19, with sales significantly reduced in 2020.

4.5.2 The GM licensing whitelists for Hackney Carriages and PHVs have been obtained for December 2020. These data show that only two compliant Hackney Carriages were registered since 23rd March 2020, and 85 PHVs, representing a reduction against pre-Covid rates in new registrations of >95% and >85%, respectively.

4.5.3 Furthermore, analysis of ANPR data for licensed GM taxis and PHVs in September 2020 indicates that these vehicles were making significantly less trips than pre-Covid movements. Further information can be found in note 'CV15 Summary data note - Monitoring traffic conditions during pandemic'.

4.5.4 Based on the GM licensing data, which represents approximately 8 months of pandemic phase, whilst the full restrictions associated with the pandemic are not expected until June 2021 at the earliest which is 1¼ years, the delay to fleet renewals for both hackney carriages and PHVs will be set at 12 months.

4.6 Coach and minibus

4.6.1 Analysis of sales data for the coach and minibus markets indicates that these sectors have been heavily impacted by Covid 19, with sales significantly reduced. However, neither of these vehicle types are explicitly modelled within the transport or air quality modelling process and therefore the impacts of delayed fleet upgrade cannot be included in the predictions of future air quality. Testing has demonstrated that these vehicles do not contribute significantly to overall vehicle emissions. However, it is recognised that coach and minibus operators will be subject to CAZ charges in practice, and these issues are being considered in relation to mitigation CAF funds. Further information can be found in note 'CV12 Covid Impacts – Coach & Minibus'.

4.7 Summary of recommendations for vehicle fleet and upgrade rates

4.7.1 A summary of recommended approaches for representing the impacts of Covid-19 on the vehicle fleet upgrades are provide by vehicle type in Table 4-2.

Table 4-2 Recommendations of Vehicle Fleet and Upgrade Rates: assumptions by vehicle type

Vehicle Type	Change Proposed	Justification
Bus	No	Fleet mix assumptions will not be altered. Bus operators already responding to CAZ and so not considered likely that bus fleet will age more than expected. Electric bus routes will be incorporated when funding is secured or already in operation.
HGV	No	Purchases were disrupted in 2019 and 2020 by factors other than Covid. Analysis suggests that overall purchases across the two years were fairly typical of an average year.
LGV	**Yes**	Purchases were depressed in 2020, with some recovery in early 2021. Analysis suggests that **a delay of c3 months is plausible**, with the age of the fleet **gradually converging to close to the pre-Covid forecast by 2025** if sales recover over time.
Hackney Cab & PHV	**Yes**	Consider that significant impact likely – based on licensing data, propose applying **a delay of one year** to the upgrade of the Hackney & PHV fleet**, to be maintained throughout the lifetime of the plan i.e. to 2025.**
Car	**Yes**	Although not in scope for CAZ, important contributor to background emissions. Evidence suggests a significant delay in fleet upgrade and that this is likely to be maintained in future years. **Delay of c7 months proposed, to be maintained throughout the lifetime of the plan i.e. to 2025**.
Coach and Minibus	No	No changes to the transport and air quality modelling are applicable, because not directly represented in these tools.

5 Rationale and evidence for proposed changes to behavioural responses

5.1 Introduction

5.1.1 As set out in Section 1, to support the development of the Option for Consultation for GM CAP, a series of Cost Response Models were developed by GM. These models were developed to support the understanding and forecasting of behavioural responses for how owners of non-compliant vehicles might respond to GM CAP.

5.1.2 This Section discusses the proposed changes to the Cost Response Models to reflect the changes in forecast behavioural responses forecast for GMCAP, considering the increased vulnerabilities imposed on the project due to the Covid 19 global pandemic. The sections below provide:

- Background on the Cost Response Models and overview of the approach in developing the Option for Consultation;
- Identifies proposed changes to the core modelling assumptions in response to the pandemic; and
- Identifies further sensitivity testing in relation to further changes in behavioural response that may be expected as a result of the pandemic.

5.2 Background to the Cost Response Models

5.2.1 Following the submission of the OBC, Cost Response Models were developed to provide a greater understanding in the ways that non-compliant vehicle owners could likely respond to GM CAP. These models form the first part of GM's modelling suite for assessing the air quality impacts of the GM CAP.

5.2.2 The cost models incorporate the following vehicle modes:

- Heavy Goods Vehicles;
- Vans (Light Goods Vehicles);
- Hackney Carriages; and
- Private Hire Vehicles (PHVs).

5.2.3 These modes forecast a range of response to GM CAP, most notably:

- Upgrade;
- Do Nothing (stay & Pay);
- Change mode; and
- Change business model / leave sector.

5.2.4 The responses forecast by the cost models inform the change in demand forecast for GM CAP through the prediction of changes in the mix of compliant and non-complaint vehicles, which are applied in the Demand Sifting Tool and through the GM modelling suite to assess the air quality impacts.

5.3 Proposed revision to core modelling of behavioural responses

5.3.1 As set out in Section 4, for some vehicle types, the natural turnover/upgrade of vehicles has been delayed due to Covid 19. This means that for some vehicle types, there will be more non-compliant vehicles when the CAZ is introduced than previously forecast.

5.3.2 In effect, the cost models assume that commercial vehicle owners will take the best value option, upgrading where it makes financial sense to do so. The cost models do not place any constraints or financial barriers to prevent non-compliant vehicle owners to upgrade where it makes financial sense to do so. However, GM recognises that as a result of the pandemic, vehicle owners may not be in a position to upgrade even where it would make financial sense to do so, due to have used up savings/reserves, greater indebtedness and so on.

5.3.3 As discussed in Table 2-4, GM does not consider that there is sufficient certainty in terms of how the impact on businesses may affect their behavioural responses to the scheme to allow for changes to be made to the core scenario. It is therefore proposed that a series of sensitivity tests are carried out to reflect plausible impacts on the affordability of, or ability to, upgrade. These are likely to include:

- Upgrade becomes less affordable – represented in the cost models through increases in the cost of upgrade and decreases in the residual value of existing vehicles; and
- Access to finance is restricted – represented in the cost models by a proportion of vehicle owners being blocked from upgrading, based on evidence from GM's vehicle finance panel in terms of the proportion of vehicle owners expected to be declined for credit.

5.3.4 However, beyond this, GM has identified an issue resulting in a proposed change. Applying a delay to the natural upgrade of vehicle fleets for vans and taxis within the modelling means that more non-compliant vehicles are in scope for the CAZ. Because the model assumes that vehicle owners will upgrade if it is cost effective to do so, where planned (and therefore cost effective) upgrades have been delayed, the model will judge it as being in the interests of the vehicle owner to upgrade to a compliant vehicle. This seems implausibly optimistic – it is unlikely that all those vehicle owners who have delayed a planned upgrade as a result of the pandemic will then be in a position to upgrade in response to the CAZ.

5.3.5 Table 5-1 sets out the options that have been considered in terms of how to handle the impacts of the delay to fleet upgrade within the cost models.

Table 5-1 Consideration of options for the treatment of delayed fleet upgrades within the cost models

Option	Impact	Narrative
A: Cost models applied without further intervention	% upgrade response increased compared to Option for Consultation[4]	**Discounted.** Considered implausible that more people would upgrade as a result of the CAP in a post-Covid scenario than a pre-Covid scenario.
B: Upgrade responses calculated for pre-pandemic fleet and applied as a % to post-pandemic fleet	% upgrade response same as Option for Consultation	**Discounted.** Although this is less optimistic than Option A, it still in practice applies an assumption that the vast majority of those who delayed their vehicle upgrade as a result of the pandemic will upgrade in response to the CAP. This is considered overly optimistic.
C: Cost models applied to pre-Covid fleet only – non-compliant vehicles are allowed to respond as predicted by the cost model. Additional non-compliant vehicles resulting from delayed fleet upgrades are not given the opportunity to upgrade as a result of CAP.	Number of vehicles upgrading as a result as CAP as per Option for Consultation but % upgrade response decreased compared to Option for Consultation. In total, more vehicles remain non-compliant with CAP post-Covid.	**Recommended.** This is considered a conservative estimate, reflecting the ongoing impact of the pandemic on the ability of businesses to undertake capital investment. It is the only option which does not lead to a more optimistic representation of the impact of the GM CAP post-pandemic than pre-pandemic.

5.3.6 Following the review of the options identified above, GM proposes that Option C is included within the updates to the modelling. Option C accounts for the delayed fleet upgrade discussed above, and does not allow for an over-optimistic resolution of that delay within the cost models. Although in practice it is likely that some of those vehicle owners previously planning to upgrade their vehicle do in fact do so as a result of the CAP, this may be offset against those forecast to upgrade but no longer in a position to do so. It is not possible to quantify the scale of either of these groups, and therefore GM considers that taking this most conservative approach is in line with JAQU's guidance that "given the considerable uncertainty we must accept that there is a risk of putting in place clean air measures that overachieve, however, this is preferable to inaction which leads to poor air quality".

[4] Note that in practice the Option for Consultation will be replaced by the post-Consultation option. Any changes to the proposed charges, discounts and exemptions or funds may have the effect of changing the forecast behavioural responses.

6 Summary of Covid 19 impacts and proposed changes by element of the modelling suite

6.1.1 Table 6-1 sets out the modelling system used in the study with a discussion of its appropriateness for the project and a consideration of the Covid 19 impact.

6.1.2 It highlights where changes to the core scenario are proposed, and beyond this where Covid-related factors will be considered in sensitivity testing. A full list of proposed sensitivity tests – considering Covid and non-Covid related factors – will be supplied at a later date.

Table 6-1: Modelling process description, discussion of appropriateness and proposed changes to the core scenario to represent Covid 19

Modelling process		Discussion as at OBC	Update as at Consultation	Proposed changes to the core scenario to represent Covid 19
1	An option sifting tool was developed in the first instance to allow measures to be tested in a quick and efficient way prior to any detailed assessments being undertaken using the highway and air quality models. This was further developed into a WebTAG-style variable demand model, named the Demand Sifting Tool, to allow the behavioural change of measures to be estimated before passing data on for further assessment using highway assignment and air quality models.	An appropriate variable demand model was not available and it would not have been possible to develop one in the time available. The demand sifting tool has been developed for the GM CAP and is considered appropriate. It relies on input data from stated preference surveys, discussed in more detail below. The demand sifting tool is an elasticity model, rather than one that represents each different behavioural response separately. It is not a full variable demand model and does not represent, for example, the impact of suppressed trips being released. As the primary response is vehicle upgrade (most relevant for a CAZ A-C) it was considered that the schemes that were being considered would not have a significant impact on highway congestion and therefore little impact on suppressed demand.	The Demand Sifting Tool approach is retained but the behavioural responses have been enhanced by the development of a series of bespoke cost response models. These models reflect the local characteristics of the LGV, HGV, Hackney Cab and PHV fleets in GM. The cost response models include additional choice options for LGV and HGV trips such that they can, for appropriate sectors and vehicle types, downsize (e.g. van to estate car) or consolidate to larger vehicles. Details of the development of these models has been reported to JAQU in a series of Technical Notes and the modelling approach is set out in T4. A Demand Sifting Tool Manual has been produced.	Versions of the Demand Sifting Tool and cost models will be developed to represent 2022. Delays to normal fleet upgrade will be applied as set out in section 4. It is considered that the approach applied in the Demand Sifting Tool remains appropriate and no changes will be made to the core scenario. It is considered that the approach applied in the cost response models remains largely appropriate, with a minor change proposed to the way the cost models are applied, to prevent them over-forecasting an upgrade response to the CAZ where 'natural' fleet upgrade has been delayed by the pandemic. This is set out in section 5. No further changes will be made to the core scenario in the cost models.

