

OBC Supplement – Technical Note

Reducing the Risks of Non-Compliance of Our Preferred Option

1. Introduction

This Technical Note describes the modelling and analysis undertaken between the submission of our OBC Clarification Note (on the 21 June 2019) and the end of August 2019.

In particular it describes the results of further refined tests of our CAZ C+ Preferred Option, particularly in relation to modelled traffic emissions in the vicinity of the St Mary's Road (east) air quality 'hot-spot (on Sheffield's Inner Ring Road), and describes a set of additional sensitivity tests requested by JAQU, involving a combination of taxi fleet and car fleet-related sensitivity test assumptions.

Appendix A provides additional clarification of the relevant taxi fleet upgrade assumptions used in the three new tests.

2. Background

The main OBC for Sheffield & Rotherham's Clean Air Strategy was submitted on 21 December 2018. This included a Preferred Option based on a 'CAZ C+' scheme covering Sheffield's Inner Ring Road (A61 & Hanover Way) and the streets inside this cordon, plus a number of other supporting fleet improvements, local road schemes, marketing campaigns and policy-based measures. The vehicles required to pay a daily charge for entering the CAZ area included the standard 'Class C' vehicles, with the requirement for taxis strengthened to allow only LPG, petrol-hybrid or pure electric taxis to enter the CAZ area free of charge.

Following this submission, JAQU suggested/requested a number of changes to the main modelling assumptions included in this Preferred Option, including:

- an extension of the fleet upgrade response to the trips travelling through the CAZ in the baseline scenario (and which therefore had the option to re-route), with this upgrade assumed to be at 50% of the level assumed for trips travelling to/from zones within the CAZ (which did not have the rerouting option); and
- more-detailed representation of the impact of the significant decrease in the %diesel in new car sales within the emissions modelling.

The results of these changes and a number of 'breaking point' sensitivity tests were reported on the 21 June 2019.

One of the side-effects of these changes was to increase emissions on a number of routes used predominantly by 'through traffic', including Sheffield's Inner Ring Road, where the increase in the number of compliant vehicles able to use these routes free of charge more than offset the benefits from the cleaner 'through trips', particularly for LGVs, where the difference in NO_x emissions between EURO VI diesel and the earlier standards is relatively small.

As a result, the safety margin between 'compliance' and 'non-compliance' for the Preferred Option decreased.

3. The Changes Made to the Road Network

Detailed investigation of the predicted 2021 NO_x emissions in the St Mary's Road (east), Suffolk Road and Granville Square area around the Inner Ring Road (IRR) identified a number of improvements to signal settings and lane configurations at the key junctions in this area. This included some changes associated with a mismatch between the model and the current on-the-ground signal settings, due to recent changes implemented by SCC's traffic management team, to regulate the traffic flow joining the IRR at this location.

In addition, it was found that diverting the frequent 51 bus service away from a section of the St Mary's Road to the east of the Bramall Lane Roundabout would help maintain compliance at a potential AQ hot-spot on this link.

Both of the above changes have been included in a further revised test of the Preferred Option CAZ C+ referred to as Test A_0.

The full optimisation of the signals around the IRR, using dynamic signal settings to minimise emissions at the key hot-spots right round the IRR forms part of the proposed package of supporting measures for our Preferred Option (as described in the December 2018 submission). Subject to FBC approval, this signal optimisation would be delivered as part of the implementation of the CAZ scheme, if the results of the detailed traffic signal design confirm that it would help deliver compliance. This signal optimisation would take account of the predicted post-CAZ implementation traffic conditions on the IRR.

This signal optimisation provides a further measure to secure additional reductions in NO₂, as we would expect that this has the potential to deliver up to a 10% reduction in emissions from traffic using the IRR in 2021, relative to the fixed cycle timings currently 'on-the-ground' and assumed in the SRTM3B traffic model.

Detailed microsimulation modelling (using a more-detailed AIMSUN model of the IRR) between now and the submission of the FBC will confirm the amount of emission reduction which this signal optimisation can deliver.

4. Hearts and Minds and Taxi Upgrade Sensitivity Tests

Our Preferred Option includes a 4% move away from diesel private car purchase at the point drivers renew their vehicles. This is associated with a proposed Hearts and Minds campaign.

