# SHEFFIELD AND ROTHERHAM CLEAN AIR PLAN FEASIBILITY STUDY

# LOCAL PLAN AIR QUALITY MODELLING TRACKING TABLE (AQ1)

**April 2022**

Sheffield City Council

Rotherham Metropolitan Borough Council

DOCUMENT CONTROL

| Version | Name | | Position | Date |
|---|---|---|---|---|
| **V1.00** | Authors | Julie Kent<br><br>Ogo Osammor | RMBC – Air Quality Officer<br>SCC – Air Quality Officer | 08/04/2022 |
| **V2.00** | Checked by | Chris Robinson | SYSTRA | 08/042022 |
| | Approved by | Tom Finnegan-Smith<br><br><br>Tom Smith | SCC – Head of Strategic Transport, Sustainability and Infrastructure<br>RMBC – Assistant Director, Community Safety and Street Scene | 11/04/2022 |

## Air Quality Modelling Tracking Table (AQ1)

| Ref | Requirement | Local Authority Description | JAQU Review Comments |
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| A | **Air quality model specification** | Airviro is a web based system for Air Quality Management developed by Apertum IT AB Airviro \| Apertum. Airviro is an integrated system for time series data handling, emission inventories and dispersion modelling. Airviro has been continuously developed since 1990 and it is now the most extensive Air Quality Management system on the international market, with installations in around 80 places world-wide. SCC and RMBC have used the Airviro system for air quality modelling, time series data collection and validation continuously for over 20 years, in partnership with Doncaster and Barnsley Councils. | |
| A.1 | **Model selection** | | |
| A.1.1 | Details of emissions model based on COPERT 5 emissions to be used. | To produce the transport emissions for the model for the CAZ Feasibility study we used the latest version of the DEFRA developed Emissions Factor Toolkit (EFT) combined with outputs from the SCRTM1 traffic model. Emission Databases were created for each modelled scenario and year. Emissions are also proportioned differently for each day type, reflecting the differences between weekdays, Saturdays and Sundays. The inputs to the EFT reflect actual local traffic data collected over the period of a year. | |
| A.1.2 | Gradient effects included? | Gradient effects were not included in our core modelling. The impact of gradient was accounted for in model adjustment post dispersion. Further information can be seen in Clean Air Plan Document AQ2 (The Air Quality Planning Methodology Report). | |
| A.1.3 | Details of air quality dispersion model to be used. | The Dispersion module in Airviro was used for the dispersion modelling. There are also various models available for use including the Gaussian Model (which was the main model used in this study -suitable for areas up to 20km square), Grid model, USEPA Aermod, Street Canyon, etc. Reference: Volume 2 (airviro.com) | |
| A.1.4 | Canyon effects included | There is a Canyon model within Airviro, and this was used to assess locations which had canyon effect – see the Clean Air Plan Document AQ2 (The Air Quality Planning Methodology Report). | |

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| A.1.5 | Tunnels and flyovers included? | The capability for including flyovers is within the Emissions Database structure in Airviro. However, there are no tunnels and flyovers considered within the modelled domain and therefore there was no necessity to model these. | |
| A.2 | **Air quality model domain** | **Local Authority Description** | |
| A.2.1 | Please provide a map (in report) showing model domain in relation to exceedance locations identified in PCM model. | Supporting Document SD03 illustrates the geographic coverage of the Airviro model and the annual mean $NO_2$-related AQ areas of exceedance (including PCM) identified in 2017. The Airviro model will be able to provide predicted levels of current (2017) and future annual $NO_2$ levels within this modelled area. | |
| A.2.2 | Locally identified exceedance locations included? | Yes, all of the current exceedance locations are covered by the Airviro model domain - see the Clean Air Plan Document AQ3 (The Local Plan Air Quality Modelling Report). | |
| A.2.3 | Domain includes displacement routes? | Yes, the modelled domain includes all of the displacement routes included in the relevant traffic models. | |

