

Leeds Clean Air Zone

Modelling Report

Version

1 - RM

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Polly Cook - Chief Officer for Sustainable Energy & Air Quality

For further queries please contact: [cleanairleeds@leeds.gov.uk](mailto:cleanairleeds@leeds.gov.uk)

This report details the narrative driving the modelling work and collects the various evidence generated during the Leeds Clean Air Zone project delivery phase. Both to support the 2018 decision to implement and the subsequent decision made in October 2020 not to proceed.

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# Introduction

The Draft UK Air Quality Plan 2016 identified Leeds along with Birmingham, Derby, Nottingham and Southampton as cities where immediate action was to improve levels of NO2 (Nitrogen Dioxide) in order to comply with the EU Air Quality Directive (AQD) 2005/50/EC. This requires the annual average for NO2 not to exceed 40µgm3.

The Joint Air Quality Unit (JAQU) is a government body charged with delivering the UK’s national air quality plans to reduced levels of Nitrogen Dioxide. It liaises with the relevant local authority partners, oversees proposals to improve Air Quality, and awards funding to implement measures. Staff are drawn from DEFRA and the Department for Transport, whilst it reports to the Secretary of State for the Environment and Secretary of State for Transport.

Leeds City Council (LCC) as the relevant local authority were required to implement measures in the shortest possible time to bring local air quality levels in line with the directive. To understand the impact of specific measures required air quality modelling, the process is outlined in this report, and further detailed in the listed appendices.

# National Modelling

For the purpose of reporting compliance with the Air Quality Directive as required by the EU, Air Quality modelling at a national level is undertaken by DEFRA using a suite of modelling software. The main tool is the Pollution and Climate Mapping (PCM) Model, maintained by Ricardo Energy and Environment. Further information on the PCM model can be found here: <https://uk-air.defra.gov.uk/research/air-quality-modelling?view=modelling>

The PCM model assesses major road links across the UK, and combined with other data from the suite reports on roadside levels of NO2 which resulted in the Wave 1 cities listed above being required to implement measure to reduce air pollution.

Due to the national scale of the PCM model, it has simulation running times of weeks, and has difficulty assessing local interventions. This led to the requirement for local authority partners to conduct their own Air Quality modelling utilising local knowledge and tools able to better reflect local conditions and road network. The local model runs were to be validated against the PCM model to ensure suitability for reporting compliance in relation to the EU AQD.

# Local Modelling

The approach adopted by LCC is based on national guidance published in [LAQM TG.16](https://laqm.defra.gov.uk/technical-guidance/). This is a well-established process commonly used to assess the AQ impact of Highways schemes. A traffic model generates estimated annual average daily traffic flows and speeds. The flows and speeds are then passed to an emissions model to generate pollutants on a link basis, the emission model being the [Emission Factor Toolkit](https://laqm.defra.gov.uk/review-and-assessment/tools/emissions.html) published by DEFRA.

A dispersion model is then used to disperse the pollutants across the area. Leeds use [Airviro](https://www.airviro.com/airviro/), developed by Apertum for the Swedish Meteorological Office. This is one of the few available Gaussian plume air dispersion models which can model concentrations as either a point or grid formation. The concentrations from the dispersion model are adjusted and validated against a base year, in this case 2015. The adjustment factors are then applied to all future year scenarios.

In order to match up with the PCM model for validation purposes, adjacent to each link in the PCM model is represented by one point in the Airviro model referred to as Target Determination receptors. These were placed by Leeds and reviewed by JAQU for comparison to the PCM points.

The points are placed according to requirements which are defined by limitations of the modelling software, specifically more the 25m from a junction, 4m from the kerb and at 2m in height within the modelling environment. This is due to the highly complex dispersion factors that occur at road junctions. More complex models can account for this but employ fluid dynamic techniques which require significantly greater computing and time resources and as such are typically only modelling in academic environments for research purposes.

# 2018

The work undertaken for the 2018 decision to implement the CAZ and to support the business case submission to JAQU is detailed in Appendix 1,2 & 3.

## Appendix 1 – AQ modelling report.

This contains the full explanation of the methodology followed, including Number Plate surveys of the local vehicle fleet to understand the local distribution between Euro standards, projections of the fleet data forward to future years, how the emissions tools and dispersion models were developed, the validation procedure and the adjustment factors generated.

