Sheffield & Rotherham Clean Air Plan Full Business Case Analytical Assurance Statement April 2022

Final Version
Date Issued: 12th April 2022

Document Controls

Document Approval			
Version Number:	FBC Final		
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Revision History	
Version	**Nature of Revision**
21/01/2022	Initial FBC Version
08/02/2022	SYSTRA Review
12/04/2022	FBC Final

Introduction

This document is the Analytical Assurance Statement for the Transport and Air Quality Modelling work undertaken to support the Sheffield and Rotherham Clean Air Plan (CAP) Preferred Option measures. This document has been prepared to support the Full Business Case (FBC) submission and has been developed in accordance with JAQU guidance. This version of the document supersedes the previous version which was submitted to JAQU and T-IRP in June 2020, as part of the clarification process around the earlier OBC submission.

This document sets out the main limitations, risks, uncertainties, and suitability for use of the Transport and Air Quality Modelling packages used to inform the Sheffield and Rotherham CAZ Preferred Option. 11. It should be read in conjunction with the main Business Case documents and the supporting technical documentation.

Limitations of the Analysis

This section seeks to answer the key questions around the limitations of the modelling and analysis, with a separate section for each of the queries posed in the guidance.

a. *Has the analysis been constrained by time or cost, meaning further proportionate analysis has not been undertaken?*

On the Transport Modelling side, we have used the latest available version of the Sheffield City Region Strategic Transport Model (SCRTM1) to undertake the modelling work to inform the FBC. This model became available for use in forecasting scenarios in late 2019 and represents an improved modelling platform compared to the Strategic Outline Case (SOC) and the Outline Business Case (OBC), which used the older Sheffield and Rotherham Model (SRTM3B).

Furthermore, for the initial option testing undertaken during the SOC and OBC stages of the project, a simplified traffic and fleet adjustment-based approach was used, to reduce the need for time-consuming runs of the full Variable Demand Model (VDM) on all the numerous variants tested during the Study. The Preferred Option has however, been tested using the full VDM, to ensure that we have a full understanding of all the demand responses to the scheme. However, the analysis for the economic case there was a very constrained time scale to the end of the programme as despite all the transport modelling having been checked the option taken forwards was not finalised until late in the programme. Additional analysis has been undertaken to better understand the economic results between the production of draft FBC and the final FBC.

The Air Quality Modelling has not been constrained. An annual 'scenario' of 'typical' meteorological data was utilised for the study to reduce modelling run times to around 2-3 days using the latest version of Airviro v5.01.

Additional analysis to minimise the effects of the key limitations identified and described above, including:

- Sensitivity Tests (described in a separate report) to determine the impacts of the principal areas of uncertainty within the Transport, Economic and Air Quality Modelling; and
- Use of both Local and National Behavioural responses (also covered in T4 and later in this document) to confirm the expected impacts on local road users of the Preferred Option, noting that the local socio-economic composition in Sheffield and Rotherham is different to the national picture.

b. *Could this further analysis lead to a substantive change in the conclusions?*

There have been a large number of sensitivity tests undertaken in four separate phases of this Business Case preparation, as follows:

- in support of the original OBC (submitted in December 2018);
- a period of clarification of the OBC (under instruction from JAQU) during 2019 (Q1-Q3);
- as part of a review of the impacts of the Covid19 pandemic on future air quality and the Preferred Option (during 2020); and

- to support a Draft Full Business Case submitted in December 2021 (and associated TiRP submission in November 2021)

- to support the Full Business Case planned to be submitted in **April 2022**The relevant results from these sensitivity tests (particularly those carried out to support the FBC) are described later in this document.

These sensitivity tests along with the team's experience in using the Transport and Air Quality models give us confidence that any further analysis would not significantly change the conclusions of the CAP study. There is no evidence to suggest that any additional work would alter the Preferred Option[1] or the conclusions from any of the alternative scenarios being presented as part of the FBC. However, further analysis could provide greater detail and understanding on the medium-term impacts on travel patterns in Sheffield and Rotherham and additional local behavioural research could provide useful additional information about the distribution of responses of the owners of non-compliant vehicles in the post-Covid world.

The Transport Modelling also suggests that the expected Business as Usual fleet upgrades (i.e. retaining the current age profiles of the various fleets) will be sufficient to achieve compliance with the 40 $\mu g/m^3$ annual average limit value for NO_2 concentrations by 2025. It should be noted that this represents the same timescale as was predicted by the SRTM3B model at OBC stage, thus demonstrating a good level of agreement between the two modelling platforms used to underpin this work.

The additional analysis undertaken on the economic results between the draft FBC and the final FBC does have the impact of changing the numbers, in particular the NPV and the BCR and the economic methodology report and economic case have been updated accordingly with the new numbers and additional commentary. However the majority of that extra analysis surrounded an alternative economic Baseline and no changes to the Preferred Option (see the Cconomic Case for a fuller commentary). Whilst the revised baseline changes the scale of benefits, it does not impact on the choice of Preferred Option or elements contained within it.

c. Does the analysis rely on appropriate sources of evidence? (Rate the source of evidence high/moderate/low)

The Transport, Economic and Air Quality modelling work undertaken to inform the FBC has used the best models available at the time and also the best data sets available. The key data sets are discussed in detail in the table below and each source is rated based on our assessment of its quality. This table covers both the input data sources used in the Transport Modelling and the Air Quality modelling and is ordered in terms of the highest ratings. *Note: A number of data sources have been updated between OBC modelling and FBC modelling, and these changes are reflected in the table.*

Data	Description	Rating (Rank)
ANPR Data	Comprehensive ANPR data collected at a number of sites in Sheffield and Rotherham, including a year's worth of multi-site ANPR data collected in 2017 and a month's worth of multi-site data from February 2019. The 2017 data provided invaluable information about the trip frequency distributions of the various fleets, while the February 2019 data provides the starting point for the	Very high (1)

