

1 Introduction

During 2019, several options were modelled to help identify a preferred option to resolve air quality issues within the North Staffordshire area. Throughout 2020, the COVID-19 pandemic has had a significant impact on travel patterns. These impacts have included changes to work patterns, economic factors and people's preferred mode of transport. The Government's Joint Air Quality Unit (JAQU) have requested sensitivity tests to investigate how predicted post-COVID-19 transport behaviour will impact upon levels of nitrogen dioxide (NO₂) air pollution. Sensitivity testing is a key step within the analytical process and aims to quantify the impact of uncertainty in the analysis.

The Air Quality Directive states that a road is compliant when annual average NO₂ concentrations are at or below 40 µg/m³. Three road links in North Staffordshire (namely; A50 Victoria Road, A53 Etruria Road and Bucknall New Road) were predicted to exceed permitted NO₂ levels in the 2022 compliance year if no interventions were made. The existing preferred option was designed to address concentrations along these links and the modelling work to date has shown it will reduce concentrations to legal levels in 2022 whilst minimising adverse impacts. The sensitivity tests are designed to indicate what changes might occur to the compliancy of the network for a reference case scenario and to determine if the preferred option still achieves compliance across the network when the impacts of COVID-19 are considered.

The additional sensitivity tests are outlined within Section 2 and relate to:

- A one-year delay in the implementation period from 2022 to 2023 as agreed with JAQU to take account of the impacts of COVID-19, both on the local economy and the local authorities' ability to complete the business case given conflicting service pressures.
- A one-year delay to fleet renewal as users put off upgrading their vehicles.
- A best estimate of COVID-19 related impacts on travel patterns.

2 Scenarios

The following sensitivity tests were undertaken.

2.1 Test 1 - 2022 Preferred Option with delayed fleet change

This test is like the previously conducted 2022 preferred option though with the inclusion of a one-year delay to the vehicle fleet change. The fleet change delay is considered because economic constraints or concerns created by COVID-19 may delay private individuals' decisions to upgrade their existing vehicles by a year, thus resulting in a more aged and polluting fleet at 2022 than previously modelled.

Concentrations of NO₂ are decreasing over time without any local action. People replace their older vehicles with newer vehicles meeting stricter emissions standards. National modelling by the Department for Environment, Food & Rural Affairs (Defra) predicts that concentrations along major roads in North Staffordshire will reduce by approximately 1 - 2 µg/m³ per year on average as the fleet is modernised. This test delays this fleet change by applying the same fleet mix as predicted in 2021 for 2022, whilst assuming 2022 levels of traffic flows with no reduction in traffic as a result of COVID-19 impacts. This test can be regarded as an unrealistic worst-case assumption of the impacts due to it not modelling COVID-19 related reductions in flow, or assuming a delay in the implementation of local measures. It is still a valuable test as it allows the uncertainty in the existing modelling to be better studied and to determine that if such an extreme set of assumptions were to occur, would the preferred option still achieve compliance in 2022. It should be noted that JAQU have requested all local authorities with clean air plans to undertake this test for comparative purposes.

2.2 Test 2 - 2023 Reference Case with delayed fleet change

This test applies a one-year fleet change delay whilst the modelled compliance year is delayed to 2023 to reflect the impact of a one-year delay in implementation. No other COVID-19

assumptions are made. This scenario only includes committed land use and transport schemes, that is, it does not include the preferred option.

2.3 Test 3 - 2023 Reference Case with delayed fleet change plus best estimate of COVID-19 impact

This test is similar to test 2 although additionally applies the predicted impact of COVID-19. As this test models the reference case, it confirms wherever mitigation is still required post-COVID-19 to achieve compliance with the Air Quality Directive.

2.4 Test 4 - 2023 Preferred Option with delayed fleet change

This test is similar to test 1 in that it models the preferred option with a delayed fleet change, though for this test the implementation date is delayed to 2023. The test allows the suitability of the proposed mitigation measures to be tested but doesn't allow for the air quality benefits resulting from a reduced number of trips due to the impacts of COVID-19.

2.5 Test 5 - 2023 Preferred Option with delayed fleet change and best estimate of COVID-19 Impact

The final test has the same assumptions as test 4 but in addition includes a best estimate of the effects of COVID-19. The COVID-19 assumptions will reduce travel demand which are expected to reduce the level of NO₂ emissions. This test will only be required if test 4 fails with levels of exceedance predicted.

