THIRD WAVE LOCAL AUTHORITIES – TARGETED FEASIBILITY STUDY TO DELIVER NITROGEN DIOXIDE CONCENTRATION COMPLIANCE IN THE SHORTEST POSSIBLE TIME

Local authorities covered	Bradford Metropolitan District Council

Further information on the content of each section is set out in the guidance.

Part 1: Understanding the problem

This section should set out background on the information about the road links projected to have exceedances in the PCM national model, in combination with source apportionment data, to provide a description of the severity of the NO_2 exceedance and its possible sources and causes. It should set out the scale of the problem and the case for change. Maps and local data should be included. ***Each road link should be addressed in turn.***

Bradford Metropolitan District Council, like many areas across the UK, continues to experience areas of poor air quality. The Council has been highlighted by Defra as one of a number of Local Authorities where the UK's national air quality assessment has identified road links that are currently exceeding the annual mean nitrogen dioxide (NO_2) limit value, with exceedances predicted to continue in 2019 and in some cases beyond.

The Council, along with 32 other Local Authorities, received a Ministerial Direction on the 23rd March 2018 to undertake a feasibility study into nitrogen dioxide compliance. This is the 'third wave' of Local Authorities charged with undertaking such a study. Previously 5 Local Authorities (the so called 'first wave') were directed to undertake a feasibility study, these were followed by a second wave of 23 Local Authorities directed to undertake a local study in 2017.

The UK's national air quality plan has identified 3 links on the A650 (bordering the east of the city centre) and 2 links of the A6177 ring road (between the junction with Wakefield Road and Junction 3 of the M606) as in exceedance of the annual mean NO_2 Air Quality Directive Limit value. A map of the road links highlighted as in exceedance within the UK's national air quality assessment is shown in Figure 1.

These road links are predicted to demonstrate compliance in 2021 (Table 1). In order to achieve compliance in 2020 the concentrations on link with census ID 74525 need to reduce by at least 1 $\mu g/m^3$. To demonstrate compliance in 2019 the concentrations on the links need to reduce by between 1 and 3 $\mu g/m^3$ depending on the link, while to meet the objective in 2018 the concentrations need to reduce between 2 and 5 $\mu g/m^3$. The largest reductions are needed on links 74525 and 74397. The adjacent road links will be discussed together therefore two discussions are provided below, one for the A650 (links with census ID 28710, 8580 and 74525) and one for the A6177 ring road (links with census ID17705 and 74397).

Figure 1: Map of Bradford Metropolitan District Council showing the non-compliant links for NO_2 that are the focus of this feasibility study.