[1] This has been borne out by the post-OBC sensitivity testing

	forecasting the baseline emissions profiles of the various fleets. Our Monitoring and Evaluation Plan will provide regular (Quarterly) updates which will be used to monitor the evolution of these fleets over time.	
Local Meteorological Data	The meteorological data used in Airviro is either measured data from Sheffield CC's Met Mast or bought in and converted Met Office data from suitable local sites if there is insufficient data from the local mast for a particular year. It is essential to have good data capture for the weather data. A meteorological pre-processor routine within the AIRVIRO software tool analysed the local weather data obtained from the weather mast within the urban area of Sheffield. This is done for 360 different weather cases, representing the various possible combinations of wind direction and stability, including velocity and vertical temperature profile. Due to the location of the weather mast the data is deemed to be representative and a highly reliable source of evidence.	High (2)
Automatic and Diffusion Tube Air Quality Data	The two Councils operate 12 automatic stations which collect NO_X, NO and NO_2 data throughout their administrative areas. Diffusion Tube data has been collected from over 200 sites across Sheffield and Rotherham throughout the last 20 years of LAQM work. This gives very good coverage of the two urban areas and concentration trends. It also means that the two Councils have a very good understanding of the actual levels of nitrogen dioxide in their areas, as reported under LAQM since 2000. Each current monitoring location has been assessed against the requirements within Annex III of the EU AQ Directive and JAQU's guidance (see Document AQ2 Appendix 1 SD01[2]). The collection of this data has been undertaken in line with guidance and is therefore, considered a very robust piece of evidence. This monitored data is key for validating model outputs as it has spatial coverage which cannot be achieved with a few automatic monitors and can also monitor levels of nitrogen dioxide close to roadside where it may be impossible to site automatic equipment. Note that this data collection is on-going and will therefore, form a key part of our FBC Monitoring and Evaluation Plan.	High (3)
Data used to build the Traffic Model	The OBC used the SRTM3B, which was robust at the time of its original development but had become outdated. For the FBC, we therefore switched to the newly available SCRTM1 with a 2017 Base Year. The model was built using a significant amount of up-to-date data and in line with TAG guidance. More detail can be found on the calibration and validation of this model in the accompanying T2 Transport Model Validation Report.	High (4)
Site Specific Calibration	Adjusting the modelled output using site-specific factors minimise the uncertainty in future projections. This	High (5)

[2] A technical description of valid locations, including the exclusion of sites with no pedestrian access

	approach reflects and takes into account the level of pollution in the surrounding area, therefore can be said to infer the effects of road gradient and canyon.	
Damage cost values	Valuations used to calculate the economic benefit of each unit of NOX, PM10 and CO_2 saved due to the CAP. Obtained from DEFRA Air Quality Guidance.	High (6)
Local Behavioural Research	For OBC Local Behavioural Research was carried out to determine the likely response of residents, taxi drivers and goods vehicle operators to charging within Sheffield and Rotherham. This is a piece of primary research we understand has not been undertaken by many of the other CAP studies and as such is considered a very strong piece of evidence. This research was undertaken prior to the covid pandemic and has not been updated to reflect any long-term impact of the pandemic on these responses – in line with JAQUs COVID position (established in Feb 2021). In addition, this data set represents a Stated Preference rather than a Revealed Preference response and may not fully reflect real life responses.	Medium / High (7)
Traffic Flows	The traffic flows used in the emissions calculations and the Air Quality modelling are taken from the SCRTM1 transport model. The vehicle splits used in the emissions modelling comes directly from the ANPR camera data for 2017. It therefore represents a very good match for the Base Year fleet (split by Sheffield and Rotherham separately). This fleet is then grown in line with EFT forecasts as per JAQU guidance. This approach gives us confidence in the detailed fleet splits used in the modelling.	Medium / High (8)
Traffic Speeds	The traffic speeds used in the emissions calculations in the Transport modelling are taken from the SCRTM1 model. These traffic speeds have been validated using local TrafficMaster data, this validation and this is discussed in the accompanying T2 Transport Model Validation Report.	Medium (9)
Emissions Factor Toolkit	It was found that the version of the Emissions Factor Toolkit (EFT), v8.0.1b, which was used at OBC stage to generate emissions from the outputs from the Transport Model (via the ENEVAL process[3]) was very pessimistic in its future fleet development. This included a very slow uptake of new vehicle technologies. It also predicted a continuing growth in diesel cars up to 2021, whereas evidence from DfT and from the Society of Motor Manufacturers and Traders, SMMT, which publishes monthly data on car sales: https://www.smmt.co.uk/vehicle-data/car-registrations/ suggested that diesel car sales are already in decline.	Medium (10)

[3]ENEVAL is SYSTRA's environmental assessment software which is designed to automate the estimation of link-based emissions from the outputs of our traffic models, using emissions factors derived from the values used in v8.0.1b of the Emissions Factors Toolkit

	Therefore at the OBC stage it was deemed likely that the assumptions in the EFT would overstate the scale of NO_X emissions in the coming years, with a separate technical note submitted to JAQU on this point. However, a new version of the EFT was released by JAQU before the FBC modelling was undertaken which on the flip side, the EFT, v9.1, which addresses several of these elements, so this has been used in conjunction with a stand-alone car fleet forecasting tool in order to get a better representation of the possible 2022 fleet. In addition, it is worth noting that the EFT makes several assumptions about the effectiveness of new technologies to reduce emissions and it is not yet clear whether these emissions reductions will be achieved in real life driving conditions.[4]. Emissions which are not accounted for include cold start, low load, acceleration up a steep gradient and idling of vehicles whilst stationary.	
Bus Idling – Emissions Data	The data that underpins the bus idling emissions – PTEG Bus Idling Results Report final v1.0.doc – is over 10 years old, and was only undertaken for a handful of services in the Sheffield area. It is likely that the idling emissions from buses have decreased since then due to stop start technology for example, but there is no hard evidence for an alternative figure. This is therefore likely to mean we are over-estimating the idling emissions. However, based on analysis of EFT average bus fleet NOX emissions at 5kph between 2010 and 2017 this is likely to not be greater than 40%, applying this figure to the modelling compliance would still be achieved.	Medium (11)
Bus Idling – Time Data	The idling data from Arundel Gate shows significant variations but it is unlikely that has changed given there have been no material changes to Arundel Gate operation since that data was collected. The idling time data is also likely to include some time which is really waiting to pull out and waiting at signals rather than specifically idling at a stop. This means that the average idling time is overestimated which will could cause an overestimate of the emissions. However, it is important that this engine running is considered and only one of many signals on Arundel Gate are actually included in the strategic model.	Low (12)
Data Used in DIA	Data on inequality, size of vulnerable populations etc. is based on the 2011 Census and therefore could be out of date. However, there have been no significant high-level changes in population and households in Rotherham and Sheffield in that period, but there will be some localised changes.	Low (13)
Revenue Generated	The revenue generated is derived from the number of trips by non-compliant vehicles in the zone (taken from the	Low (14)