Modelling process		Discussion as at OBC	Update as at Consultation	Proposed changes to the core scenario to represent Covid 19
2	The highway assignment model (Saturn), which is used to provide details of traffic flows and speeds for input to the emissions model and forecasts of travel times, distances and flows for input to the economic appraisal	The GM CAP uses the do-minimum model developed for the appraisal of the planned extension of the Greater Manchester traffic model. This model was considered to be the most appropriate given its base year of 2013, (which was close to the 2016 base year required for the CAP project), and its forecast year of 2020, which was close to the opening year for the CAP proposal. TfGM's county-wide SATURN model is a well-established tool used for the assessment of numerous major schemes. The traffic model validates well at a county level in terms of its link flow validation, although the journey time validation suggests that the modelled speeds in the peak hours tend to be too high on strategic links. Tests have been carried out to investigate how errors in the journey time validation might impact on modelled road traffic emissions for 2016 by applying adjustment factors to the modelled link speeds (at an aggregate level) to give a closer fit between the modelled and observed speeds across the County-as-a-whole. The results of these tests indicated that there was relatively little impact on the calculated emissions. Further details are available in the T2 report.	The highway modelling approach is unchanged but there have been updates to reflect: ▪ Latest information on bus services and fleet operating within GM; and ▪ ppm / ppk values derived from the latest version of the TAG Databook. Detailed analysis has been conducted of traffic composition, speeds and congestion at those locations identified as non-compliant in 2023 in Option 7 as tested at OBC ie: a GM-wide CAZ B scenario plus additional measures. These were selected as the sites most likely to determine the year of compliance, and where further additional measures could potentially act to bring forward the year of compliance. As a result of this analysis, alongside a wider assessment of conditions at the locations, some revisions have been made to model inputs to better reflect real-world conditions. In those locations found to have significant exceedances, an exercise has been undertaken to identify potential traffic management and other relevant solutions.	GM has reviewed the assumptions underpinning the highway assignment modelling including bus services/fleet, traffic volumes and composition and future schemes. Since the previous review of bus services, a fleet of zero emission buses has been deployed on routes in the city centre. The highway model will be updated to reflect these new buses. A test of the Consultation Option model, excluding the Full WGIS and M60 Jn 24-27 and Jn 1-4 smart motorway schemes (those elements of the WGIS scheme that have been built will be included) will be undertaken as a sensitivity test but changes will not be applied in the core scenario. No further changes will be made to the core scenario in the highway assignment model.

Modelling process		Discussion as at OBC	Update as at Consultation	Proposed changes to the core scenario to represent Covid 19
3	The emissions model, which uses TfGM's EMIGMA (Emissions Inventory for Greater Manchester) software to combine information about traffic flows and speeds form the highway model with road traffic emission factors and fleet composition data from DEFRA's EFT to provide estimates of annual mass emissions for a range of pollutants including oxides of nitrogen (NOx), nitrogen dioxide (NO_2) particulate matter (PM_{10} and $PM_{2.5}$) and CO_2.	The EMIGMA tool uses DEFRA's EFT v8.0 tool to calculate vehicle emissions and is considered best practice and appropriate. It draws on appropriate and relevant national and local data sources. The EFT uses data from the Copert modelling which, whilst appropriate for steady state conditions can be less reliable in congested or queuing conditions.	The latest version of DEFRA's EFT tool (version 9.1a) has now been incorporated into the modelling process. This updates the vehicle fleet mix particularly for the diesel/petrol fuel splits for passenger cars, to reflect more recent sales trends away from diesel. This does not alter the base year or air quality verification, but does alter future year Do Minimum and with-action modelling results.	Delays to normal fleet upgrade will be reflected in the calculation of emissions as set out in section 4. It is not considered that any technical changes are required to the emissions modelling process as a result of the Covid 19 pandemic.

Modelling process		Discussion as at OBC	Update as at Consultation	Proposed changes to the core scenario to represent Covid 19
4	The AQ modelling process, which uses ADMS-Urban software to combine information about mass emissions of pollution (from EMIGMA) and other data such as wind speed and direction, topography plus background datasets and atmospheric chemical reactions to predict total ambient pollutant concentrations.	The emission rates for each modelled scenario in EFT have been input into ADMS-Urban air quality dispersion model (v4.0.1.0), along with hourly meteorological data from Manchester Airport meteorological station for 2016. The meteorological hourly data set includes all key parameters such as wind speed, direction, temperature etc. This is considered an appropriate tool as applied. The outputs of the AQ modelling were verified against NO_2 monitoring data, which was located in relevant locations across Greater Manchester. This process is described further in AQ3. GM already has an extensive monitoring network of continuous monitors supplemented by diffusion tubes. However, not all of the PCM links are covered directly by the existing monitoring locations. Therefore, additional diffusion tube monitoring is being undertaken.	No change to the dispersion modelling process or verification has been applied from the OBC process.	It is not considered that any changes are required to the AQ modelling process as a result of the Covid 19 pandemic.

7 Consideration of the impacts of Covid 19 on uncertainty in the GM CAP modelling process

7.1 Sources of uncertainty in modelling the challenge

7.1.1 Table 7-1 sets out the possible impacts of the Covid 19 pandemic on sources of uncertainty in the modelling of the challenge as identified in the Analytical Assurance Statement (January 2020). This shows that there is greater uncertainty as a result of the pandemic, with some aspects likely to worsen air quality, and others potentially providing air quality improvements. Overall, it is very unlikely that any improvements to air quality would be of a sufficient scale to mean that action was no longer required.

7.1.2 Monitoring will be required to ensure that the policy and proposals contained in the GM CAP remain appropriate throughout the lifetime of the interventions. Monitoring will also be required where uncertainty remains as to post-pandemic conditions, for example in terms of vehicle fleets, travel patterns and the provision of bus services.

7.2 Sources of uncertainty in modelling the impacts of the CAZ

7.2.1 Table 7-2 sets out the possible impacts of the Covid 19 pandemic on sources of uncertainty in the modelling of the Clean Air Zone as identified in the Analytical Assurance Statement (January 2020).

7.2.2 At the time of writing, in April 2021, the UK is still operating under pandemic-related restrictions on activity and travel. It is therefore too early to say with certainty what the impacts of Covid 19 will be post-pandemic on behaviour, travel patterns, businesses and the economy. In order to achieve compliance in the shortest possible time, GM needs to progress the modelling underpinning the GM CAP based on a set of reasonable assumptions about the medium-to-long term impacts of the pandemic. Where uncertainty remains, monitoring will allow GM to apply an ‘adaptive planning’ led approach to the delivery of the GM CAP, to ensure the Plan remains appropriate and effective.

Table 7-1: Sources of uncertainty in the modelling of the challenge

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of Covid 19 impact
Vehicle purchasing / ownership patterns and trends	The projected fleet mix for buses and other road traffic in the forecast year is estimated, based on an assumption that the age profile of the vehicle fleet remains unchanged over time. ANPR data has revealed that the Greater Manchester fleet is older than the national average. There is some emerging national evidence of slowing new vehicle sales and of a shift from diesel to petrol in new car purchases. Sensitivity testing suggests that a slower change in the fleet age over time could result in mass NOx emissions for 2023 that are approximately 25% greater than the reference case. Monitoring of the fleet profile will be required. New ANPR survey data from 2019 will assist in determining the projection rate used between 2016 to 2021/23.	Additional ANPR data has been collected to improve the evidence base with regard to the fleet age profile, and temporal projection. Research has been undertaken into the vehicle renewal patterns of different market sectors and this has been incorporated into the LGV and HGV cost models, providing a more informed position on the likely behavioural responses to the CAAP. GM has applied EFT v9.1a, which has primarily affected the split of petrol and diesel cars, increasing the petrol and EV/hybrid fleet in line with more recent sales trends and again reducing uncertainty in terms of the accuracy of car emissions.	The Do Minimum fleet mix assumes a normal pattern of vehicle upgrades, including the purchase of new vehicles, trading of second-hand vehicles and the scrapping of the oldest vehicles from the fleet. The impacts of the Covid 19 pandemic include: • Reduction in the number of new vehicles manufactured due to lockdowns; • Delay in transactions due to lockdown constraints; • Reduction in vehicle upgrades due to direct economic impact of lockdown or wider recessionary impacts, or because vehicles are not being used as heavily as before; and therefore • The oldest vehicles remaining in the fleet for longer. Analysis shows that these impacts vary between different vehicle types and business sectors with some more affected than others. Sensitivity testing of an older-than-expected fleet has been carried out and it is proposed that some adjustments are made to the car, van and taxi fleets to reflect the emerging evidence that the normal pattern of vehicle upgrades has been affected for those fleets, set out in Section 4.