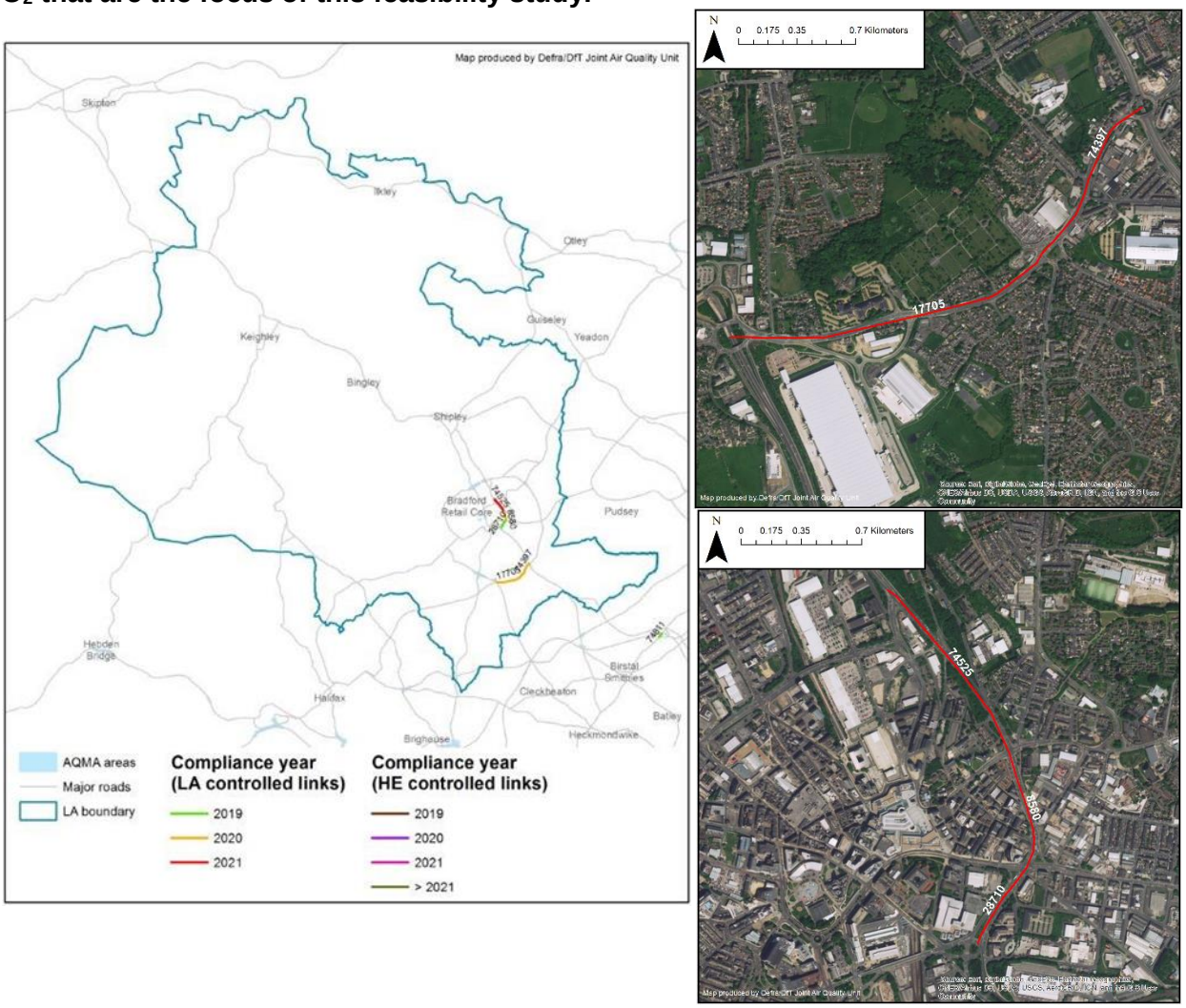


Table 1: Predicted concentrations of NO_2 on the A650 and A6188 road links for 2017 – 2021 (Defra national PCM modelling). Cells highlighted in red exceed the NO_2 limit value, while green cells show the road links are compliant. This modelling indicates links in Bradford Metropolitan District Council demonstrate compliance in 2021.

Census ID of road link	2017	2018	2019	2020	2021
74525	47	45	43	41	39
8580	44	42	41	39	36
28710	43	42	40	38	36
17705	45	43	41	39	36
74397	47	44	42	40	38

A650 (links 28710, 8580 and 74525)

The Department for Transport have three traffic count locations along the non-compliant links of the A650. Census ID 28710 (road length 0.3 km) is located between the A650 junctions with Croft Street and Leeds Road; Census ID 8580 (road length 0.5 km) is located between the A650 junctions with Leeds Road and Barkerend Road; and Census ID 74525 (road length 0.7 km) is located between the A650 junctions with Barkerend Road and Canal Road (Figure 2).

Figure 2: Location of DfT traffic count points along the non-compliant A650.