## Appendix 2 – Summary of Traffic Modelling

An explanation of the demand, modal choice and traffic modelling software developed. The model was able to implement a charging cordon around the city which added the fee to the generalised cost of the trip.

The behavioural dynamics relating to the choice to upgrade, avoid or pay were based on guidance provided by JAQU.

## Appendix 3

Contains reports relating to traffic modelling for the various scenarios and different cordons tested.

## Modelled Cordons

As the site expected to be exceeding was on the Inner Ring Road, this required including it within the cordon limits. A small cordon covering just Leeds City Centre and the IRR resulted in traffic diverting through the local neighbourhoods on roads unsuited to high volumes of traffic.

A larger cordon was developed extending out to the outer ring road to the north and including south Leeds to the M62. This was found to have no significant impact on AQ levels within south Leeds, so a reduced boundary CAZ was introduced using the M621 as the southern border.

Leeds was not allowed to include the M621 within the CAZ as this was in the remit of Highways England who were pursuing alternate measures to improve AQ.

When modelling the reduced boundary CAZ, using a CAZ-B+ was found to have the level of impact required to reach compliance. The ‘+’ requiring Hackney Carriage and Private Hire drivers to Hybrid vehicles, vs the standard CAZ-B guidelines which would have required Euro 6 Diesel or Euro 4 Petrol vehicles.

## Submission

The evidence basis was reviewed by JAQU internal specialists, with a Technical Independent Review Panel composed of industry and academic specialists providing additional oversight. This process generated some minor tweaks or amendments. The end conclusion was the approval of the business case for the Leeds Clean Air Zone and the award of £29m to implement the CAZ and support local businesses and drivers through the transition.

The original “Go-Live” data was written into the Leeds Clean Air Zone Charging Order (2018) as the 1st of January 2020, requiring all Buses and HGVs to be Euro VI, and Private Hire and Hackney Carriages to be either Hybrid vehicles or Euro 6. This included a range of time limited exemptions for various user groups, and grants to support retrofit, or new compliant vehicle purchases.

# 2020

Due to delays in developing national level support systems, in September 2019 the decision was made to push the Go-Live date back to no sooner than July 2020 in order to allow for sufficient progress on system development to be made to give certainty of go live. In early March 2020, 28 September 2020 was nominated as the go-live date.

In March 2020 the SARs-Cov2 pandemic generated further uncertainty, which resulted in an expected Go-Live date of no sooner than January 2021, a year later than initially planned. As the pandemic had clearly caused improvements in air quality due to reduced traffic, the challenge was to predict when in 2021 would be the right time to launch the scheme. This led to the review into Leeds Air Quality.

The original 2018 Business Case submission reported on 2020 and 2022 scenarios. The 2020 Do-Minimum scenario reported exceedances without a CAZ at one location, that site becoming compliant under the proposed CAZ-B+ in 2020.

The 2022 scenario reported compliance both in a CAZ and no-CAZ scenario.

2021 was deliberately omitted from assessment due to a large number of roadworks expected to take place in 2021 that would materially impact on the expected operation of the city including;

* Contraflow on the A64(M) due to Regent St Bridge replacement works
* Changes to Armley Gyratory to accommodate displaced traffic from changes to the city centre
* Major works on the M621 Jn 1-4 to deliver the Highways England Route Improvement Scheme
* Upgrade of Dawson’s Corner Roundabout on the Outer Ring Road
* Delivery of a number of Leeds Public Transport Improvement Programme schemes within the city centre and on radial routes to improve bus reliability, journey times and public realm in the city centre
* Construction of the East Leeds Orbital Route, a dual carriageway bypass of the A6120 outer Ring Road in east Leeds.

As such there was no continuous period in 2021 that would allow for a representative annual average to be calculated and so it wasn’t modelled.

As the Go-Live date was now starting in 2021, and initial modelling had indicated compliance in 2022, questions around the impact of implementing the CAZ for one year only. JAQU requested additional work exploring whether compliance could be achieved by different measures which would require additional modelling work to cover 2021.