[4] A newer version of the EFT has been made available by JAQU after the SCC/RMBC OBC was submitted which starts to recognise these trends (v9.0)

	transport model) and JAQU-approved assumptions regarding how many 1-way trips the different types of vehicle make per day. The modelling does not assume any significant reduction in the number of 1-way trips, assuming instead that any trips which are not made due to the vehicle owner 'taking his business elsewhere' will be replaced by a compliant vehicle. If, instead, the non-compliant vehicle owner consolidates his/her business, eg by combining two days' business into one, the revenue forecast will be the same as if one of these two days was replaced by a compliant vehicle. The main uncertainty affecting the revenue forecast is therefore the proportion of non-compliant vehicles in each of the years that the CAZ is assumed to operate, which will be monitored regularly via analysis of the ANPR data collected by the CAZ cameras.	

d. *How reliable are the underpinning assumptions? (Rate level of reliability high/moderate/low)*

The CAP study uses a wide range of assumptions in both the Transport and Air Quality models, most of these are either applied directly or have been derived from the JAQU guidance. However, a number of local assumptions have been made based on locally available data sets and primary research undertaken as part of the study.

A full review of the key assumptions underpinning the Transport and Air Quality modelling has been undertaken to evaluate the level of reliability of each. These are detailed in the following table along with a rating and rank of the reliability, with those considered the most reliable first (and hence have a higher rank).

Assumption	**Description**	**Rating (Rank)**
GDP Deflator / Discount Rates	GDP Deflator - data series to convert price base of costs and benefits into a consistent price base for presentation in the cost-benefit analysis, as specified in DfT Transport Analysis Guidance (TAG). Discount rates – single value (3.5% per annum) used to deflate future year costs and benefits to account for social time preference as specified in TAG. Both inputs taken from latest TAG databook, November 2021, for use in economic appraisal of the scheme.	Not ranked as latest versions used
Site-specific versus area-wide calibration of the AQ model	The two Councils operate 12 automatic stations which collect NO_X, NO and NO_2 data throughout their administrative areas. Diffusion Tube data has been collected from over 200 sites across Sheffield and Rotherham throughout the last 20 years of LAQM work.	High (1)

	The data from these AQ monitors are used to calibrate the Airviro dispersion model, providing a much-more reliable estimate of local air quality than could be produced using a more-assumption-based AQ modelling approach.	
Base Year Local Fleet	Based on local high quality ANPR data collected over a 4-week period in early 2019. The Base year fleet assumptions derived from this are considered to be very reliable.	High (2)
Base Year Air Quality	Base year air quality data, 2017, is considered high quality as they come from Diffusion Tube data which has been collected from over 200 sites across Sheffield and Rotherham as part of LAQM work. The data from these AQ monitors are used to calibrate the Airviro dispersion model, providing a much-more reliable estimate of local air quality than could be produced using a more-assumption-based AQ modelling approach.	High (3)
Meteorological Data	As this is based on locally collected data from the weather mast within the Sheffield urban area or purchased from the Met Office and converted by the Swedish Meteorological and Hydrological Institute when local data is not available. This data are considered highly reliable and has high levels of data capture.	High (4)
Frequency Data	The frequency data used to convert trips to unique vehicles entering the CAZ is based on analysis of the 2019 ANPR data. This is only 3 years old and is not expected to have changed materially in advance of the compliance year modelled (2022).	High (5)
Local Development	Local Development data used to drive changes in traffic flows over time has been taken from the data developed in 2018 for inclusion in the SCRTM1 model development process. It should be noted that this is a slightly different set to that used at OBC stage which was the Sheffield City Plan data developed for the SRTM3B model. A new and revised Sheffield City Plan is due to be released later this year but the time scales around that were not in time for inclusion in the CAZ modelling.	High (6)
Committed Schemes	As with the Development data above, the committed schemes which are likely to be delivered between now and the end of 2024 have been taken from the standard uncertainty log developed for the SCRTM1 model (pre-covid). The reliability of these assumptions will be high for the early years (ie the period when the	High (7)

	predicted traffic emissions are most-critical to this study) but will then decrease over time.	
Measured Roadside Concentrations	The two Councils both have automatic monitoring stations for nitrogen oxides, which are audited by the National Physical Laboratory and also by Ricardo-AEA, and also carry out large surveys annually using diffusion tubes. This data is bias-adjusted annually following LAQM(TG16) methodology. Outputs from the air quality modelling Base Year were validated and adjusted using base year monitored data. The monitoring is undertaken following LAQM(TG16) guidance. We measure average NO_2 using the diffusion tubes. The Defra NO_X:NO_2 calculator diffusion tube tab has been used to convert between NO_X and NO_2 roadside concentrations, in line with LAQM (TG16) and JAQU Guidance.	High (8)
Air Quality Assumptions	Road emissions are not the only source of NO_X. Sheffield and Rotherham have worked with their Airviro model for over 20 years and have EDBs containing all known point and area sources. This EDB was used to establish the contributions from industrial, domestic, minor road sources etc. A regional background for nitrogen dioxide was obtained from Ladybower AURN site (situated in the Peak District to the west of the study area) The combined ‘background’ was made up of these sources and is regarded as good quality data.	High (9)
Forecast Year Local Fleet Data	This is based on the Base Year local fleet split derived from 12 months of ANPR data with EFT changes over time applied to obtain the forecast fleet composition. Our review at OBC stage noted some concerns with the EFT forecasts in particular that the national (non-London) values contained in the EFT may not be representative of the changes which will occur in Sheffield and Rotherham over time. However, some of these concerns have been alleviated in the newer version of EFT (v9.01b) used for FBC testing. This doesn’t consider potential post-covid impacts on the affordability and availability of fleet, as that position is still emerging.	High / Medium (10)
Transport Model (flows and speeds)	The SCRTM1 transport model has been created recently and has gone through a calibration and validation process which is in line with TAG guidance, so there is a good level of confidence in the model.	Medium (11)
Behavioural Responses to a Charging CAZ	The assumptions used in the transport modelling to describe how different groups will react to a Charging CAZ come from the Local Behavioural Research undertaken at OBC stage. This is described in greater detail in the T4 document and as noted above is a robust data source. However this research was	Medium (12)