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of Covid 19 impact
Trends in background emissions	Background emissions are based on the DEFRA background emissions maps 2015. Comparison of this with local background measurements suggests that the DEFRA maps are lower than monitored values. Background emissions are higher than average in parts of Greater Manchester, accounting for 25 µg/m3 at some non-compliant sites, after removal of the transport sector, in 2021. GM assumes that DEFRA will keep abreast of trends in background emissions. GM will apply any new guidance as it emerges where possible.	The Defra background maps were updated to a 2017 base year, however these are not consistent with the projections used in EFT 9.1a. Additionally, a 2016 dataset was not provided so the latest 2017 based maps cannot be used in the GM modelling which has a 2016 Base Year. This issue was flagged to JAQU before the mapping was released. Background concentrations vary each year for many environmental factors, so assumptions based on the Base Year are subject to projection uncertainty, which cannot readily be addressed without altering assumptions that affect the Base Year verification and Target Determination results.	It is not considered likely that Covid 19 would have a significant impact on background emissions.
Traffic growth trends	The SATURN model forecasts traffic growth of around 12% between 2016 and 2025, reflecting population and economic growth. Current trends suggest traffic is not growing at this rate and therefore sensitivity testing of a low traffic growth scenario has been carried out.	Note that a correction has been applied in the revised Do Minimum modelling ensuring that van growth is correctly represented.	The initial lockdown phase had a very significant but temporary impact on traffic, with traffic volumes returning closer to normal during 2020 - albeit with different demand patterns in terms of geography, time of day, day of week etc - and later lockdowns having much less impact on traffic volumes. In the longer term, it remains possible that the Covid 19 pandemic could affect traffic growth in any of the following ways:

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of Covid 19 impact
	Sensitivity testing suggested that a plausible low growth scenario resulted in relatively small reductions in vehicle kms and NOx emissions of about 6% relative to the do-minimum scenario.		• Reduction in traffic or a loss of growth due to a recessionary impact; • Reduction in traffic in peak periods due to sustained behavioural changes such as more working from home; • Increase in the car mode share due to restrictions on public transport use, or people being deterred from public transport by fear of infection; and/or • Increase in freight traffic (especially LGV) due to sustained behavioural changes such as increased internet shopping. As pandemic-related travel restrictions remain in place at time of writing, it is not possible to assess with any certainty the likelihood, scale or nature of any such changes. As per the JAQU guidance, GM does not propose to reflect any possible travel behaviour or traffic changes in the core scenario. Sensitivity testing of the impact of increased working from home and reduced traffic will be carried out. Monitoring of traffic patterns, public transport passenger data and survey data about behavioural choices will demonstrate whether any changes are sustained post-pandemic.
Fuel costs and other wider changes in costs/travel time	Traffic modelling assumes fuel costs as recommended by TAG. In theory, if fuel costs or other similar costs were to change in future, it could have an impact on vehicle purchasing choices and on kilometres travelled.	No change	Unlikely to be a material impact and CAP is relatively insensitive to change in this aspect. GM is not proposing any sensitivity testing of changes to fuel or travel time costs.

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of Covid 19 impact
	Sensitivity testing of the GM CAP has demonstrated that the conclusions are not sensitive to fuel costs.		
Effectiveness of future emissions standards	It is assumed that future emissions standards perform as planned. The performance of earlier emissions standards against forecasts has been variable. This is a known source of uncertainty that cannot meaningfully be mitigated at a local level.	No change	Not affected by Covid 19.
Assumptions about real-world emissions	Emissions rates have been based on the EFT version 8.0. The emissions rates of vehicles in the real world may differ from those modelled. The analysis in the base year is calibrated to real data and so this is internalised into the analysis. However, this cannot be adequately weighted to differing vehicle types/ages/fuel types which affects future year assumptions as the fleet renews over time. This is a known source of uncertainty that cannot meaningfully be mitigated at a local level.	This is not altered from OBC position, because EFT 9.1a is also based on Copert.	Not affected by Covid 19.

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of Covid 19 impact
Assumptions about the impact of urban canyons	Greater Manchester is a complex urban environment. Overall, it is considered likely that there is considerable variation of modelled concentrations in central Manchester due to the presence of canyons. The assessment has applied a recognised best practice approach to representing model predictions in the vicinity of canyons. It is also noted that the highly variable and complex nature of modelling this type of environment is not readily compatible with the overall approach of the EU Air Quality Directive, which indicates model outputs should be representative of relatively long stretches of road, not affected by changes to traffic flow or junctions. Canyons are a similar effect resulting in spatial discrepancy in NO_2 concentrations. JAQU guidance recognises this issue and recommends additional Scheme Evaluation Monitoring is implemented in canyon locations, but not that this should be done to inform the Target Determination process / Options Appraisal of OBC which	The approach to modelling canyons followed best practice, both in the application of the canyons module, with a canyons file produced for GM by CERC (the ADMS model developer), but by applying a separate AQ model verification zone around the IRR area where the canyons module was used explicitly. However, even with this approach the uncertainty in predictions is highly sensitive to the local effects of canyons, and several of the last locations to comply are found inside the IRR area. Additional air quality monitoring has been deployed in July 2019, and further monitoring will be needed to meet the requirement of the Monitoring and Evaluation project, and guidance issued by JAQU in 2019. These sites included many in the canyon locations where exceedances had been predicted in the AQ modelling. Sufficient data is not yet available to draw meaningful conclusions on annual mean NO_2 concentrations.	Not affected by Covid 19.

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of Covid 19 impact
	would like to delay the programme by 6-12 months.		
Gradients and Topography	The effects of gradients have not been able to be incorporated in the timescales. The locations of significant gradients were reviewed and it is considered that this would have only a limited effect on verification or key output sites. Topography of the road network is difficult to determine as the road network is not always at grade. However, the last points of compliance in the modelling are not significantly affected by gradients.	No change. Incorporation of gradient into the modelling would have required updating Target Determination, because we would have had to alter the Base year modelling and verification process. This was not considered proportionate because the last points of compliance in the modelling are not significantly affected by gradients.	Not affected by Covid 19.
Assumptions about bus service patterns and fleet profile	The highway modelling is based on 2015 bus service patterns. Bus mileage has, however, been falling in recent years and it is possible that this approach over-estimates likely future bus mileage. There is uncertainty around bus vehicle upgrade patterns. The impact of new funding to support the purchase of electric buses has not been incorporated in the analysis.	The traffic model has been updated to reflect the latest information on service patterns and fleet profiles from 2019. The GM bus market is complex with numerous operators and fleet age profiles which reflect uncertainty around the future direction for bus service provision in GM.	Covid 19 has had a very significant impact on bus operations, with public funding required to maintain services, and constraints on bus use. GM considers that it is most likely that current service patterns are broadly maintained through the lifetime of the Plan but there remains a risk that the Covid 19 pandemic results in: • A reduction in bus services; • Delays to planned fleet upgrades, so that the fleet is older than forecast; and • A reduced ability of bus operators to be able to respond to the GM CAP by upgrading their fleets.

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of Covid 19 impact
		Proactive engagement with the bus operators has shown a good awareness of the CAP and a willingness to improve their fleets. Uncertainty will remain however around the commercial decisions to be made until the level of potential financial support can be confirmed.	Indicative sensitivity testing of an older-than-expected fleet and the impact of a reduced bus service has been carried out. One or both of these tests may be repeated on the post-Consultation GM CAP scheme. Monitoring of bus services, on-the-road fleets and of the ongoing position of bus operators and Government subsidies will be required post-pandemic. However, there are specific services where electric buses are funded or now in full operation, and these will be incorporated to the revised modelling.
Assumptions about future growth and related schemes	The GMVDM matrices were used to calculate demand changes; these matrices included early estimates of GMSF (Greater Manchester Spatial Framework) growth, which were not available at the time that the 2021 CAP matrices were developed. It needs to be born in mind, however, that the GMSF is still open to consultation and will be subject to uncertainty. Overall traffic growth has also been constrained to NTEM forecasts.	A review will be undertaken prior to FBC submission to assess whether any approved schemes are expected to affect the topology of the road network and review the assumed networks for 2023 and 2025.	GM has carried out a review of whether Covid 19 is expected to result in the delay or cancellation of some future development schemes that affect the topology of the road network and of the assumed networks for 2023 and 2025. It is not considered that any known scheme delays will have a meaningful impact on compliance. More detail is provided in Table 2-3. Several temporary road schemes have been put in place during the pandemic. Although it is possible that they may continue, or that other schemes could be introduced which affect traffic patterns or the road network, the GM CAP team is not currently aware of any new funded and approved schemes of this nature.

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of Covid 19 impact
	It was decided as part of this process to also include all of the 2025 schemes in the 2023 networks, to ensure that both networks were topologically the same. This approach was adopted to avoid having to update the road width and street canyon files that had been developed for use with the 2025 dispersion model, which would have been time-consuming and could have delayed the project.		
Other assumptions about road network and weather conditions affecting air quality forecasting	The GM region is a very large study area, with a diverse range of topography and surface features. Additionally, road transport fleet age may vary depending on the nature of road type or function. This area has necessarily been modelled as a homogenous area in ADMS.	No change	Not affected by Covid 19.

Table 7-2: Sources of uncertainty in modelling a Greater Manchester Clean Air Zone

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of the impacts of Covid 19
Vehicle purchasing/ ownership patterns and trends	A series of assumptions have been made about upgrade choices and costs, for example that drivers would not choose to downgrade their vehicle as a result of the GM CAP. If further evidence becomes available that challenges these assumptions, the number of vehicles in-scope could potentially be altered, and the base level altered. However, this would be relatively consistent between scheme options and thus would be unlikely to affect the decision to proceed with Option 8. In behavioural response terms, the primary impact is on the costs and benefits of the proposals, and on the mitigating measures that may be required.	The cost models developed for LGV and HGV allow for drivers to downgrade (LGV to estate car, HGV to LGV etc.) where appropriate based on a consideration of the market sector they operate in. The cost model developed for Taxi / PHV includes the functionality to allow downgrade from Hackney operation but this has not been implemented. Further detailed research would be required into the commercial operation of this sector to enable a robust assessment. It is currently assumed that the choice to operate a Hackney (rather than PHV) would not be impacted by the CAP as the charge would apply equally to both modes. Further work has been done to substantiate the cost assumptions being used for upgraded vehicles and for the feasibility, availability and cost of retrofit. In addition, comparing the original and new ANPR surveys conducted in GM has provided greater confidence that our assumptions about vehicle purchasing patterns are correct.	See Table 7-1 for a discussion of possible impacts on vehicle purchasing patterns. Note that it is also possible that if the pandemic leads to business failures amongst medium/large businesses, this could lead to fleets of compliant vehicles coming on to the market.

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of the impacts of Covid 19
Behavioural responses	Our assumptions in terms of how drivers would respond to a CAZ in Greater Manchester have been based upon data collected in Bristol. This is the best data available and is considered more appropriate than applying survey data from London. New information from Sheffield is now available, and this needs to be tested to see whether it corroborates existing assumptions. GM will also consider any 'revealed preference' data that becomes available from other cities as schemes are launched elsewhere.	The Bristol stated preference data is no longer used. See Appendix A of the Analytical Assurance Statement for further details on a measure-by-measure basis.	There is a risk that Covid 19 affects behavioural responses to the CAZ/Funds, for example because: • Underpinning assumptions – such as the cost to upgrade – change, thus changing the relative appeal of upgrading; • Those affected are less able to make the most cost effective choice, if that requires up front investment or borrowing (see more detailed commentary below); • The availability of suitable, compliant vehicles is less than forecast; or • More vehicles are in scope for charging, because of delays to normal fleet upgrades, and therefore the support packages are not sufficient to support everyone in need. Indicative sensitivity testing has been carried out to assess the impacts of changes to behavioural responses on the effectiveness of the proposals, and on the need for support. Further sensitivity testing is planned on the post-Consultation GM CAP scheme. Monitoring of related factors (vehicle availability and cost, business and economic performance, vehicle markets etc) will be required post-pandemic.