In a previous Technical Note¹, we have shown that there is already an ongoing downward trend in the %diesel in new car sales in the UK² (including a 22% decrease between July 2018 and July 2019). This trend is shown to continue and will deliver a 2% reduction in the %diesel in the car fleet in

¹ Supporting Document OBC_SD18

² <https://www.smmmt.co.uk/vehicle-data/car-registrations/>

central Sheffield by mid-2021. Our 'Business as Usual' Base-line emissions model, as agreed with JAQU assumes no reduction in the %diesel in new car sales after mid-2018.

This means that 2% of the predicted H&M change is already happening and the further 2% builds on this existing / evidenced trend and is assumed to be delivered as a result of 'Hearts and Minds' behavioural change among the Sheffield car-buying public

In addition to the revised CAZ C+ Preferred Option **Test A_0** JAQU have requested two further sensitivity tests around the '4% Hearts and Minds' assumption and that these are tested in conjunction with a further assumption that lower levels of taxi upgrades occur when compared to the preferred option.

These 2 tests are:

Test B

- '2% H&M test', modelled as a car fleet mid-way between the 0% and 4% H&M scenarios, which effectively assumes that the recent steep decline in the %diesel in new car sales will quickly 'flat-line' and continue at the current (July 2019) level between August 2019 and mid-2021; with
- taxi upgrades only in line with the Local Behavioural Research response.

Test C

- '0% H&M' test which assumes that the 2021 car fleet is as per the current Baseline assumption (which in practice would require the %diesel in new car sales to 'rebound' significantly, to remove the reductions in diesel cars already accrued between 2018 and 2019); along with
- taxi upgrades only in line with the Local Behavioural Research response to a charging zone.

5. Test Definitions

Three new 2021 scenarios, derived from the 21 June version of the Preferred Option, have been modelled through the traffic/emissions/air quality suite of models used throughout the OBC appraisal process, as follows:

Test A_0 - A new version of our CAZ 3C⁺-based Preferred Option which assumes:

- localised improvements to the current 'fixed-cycle' signal settings and the representation of the current junction lay-outs etc in St Mary's Road (east), Suffolk Road and Granville Square area, as described in Section 3 above;
- the 51 bus rerouted to avoid the St Mary's Road section of its current route;
- all fleet upgrade assumptions remain unchanged from previous PO tests; and
- a 4% 'H&M' decrease in the %diesel in the 2021 car fleet (relative to the current baseline).

Test B_0 - A sensitivity test built from Test A_0, but with:

- taxi fleets only upgrading in line with the local behavioural research responses to the Charging Zone; and
- just 2% H&M effects

Test C_0 - a sensitivity test built from Test A_0, but with:

- taxi fleets only upgrading in line with the local behavioural research responses to the Charging Zone and
- 0% H&M effects

The air quality results for these three tests are summarised below

6. Air Quality Results for the Three Tests

The table below reports the predicted annual average NO₂ levels at the various locations which we need to get below the '40 µg/m³ limit value in the shortest possible time and which we predict will exceed this value in 2021 in the current (June 2019) Business as Usual Base-line.

Table 1 Predicted Annual Average NO₂ Levels in 2021 for the Various Tests

				NR 1440	NR 1447	NR1471	NR1473	NR1472
Census ID	X	Y		Current (June 2019) Baseline	Current Preferred Option (with 50% TTFE)	Test A_0	Test B_0	Test C_0
75195	435810	386626	Suffolk Road	53.38	40.27	38.72	40.16	40.45
75196	435753	386520	St Mary's Road	53.06	40.46	39.63	40.72	40.98
8758	435742	386706	Suffolk Road	52.13	39.82	38.52	39.74	40.05
8744	435362	386383	St Mary's Road	51.56	39.93	39.76	40.43	40.75
81236	435658	388179	Derek Dooley Way	50.28	39.75	39.58	41.38	41.78
75194	435548	386632	Shoreham Street	50.10	39.09	38.62	39.62	39.90
81237	435810	388040	Derek Dooley Way	50.06	39.05	38.79	40.88	41.25
81162	435402	388018	Shalesmoor	49.66	39.65	39.39	40.44	40.80
57861	435003	386381	St Mary's Gate	49.51	39.16	39.11	40.24	40.67
60030	435809	387001	Sheaf Street	49.01	37.19	35.94	36.54	36.86
48805	435531	386560	Shoreham Street	48.69	37.95	37.70	38.41	38.75
76045	436210	387645	Sheffield Parkway	48.23	38.74	38.15	39.42	39.77
75197	435573	386464	St Mary's Road	48.10	37.44	37.16	37.78	38.04
37898	435809	386349	Hawke Street	48.08	37.34	36.90	37.52	37.89
75199	435592	386538	Matilda Street	47.57	37.04	36.57	37.58	37.82
47855	437766	387454	Sheffield Parkway	46.95	39.43	39.28	39.98	40.36
76044	435936	388031	Wicker	46.08	37.04	36.79	37.78	38.03
n/a	435601	387255	C710 Arundel Gate	45.47	35.49	32.18	35.26	35.45
76046	436246	387844	Derek Dooley Way	44.92	36.14	35.83	38.08	38.48
17809	434808	388215	Hoyle Street	44.90	35.95	34.77	35.17	35.44
56608	435009	388014	Moorfields	44.41	35.64	35.17	35.49	35.83
75198	435737	386648	Fornham Street	42.76	34.23	33.56	34.52	34.66
37441	439717	390829	Attercliffe Common	41.30	38.99		39.33	39.62
38549	438601	389692	Attercliffe Common	40.03	37.68		38.18	38.39