Map data copyrighted OpenStreetMap contributors and available from https://www.openstreetmap.org

The following traffic counts were made at the locations shown in Figure 2 between 2012 and 2016 (Table 2). It should be noted that the Defra national modelling uses 2015 as its baseline and uses projections of traffic for future years assuming national growth factors (for 2015 to 2016 the growth factors were in the region of 2 %). Traffic counts for Census ID 8580 show a reduction in traffic between 2015 and 2016 by ~1 %. Census ID 28710 showed slight increases in traffic between 2015 and 2016 that slightly exceeded the projected growth factors (~3 %). Traffic counts on Census ID 74525 increased by 11 % between 2015 and 2016, therefore it would be expected that local air quality modelling may show a higher than predicted annual average NO_2 concentration for 2016 than that suggested by Defra's current national modelling.

Table 2: Traffic counts at DfT sites along the A650 road links of interest for 2012 – 2016

28710					
Year	**Total traffic**	**Cars**	**LGV**	**HGV**	**Bus**
2012	54526	45393	6927	1713	172
2013	52641	43702	6558	1846	208
2014	51992	43044	6008	2409	240
2015	52918	43981	6696	1703	173
2016	54680	45205	7038	1902	169
8580					
Year	**Total traffic**	**Cars**	**LGV**	**HGV**	**Bus**
2012	49460	40884	6096	1964	191
2013	49263	40653	6165	1939	180
2014	55162	45850	6484	2286	217
2015	54643	45009	6820	2268	215
2016	53878	44409	7074	1948	125

74525					
Year	**Total traffic**	**Cars**	**LGV**	**HGV**	**Bus**
2012	48269	39987	6102	1792	120
2013	49977	40995	6918	1625	144
2014	50648	40570	7878	1734	153
2015	49016	40987	5566	1964	97
2016	54748	44967	7254	2126	116

Due to time constraints it was not possible to undertake local counts and consequently calculate local source apportionment, therefore the source apportionment for the non-compliant links was taken from the Defra PCM model (Table 3).

Diesel cars contribute the largest proportion of total NO_x on the A650, followed by diesel LGV's. Links 8580 and 74525 also have a large proportion of emissions from HGVs (19-20 % of NO_x concentrations from rigid and artic HGV's in combination). The A650 is a key road link moving traffic through Bradford in a north-south direction and providing access to the city-centre.

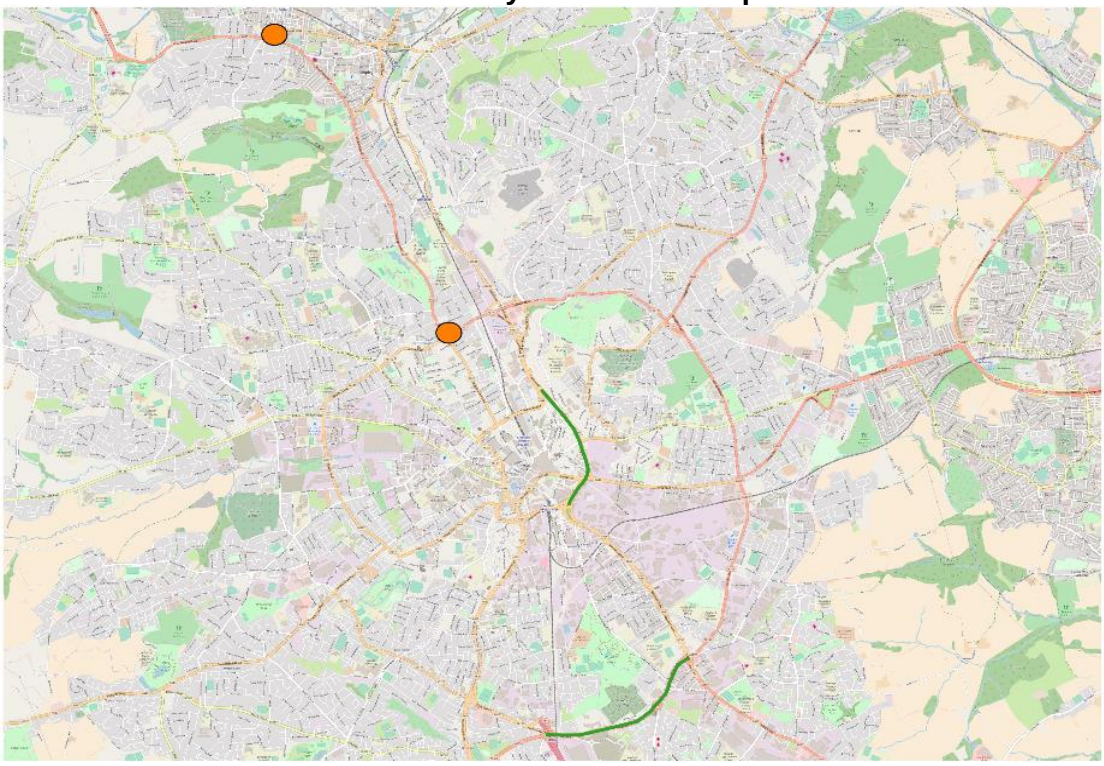
Additionally, there are a number of businesses located along the A650, including Forster Square Retail Park, The Broadway Bradford (opened in 2015) and Bradford Leisure Exchange. The largest proportion of emissions is from cars (32 – 36 % of NO_x concentrations) suggesting that these links are used for personal journeys including commuting to work or leisure activities/shops. The road links also appear to be a main distribution route for goods vehicles. Links 74525 and 8580 are located on a gradual slope with the brow of the hill located between these two links.