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of the impacts of Covid 19
Frequency of travel	The cost effectiveness of different behavioural responses depends in part on the frequency of travel. We have identified the need for better data and new data collection is underway using ANPR surveys. We will also investigate the feasibility of further data collection to improve our knowledge. However, given the regional scale of the scheme, it is likely that the majority of vehicles in-scope will be local and therefore travel frequently and so this is less influential than for a smaller scheme.	New ANPR data has been collected however there remains a degree of uncertainty with regard to trip frequency particularly for freight (LGV and HGV) vehicles travelling into GM from outside. There will be a high degree of variation which may not have been captured adequately by the ANPR e.g. long-distance HGVs which visit infrequently and similarly coach traffic relating to particular events.	In responses to lockdown, some businesses/sole traders temporarily suspended activity, but increasingly it may be the case that activity will recommence but at a lower intensity than before. It seems likely however that this is a short term impact and that in the medium term post-pandemic those who remain trading will travel at broadly the same frequency as before (considering only the commercial vehicles in scope for the CAZ, and not car travel).
Infrequent and long distance travel	We have assumed that long distance travellers (>50 miles trip length) do not respond, which seems reasonable.	No change.	Not affected by Covid 19.

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of the impacts of Covid 19
	However, we cannot take account of the possible impacts of schemes in other cities on the national fleet profile. It seems reasonable to assume that if many cities introduced similar schemes, this would have a meaningful effect on the national fleet profile for in-scope vehicles, by affecting operators' abilities to relocate a non-compliant fleet, or the total cost of becoming compliant vs upgrading.		
Cost of upgrade	It is possible that the introduction or expectation of CAZs increases the price of compliant vehicles, and/or decreases the value of non-compliant vehicles. This has not been taken into account in the analysis.	We have allowed for market distortion to be considered as part of the functionality of the cost models. This has not been implemented in the core reporting but can be used for sensitivity testing.	The possible impact of a CAZ in distorting market prices is not affected by Covid 19. However, the pandemic itself may distort vehicle prices. It is possible that prices could increase as a result of constraints in the availability of compliant vehicles, as set out above, or due to increased demand arising from sustained behavioural changes post-pandemic. For example, the rise in internet shopping has led to increased demand for vans, with anecdotal evidence that vans temporarily released by construction firms were re-purposed for deliveries during lockdown. A sustained increase in van demand could place pressure on the van market. Media reports suggest that the price of second hand vans may be rising.

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of the impacts of Covid 19
		The extent to which this distortion occurs will be dependent on the number and scope of other CAZ projects around the country and factors in the vehicle supply chain and potential retrofit technology which are outside the control of GM. Indications for LGVs are that the issue is relatively minor for a 2023 charging scheme, but could materially affect responses in 2021 when the market supply of compliant second-hand vehicles would be constrained. There is also evidence that the availability of compliant Euro 6 diesel Hackney Cabs is very limited.	Sensitivity testing has been carried out and suggests that the GM CAP has relatively low sensitivity to price increases. Nevertheless, monitoring of vehicle prices, particularly vans, will be required post-pandemic and further sensitivity testing will be carried out on the post-Consultation GM CAP scheme.
Impact of discounts and exemptions	The analysis conducted to date assumes all vehicles are in scope for the CAZ and does not take into the possible impact of discounts and exemptions. These will be developed at FBC and are subject to public consultation.	A series of proposed discounts and exemptions have been developed with supporting policy documentation that will be subject to the planned public consultation exercise. All major discounts and exemptions are included in the core model runs.	Proposals for discounts and exemptions are being reviewed in light of the Consultation feedback and evidence on the impacts of Covid 19. The impact of any proposed discounts and exemptions will be assessed in the modelling of the post-Consultation GM CAP scheme.

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of the impacts of Covid 19
		Work has been conducted, as is presented in Note 12: 'Evidence of the impact of a 2021 CAZ C', to demonstrate that removing the LGV temporary exemption cannot bring forward compliance. This was supplied to JAQU on 12th July and further discussions and evidence sharing have taken place since then. Revised estimates of the number of LGVs expected to upgrade to new and second-hand vehicles were supplied to JAQU on 22nd October 2019 and further evidence on the issues with removing the LGV temporary exemption was supplied by letter on 1st November. A freight data annex was supplied on 22nd January 2020 providing freight fleet data.	
Re-routeing or change of destination	For the region-wide CAZ proposals, the demand responses to charging are applied in the demand sifting tool rather than in the highway assignment model. Therefore possible changes to origins and destinations are not captured. The GM-wide nature of the schemes reduces the likely effect of destination change at the last point of compliance.	Investigations have been undertaken using the assignment model to check on the risk of diversion. Involved liaison with infrastructure team (signing etc.) to ensure impact minimal.	Not affected by Covid 19.

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of the impacts of Covid 19
Access to equity or credit to facilitate behaviour change	None.	It has been assumed in simple terms that vehicle owners will take the lowest cost option, upgrading if this saves money compared to paying the charge. This in turn assumes that vehicle owners have the equity and/or access to credit to enable them to make the best financial choice. However, evidence suggests that people and businesses are not always able to save money if to do so involves a large up-front capital investment. At present around one third of credit applications are refused. Those with poor credit ratings, low or unreliable incomes, or who need to purchase a high value vehicle may struggle to access the credit they need to upgrade. The CAZ will bring forward investment in fleet upgrade. This will affect the credit worthiness of applicants, as they will have had less time to accrue a deposit, may need to purchase a higher value vehicle than normal, and may need to finance multiple vehicles at one time. As a result, total indebtedness will rise, affordability will fall and they may either face more expensive credit or be refused.	There is a risk that Covid 19 affects (worsens) access to equity or credit to facilitate behaviour change. In particular: • Businesses, individuals and charities may have reduced or exhausted their reserves/savings during the pandemic; • Businesses, individuals and charities may have become more indebted, by accessing Government or other loans, overdrafts and credit options; • Businesses, individuals and charities may not have been able to trade as normal during 2020 and therefore may find it more difficult to demonstrate that they are credit-worthy; • Turnover and profitability may be reduced due to any economic downturn arising from the pandemic, reducing the ability to save or borrow; and/or • Normal vehicle upgrades may have been delayed, increasing the loan-to-value ratio for those upgrading (because they are financing more vehicles at one time). Evidence from business surveys and statistics shows that many businesses have been affected by the pandemic in these ways. Indicative sensitivity testing has been carried out, as set out above in terms of the impact on behaviour change.

Source of uncertainty	OBC Discussion	Update as at Consultation	Consideration of the impacts of Covid 19
		Thus, there is a risk that the models over-state the likelihood that vehicles upgrade, if upgrade is not possible or affordable due to a lack of equity or credit. The provision of grants and/or loans to assist upgrade will mitigate this risk, as well as mitigating negative socio-economic impacts on in-scope groups. It could be considered that the 'with grants' behavioural responses are more robust than the 'CAZ only' responses.	Ongoing monitoring of business performance and surveys will be required.

8 Conclusion

8.1 Summary of recommendations

8.1.1 In summary, GM is proposing to make the following changes to the modelling process for the core scenario, in order to represent the impacts of Covid:

- Representation of delayed CAZ launch date of 2022;
- Update to bus fleet reflecting current deployment of zero emission buses;
- Apply a delay to normal fleet upgrades to the private car, van, and taxi fleets; and
- Apply a correction to the cost modelling process to prevent over-optimistic forecasting of upgrade responses as a result of the application of delays to fleet upgrades for van and taxi.

8.1.2 Any other possible impacts of the pandemic that have been identified by GM as plausible and potentially impactful will be considered via sensitivity testing.

8.2 Next steps

8.2.1 GM has submitted this paper seeking JAQU approval of the proposed approach.

8.2.2 Following approval of this approach, GM will progress re-modelling of the Do Minimum scenario and commence modelling of a post-Consultation package of measures, subject to local decision-making processes. A paper setting out the air quality impacts of these Covid 19 related revisions and of the proposed post-Consultation package of measures will be supplied to GM's ten local authorities in summer 2021.

8.2.3 Revised versions of each Technical Report as set out in Section 1.1 will be supplied as appendices to the FBC.

APPENDIX ONE: JAQU's guidance to local authorities, February 2021

Department for Transport

Department for Environment Food & Rural Affairs

Cllr Andrew Western
Trafford Council,
Trafford Town Hall,
Talbot Road,
Stretford,
M32 0TH

22 February 2021

Dear Andrew,

The Government is implementing the 2017 Air Quality Plan to ensure that compliance with roadside nitrogen dioxide concentrations is achieved in the shortest possible time. Due to the impacts of Covid-19, we are now operating in an environment of considerable uncertainty. Despite these uncertainties we must continue to deliver cleaner air. The future impact of the pandemic on traffic levels and nitrogen dioxide emissions/concentrations will be difficult to predict. Roadside nitrogen dioxide levels will be impacted in the short term by how quickly local traffic flows re-start and in the longer term by several factors (e.g. fleet evolution, home working, modal shift, etc). Analysis and modelling can provide an indication of possible outcomes, however, given the considerable uncertainty we must accept that there is a risk of putting in place clean air measures that overachieve, however, this is preferable to inaction which leads to poor air quality.

JAQU officials have been working with Local Authorities to review the impacts of Covid-19 on their delivery plans and NO_2 levels. Based on these conversations, the data LAs have supplied to us, discussions with our expert panel and our internal review of evidence, we are now in a position to confirm next steps as to how Covid-19 impacts can be applied to central scenarios.

LAs will be able to apply some, but not all, of the results of sensitivity tests to central scenarios, depending on the level of uncertainty associated with underlying assumptions and the impact of the result on the plan. JAQU (with TIRP steer) have RAG rated the sensitivity tests that LAs have discussed with us in **Annex 1**.

LAs can use the test results as follows:

- **"Green"** rated – results can be used to influence central scenario modelling due to a higher level of confidence in the evidence (lower level of uncertainty) and/or small impact on outcomes.
- **"Amber"** rated – results may be used to influence central scenario modelling if the LA has appropriate supporting evidence. The degree of change brought about by these results will also play a factor. JAQU will require the LA to make a strong case for their inclusion, which will be assessed by JAQU and TIRP, with

a recommendation given to Ministers as to whether JAQU supports inclusion of this impact in their core modelling.