7. Conclusions

These results suggest the following conclusions:

- Test_A0 (which is likely to form the basis of SCC/RMBC's new 'Preferred Option') is predicted to comfortably achieve compliance at all of the required locations by 2021;
- Test_B0, which combines very conservative 'Worst Case' assumptions regarding upgrades to the Sheffield taxi fleet and the %diesel in the central Sheffield car fleet) and no optimisation of the IRR signals is predicted to fail to achieve compliance at three locations, with location 81236 on Derek Dooley Way (on the IRR), predicted to be significantly above the required threshold; and
- the (unrealistic) Test_C_0 scenario (which assumes a significant rebound in %diesel in new car sales from the July 2019 levels) is predicted to fail to achieve compliance at six locations, with the highest level (close to 42 $\mu\text{g}/\text{m}^3$) again predicted to occur at location 81236 on Derek Dooley Way, suggesting that compliance with the required AQ standard would not be achieved until 2022³ under this scenario.

The above confirms that with the additional mitigation (signal timings at certain points of the IRR and bus route change) the Preferred Option of a CAZ C+ is now shown to achieve compliance at all locations below 40 mg/m^3 in 2021.

³ AQ Trend Analysis reported elsewhere suggests that SCC's NO₂ concentrations are currently falling by around 2.4 $\mu\text{g}/\text{m}^3$ per year

Appendix A Taxi Upgrade Assumptions for the Three Tests

Local Behavioural Research Responses to a £10/day Charge			
	PtP%	U%	
	Pay to Pollute	Upgrade	Go Away
Black Cabs	16.3%	60.47%	23.3%
PHVs	4.8%	69.0%	26.2%
These proportions are calculated by adding together the proportions for the relevant responses in the Local Behavioural Research Responses to a £10/day charge			
Black Cabs	X%	$X\% + (1-X\%) * U\%$	$X\% + (1-X\%) * (1-PtP\%)$
Test	%Upgrade due to taxi policy	% of fleet to be upgraded	% of Kms driven by clean taxis
A	60.0%	84.2%	93.5%
B	0.0%	60.5%	83.7%
C	0.0%	60.5%	83.7%
The X% column are input assumptions for each test			
The %fleet upgrade is the X% value plus the upgrade proportion applied to the remainder			
All of the taxi kms are provided by upgraded vehicles, apart from the set which are provided by the taxis which do not get upgraded due to taxi policy and choose the 'Pay to Pollute' option.			
PHVs			
PHVs	X%	$X\% + (1-X\%) * U\%$	$X\% + (1-X\%) * (1-PtP\%)$
Test	%Upgrade due to taxi policy	% of fleet to be upgraded	% of Kms driven by clean taxis
A	60.0%	87.6%	98.1%
B	0.0%	69.0%	95.2%
C	0.0%	69.0%	95.2%
The comments below the Black Cab table also apply here			

The taxi policy-related measures which SCC and RMBC propose to introduce to support the upgrade of their two taxi fleets were summarised in a submission on 5 August 2019⁴. In the interests of brevity, these measures are not repeated here.

⁴ See OBC Supporting Documents SD 19 to SD 23 on Huddle for details

APPROVAL					
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