Table 3: Source apportionment for total NO_x (%) from Defra PCM model for non-compliant links on the A650

Census ID	Regional Back Ground BG	Urban BG (non-traffic)	Urban BG (traffic)	Diesel Cars	Petrol Cars	Diesel LGV	Petrol LGV	rHGV	aHGV	Bus
28710	6	15	16	26	6	15	0	8	6	2
8580	5	11	11	28	6	16	0	14	6	3
74525	5	10	14	29	7	14	0	13	6	1

Bradford Metropolitan District Council have also undertaken some independent traffic counts in the area surrounding the road links of interest on the A650 (Figure 3). The proportion of each vehicle type of the total counted traffic in those counts is similar to those measured by the DfT (Table 4).

Figure 3: Location of traffic counts made by Bradford Metropolitan District Council in 2017.



Map data copyrighted OpenStreetMap contributors and available from https://www.openstreetmap.org

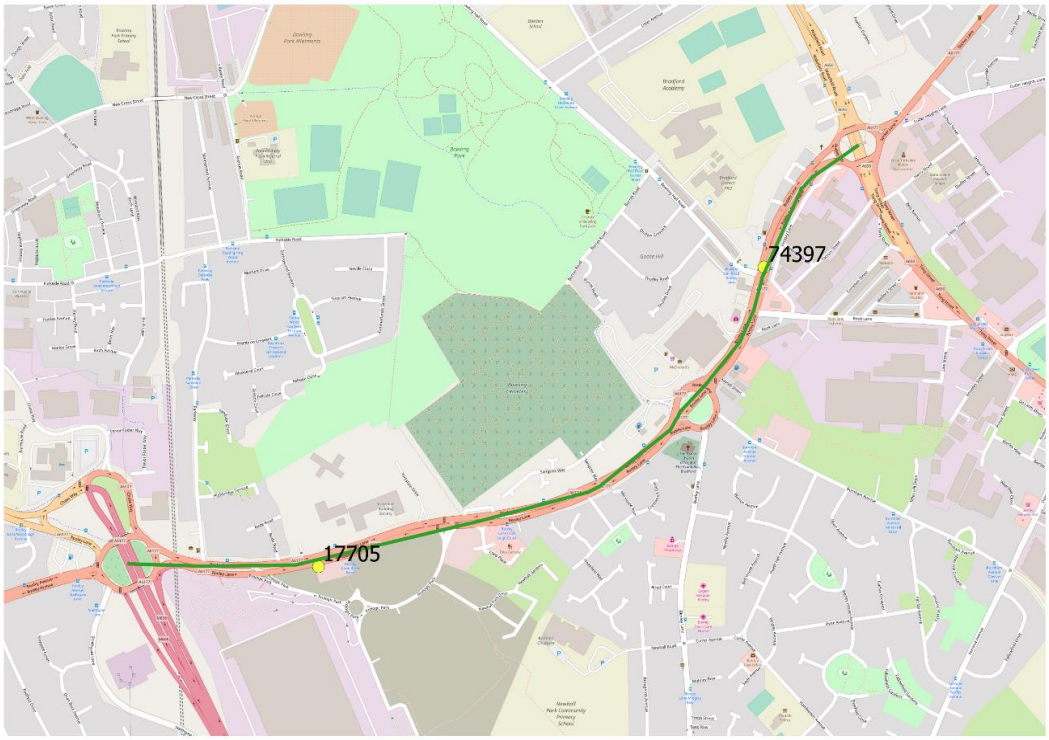
Table 4: Traffic counts made by Bradford Metropolitan District Council (2017, Period: 0700 – 1900).