- **"Red"** rated – due to the high level of uncertainty with these tests, LAs will not be able to use the results to influence central scenario modelling, however results can be included in business cases to indicate degree of shift possible within the plan.

LAs must note that the evidence required to support Covid-19 assumptions is expected to be of at least the same level of robustness as evidence included in plans as standard. Where evidence does not achieve the required standard the results from the sensitivity tests cannot be applied to the central scenario modelling but may be included as a sensitivity test in the business case submission. LAs that include Covid-19 impacts in the central scenarios will be expected to include KPIs to monitor and evaluate these in their Monitoring & Evaluation plan.

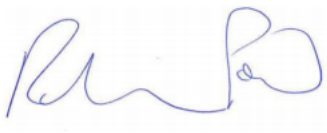
The steps for LAs who intend to apply Covid-19 impacts to their plans are set out in **Annex 2**. The process has been designed to minimise additional delays and provide a swift decision that will enable Local Authorities to proceed in finalising their plans and implementing their measures. LAs will be expected to proceed with applying any approved Covid-19 impacts following a single TIRP and JAQU recommendation and direction or letter (as appropriate). LAs will be expected to agree a timeline with JAQU officials on the submission of their sensitivity test results by 1st March 2021. After TIRP review it is anticipated that should any further modelling be required that an LA should complete this within a maximum of 8 weeks and be done in parallel to current work.

Please do not hesitate to contact your account manager if you have any questions.

Yours sincerely,

RACHEL MACLEAN

PARLIAMENTARY UNDER SECRETARY OF STATE FOR TRANSPORT



REBECCA POW

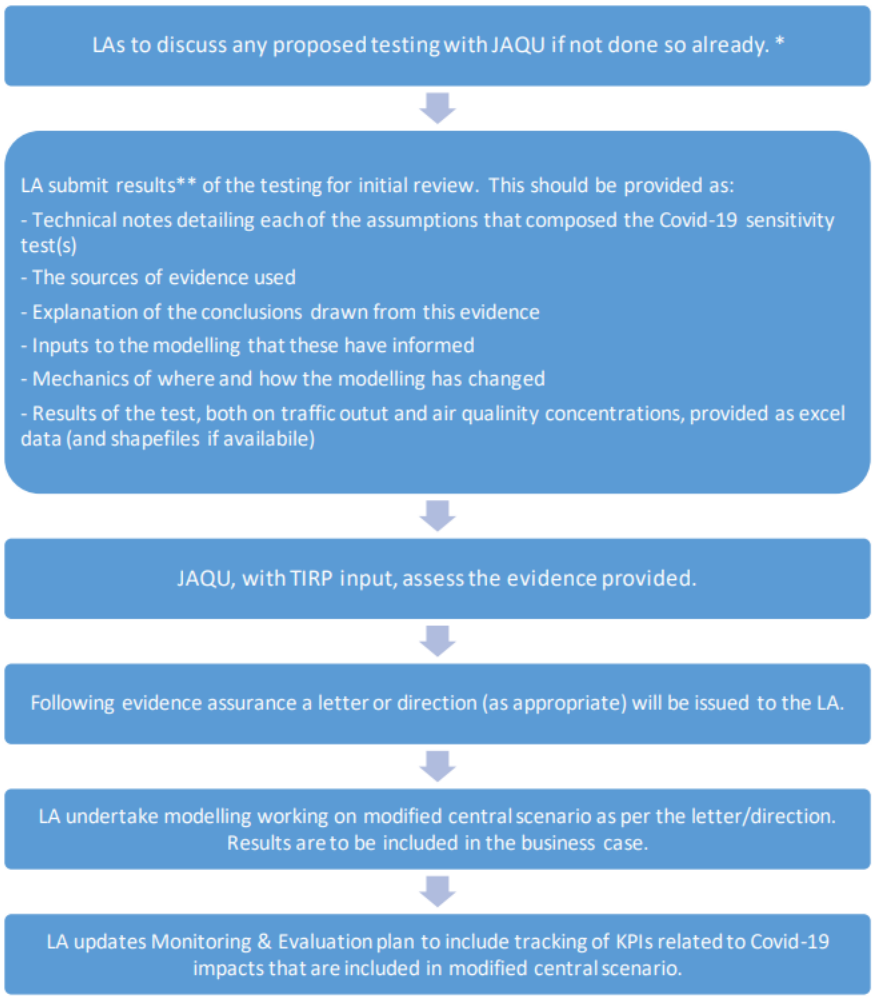
PARLIAMENTARY UNDER SECRETARY OF STATE FOR ENVIRONMENT AND RURAL AFFAIRS

Annex 1: RAG rating for sensitivity tests

Test & RAG status	Justification for categorisation and guidance on what evidence to include
Impacts of a CAZ implementation delay	• Robust evidence within LAs of any delay to CAZ go-live. • Delays simple to model.
Green recovery/measures	• Robust evidence as some LAs have developed measures that have been agreed and in places already implemented through other funding initiatives. • Impact of these tends to be highly localised (single roads, junctions, etc.)
Delayed development plans (new residential or commercial developments /infrastructure, etc.)	• Robust evidence as planning already in progress for these schemes. The original assumed demand for such schemes was known to the LA. • Only schemes of significant size will have a high impact, but most large schemes will have been considered already by LA modelling.
Fleet upgrade delay impacts	• Delay simple to model and national data readily available. • LA may have evidence to support such a delay derived from observed purchasing trends throughout 2020. • Fleet upgrade could be influenced by economic performance depending on timing of CAZ and length/depth of recession.
Reduction in CAZ charges	• LAs set these responses in their modelling based on either locally gathered surveys, central gov estimates or a literature review of similar schemes during plan development. • JAQU does not want to rule out (by putting in red) that an LA may be able to bring together a body of evidence that indicates an adjustment to these assumed response levels is warranted. • Note: JAQU central assumptions will not be updated at this time in respect to Covid-19.
Increased Stay & Pay response	• LAs set these responses in their modelling based on either locally gathered surveys, central gov estimates or a literature review of similar schemes during plan development. • JAQU does not want to rule out (by putting in red) that the LA is able to bring together a body of evidence that indicates an adjustment to these assumed response levels is warranted. • JAQU central assumptions will not be updated at this time in respect to Covid-19.
LGV/HGV change response	• Trend in goods vehicle trips and GDP growth tend to mirror each other.

	• LAs may be able to adequately source bespoke local evidence to warrant a change. Changes to this response would be inspired by local understanding of the types of businesses serviced in the CAZ area and the adaptation/ survival of those businesses post-Covid. • Note: JAQU central assumptions will not be updated at this time in respect to Covid-19.
Increased homeworking	• Level of continued homeworking post-Covid is highly speculative.
Shopping/Leisure trips (increase due to home working and/or reduction due to online shopping)	• Level of shopping and leisure trips post-Covid is highly speculative.
GDP impacts (reduced employment)	• GDP performance is highly speculative.
Impacts on public transport/modal shift (reduction in demand/capacity/supply)	• Short term aversion to public transport is driven primarily by the immediate threat of transmission of the virus so there is an expectation that this does not impact longer term behaviour. • Model limitations used in LA plans may prevent adequate modelling of these impacts (i.e. economic impact and social distancing; change in transport mode preference due to perceived fear of virus, cost of mode, etc.).
Change in car ownership assumptions	• We do not support inclusion of changes of these factors in central scenario modelling. • These factors are highly speculative (based on long term behaviours & GDP, as well as international factors). • Subcategory/consequence of GDP - wider economic, employment forecasting would need to be taken into account. Driven by length and depth of long/short term recession. Also dependent on price of oil/level of subsidy.
Changes to vehicle purchase costs/pricing (fare)	• Speculative (long term behaviours & GDP). • Subcategory/consequence of GDP - wider economic, employment forecasting would need to be taken into account. Dependent on price of oil/level of subsidy/fare.

Annex 2: Steps for LAs to follow



*LAs that have not submitted a baseline at IES stage should include green-rated tests in their baseline.

**Data needed: In addition to those items explained above, if LAs have tested a potential revised package of measures on top of the sensitivity test baseline, this should be provided for review.

***If they wish, LAs are welcome to update Monitoring & Evaluation plans to track KPIs associated with Covid-19 impacts that informed sensitivity tests but were not taken forward into the modified central scenario.

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

Appendix 6E: Note 38: Discounts & Exemptions – updated with final GM CAP Policy

Warning: Printed copies of this document are uncontrolled

Version Status:	DRAFT FOR APPROVAL	**Prepared by:**	Transport for Greater Manchester on behalf of the 10 Local Authorities of Greater Manchester
Date:	20th June 2021		

Contents

1 Introduction

Overview

1.1 In July 2017 the Secretary of State issued a Direction under the Environment Act 1995 requiring a number of Greater Manchester local authorities to produce a feasibility study to identify the option which will deliver compliance with the requirement to meet legal limits for nitrogen dioxide in the shortest possible time.

1.2 The 10 Greater Manchester local authorities have been developing the study collectively together with the GMCA, coordinated by TfGM in line with Government direction and guidance. An Outline Business Case (OBC) was duly submitted in March 2019.

1.3 Ministerial feedback was received in July 2019 along with a further direction under the Environment Act 1995 which requires all ten of the Greater Manchester local authorities to:

> *"take steps to implement the local plan for NO_2 compliance" (which was summarised as involving a Class C Charging CAZ with additional measures) and "ensure that the local plan for NO2 compliance is implemented so that–*
>
> *(a) compliance with the legal limit value for nitrogen dioxide is achieved in the shortest possible time, and by 2024 at the latest; and*
>
> *(b) exposure to levels above the legal limit for nitrogen dioxide are reduced as quickly as possible."*

1.4 The ten authorities were also required to submit further options appraisal and information which they subsequently did resulting in a number of changes to the local plan, albeit that it still provided for a Class C Charging CAZ.

1.5 The 10 Greater Manchester local authorities are now subject to a Ministerial direction dated 16 March 2020 requiring them to implement the local plan for NO2 compliance considered by the Secretary of State on March 16 2020 (which includes a Class C Charging CAZ in Greater Manchester) as soon as possible and at least in time to bring forward compliance to 2024.

1.6 The ten GM authorities conducted an eight-week consultation from 8 October to 3 December 2020. The purpose of the consultation was to seek views from residents, visitors, stakeholders and businesses on the local plan to achieve legally compliant NO_2 levels in Greater Manchester.

1.7 GM has considered the feedback from the consultation has made a number of changes to the proposals, set out in the GM CAP Policy, following consultation.