	undertaken pre-Covid and has not been updated to reflect any long-term impacts of Covid on vehicle owner responses. In addition, the use of this Stated Preference data (rather than Revealed Preference) in the model is subject to the normal caveats surrounding this type of data. For example, the outturn responses of the population may be somewhat different. However, with the lack of any scheme in place, no outturn analysis has been undertaken so these assumptions are deemed to be the best available. Also, two different variants of the responses were produced: a conservative estimate and a pessimistic estimate. It is the former that has been used in the modelling, which was approved by JAQU during the preparation of the OBC.	
Emission Factors	Emissions factors (and associated scaling parameters) have been used as per the latest EFT (v9.1b). The assumptions included in the EFT, particularly for emerging vehicle types, are based on 'lab-based' testing regimes and may not reflect real life driving conditions.	Medium (13)
Values of Time	Absolute and Changes in Values of Time have been applied as per the TAG Databook (TAG Databook July 20121. No update has been made for local conditions.	Medium (14)
Car Occupancy Changes	Car Occupancy changes over time have been based on the default profiles provided in the TAG Databook (July 2021), with no attempt to calibrate these to local conditions, such as current occupancy, local car ownership patterns, household size etc. This is unlikely to be a significant issue over the short-term timescales being considered in this Study	Medium (15)
Number of Upgrades required to the fleet of articulated HGVs	The default behavioural responses of the owners of non-compliant HGVs provided by JAQU would imply that a significant number of very low frequency[5] articulated HGVs will upgrade in response to the different CC and RMBC CAP compliance measures being tested here. While these long-distance articulated HGVs are likely to be affected by CAZ schemes elsewhere in the UK (and beyond) and may therefore upgrade in line with the JAQU guidance, the absence of any national modelling/ forecasting makes it difficult to confirm this. It is therefore not appropriate to assume the full cost of upgrading this large fleet of low frequency articulated HGVs within our economic appraisal. We propose to exclude the cost of upgrading these low frequency articulated HGVs from our economic analysis.	Medium (16)

[5] ie passing a given camera location less than once per month

Interpolation of traffic flows and benefits	The forecast year of the SCRTM1 model is 2024, so to obtain traffic flows in 2022 we have interpolated the traffic flows and speeds from 2017. We have removed developments from the 2024 forecast which we know for certain will not be in place by mid-2022 and assumed that other more-general developments will come on-stream 'linearly' (ie with 5/7ths of their traffic impacts affecting the road network in 2022).	Medium (17)
Construction Traffic	The Transport modelling has not attempted to include the impacts of any roadworks or construction traffic which might affect the level of NO_X emissions at any key air quality 'problem' locations during 2022. In particular, the emissions-related impacts of the construction phase of the proposed widening of the A630 Parkway to the west of the M1 has not been included in our forecasting of 2022.	Medium (18)
Taxi Emissions	The level of black cab emissions in the modelling is based on their emissions factors as set out in EFT V9.1b. However, some Real Driving Emissions (RDE) data, collected for a previous study in Sheffield highlighted that local taxis were often emitting significantly more pollution than would be expected based on their age/EURO category, presumably due to the much-higher-than-average total mileage of these vehicles. This would be an underestimate more in the Base Year than in the forecast Baseline or Preferred Option.	Medium (19)
Goods vehicle trip patterns	The goods vehicle component of the SCRTM1 has been mainly calibrated using traffic counts and therefore, while it will provide a reasonable estimate of goods vehicle traffic on individual links, there is less evidence supporting the underlying origin-destination travel pattern of goods vehicle movements. This needs to be borne in mind when considering the predicted rerouting impacts of any CAZ scheme which affects goods vehicles.	Low / Medium (20)
The number of different vehicles driving within the CAZ per day	The SCRTM1 uses a tour-based representation of trip-making, with the set of 1-way trips split into a set of discrete home-based pairs and 1-way trips. The model does not provide any information about how many trips each individual vehicle makes in a given area per day. Assumptions are therefore required when converting from the set of 1-way or simple 2-way trips within the CAZ and the number of vehicles which would pay the daily charge. These 'average trips per day' factors are particularly important for light goods vehicles, many of which are likely to make multiple city centre trips per day. These assumptions do not affect the fleet upgrading or emissions modelling, but are needed in the Economic and Financial Cases, to predict the	Low / Medium (21)

	assumed amount of CAZ charges paid by a day's worth of 1-way trips by non-compliant vehicles. We propose to use values which are consistent with those used in modelling London's Congestion Charging scheme.	
Bus Upgrades Achievable	All Buses operating in the modelled domain can in theory upgrade to Euro VI, Euro VI equivalent, through retrofitting or better by mid-2022. This is an achievable but challenging assumption but requires financial support packages (subject to Subsidy Control regulations) and may cause issues for smaller operators and will be slightly more difficult to achieve in Rotherham due to the geographical location of Air Quality issues in that authority.	Low / Medium (22)
Taxi Upgrades	The current (early 2021) taxi fleet is based on taxi fleet information provided by the two Councils. The emissions forecasting assumes that over 90% of Black Cabs and Car based Private Hire Vehicles will have upgraded to Euro 6 or better by mid-2022. Some of this as a result of behavioural change due to the threat of a CAZ and some due to the prospect of new Licensing obligations to be introduced by SCC. This assumes a steady renewal rate for the fleet which may not be achieved and does not include any exemptions and it doesn't include any assumptions relating to some older vehicles being granted an extension to their license period (by the Licensing Committee) in response to COVID. There are also possible issues around availability of newer vehicles due to impact of nearby schemes and affordability issues which are not included	Low / Medium (23)

Distributional Impacts Assumption	Analysis have been carried out on current population demographics assuming similar patterns will be in place in future.
	User benefits/disbenefits and affordability will be based on TUBA and it is assumed that all benefits and user charges will be modelled using TUBA.
	For impact on people benefits/disbenefits included are:
	• Trip purposes 'Commuting' and 'Other';
	  o AM home based (from zones);
	  o IP average to and from each zone;
	  o PM to zone trips;
	• For impact on businesses benefits/disbenefits included are:
	  o Trip purpose 'Business';
	  o AM, IP and PM average to/from each zone;
	• For impact on LGVs:
	  o AM, IP and PM average to/from each zone;
		Low / Medium (24)

	• Air quality benefits/disbenefits provided in georeferenced sensitive receptors will be distributed to population per LSOA	

Some of the above assumptions have been considered in the Sensitivity Testing which is detailed in the T4 Local Plan Transport Model Forecasting Report and the AQ3 Local Air Quality Modelling Report. These results align with the relative reliability of the assumptions, as presented above.

Overall, the reliability of the assumptions contained in the Transport and Air Quality modelling is considered to be High / Medium, which is as high as possible, given the tight timescales available to undertake this work.