3 Method

The approach to modelling the traffic flow impact of COVID-19 on both the 2023 reference case and preferred option has been informed by the JAQU guidance, "Accounting for local COVID-19 economic impacts". This guidance recommends local authorities consider the relevant effects of COVID-19 regarding:

- Higher prevalence of home working.
- Lower use of public transport.
- Higher use of active transport.
- Fewer business trips due to suppressed economic activity.
- Lower fleet turnover due to fewer new vehicle sales.

3.1 Higher prevalence of home working

COVID-19 has directly led to a large increase in home working. This has been the result of the requirement to keep social distancing, both in the work environment and also on public transport for the commute to work. This shift has been encouraged by government lockdown restrictions and guidance, greater acceptability of home working amongst employers and a trend towards home working by employees.

Not all jobs are suitable for transferring to home working and this shift is primarily in office related roles rather than service or manufacturing jobs which are typically not suited for home working.

A pre-COVID-19 survey for the Chartered Institute of Personnel and Development (CIPD) found that 7% of people could work from home but chose not to. The Department for Transport (DfT) has forecast a medium case whereby this 7% have begun working from home during the pandemic and will continue to work from home post-COVID-19. The same assumption is assumed for both commuting and business trips.

Home working is primarily an option for office-based jobs. The tests presented here have identified zones within the transport model which largely consist of office-based employment sites such as Park Hall Business Village, Stoke-on-Trent town centre, Etruria Valley, Festival Way, Smithfield and Keele University.

With the exception of the Keele University zone, a reduction of 7% for home-to-work and business trips starting and finishing in the identified zones has been applied for all modelled time periods. For Keele University, it is estimated that 40% of employed people could work

from home. Therefore, the 7% reduction is applied to a 40% subset of commuting and business trips.

3.2 Lower use of public transport

The North Staffordshire bus passenger market contains many users who have no alternative private method of transportation due to economic or health factors. It is therefore assumed there would be no impact on bus passenger numbers. Given the impact of COVID-19 on bus operations, it is assumed there will be no investment or provision of additional bus services from that which existed pre-COVID-19 and therefore the future 2023 bus service provision should reflect what operated pre-COVID-19.

3.3 Higher use of active transport

There are no significant active transport schemes planned in addition to what is currently being promoted within the region and no schemes that could be regarded as a step change in active travel provision. Previous schemes such as Cycle Stoke have resulted in a greater number of trips made by bicycle, however these trips have not resulted in a significant mode shift from car usage. For this reason, a greater use of active transport is not expected to have any additional impact on the number of car trips in North Staffordshire.

3.4 Fewer business trips due to suppressed economic activity

As businesses are forced to temporarily or permanently close as a result of COVID-19, business related trips will reduce.

The DfT have shared information entitled “Covid and Rail Demand Forecasting – Uncertainty and its Consequences – Rail Analysis”. This includes employment and Gross Domestic Product (GDP) forecasts taken from the Centre for Economics and Business Research (Cebr). This work predicts a medium case of employment being 99% and GDP being 97% of what it would be if COVID-19 had not occurred.

The tests presented here are based on traffic growth from the DfT National Trip End Model (NTEM). The employment forecast can be adjusted to show revised growth for car trips accounting for the impact of COVID-19 on economic activity. For goods vehicles, there is a well-established trend between goods vehicle trips and GDP growth whereby they tend to mirror each other. Therefore, a reduction of 3% in growth from the base year to 2023 has been applied for both Light goods vehicle trips (LGVs) and heavy goods vehicles (HGVs) to reflect the economic impact of COVID-19.

3.5 Lower fleet turnover due to fewer new vehicle sales

The real and perceived economic impacts of COVID-19 will affect private individual’s decision making for large purchases such as the purchase or upgrade of cars. Such decisions may also be influenced by a decline in car use associated by the rise in home working and home schooling.

Where a test assumes a one-year delay to fleet change, this is achieved by the use of the Defra Emissions Factor Toolkit (EFT). This tool has been used for the existing modelling undertaken and allows an estimate of the Euro emissions ratings for the fleet to be established for a given year and for all vehicle types. To establish the emissions profile for a one-year fleet upgrade delay, the previous years modelled profile was used. Therefore, for a 2023 delayed fleet change, the EFT Euro emissions for 2022 were used.

4 Results

4.1 Sensitivity Test 1: 2022 Preferred Option with delayed fleet change

The results for test 1 are shown in Table 4-1. For the original modelling of the preferred option for 2022, there were no roads showing NO₂ exceedances. When the same modelling is repeated though with the addition of a one-year fleet delay, several exceedance locations are forecast. These locations correspond to those identified for the original 2022 reference case scenario along with four new sites.