1.8 This Technical Note 38 sets out the evidence underpinning the rationale for the local discounts and exemptions proposed in the GM CAP Policy following consultation. It also sets out the results of analysis undertaken to assess the possible impact of the proposed national and local discounts and exemptions on achieving compliance in the shortest possible time.

2 Background

National Guidance

2.1 The UK government's 'Clean Air Zone Framework: Principles for setting up Clean Air Zones in England'[1], sets out the approach that is expected to be taken by local authorities when implementing and operating a Clean Air Zone in England. Section 3.9 of the guidance states the following in relation to discounts and exemptions:

> *"There is a general presumption that the requirements for charging Clean Air Zones will apply to all vehicles according to the relevant zone class.*
>
> *There will be certain circumstances where exemptions and discounts from a charge will be appropriate. This may be because of a person's particular circumstances; the type of vehicle concerned may be difficult or uneconomic to adapt to comply with a zone's requirements; or the operation a vehicle is engaged in is particularly unique or novel.*
>
> *Discounts and exemptions should, in general, be based on the principle that;*
>
> - *specialist vehicles that can never be compliant should qualify for an exemption from a charge;*
> - *a sunset period should be allowed for specialist or more novel vehicles that can become compliant in a suitable time to allow for them to be changed.*
>
> *While exemptions should be kept to the minimum necessary in order to maximise the benefits of a zone, local authorities may also consider additional exemptions or discounts based on particular local circumstances. Local authorities may consider ways in which the cost of any charge to enter areas could be reduced for groups they identify as facing particular challenges, so long as this is achieved in a way which does not slow down the achievement of the outcomes of the zone. This might, for example, take into account the location of a charging zone in relation to key local businesses or services.*
>
> *Local Authorities will also need to think about enforcement relating to exemptions and discounts in designing a zone. This section sets out*

[1] Department for Environment, Food & Rural Affairs and Department for Transport. 2020. Clean Air Zone Framework. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/863730/clean-air-zone-framework-feb2020.pdf

where national exemptions should apply, and the circumstances in which local exemptions or discounts may be appropriate. Additional exemptions should not be applied where doing so would negate the overall benefits of the zone."

2.2 There are no temporary national exemptions or national discounts stipulated within the Government's Clean Air Zone Framework.

3 Greater Manchester's principles for discounts and exemptions

3.1 Whilst there is a general presumption that the requirements for charging Clean Air Zone (CAZ) will apply to all vehicles according to the relevant zone class, there will be certain circumstances where discounts or exemptions from a charge will be appropriate.

3.2 Taking the Government guidance into account, the following principles for discounts and exemptions in GM will apply:

- Guidance on national exemptions will be adhered to, meaning certain categories of vehicles which cannot reasonably comply with the required emissions standards (e.g. historic or non-road going vehicles) will not be required to pay a charge; and
- As per the Government's guidance in Section 145 of the CAZ Framework, any local discounts or exemptions, when considered in addition to the national exemptions, will not negate the overall benefits of the zone.

3.3 GM have treated the policy in respect of local discounts and exemptions (namely, to ensure that any local discounts or exemptions will not negate the overall benefits of the zone) as requiring (i) that they will not postpone the date on which legal compliance in Greater Manchester is achieved, and (ii) that the benefits of not charging users outweigh the disadvantages of doing so.

3.4 The proposed discounts and exemptions for the GM CAZ, both permanent and temporary, are described in turn below, alongside the JAQU guidance, rationale and evidence. It should be noted that the majority of these discounts and exemptions are consistent with the published approaches taken by other cities proposing a CAZ e.g. Leeds and Birmingham.

3.5 These discounts and exemptions fall into four categories:

- Permanent national exemptions;
- Permanent local exemptions;
- Temporary local exemptions[2]; and
- Permanent local discounts.

[2] A temporary local exemption is time limited exemption, applied for a fixed period. Within this temporary local exemption period, eligible vehicles would not pay a charge. Following the expiry of a temporary local exemption, non-compliant vehicles will be charged. Note that there may be a requirement to apply for discounts and exemptions

3.6 The proposed discounts and exemptions were subject to consultation in autumn 2020 and the proposals considered here reflect the position set out in the GM CAP Policy following consultation.

4 Permanent exemptions

Permanent national exemptions

4.1 The Government's Clean Air Zone Framework sets out permanent national exemptions i.e. those which will be exempt from charges for all CAZs within England, including the GM CAZ. These are in place due to some types of vehicle being particularly difficult or uneconomic to adapt to comply with the framework's requirements. They also cover vehicles that are engaged in particularly unique or novel operations. National, permanent exemptions that apply to all CAZs are set out in **Table 4-1**, alongside the rationale for inclusion and an assessment of the possible impact on achieving compliance in the shortest possible time.

4.2 **Table 4-1** shows that applying the permanent national exemptions is not likely to undermine the ability to meet air quality compliance in Greater Manchester in the shortest possible time. The permanent national exemptions are set out in the CAZ Framework and GM considers that the benefits of not charging users in such cases outweigh the disadvantages of doing so.

4.3 All permanent national exemptions are assessed as having a negligible impact due to the very small proportion of vehicles in scope.

Permanent local exemptions

4.4 In addition to stipulating national exemptions, the Government's Clean Air Zone Framework makes provision for local authorities to consider allowing additional exemptions or discounts based on particular local circumstances. GM has proposed a series of permanent local exemptions in the Policy following Consultation. These are set out in **Table 4-2**, alongside the rationale for inclusion and an assessment of the possible impact on achieving compliance in the shortest possible time. This analysis considers the possible impact in terms of the proportion of the total vehicle fleet within the scope of the GM CAZ.

4.5 It is also worth noting that, where it is not possible or practical to upgrade vehicles, applying an exemption would remove the cost burden of the charge. It would not however be expected to affect the choice to upgrade or not. In other words, this group would not be expected to upgrade with or without the exemption.

4.6 Three new permanent local exemptions have been proposed following consultation. These are for LGVs and minibuses that have been adapted for use by a disabled user (but do not qualify for the Disabled Tax Class exemption, which depends upon eligibility for certain benefits); driver training buses; and heritage buses not used for hire or reward.

4.7 **Table 4-2** shows that applying the permanent local exemptions is not likely to undermine the ability to meet air quality compliance in Greater Manchester in the shortest possible time. GM considers that the benefits of not charging users in such cases outweigh the disadvantages of doing so.

4.8 All proposed permanent local exemptions are assessed as having a negligible impact due to the very small proportion of vehicles in scope.

Table 4-1 Permanent national exemptions to CAZ charges, set by the Government

Permanent national exemptions	Description	Rationale	Impact on compliance
Historic vehicles	Vehicles with a 'historic' vehicle tax class (vehicles built or first registered more than 40 years ago)	Exempt due to age and unsuitability for compliant retrofitting	Negligible. Based upon ANPR sample data[3] and analysis of recorded vehicles which are within the historic vehicle tax class, the quantity of eligible vehicles has been estimated at less than 0.5% of total vehicles serving GM.
Military vehicles	Vehicles in use by UK Armed Forces	Exempt from charges by virtue of Section 349 of the Armed Forces Act 2006	Negligible. Military vehicles could not be identified from the ANPR dataset. The volume of military vehicles is assumed to be low as there are no military bases in GM and only a small number of Army Reserve Centres.
Disabled Passenger Vehicle (DPV)	Vehicles within the DVLA Disabled Passenger Vehicle tax class, used by organisations providing transport for disabled people.	This group of vehicles may include a range of specialist and/or novel or adapted vehicles, where it may generally not be practical to upgrade to a vehicle compliant with the emission standards of the GM CAZ.	Negligible. Based upon ANPR sample data and analysis of recorded vehicles which are within the DPV tax class, the quantity of eligible vehicles has been estimated at less than 0.5% of total vehicles serving GM based on the ANPR sample.
Specialist Emergency Service Vehicles	Specialist vehicles in use by emergency services, such as aerial ladders and major incident command vehicles.	This group of vehicles may include a range of specialist and/or novel or adapted vehicles where it may generally not be practical to upgrade to a vehicle compliant with the emission standards of the GM CAZ.	Negligible. Emergency services vehicles (including specialist emergency service vehicles and other vehicles used by emergency services) were identified in the ANPR data as accounting for less than 0.5% of total vehicles recorded. Emergency services in GM have a 4 – 10 year replacement cycle and therefore much of the fleet will be compliant upon the operation of the GM CAZ.

[3] For details of GM's ANPR survey, see Technical Note 5: ANPR Survey - Summary of Initial Findings

Table 4-2 Permanent local exemptions to GM CAZ charges proposed by Greater Manchester

Permanent local exemptions	Description	Rationale	Impact on compliance
Specialist Heavy Goods Vehicles	Certain types of heavily specialised HGVs, such as certain vehicles used in construction or vehicle recovery. The following are eligible to apply for exemption: • Vehicles in the DVLA Special Types Tax Class [4] and specified in an Order under Section 44 of the Road Traffic Act 1994; • Vehicles in the DVLA Special Vehicles Tax Class and meeting the definition of a "special vehicle" under Part IV of Schedule 1 of the Vehicle Excise and Registration Act 1994 (VERA); • Vehicles in the DVLA Recovery Vehicle Tax Class and meeting the definitions and criteria in	This group of vehicles includes certain novel or adapted road going HGVs of a particularly specialised nature, meaning it may not be practical to upgrade to a vehicle compliant with the emission standards of the GM CAZ.	Negligible. Based on data obtained from the DfT the quantity of specialist HGVs has been estimated at less than 0.5% of total vehicles serving GM[5]. Specialist HGVs represent c.6% of the HGV fleet and are assumed to make up a lower proportion of total HGV mileage, as they spend most of the time stationary.

[4] Information on tax classes for vehicles is available at: https://www.gov.uk/government/publications/v3551-notes-about-tax-classes

[5] 29,500 non-road going and specialist vehicles have been identified by the DfT, around 6% of the total number of HGVs registered in the UK, see https://www.theconstructionindex.co.uk/news/view/all-terrain-cranes-to-remain-exempt-from-mandatory-checks

Permanent local exemptions	Description	Rationale	Impact on compliance
	Part V of Schedule 1 of the VERA; • Vehicles in the DVLA Special Concessionary Tax Class and meeting the definitions and criteria in paragraphs 20B, 20C, 20D, 20E, 20F, 20H or 20J of Schedule 2 of the VERA); • Vehicles in the DVLA Limited Use Tax Class and meeting the definition and criteria in paragraph 20A of Schedule 2 of the VERA.		
Non-road-going vehicles	Certain types of non-road going vehicles which are allowed to drive on the highway such as agricultural machines; digging machines; and mobile cranes	This group of vehicles includes a range of specialist and/or novel or adapted vehicles, where it may generally not be practical to upgrade to a vehicle compliant with the emission standards of the GM CAZ.	Negligible. Based upon ANPR sample data and that obtained from the DVLA, as above, the quantity of non-road going vehicles has been estimated at less than 0.5% of total vehicles serving GM.
Vehicles used by emergency services	Certain types of vehicles used by emergency services front line emergency and certain non-emergency vehicles	This group of vehicles includes a range of vehicles, associated with front line emergency response, and where it may generally not be practical to upgrade to a vehicle compliant with the emission standards of the GM CAZ, which are not captured by the national exemption.	Negligible. Emergency services vehicles (including specialist emergency service vehicles and other vehicles used by emergency services) were identified in the ANPR data as accounting for less than 0.5% of total vehicles recorded. Emergency services in GM have a 4 – 10 year replacement cycle and therefore much of the fleet will be compliant.