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| A.3 | **Air quality model receptor locations** | **Local Authority Description** | |
| A.3.1 | Details of receptor grid size and other receptor locations. | Airviro models NOx sources across the whole domain. We used a similar methodology to the one used by Leeds City Council for their CAZ Feasibility Study. The basic modelled grid size across the domain was a 250m x 250m grid (spatial resolution). This grid size was reduced to a 10m receptor grid within 50m of a modelled road, point or line source emitting more than 0.000001g/s. This approach resulted in reasonable model run times. Attempting to run the whole of Rotherham and Sheffield as a domain with a 50m grid would result in extremely long run times. The "*Quad Grid*" function within Airviro Dispersion module was used, with the threshold emissions value set to > 0.000001 or $1e^{-06}$g/(s*m) to ensure all road links with a significant emission rate are included. | |
| B | **Air Quality Base Year modelling** | | |

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| B.1 | **General** | | |
| B.1.1 | Base year to be used. | 2017 | |
| B.1.2 | Details of Meteorological data to be used. | An annual "scenario weather" data file representing typical Sheffield and Rotherham meteorological conditions has been used for most of the dispersion modelling – see wind rose for "scenario weather" within Document AQ2. If a time period of a whole year's meteorological data is used, the run times become very long. | |
| B.2 | **Traffic input data** | | |
| B.2.1 | Source of traffic activity data and vehicle types. | SYSTRA modelled Base Year (2017) and future (2022) link-based $NO_X$ annual average daily emissions on an ITN-based mapping layer. These were created via a SCRTM1 strategic Saturn-based highway traffic model. The traffic flows from that model were combined with emissions factors from the latest version of EFT (v9.01b) to produce the $NO_X$ emissions estimates.<br>Supporting Document SD05 provides details of how the vehicle types within the traffic model have been split into emission categories when calculating the traffic-related emissions which will be used in the AQ model. Also supporting document T1-SD03 describes how the 2022 values were produced from the standard 2022 SCRTM1 forecast year. | |
| B.2.2 | Details of representation of road locations (achieved through use of a georeferenced transport model or another approach?). | SYSTRA used the processes developed for other CAZ studies they are involved in to convert the SCRTM1 Saturn model-based link emissions to a geo-rectified mapping layer to produce a representation of the road locations. The NOx emissions predicted by the transport model were then attached to this layer. | |
| B.2.3 | Source of vehicle fleet composition information (local/EFT). | SCC/RMBC ANPR data for a whole year (2017) from their **continuous** ANPR camera network was used, plus a recent ANPR survey on the Sheffield Parkway (A630) commissioned by RMBC.<br>Supporting Document SD02 describes the camera locations which were used to provide the fleet profiles at the known $NO_2$ exceedance areas. | |

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| B.2.4 | Source of vehicle speed information. | Sheffield City Region Transport Model (SCRTM1) | |
| B.3 | **NOx/$NO_2$ emissions assumptions** | | |
| B.3.1 | Source of primary $NO_2$ emission fractions (f-NO2). | f-NO2 was derived for the local fleet for each key route in the study (see AQ2 and Technical Document T3 section 3.1). The Defra NOx:$NO_2$ calculator was used for the conversion of NOx to $NO_2$. This is based on version 6.1 released in October 2017. | |
| B.3.2 | Details of method used to calculate projections for f-$NO_2$ and to calculate $NO_2$ concentrations from NOx concentrations. | Same as above. | |
| B.4 | **Non-road transport modelling** | | |
| B.4.1 | Details of modelling for non-road transport sources. | Emission Databases (EDBs) containing industrial, commercial and domestic sources for Rotherham and Sheffield have previously been developed in the South Yorkshire Airviro system independently of the CAZ programme. They include all known industrial emission sources such as biomass power plants, steel works, non-ferrous metal processes, and incinerators. As South Yorkshire is still an industrial area, it is important to include these sources in any modelling exercise. Many sources are represented as point sources within the system - see subsection 3.1.1 of the Clean Air Plan Document AQ2 (The Air Quality Planning Methodology Report). Supporting Document SD06 provides examples of the point sources included in the EDBs | |
| B.5 | **Measurement data for model calibration** | | |
| B.5.1 | Details used for the model calibration e.g. dates, locations. | The dispersion modelling is validated using local monitored data. Please See Supporting Document SD04 | |
| B.5.2 | Type of monitoring data (automatic and/or diffusion | Both automatic and diffusion tubes data were used – see Supporting Document SD04. | |