Risk of Error / Robustness of Analysis

e. *Has there been sufficient time and space for proportionate levels of quality assurance to be undertaken?*

SYSTRA who are consultants on this project for Sheffield City Council (SCC) and Rotherham Metropolitan Borough Council (RMBC) have their own internal quality management process which is in line with international standards ISO9001. Quality Assurance (QA) procedures also form part of the standard SYSTRA project management systems and each project are subject to regular quality and risk review. The SYSTRA Project Manager and Project Director take the lead in ensuring these processes are adhered to and have substantial experience in doing so.

On the Transport Modelling side time has been allocated for QA and checking of the model runs and outputs, particularly those forming the Preferred Option. QA was undertaken on the other options included in the OBC and modelled between OBC and FBC stages. Throughout the process this has permitted some issues in the Baseline and Scenario tests to be captured and corrected before the emissions outputs were provided to the Air Quality modelling and locked down for input into the FBC appraisal process. A couple of issues which were not captured until after the model lock down are described in *3b*, but neither are considered to be material.

For the Air Quality modelling there has been time allocated for carrying out many Air Quality Model runs, including the Preferred Option and the other scenarios and sensitivity tests, some of which are presented in the AQ Documents which accompany the FBC. A proportionate level of QA has been undertaken to ensure the outputs are as robust as possible. In particular, SCC have undertaken a significant amount of quality assurance checks on the precise location of their AQ monitors, to inform the relevant distance-from-kerbside adjustments.

Time has been allocated so that the work and assumptions which have fed into the Business Case Appraisal and the Distributional Impacts of the FBC have been reviewed at each stage in the process. Our proposed approach to the main economic appraisal of the options and the Distributional Impact Analysis has been documented, discussed with JAQU experts, and amended to reflect their comments to ensure that it meets the required standards, both at OBC stage and subsequently at FBC stage.

f. *Have sufficient checks been made on the analysis to ensure absence of errors in calculations?*

On the Transport Modelling side, a sufficient amount of checking and analysis has been undertaken on the Baseline and Scenario tests to ensure there are no systematic errors in those Scenarios. Any errors in the underlying SCRTM1 transport modelling suite may still be present but are likely to cancel out in all pairwise comparisons between the Scenarios and the Baseline. Furthermore, any minor errors which have been found in the checking process, but not incorporated into the final Scenarios due to time constraints, have been subject to appropriate Sensitivity Tests in the Transport Model which are subsequently documented within the T4 Local Plan Transport Model Forecasting Report and later in this document.

The economic models have been reviewed internally within SYSTRA to ensure all elements have been modelled correctly. In addition a full review and restructure to combine the different spreadsheets to ensure greater clarity has been undertaken between the draft and final stages of FBC. Sensitivity Tests have been undertaken to ensure the robustness of this analysis and this is contained in the Sensitivity Test report.

The Base Year Air Quality modelling road NOx outputs are compared with those derived from air quality monitoring data. Verification and adjustments are then undertaken. Model verification is the process by which uncertainties are minimised, however there will never be a modelled run which does not differ from reality in some respect. As per LAQM.TG16 a model ideally performs well if within +/-25% (preferably within 10%) of measured values. As the main purpose is to establish in which year compliance is likely, absolute values are not as important as the difference between Baseline, Business as Usual (BaU) and scenarios.

Section 3.3 of the AQ2 report covers the fit of the air quality model. This includes a calculation of the R-squared (R^2) values, which is a measure of the correlation between modelled and monitored baseline NO_X and NO_2 data. This analysis of R^2 shows a strong fit and a high likelihood that the individual required measures would achieve the results necessary for compliance. The AQ2 report also includes Root Mean Square Error (RMSE) and Fractional Bias calculations .

We believe all reasonable checks have been undertaken and that these checks are proportionate and appropriate given the timescales available.

It should however be noted that during detailed analysis of the transport modelling as part of the FBC documentation phase, a couple of minor issues in the way the model was set up have been discovered. It was too late to include them in a new run of the with-scheme option as it would have required a full update of all analysis. However, two sensitivity tests have been undertaken to ensure that the impact of these findings on the Preferred Option were not material. The two issues were as follows:

- Application of the behavioural upgrades to the LGV fleet was not correctly applied for all movements in the Preferred Option. The result of this was that in essence a slightly more conservative fleet was tested and in reality the fleet would only be better than predicted. A test was undertaken to correct this error and in general it was found to have a 1% improvement impact on traffic emissions, and around 0.5% on NO2 concentrations. The conclusion being that this issue has no impact on the Baseline or on the likelihood of reaching compliance in the Preferred Option; and

- Pence Per Minute (PPM) – These values were found to change slightly between the Baseline and the Preferred Option within the SATURN model. The impact of this was a small amount of rerouting in the external model areas, however as sensitivity test with these corrected shows impact of this within the study area is negligible, with no effect on routeing, emissions and therefore likelihood of compliance.

Regarding the diversion impacts predicted by the model, there are a number of caveats to the responses which should be noted:

- SCRTM1 is a strategic model and therefore doesn't have full road coverage, some of the orbital rerouting close to the city centre may be on roads not actually included in the model. In some areas the roads included in the model are 'valves' in order to allow trip movements contained within the matrix to occur. In some cases, one road included in the model may actually represent 2 or 3 roads so any dispersal is likely to be spread across several roads;

- In SCRTM1 there is more rerouting going on to the West of the city. However the SRTM3B model (used at OBC stage) suggested more would occur to the east. Some of the more minor orbital routes are not very well represented in the strategic models so it introduces a higher level uncertainty in these responses. We know that traffic will reroute, but the exact routings are of higher uncertainty than other modelled impacts; and

- For non-compliant through trips which do not upgrade and continue to drive through the charging zone, they will only experience the 50% one-way charge. This will not result in underestimating the diversion impact as the frequency analysis has shown that each unique vehicle is identified by ANPR cameras making on average over 2 trips per day in the charging area. Indeed there may be a slight overestimate of the number of trips rerouting.

Finally, it should be noted that emissions factors (from EFT / ENEVAL) at low speeds (<12kph) are very uncertain. We have identified links in the model with an average speed <12Kph, checked how many of those are near key locations and decide if they are likely to lead to a non-compliance. This has only been considered in the Preferred Option case, where it is important that as much headroom as possible is achieved at these locations. At all the sites where there are predicted to be compliance issues in the Baseline in 2022, the headroom is sufficient to mitigate this.

g. Have sufficiently skilled staff been responsible for producing the analysis?

Experienced staff have undertaken and reviewed both the Transport and Air Quality modelling work. This has been supplemented by input from other senior members of staff or specialists where necessary.