Permanent local exemptions	Description	Rationale	Impact on compliance
Community Minibuses	Those operating under a permit under section 19 or section 22 of the Transport Act (1985), issued by a body designated by the Secretary of State	These vehicles provide important access to employment, education and training for people who may otherwise be isolated, including those with mobility issues and located in areas with poor public transport accessibility. They also facilitate inclusion in social and community activities.	Negligible. Based on ANPR sample data, minibuses are estimated to make up less than 1% of vehicles serving GM and it is estimated that around 30% of this fleet is eligible for section 19 and section 22 permits.
Showmen's vehicles	Fairground/funfair vehicles which are registered with the Showmen's Guild, in the tax classification of Showman's HGV or Showman's Haulage under the DVLA Special Vehicles Tax Class and meet the definition of a 'showman's vehicle' or a 'showman's goods vehicle' within the meaning of section 62 of the VERA.	This group of vehicles includes a range of specialist and/or novel or adapted vehicles, where it may generally not be practical to upgrade to a vehicle compliant with the standards of the GM CAZ.	Negligible. Showmen's Guild vehicles could not be identified from the ANPR dataset. The volume of such vehicles is assumed to be low given their specialised use for intermittent events.
Driving within the zone because of a road diversion	Vehicles driving within the zone because of a road diversion who would otherwise not have entered the GM CAZ. Applies only while the diversion is active and subject to non-compliant vehicles being on the designated diversion route.	This exemption is aimed at protecting road safety and recognises that vehicles may enter the GM CAZ for reasons outside of the driver's control. The exemption will apply to vehicles which enter the GM CAZ as a direct result of a road diversion only.	It is not possible to quantify the impact of this exemption but it is likely to be negligible as the incidences would be of short duration and involve a very small proportion of the total vehicles travelling within the GM CAZ, where eligible vehicles are not already visiting GM as part of their overall journey in any case.

Permanent local exemptions	Description	Rationale	Impact on compliance
Disabled Tax Class vehicles	Vehicles used by, or for the purposes of a disabled person which are exempt from vehicle tax, i.e. those in the DVLA Disabled Tax Class and meeting the definitions and criteria in paragraphs 18 and 19 of Schedule 2 of the VERA are eligible to apply for exemption.	This exemption is complementary to the exemption for Disabled Passenger vehicles. An exemption certificate will have been secured for vehicles within this group, following a successful application to the Driver and Vehicle Licensing Authority (DVLA) for exemption from vehicle tax. The vehicle must be used solely for the purposes of the disabled person.	Negligible. Based upon ANPR sample data and analysis of recorded vehicles which are within the Disabled tax class, the quantity of eligible vehicles has been estimated at less than 0.5% of total vehicles serving GM based.
LGVs and minibuses adapted for a disabled user	LGVs and Minibuses specifically adapted for use by a disabled user and not used for hire or reward. These vehicles will have a substantial and permanent adaptation to the vehicle, specific to suit a disabled wheelchair user's particular needs to enable them to travel in the vehicle, or enter and drive it[6].	This exemption recognises privately owned LGVs and Minibuses specially adapted for use by a disabled user, which are not covered by the Disabled Tax Class exemption. The exemption is subject to restrictions on its use through eligibility criteria to ensure it is used primarily for the transport of a disabled person and is not used for hire or reward.	Negligible. It is likely that most specially adapted LGVs and minibuses will be eligible under the Disabled Tax Class exemption and that only this exemption will apply to a very small number of additional vehicles.

[6] The definition of substantial and permanent adaptation draws on guidance from HMRC that: The adaptation to the vehicle must be both necessary and specific to suit the disabled wheelchair user's particular needs to enable them to travel in the vehicle, or enter and drive it. The adaptation should alter the vehicle in a meaningful way, enabling the wheelchair user to use the vehicle which they could not use before it was adapted. For a vehicle to be considered as substantially and permanently adapted it is expected that significant change to the vehicle has been made with the adaptations being bolted or welded to the body or chassis of the vehicle. Adaptations that are wired into the electrics of the vehicle could also qualify as substantially and permanently adapted. For adaptations to be considered permanent it's expected that they should be fitted to the vehicle for the shorter of either a minimum of 3 years or the lifetime of the vehicle. If the adaptation is removed before this time, then the adaptation may not be considered to be permanent and therefore the vehicle should not have been eligible for exemption. A disabled person who usually uses a wheelchair needs to be able to take it with them in the vehicle. Vehicles often need to be substantially adapted to allow a fixed frame or motorised wheelchair designed for permanent use to be transferred into the vehicle, using a ramp and a winch or a hoist, and for it to be held safely and securely in place throughout the journey. Where a wheelchair can be folded and stowed in the boot of a vehicle, the vehicle does not need to be substantially and permanently adapted to carry it. Whilst some minor adaptations may be required, it's not sufficient to meet the 'substantially and permanently adapted' qualifying condition and the vehicle will not qualify for exemption. The following are not considered as substantial and permanent adaptations because they are widely available accessories or upgrade options the: fitting of a roof rack or standard roof box; attachment of a trailer to the back of a vehicle; fitting of automatic transmission; fitting of parking or reversing sensors. This list is not exhaustive. Further information available at: https://www.gov.uk/guidance/vat-relief-on-adapted-motor-vehicles-for-disabled-people-and-charities-notice-1002#sec3

Permanent local exemptions	Description	Rationale	Impact on compliance
Driver training buses	Buses adapted for use for, and dedicated to, driver training purposes and owned by the Applicant prior to 3rd December 2020.	This exemption recognises specially adapted buses for dedicated use as driver training vehicles, which are specialist and/or novel or adapted vehicles, where it may generally not be practical to upgrade to a vehicle compliant with the standards of the GM CAZ.	Negligible. Driver training buses account for a very small proportion of total bus mileage. Any buses coming into operation from 2021 onwards will be required to be compliant or pay the charge.
Heritage buses not used for hire or reward	Heritage buses which are over 20 years old and which are not used for hire or reward.	This exemption recognises privately owned heritage buses over 20 years old that do not fall within the Historic Vehicle Tax Class, which are specialist and/or novel or adapted vehicles, where it may generally not be practical to upgrade to a vehicle compliant with the standards of the GM CAZ. The exemption is subject to restrictions on its use through eligibility criteria to ensure the vehicle is not used for hire or reward.	Negligible. Very few vehicles, likely to be operating at low mileage, are likely to be in scope for this exemption.

5 Temporary exemptions

Temporary national exemptions

5.1 No temporary national exemptions are proposed.

Temporary local exemptions

5.2 GM has proposed a series of temporary local exemptions in the Policy following Consultation. These are set out in **Table 5-1**, alongside the rationale for inclusion and an assessment of the possible impact on achieving compliance in Greater Manchester in the shortest possible time. This analysis considers the possible impact in terms of the proportion of the total vehicle fleet in scope.

5.3 Following consultation, all temporary local exemptions proposed by GM, set out in **Table 5-1,** are proposed to expire on 31st May 2023.

5.4 The modelling process applies these temporary local exemptions in the relevant years and where the relevant vehicle type and behavioural response is represented within the modelling architecture. The cost modelling approach applied calculates the various proportions of responses (upgrade, stay and pay, cancel trip) to the charging CAZ measures alongside the associated financial assistance where applicable in each of the modelled years of 2021[7], 2023 and 2025, with interpolation applied to estimate outcomes in interim years.

5.5 Within the modelling process, the CAZ is assumed to be fully in place (in other words, with no remaining temporary exemptions) in 2023. Modelling of the post-Consultation policy demonstrates that even with the scheme fully in place, compliance is not achieved in 2023. A further year of natural fleet renewal is required in order for compliance to be achieved in 2024. Therefore, the temporary local exemptions are not forecast to delay compliance from 2023 to 2024.

5.6 As long as the temporary local exemptions have been removed early enough that drivers will have had time to be influenced by the forthcoming CAZ charge, make their choices and obtain a new vehicle before 1st January 2024, then the temporary local exemptions would not affect the predicted legal compliance date.

5.7 **Table 5-1** shows that applying the proposed temporary local exemptions is not likely to negate the overall benefits of the GM CAZ or undermine the ability to meet air quality compliance within the shortest possible time.

[7] Note that modelling is being carried out for 2021 only to allow GM to interpolate results for 2022. 2021 will no longer be a reported year given that it is proposed that the CAZ opens in 2022.

5.8 Where the vehicle populations in scope (and their associated emissions) are meaningful, the proposed temporary local exemptions are assessed as having a low risk of undermining the ability to meet air quality compliance in Greater Manchester in the shortest possible time. GM considers that the benefits of not charging users outweigh the disadvantages of doing so.

5.9 Where only a very small proportion of vehicles are in scope, the proposed temporary local exemptions are assessed as having a negligible risk of undermining the ability to meet air quality compliance in Greater Manchester in the shortest possible time. GM considers that the benefits of not charging users outweigh the disadvantages of doing so.

Table 5-1 Temporary local exemptions to CAZ charges proposed by Greater Manchester

Temporary local exemptions	Description	Rationale	Impact on compliance
LGVs and minibuses (which are not a licensed hackney or PHV or used to provide a registered bus service within GM)	Light Goods Vehicles (LGVs) and minibuses which are not used as a licensed hackney, PHV or on a registered bus service within GM, are eligible for a temporary exemption until 31st May 2023. After 31st May 2023, non-compliant vehicles will be charged.	GM evidence indicates that the cost and availability of new, second and third hand compliant LGVs will not provide a viable or an affordable option for many operators (especially for the smallest businesses and sole traders) to upgrade to a compliant vehicle in 2022, given the scale of the GM CAZ[8]. Introducing a charge in 2022 risks many operators having to switch from using an LGV to a pre-Euro 6 diesel car or stop trading. Given the number of LGVs operating in GM, there is also a high risk of there being insufficient time in advance of 2022 to administer the funding required to support affected parties to upgrade to compliant LGVs.	Low. As set out above, modelling demonstrates that as long as the temporary exemptions have been removed early enough that drivers will have had time to be influenced by the forthcoming CAZ charge, make their choices and obtain a new vehicle before 1st January 2024 (the year of compliance), then the temporary exemptions would not affect the predicted legal compliance date. As the temporary exemption will expire on 31st May 2023, sufficient time is available in advance of 1st January 2024 for affected vehicles owners/registered keepers of these vehicles to upgrade to a compliant vehicle. A key rationale for the proposed exemption is that it is not considered likely that this large non-compliant fleet can upgrade by the point at which the CAZ is introduced. The provision of funds to support upgrade from 2021 is however intended to encourage early upgrade.