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| | tubes) used for the model calibration. | | |
| B.5.3 | All available automatic (and/or diffusion tube) monitoring data included in the model calibration. | All monitoring sites were included. Please See Document AQ2 and Supporting Document SD04 | |
| B.5.4 | Quality assurance of measurement data. | For details of bias adjustment factors for the year of monitoring data used in the model calibration See Supporting Document SD04 | |
| C | **Projections modelling** | | |
| C.1 | **Baseline projections modelling** | | |
| C.1.1 | Years to be modelled. | 2017 and 2022 | |
| C.1.2 | Details of method for projected vehicle fleet composition. | Current fleet is derived from local ANPR-based fleet profiles (from a full year data set for 2017), this is then forecasted using EFT-based proportional year on year 'Business as Usual' Fleet Assumptions (as per JAQU Guidance). New fleet types are introduced slightly slower than EFT as it is known that the local fleet is generally older / behind the national fleet See Supporting Document SD05 for further details. Linear interpolation is applied to SCRTM1 estimates for 2019 and 2024, to forecast traffic emissions in the interim years (2022 and 2023), as described in Supporting Document T1-SD03. | |
| C.1.3 | Details of method for projected vehicle activity. | SCRTM1 Saturn-based traffic models (Current and forecast years). See Technical Documents T2, T3 and T4. | |
| C.1.4 | Impact of RDE included? | JAQU was consulted on the recommended approach for this. Our original proposal included a programme of roadside emissions monitoring, but this was not carried out, following discussions with JAQU who did not support the proposal. | |
| C.1.5 | Details of methods to calculate future fleet emissions 10 years beyond compliance to inform | As per C.1.2 above, the EFT-based proportional changes over time are applied to current 2017 fleet (based on local ANPR data), to forecast future fleet composition. In the CAZ options, JAQU Guidance has been used to implement vehicle responses in tandem with local behavioural research studies which have been undertaken for | |

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| | options appraisal (linked with C2.2). | the various scenarios. The change in fleet as a result of a CAZ scheme is then carried into the future by continuing to apply EFT year on year proportional changes. To obtain a specific year interpolation between transport model outputs for 2024 and 2034, as undertaken required – see Supporting Document T1-SD03 for further details. | |
| C.2 | **With measures projections modelling** | | |
| C.2.1 | Years to be modelled. | 2017 and 2022 – all modelled options have been presented in AQ3 | |
| | Details of method for projected vehicle fleet composition. | EFT-based year on year proportional changes applied to current (2017) local fleet, with JAQU Guidance and local Behavioural Research was used to implement vehicle replacement responses to the various CAZ scenarios. | |
| | Details of method for projected vehicle activity. | SCRTM1 forecasts, local behavioural research and JAQU guidance used to adjust highway assignment matrices to obtain forecast highway assignment matrices of compliant and non-compliant vehicles (by vehicle type) for each modelled scenario. The traffic model within the SCRTM1 is then used to predict the rerouting responses to the various CAZ scenarios and the subsequent reassignment of the traffic in response to any changes in traffic speeds and junction delays | |
| C.2.2 | Details of methods to calculate future fleet emissions 10 years beyond compliance to inform options appraisal. | EFT-based changes applied to current fleet, with JAQU Guidance and local behavioural research used to implement vehicle responses to the various CAZ scenarios. | |

JAQU review

Green – Accepted – Information meets requirement
Grey – Accepted - JAQU to provide assistance in meeting requirement
Yellow – Requires further information or a response to a question to be provided either in the table or in the report
Red – Information provided does not meet the requirement

AQ modelling proposal is complete when all listed requirements are Green or Grey and required additional information are provided in the report

**Supporting Documents**

1 SD 01 – Maps Showing the Coverage of SCRTM1 relative to the current AQ Hotspots
2 SD 02 – Technical Note identifying representative SCC/RMBC ANPR Sites for the Air Quality Hot-Spots
3 SD 03 – Airviro Domain Maps
4 SD 04 – Air Quality Monitoring Data and Site Locations
5 SD 05 – Vehicle Types and Emission Categories
6 SD 06 – Non-Transport Point Sources in the Current Airviro Model