The key positions in the team have been held by skilled staff members, in particular:

- The Programme Management team is comprised of Senior Business Owners / Leads and qualified, subject matter experts across SCC, RMBC and SYSTRA, with significant experience in managing complex projects through to delivery and in developing Business Case submissions;

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- The Senior Transport Planning lead at SCC has 25 years of experience in evidence based Transport / Air Quality Policy and Strategy Development, Transport Monitoring, and Strategic Transport Modelling. They have overseen the Strategic Transport Assessments in support of Local Plans within two Local Authority areas to determine the impact of, and assess the need for mitigation of, planned development growth; and the development of major Transport Projects within the region that have extensively used the 2008 Sheffield and Rotherham Strategic Transport Model (SRTM3) and Sheffield City Region Transport Model (SCRTM1). They also led the development of the 2019 Sheffield Transport Strategy and 2017 Clean Air Strategy;

- SYSTRA's transport modelling team is led by a Project Manager with over 15 years' experience of transport modelling and scheme appraisal, an MSc in Transport Planning and extensive experience of modelling traffic and transport in the Sheffield and Rotherham area. SYSTRA's Project Director has over 30 years' experience of transport-related behavioural research and modelling and traffic emissions-related modelling and appraisal, a 1st Class Honours in Mathematics and a PhD in Operational Research and was heavily involved in an earlier Defra-funded Low Emission Strategy Study for Sheffield City Council in 2012/13;

- The Sheffield and Rotherham Air Quality Officers have relevant graduate and postgraduate degrees in Chemistry, over 40 years combined experience of working in air quality for Sheffield and Rotherham, covering a wide range of work such as Local Air Quality Management, air quality monitoring and modelling, development control, policy guidance development, public health and were heavily involved in the 2013 Defra-funded Sheffield Low Emission Zone (LEZ) Feasibility Study modelling. As a result of this work, they have an in-depth knowledge and understanding of air quality in their respective areas;

- The Local Behavioural Research was led by a SYSTRA expert with over 30 years' experience in Market Research; and

- The economic appraisal process and the documentation of the economic case for the FBC was overseen by experts with degrees in Mathematics and Engineering, supported by staff with several years in producing Business Case documents, undertaking economic analysis, scheme appraisal and distributional impact analysis. Where possible staff continuity from OBC stage has been retained.

Furthermore, where required, supporting members of staff across SCC, RMBC and SYSTRA have had training in relevant packages where necessary, including in use of the SCRTM1 transport model, the Emissions Factor Toolkit and the AIRVIRO dispersion model.

Uncertainty

h. Is the level of uncertainty proportionate to the decision being made?

There are many causes of uncertainty within both Transport and Air Quality models. Firstly, it is important to note they are just models which try to mathematically represent real life responses and need to be used alongside professional judgement and local knowledge in order to be made best use of. These uncertainties will be included in any modelling process and will no doubt be manifest in this process.

Despite these uncertainties, we believe the current level of uncertainty in the process followed is proportionate to the decisions being made in the OBC phase of the project. The development of the models and use of the models has followed TAG / JAQU guidance as best as possible.

In the following table, we have outlined the key sources of uncertainty in the Transport and Economic Modelling.

Uncertainty	Description	Findings / Mitigation
Land Use Assumptions and Committed Schemes	The land use assumptions and committed schemes are uncertain in that they have not yet been delivered. However, they are only 1 year away so those that have been included are reasonably certain.	If less development was included, compliance would be easier to achieve so no sensitivity testing undertaken.
Local Behavioural Responses (Goods Vehicles)	There is uncertainty as to how closely goods vehicle owner responses reported and recorded in the local (pre-Covid) behavioural research will match the actual out-turn responses to the introduction of a charging CAZ. (NB the market supply of compliant vehicles is considered as a separate uncertainty later in this AAS)	Sensitivity Test have been undertaken with JAQU prescribed behavioural values for LGVs and compliance is still met. (HGVs are already using the default JAQU values in the Preferred Option)
Bus / Taxi Upgrades	There is uncertainty around the modelled assumption that all buses and taxis can be upgraded to compliant vehicle types by mid-2022, due to the capacity of the market to deliver the upgrades and the need for significant financial support packages.	The FBC assumes that the combination of CAF and Clean Bus Technology Fund will be sufficient to deliver the required level of upgrades of SCC/ RMBC bus and taxi fleets. The market supply of compliant vehicles is considered as a separate uncertainty later in this AAS. Regular monitoring of these two fleets in the M&E Plan will allow us to monitor this uncertainty closely

Emissions Factors	Uncertainty exists around whether the emissions factors for emerging vehicle technologies will actually be realised in real life driving conditions.	No mitigation or Sensitivity Tests currently undertaken as values within the EFT are the only ones available to inform the modelling at present.
Impact of CAZ schemes in nearby cities	The impact of CAZ schemes in nearby UK cities (e.g. Bradford, Manchester) are likely to impact on Sheffield and Rotherham. Without access to the detailed modelling work of those areas it is uncertain what the impact of this is likely to be.	It is likely that there will be beneficial upgrade effects on the long-distance fleets upgrading due to CAZ schemes in other nearby cities. The introduction of a CAZ C in Sheffield will avoid a migration of older non-compliant vehicles from other CAZ areas into the Sheffield area. Careful monitoring of the various fleets will be required to prevent non-compliant vehicles (e.g. buses) from being operated in Rotherham, to support the voluntary agreements with the relevant operators to operate Euro VI (or better) buses on the key AQ hot-spot routes. However, given a number of CAZ schemes are expected to be launching in a similar timeframe it could have an impact on the availability and affordability of compliant fleet, which hasn't been accounted for within the modelling conducted.
Exemptions	Vehicle exemptions have not been included in the Transport Modelling explicitly. Some commentary on the likely impact is contained in the exemptions report.	It is expected that the exemptions will only have a very small impact on model results and will not change the conclusions. The exemptions have been treated as a qualitative sensitivity test in the stand-alone sensitivity test report.
Residual impacts of the coronavirus pandemic on travel behavior	As of November 2022, traffic volumes in Rotherham had returned to an average of 96% of pre-pandemic levels, with bus usage at 72% of pre-pandemic levels. This suggests a reduction in demand for travel, and a mode shift from bus to car, which may or may not be sustained into 2022 and beyond. There may be other effects (e.g. resulting from reduction in bus services). However, JAQU recommended that these	Corresponding traffic data for Sheffield will be provided when time permits – likely to show a non-trivial drop in peak-hour traffic. The core scenario and sensitivity tests presented have been discussed and agreed with JAQU. The monitoring and evaluation plan includes for means to consider the impact of ongoing variation in traffic. Further details of the modelling of the Covid impacts are provided in