## Regent St Bridge

In the 2020 Do-Minimum scenario, the only receptor point (TD58230) exceeding 40µgm3 was located adjacent to the A64(M) at the junction with North St.

During a 2021 Do-Minimum scenario this site would be directly impacted by works occurring on Regent St Bridge. In order to determine if this was still exceeding in 2021 an adjusted traffic model was generated which ran the two contraflow scenarios occurring during sequential phases of the work. This allowed for testing of this site in isolation from other works occurring throughout the city which complicated conducting a full city test.

The 2018 modelling utilised data collected in 2016 and used to represent the base year model of 2015 then further extrapolated to represent 2020. During testing of the CAZ enforcement cameras, a Number Plate survey had been conducted in January 2020 which allowed for re-running the 2020 CAZ scenarios with the actual fleet.

## Covid-19

The impact of the SARs-Cov2 virus was not incorporated into the 2020 modelling work. Current trends in the city centre area of Leeds during September and October indicated that am peak period traffic reduction is averaging 30% below 2019 levels, with all day Annual Average Daily Traffic (AADT) trending 15-20% below 2019 levels. Public transport bus trips and Leeds Station footfall appear to be 70-80% below normal.

An assumption was made that a return to normal behavioural travel patterns would thus be the worst case scenario, outstripping any demand that may be placed on the transport network whilst Covid-19 is still prevalent. Sensitivity testing was run with traffic at 105% above normal in the event of increased car use with marginal impact on AQ levels.

## Appendix 4 – Diversion Report

Assessment of the outcome of the modelled contraflow scenarios on AQ compliance in 2021.

## Appendix 5 – AQ Technical Note

Report and appendices on the methodology applied to understand 2020 results, and appendices on ANPR collection and fleet change, and EFT setup.

## Appendix 6 – Highway Modelling

Report detailing method and impact of modelling the Regent St Bridge contraflow scenarios.

## Appendix 7 – Results

Spreadsheet with results for modelled target determination points for NO2 in µgm3.

# Conclusion

The January 2020 ANPR survey illustrated that the distribution of Euro classes across the vehicle fleet had upgraded at the rate expected should the Clean Air Zone have been implemented in January 2020.

90% of HGVs and Bus movements observed over a week were of Euro VI. The private hire and hackney carriage fleet now contains over 2500 hybrid vehicles, up from around 300 in February 2018. The total number of taxis registered in Leeds comes to just over 4500.

70% of observed Vans were of Euro 6 standard and 71% of Cars were of CAZ-D compliance standards (Euro 6 Diesel, Euro 4 Petrol or better).

These changes in the fleet have resulted in modelled AQ levels in the city falling below 40µgm3 at all Target Determination receptor points. As such the evidence indicates that continuing to implement the Clean Air Zone in the current format would have little further effect on improving Air Quality.

Whilst there are concerns relating to the roll-back to older vehicles now that the CAZ has been cancelled, LCC is continuing to provide support to affected sectors to upgrade, and is also providing free licensing for Leeds Licensed CAZ compliant taxi and private hire vehicles to lock in upgrade benefits, while continuing partnership working to deliver initiatives to improve AQ in the city.

First West Yorkshire are rolling out 9 new Electric buses from mid-October, with electric charging equipment installed in the Hunslet depot allowing for additional vehicles to be added to the fleet easily in the future.

In the Taxi trade, many have reported satisfaction with the new hybrid vehicles due to reduced fuel consumption and reduced maintenance costs. Leeds have further committed to supporting the private hire and hackney carriage fleet by providing over 30 rapid electric charge points across the city exclusive for taxi use, with another 30 available for all users, and a large number of slow chargers going in at additional locations.

# Appendices

Appendix 1 – Emission and Concentration Methodology Report for FBC 20181122

Appendix 2 – Technical Summary of Transport Modelling for FBC 20181122

Appendix 3 – Zip file of App. a to j to Appendix 2 Transport Modelling

Appendix 4 – AQ Technical Note – LCC CAZ 2021

Appendix 5 – Highway Modelling – LCC CAZ 2021

Appendix 6 – Diversion Route Report – LCC CAZ 2021

Appendix 7 – NO2 Results November 2020