[8] See Technical Note 12 - Evidence of the impact of 2021 CAZ C

Temporary local exemptions	Description	Rationale	Impact on compliance
GM licensed Hackneys and PHVs	Hackneys and Private Hire Vehicles (PHVs), which are licensed to one of the 10 GM Authorities as of the 3rd December 2020 are eligible for a temporary exemption until 31st May 2023. After 31st May 2023, non-compliant vehicles will be charged.	The evidence from the COVID-19 impacts analysis shows major impacts on the GM taxi trade. This exemption recognises that GM licenced hackneys and private hire vehicles require time to recover from the financial effects of COVID-19 and the ability to invest in upgrades to compliant alternatives before a charge is applied.	Low. As set out above, modelling demonstrates that as long as the temporary exemptions have been removed early enough that drivers will have had time to be influenced by the forthcoming CAZ charge, make their choices and obtain a new vehicle before 1st January 2024, then the temporary exemptions would not affect the predicted legal compliance date. As the temporary exemption will expire on 31st May 2023, sufficient time is available in advance of 1st January 2024 (the year of compliance) for affected vehicles owners/registered keepers of these vehicles to upgrade to a compliant vehicle. A key rationale for the proposed exemption is that it is not considered likely that this fleet can upgrade by the point at which the CAZ is introduced in 2022 due to the major impacts of COVID-19 on the trade. The provision of funds to support upgrade from 2021 is however intended to encourage early upgrade.

Temporary local exemptions	Description	Rationale	Impact on compliance
Coaches and buses not used on a registered bus service.	Coaches and buses not used on a registered bus service are eligible for a temporary exemption until 31st May 2023. After 31st May 2023, non-compliant vehicles will be charged.	The evidence from the Covid impacts analysis, shows major impacts on coach operators. This exemption recognises the high upgrade cost of coaches and that they require time to recover from the financial effects of COVID-19. 69% of coach operators are small businesses, with many providing services for vulnerable groups, particularly children, elderly people and those on low incomes. A temporary exemption provides further time for non-compliant vehicles to be upgraded to meet the standards required by a GM CAZ and protects vital services.	Low. As set out above, modelling demonstrates that as long as the temporary exemptions have been removed early enough that drivers will have had time to be influenced by the forthcoming CAZ charge, make their choices and obtain a new vehicle before 1st January 2024 (the year of compliance), then the temporary exemptions would not affect the predicted legal compliance date. As the temporary exemption will expire on 31st May 2023, sufficient time is available in advance of 1st January 2024 for affected vehicles owners/registered keepers of these vehicles to upgrade to a compliant vehicle. A key rationale for the proposed exemption is that it is not considered likely that this largely non-compliant fleet can upgrade by the point at which the CAZ is introduced, given the high cost of upgrade and the impacts of COVID-19 on the coach industry[9]. The provision of funds to support retrofit and upgrade from 2021 will encourage early upgrade.

[9] See Technical Note 4: Coach Market Analysis

Temporary local exemptions	Description	Rationale	Impact on compliance
Outstanding finance or lease on non-compliant vehicles	Non-compliant vehicles subject to finance or lease agreements entered into before 3rd December 2020 which will remain outstanding at the time at which the GM CAZ becomes operational, are eligible for a temporary exemption until the agreement ends or until 31st May 2023, whichever is sooner. After 31st May 2023, non-compliant vehicles will be charged.	A move to a compliant vehicle is not considered feasible due to outstanding finance, which was entered into before information on the GM CAZ had been made publicly available.	Low. Vehicle leasing is commonly offered for new vehicles, which would be compliant with the scheme, and therefore the impact of the exemption for leased vehicles is assumed to be negligible. It is estimated that around 30% of vehicles are purchased with vehicle finance; this is available for both new and second-hand vehicles. New vehicles would be compliant with the scheme but some vehicle owners may have outstanding finance agreements on non-compliant second-hand vehicles. GM is not able to quantify the number of vehicles this could apply to. Given that these vehicle owners are in a binding finance agreement, they may not be in a position to upgrade with or without the temporary exemption. Applying a charge would raise revenues but would not be expected to deliver additional upgrades. The temporary exemption is therefore unlikely to affect whether compliance is achieved but would provide a period for those in finance agreements to seek a route to compliance.

Temporary local exemptions	Description	Rationale	Impact on compliance
Limited supply (awaiting delivery of a compliant vehicle)	Owners or registered keepers of non-compliant vehicles that can demonstrate they have placed an order for a compliant replacement vehicle or retrofit solution, are eligible for a temporary exemption until such a time as they are in receipt of the compliant replacement vehicle or retrofit solution, or for 12 weeks, or until 31st May 2023, whichever is sooner. After 31st May 2023, non-compliant vehicles will be charged.	Upgrade to a compliant vehicle is not immediately possible due to an issue with the supply of a compliant vehicle or retrofit solution on order, which is considered outside of the control of the applicant.	Negligible. Given that vehicle owners are awaiting delivery of a compliant vehicle, they are not in a position to upgrade earlier without the temporary exemption. The temporary exemption is therefore unlikely to affect whether compliance is achieved.
Buses operating on school bus contracts entered into before 31st March 2019 and which expire in July 2022.	Buses used on a GM school bus service where the contract ends in July 2022 and where the contract was tendered prior to 31st March 2019 (submission of the GM CAP OBC[10]) are eligible for a temporary exemption to 31st July 2022. These buses must have been identified on the GM bus fleet register for at least 6 months. These vehicles will not be considered for funding under the GM CAP scheme. The vehicles must not be used for registered bus services within GM beyond 31st July 2022.	101 school bus contracts were entered into before 31st March 2019 and are due to expire in July 2022. 39 buses operating on those contracts, are reaching end of life and cannot be retrofitted.	No. The exemption applies to a small number of buses and to end July 2022 only. Any buses remaining in service beyond July 2022 will be subject to the CAZ.

[10] GM submitted an Outline Business Case (OBC) setting out the GM CAP proposals to the Government at the end of March 2019.

6 Permanent discounts

Permanent national discounts

6.1 No permanent national discounts are proposed.

Permanent local discounts

6.2 GM proposed two permanent local discounts in the Policy for Consultation. Following consultation, the proposed local discount for PHVs also used as a private car has been removed, and some changes have been made to the proposed local discount for leisure vehicles in private ownership.

6.3 The revised local discount as proposed in the Policy following consultation is set out in **Table 6-1**, alongside the rationale for inclusion and an assessment of the possible impact on achieving compliance in Greater Manchester in the shortest possible time. This analysis considers the possible impact in terms of the proportion of the total vehicle fleet in scope.

6.4 As summarised in **Table 6-1**, applying the permanent local discount is not likely to undermine the ability to meet air quality compliance in Greater Manchester in the shortest possible time. GM considers that the benefits of not charging users in such cases outweigh the disadvantages of doing so.

Table 6-1 Permanent local discounts to CAZ charges proposed by Greater Manchester

Permanent local discounts	Description	Rationale	Impact on compliance
Private HGV Tax Class vehicles	Owners or registered keepers of vehicles in the DVLA Private HGV Tax Class[11] and meeting the definition of s "special vehicle" in paragraph 4(2)(bb) of Schedule 2 to the VERA are eligible for a discounted charge. The vehicle would be subject to a charge equivalent to the LGV daily charge (£10 a day), rather than the HGV daily charge (£60 a day).	HGVs in the DVLA Private HGV Tax Class are used unladen, privately or for driver training purposes.	Negligible. It has not been possible to quantify the number of vehicles in the Private HGV Tax Class but it is considered likely that they account for less than 0.5% of total vehicles serving GM.

[11] Information on tax classes for vehicles is available at: https://www.gov.uk/government/publications/v3551-notes-about-tax-classes

7 Conclusion

Rationale for exemptions and discounts

7.1 This report sets out the rationale for the proposed temporary and permanent local exemptions and permanent local discounts. More evidence supporting this rationale can be found in the following Technical Notes and reports[12]:

- Technical Note 3: Freight market analysis
- Technical Note 4: Coach market analysis
- Technical Note 12: Evidence of the impact of a 2021 CAZ C
- Technical Note 18: Minibus fleet research
- Technical Note 19: Taxi and PHV fleet research
- Impact of Covid-19 on the GM CAP Report[13]

7.2 Feedback from the consultation is set out in the AECOM Consultation Report[14].

Impact on achieving compliance in Greater Manchester in the shortest possible time

7.3 In total, the vehicles in scope for a permanent local exemption or discount from the CAZ represent a very small proportion of the total number of vehicles serving GM (where this could be quantified) and in scope for the CAZ. Furthermore, many of the vehicles in scope would not in practice be able or likely to upgrade with a charge. The risk that applying the proposed permanent national and local exemptions and discount undermines the ability to meet air quality compliance in Greater Manchester in the shortest possible time is therefore considered to be negligible.

7.4 A more substantial proportion of the vehicle fleet is proposed to be eligible for a temporary local exemption to 31st May 2023. The GM CAP proposes a range of temporary local exemptions, set out in Section 4, which will expire on 31st May 2023 and so no longer be in place by 2024. As long as the temporary local exemptions have been removed early enough that drivers will have had sufficient time to be influenced by the forthcoming CAZ charge, make their choices and obtain a new vehicle before 1st January 2024, then the temporary local exemptions would not affect the predicted legal compliance date.

[12] All available at Technical Documents | Clean Air Greater Manchester (cleanairgm.com)
[13] Supplied as Appendix 5 of the June 2021 GMCA Report 'Greater Manchester Clean Air Plan'
[14] Supplied as Appendix 3 of the June 2021 GMCA Report 'Greater Manchester Clean Air Plan'

7.5 In summary, it is not considered likely that the proposed exemptions and discount undermine the ability to meet air quality compliance in Greater Manchester in the shortest possible time and by 2024 at the latest based on the evidence available.