	medium/long-term impacts, should be ignored and so these impacts are not accounted for in the model.	the Strategic Case of the FBC and in the Sensitivity Test Report.
Use of Modelled Data in DIA	Detailed model data, particularly in the city centre and the CAZ zone, was aggregated to MSOA level meaning detail could has been lost when attributing model changes to populations and businesses.	No mitigation as the data had to be aggregated in this way to be used in conjunction with census data sets.
Business Analysis in the DIA	Business based analysis was limited to the size and number of businesses. No additional characteristic information was available	The analysis would have benefited from being able to account for different business characteristics (eg number of vehicles, a measure of business success) similar to the way population has been disaggregated. No mitigation has been undertaken as the data was not available.
Impact of Bus Gate on Arundel Gate	The bus gate on Arundel Gate prohibits non-bus northbound traffic on this section of Arundel Gate. Because of the strategic nature of the model used the localized rerouting associated with this may be more nuanced than the model is able to predict.	No mitigation. Commentary included in economic case that the impact of the bus gate as disbenefits to non-bus vehicles may be slightly overstated.
Impact of Roadworks	During 2022 (the year of compliance) the Rotherham Parkway will have ongoing roadworks associated with the Parkway Widening scheme. These will take place right through to October 2022 and are included in the Preferred Option for the testing of compliance.	Sensitivity Test run for 2023 to show that the Parkway is compliant when the Parkway widening is complete. Unknown if changes in the configuration of the roadworks during 2022 will cause issues but if they do, they will probably be short term and not affect annual compliance at any location.
Damage cost values and carbon values	Damage cost values taken from DEFRA and carbon valuations taken from TAG include high and low range estimates.	These high and low estimates are used in sensitivity tests for the final FBC submission.

We have outlined the key sources of uncertainty in the Air Quality Modelling In the following table.

Uncertainty	Description	Findings / Mitigation
Observed Fit	There will always be a difference between	The large number of monitoring sites in the SCC & RMBC area and the high

	modelled (unadjusted) and actual 'road' NO_X in any modelling. However, once the adjustment process has been completed the Root Mean Square Error (RMSE) for observed v predicted (adjusted) NO_2 shows a good fit.	quality of the post-calibration fit between observed and modelled NO_2 concentrations help to minimise any concerns associated with this risk
Forecast Background Concentrations	There is a small amount of uncertainty in predicting the level of background oxides of nitrogen concentrations in the forecast years. Reductions have been assumed in line with the NAEI predictions.	No sensitivity tests or other mitigation measures are required for this one
Forecast Weather Conditions	We have used the same annual scenario typical weather for each model run so that we are comparing like with like for future years. Meteorological data is collected from the Sheffield Met Mast monitoring site.	No sensitivity tests undertaken but could be considered, if necessary
Gradient effects not included in modelling	These have not been included in the Transport modelling and therefore the effects are accounted for at the Air Quality modelling stage when the road NO_X is factored.	Capability in terms of emissions modelling was not available at Initial Evidence Submission and OBC stages but new version of EFT (released June 2019) now includes capability. However, underprediction of gradient effects is still apparent. In terms of air quality modelling, see comments in AQ2 and the canyon modelling section which apply for gradient and canyon effects. Gradient effects are more significant for Rotherham and canyon effects for Sheffield.
Canyon Modelling	Canyon modelling has been carried out for certain key roads using the OSPM model and using emissions data EDB built up from AADT, traffic composition etc..	A canyon model is useful in certain situations. The format in which the emissions data comes out of the transport model mean that it was not possible at the OBC stage to run a canyon model using Airviro Street Canyon model using this data. Using the OSPM model now available in Airviro addressed this issue. In many key areas, we have made use of Site-Specific calibration: further

		explanation of this can be found in AQ2. It is particularly important for key road links with uphill gradient, canyon effects and in known Air Quality Management Areas.
f-NO_2 factors	f-NO_2 factors are based on fleet composition in a particular test. There are uncertainties in the underlying f-NO_2 values themselves as well as the forecast year fleet uncertainties.	Predicted f-NO_2 factors for each modelled year are lower in Sheffield and Rotherham than the UK average because of a higher proportion of petrol vehicles than present nationally. For the final calculations using the NOx:NO_2 calculator, SYSTRA calculated route specific f-NO_2 values for each road link in the study area, based on the predicted vehicle fleet using each link. This reduces the error/uncertainty associated with using an average derived for the whole of the UK, especially given the amount of local ANPR data which provides a detailed understanding of the local fleets at different locations within the SCC/RMBC area. The change in predicted f-NO2 from year to year is very small.
Calculation of road NOx from NO_2 values	Difference between local and national default relationships between road NO_X and NO_2 (incurred by our use of Defra's NO_X:NO_2 calculator)	Methodology is as per national guidance. The errors are consistent across all calculations. No additional mitigation required or possible. We have used v6.1 (as it includes the year 2017) to calculate our results in response to JAQU's objection to us applying v7.1 factors to calculate v8.1 (the latest version) results. Further, that using v7.1 calculator resulted in lower predicted values and compliance at all locations which is not borne out by v6.1 and v8.1 results, which are very similar to each other.

We have outlined any other key sources of uncertainty in the process in the table below.

Uncertainty	**Description**	**Findings / Mitigation**
Proportion of HGV / LGV Upgrades	The number of HGVs that are predicted to upgrade is based on a JAQU default value, rather than local behavioural research.	The number of non-compliant HGVs is low, relative to LGVs, so any error in this assumption will have a fairly minimal impact.
Number of HGV / LGV Upgrades	Difficulty linking daily traffic with the number of individual vehicles required to be upgraded.	This only affects the Economic Case, not the emissions modelling.