Road	2022 Preferred Option (no COVID-19 Impacts) ($\mu\text{g}/\text{m}^3$)	2022 Preferred Option with 1-year fleet delay ($\mu\text{g}/\text{m}^3$)
A50 Victoria Road	39	41
A53 Etruria Road	39	41
Bucknall New Road	39	41
New Exceedances		
A53 Etruria Road (east of A500)	38	41
A5272 Chell Street	39	41
Quadrant Road (near Intu Potteries car park)	40	41
A5271 Longport Road	40	42

Table 4-1: 2022 Preferred Option with delayed fleet change

4.2 Sensitivity Test 2: 2023 Reference Case with delayed fleet change

This test saw an increase in non-compliant vehicle flows over almost the entire network when compared to the original 2022 reference case test. This is as expected as the new test contains an additional year of traffic growth. However, the overall traffic growth between 2022 and 2023 for North Staffordshire is only around 1%, so modest. The traffic modelling produced as part of this test was not required to be processed through the air quality model. This test was needed as a comparator with the other 2023 tests.

4.3 Sensitivity Tests 3: 2023 Reference Case with delayed fleet change plus best estimate of COVID-19 impacts

This test applies COVID-19 assumptions and also delays the implementation date to 2023. Whilst emissions are expected to increase due to the traffic growth, the COVID-19 assumptions change traffic levels and thus emissions. The net effect of the fleet change stays the same as the original 2022 reference case as the 2023 forecast year is cancelled out by the 1-year fleet delay assumption. These factors approximately balance each other out leading to very similar results compared to the original 2022 reference case results as shown in Table 4-2. This shows that post-COVID-19, mitigation will still be required in order to achieve compliance.

Road	2022 Reference Case (no COVID-19 Impacts) ($\mu\text{g}/\text{m}^3$)	2023 Reference Case with 1-year fleet delay and COVID-19 Impacts ($\mu\text{g}/\text{m}^3$)
A50 Victoria Road	46	45
A53 Etruria Road	43	43
Bucknall New Road	42	42

Table 4-2: 2023 Reference Case with delayed fleet change plus best estimate of COVID-19 impacts

4.4 Sensitivity Tests 4: 2023 Preferred Option with delayed fleet change

This test identifies whether the existing mitigations proposed as part of the preferred option are predicted to achieve compliance when a delayed fleet change is considered with a 2023

implementation year. The net effect is the additional year of traffic growth on the preferred option between 2022 and 2023. The results are shown in Table 4-3 for the three links that fail to achieve compliance in the original 2022 reference case scenario. The results show that these links still achieve compliance for the new test but with a slight increase notably on Victoria Road due to the one year of modest traffic growth. This indicates that the traffic growth only has a very marginal adverse impact on the exceedance locations and any increase in emissions incurred as a result of a delayed fleet change will be cancelled out by a delay in implementation resulting in the preferred option still achieving compliance. No other exceedances were reported.

Road	2022 Preferred Option (no COVID-19 Impacts) ($\mu\text{g}/\text{m}^3$)	2023 Preferred Option with 1-year fleet delay ($\mu\text{g}/\text{m}^3$)
A50 Victoria Road	39	40 (39.5)
A53 Etruria Road	39	39
Bucknall New Road	39	39

Table 4-3: 2023 Preferred Option with delayed fleet change

4.5 Sensitivity Tests 5: 2023 Preferred Option with delayed fleet change and best estimate COVID-19 impact

Applying the COVID-19 assumptions has been shown in test 3 to marginally reduce traffic flows and so improve air quality. Test 5 was not required to be carried out as test 4 already showed compliance with the Air Quality Directive through the mitigation measures included with the preferred option. Compliance was achieved without requiring the marginal traffic flow reductions that the COVID-19 assumptions would have created within this test.

5 Conclusion

The additional sensitivity tests presented here demonstrate that COVID-19 can have a small impact on air quality. This impact may increase the proportion of emissions through a delayed fleet update to more modern vehicles. It may also reduce emissions through modified patterns of vehicle usage driven by economic factors and the decisions of individuals. The negative impact of COVID-19 on air quality due to fleet delay is compensated for by a reduction in traffic due to home working, a predicted slowing of economic growth and an additional year to achieve compliance. This results in an approximate net zero impact within the air quality model for the preferred option. The additional sensitivity tests show that whilst there is a slight increase in NO_2 levels from pre-COVID-19 modelling, the preferred option is still predicted to achieve compliance across the network for 2023. The results of the additional testing are shown to be compatible with the existing modelling and demonstrate that whilst mitigation measures are still required to achieve compliance with the Air Quality Directive, the preferred option is still an effective and proportionate solution.