Confirming Scheme Success	The amount of work required to confirm long-term 'success' is uncertain.	The Monitoring and Evaluation Plan considers this uncertainty, taking account of the Decommissioning Guidance webinars provided by JAQU in October 2021 - JAQU still reviewing and are yet to publish their final guidance on this.
Wortley Road HGV Ban Success	The HGV ban on Wortley Road needs to achieve just under 50% success rate in order that compliance is achieved. There is a small level of risk that this will be achieved.	Available research on compliance with heavy goods vehicle prohibitions is limited but evidence from other schemes[6] indicates 70-85% compliance can be achieved with minimal enforcement. The scheme in this case has been designed to include a point restriction with no exceptions, to enable enforcement by South Yorkshire Police. RMBC is also working towards taking on new powers to enforce moving traffic offences. The Monitoring and Evaluation Plan includes a task to monitor compliance with this ban and identifies the remedial measures which might be required to deliver success if HGV flows remain higher than 50% of the 2019 values after the introduction of the northbound ban.
Market supply	There is a great deal of supply-chain uncertainly. Global supply chain issues are currently being observed supply of goods, materials, services, and staff are all affected. For example, other CAZ areas are reporting long lead-in periods for supply of new vehicles. If current supply chain issues continue or worsen these could significantly impact the relevant SCC/RMBC fleets. Transport for Greater Manchester have recently undertaken research and reported evidence of supply chain issues to	Use of ANPR data to regularly monitor the relevant local fleets. This will need to be reviewed on an ongoing basis as any issues with market supply could adversely affect the rate of improvement in the fleet. This is one of the biggest risks to compliance (as identified in the Manchester case).

[6] http://www.its.leeds.ac.uk/projects/konsult/private/level2/instruments/instrument038/l2_038c.htm

	Government seeking their intervention.	

In order to better understand the uncertainty, a series of sensitivity tests were undertaken on the Preferred Option modelling. These have been done around the transport modelling assumptions, the Economic Case, and the Air Quality modelling assumptions. These are outlined in the Sensitivity Test Report which is also submitted as part of the FBC package of documents.

Use of Analysis

i. Does the evidence provided support the business case?

The evidence provided in the earlier OBC supported the selection of the Preferred Option, by highlighting why that option out-performed the various alternatives, while still achieving the required air quality-related 'success' in the shortest possible time.

The additional evidence justifies the modifications made to this Preferred Option between OBC and FBC and fully supports the Full Business Case for the current version of the Preferred Option.

The key conclusions supported by this evidence are as follows:

- The Preferred Option (ie A CAZ C with £10 daily charge for LGV and £50 for HGV inside and including Sheffield Inner Ring Road, introduced in September 2022, a full upgrade of the relevant bus fleets to Euro VI emission standards, an upgrade of a proportion of the respective black cab and car-based taxi fleets in Sheffield/Rotherham to Euro 6 emissions standards and various other supporting measures designed to tackle air quality issues at three specific 'hot-spots' in Rotherham) and the agreed package of support measures to deliver the required upgrades to the various fleets (taxis, LGVs, HGVs, coaches & scheduled buses), is predicted to achieve NO_2-based 'success' (ie annual average concentrations of NO_2 below 40 µg/m^3 on all relevant road locations[7] for reporting compliance within the scope of this study) in 2022 and in all subsequent years. This is subject to the uptake of cleaner compliant vehicles, which may be impacted as a result of availability / affordability issue as described earlier in this document;

- The extensive modelling of this Preferred Option over the past three years, the previous consultation undertaken in 2019, the Legal Direction to implement a CAZ C scheme and the funding awarded to help deliver this together ensure that this Preferred Option can be delivered significantly more-quickly than any other package of measures which might deliver a similar level of air quality improvement;

- The Preferred Option therefore fulfils the criteria of being the scheme which delivers NO_2-based 'success' in the Shortest Possible Time;

- Whilst the Preferred Option achieves compliance, the overall scheme has a negative Net Present Value (NPV) and a negative Benefit Cost Ratio (BCR). The reasons behind this are largely due to rerouting of traffic away from key air quality problem areas and onto slightly longer routes, but which are not predicted to be in exceedance, this is discussed in more detail in the Economic Case. However, as demonstrated through the Distributional Impact Analysis it is not expected to have a disproportionally negative impact on any vulnerable groups within the area;

- A number of the sensitivity tests undertaken and the variability in annual average NO_2 concentrations at the various air quality monitoring locations across Sheffield and Rotherham suggest that relying on 'Business as Usual' fleet upgrades might fail to achieve this NO_2-based 'success' at a number of locations in 2022, confirming that 'do nothing' (or 'doing very little') cannot be relied on to deliver the required improvements to local air quality in the shortest possible time; and

[7] See "AQ3 – The Local Plan Air Quality Monitoring Report" for a list of the in-scope reporting locations

- The Monitoring and Evaluation Plan (which forms part of the Management Case of the FBC) will help ensure that progress towards this 'success' is monitored closely.

The evidence therefore fully supports the choice and content of the SCC/RMBC Preferred Option being appraised in the FBC.

Summary

This Analytical Assurance statement for the Sheffield and Rotherham Clean Air Plan has outlined the key limitations and assumptions made in the Transport and Air Quality modelling work to inform the CAP FBC. Our methodology was agreed at each stage with JAQU. It has also described the reliability of the data sources underpinning the evidence presented in the accompanying documentation. Furthermore, it has considered the Sensitivity Testing (see separate sensitivity testing report) which has been undertaken to give more confidence in the modelling outcomes.

We believe that all requirements set out by JAQU in the guidance have been covered here and in the other associated FBC documentation. Overall, we therefore, believe that the limitations described are within acceptable levels and the evidence presented robustly supports the Business Case.

Based on the transport modelling and air pollution modelling undertaken along with the Sensitivity Tests the Preferred Option is predicted to achieve NO_2-based 'success' in 2022 and in all subsequent years across the Sheffield and Rotherham CAP area.

In Sheffield compliance is largely dependent on realising the assumed fleet upgrade in response to the CAZ. As set out in this document there are a number of uncertainties associated with this that could result in delayed fleet upgrade. The greatest area of uncertainty, and therefore risk, relates to current supply chain issues which are resulting in limited availability of compliant second-hand vehicles, long lead in times for new vehicles with some companies freezing orders until back-logs are cleared, delays to retrofit upgrades, some retro-fit companies have permanently closed as a result of COVID resulting in limited access to local providers, some markets are seeing artificially inflated costs e.g. second hand LGV market. The range of electric, fully wheelchair accessible taxis is limited and has not increased over the last three years, these vehicles are very expensive. Supply chain issues are a national concern and cannot be addressed at a Local Authority level, if the position does not resolve it will delay fleet upgrade across the country.

In Rotherham, compliance will be achieved through a combination of highways schemes which will be in place by within 2022 (the final one being completed in September 2022) and bus fleet upgrades on key routes, which will also be achieved by mid-2002. Compliance in Rotherham is therefore not significantly affected by the date of implementation of the CAZ scheme in central Sheffield or vehicle owners' responses to it and is therefore less affected by the associated risks and uncertainties.