Location	Total traffic	Cars	LGV	HGV	Bus
Saltaire Road/Bingley Road	31085	25190	3522	1974	399
Manningham Lane/Queens Road	30834	26851	2560	932	491

A6177 ring road (links 17705 and 74397)

The locations of the counts made by the DfT along the A6177 are shown in Figure 4 below. Census ID 17705 (road length 1.5 km) is located between the M606 roundabout and Bierley Lane roundabout; and Census ID 74397 (road length 0.4 km) is located between the Bierley Lane Roundabout and the A650 Roundabout.

Figure 4: Location of DfT traffic count points along the non-compliant A6177.



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The DfT traffic counts made at the two sites are provided in Table 5. Traffic counts for Census ID 17705 show a 1 % reduction in total traffic between 2015 and 2016 which could lead to the current Defra regional model predicting higher concentrations than a local model. Census ID 74397 shows a 3 % increase in total traffic which is slightly larger than the 2 % national growth factor used for the regional model, meaning the local air quality model may also show a higher than predicted annual average NO_2 concentration for 2016 than that suggested by Defra's current national modelling.

Table 5: Traffic counts at DfT sites along the A6177 road links of interest for 2012 – 2016

17705					
Year	**Total traffic**	**Cars**	**LGV**	**HGV**	**Bus**
2012	48056	38689	6237	2670	229
2013	46416	37745	5714	2616	222
2014	47001	37354	6507	2779	235
2015	51269	41650	6351	2805	226
2016	50709	40698	6824	2726	226
74397					
Year	**Total traffic**	**Cars**	**LGV**	**HGV**	**Bus**
2012	48871	39741	6448	2135	297
2013	48680	39516	6522	2112	280
2014	49059	39205	6213	3144	300
2015	48660	38485	6536	3141	298
2016	50205	40384	6705	2663	266

The source apportionment for the non-compliant links for the A6177 from the PCM model are shown in Table 6. Cars are the largest contributor to total NO_x concentrations on the non-compliant A6177 links (average contribution 25 % diesel and 5.5 % petrol), followed by HGVs

(average contribution 14.5 % rHGV and 11 % aHGV). The road links being investigated on the A6177 are directly accessible from the M606 which can be used to access the M62 and the national motorway network. The large proportion of cars suggest these links are used for personal journeys such as commuting or leisure activities. There is also a large superstore located alongside these links which could be a frequent journey destination. The high proportion of total NO_x from HGV's suggest this route is also a major route in the movement of goods into and out of the city.

Table 6: Source apportionment for total NO_x (%) from Defra PCM model for non-compliant links on the A6177

Census ID	Regional BG	Urban BG (non-traffic)	Urban BG (traffic)	Diesel Cars	Petrol Cars	Diesel LGV	Petrol LGV	rHGV	aHGV	Bus
17705	5	9	12	26	6	15	0	13	11	3
74397	5	9	11	24	5	15	0	16	11	3

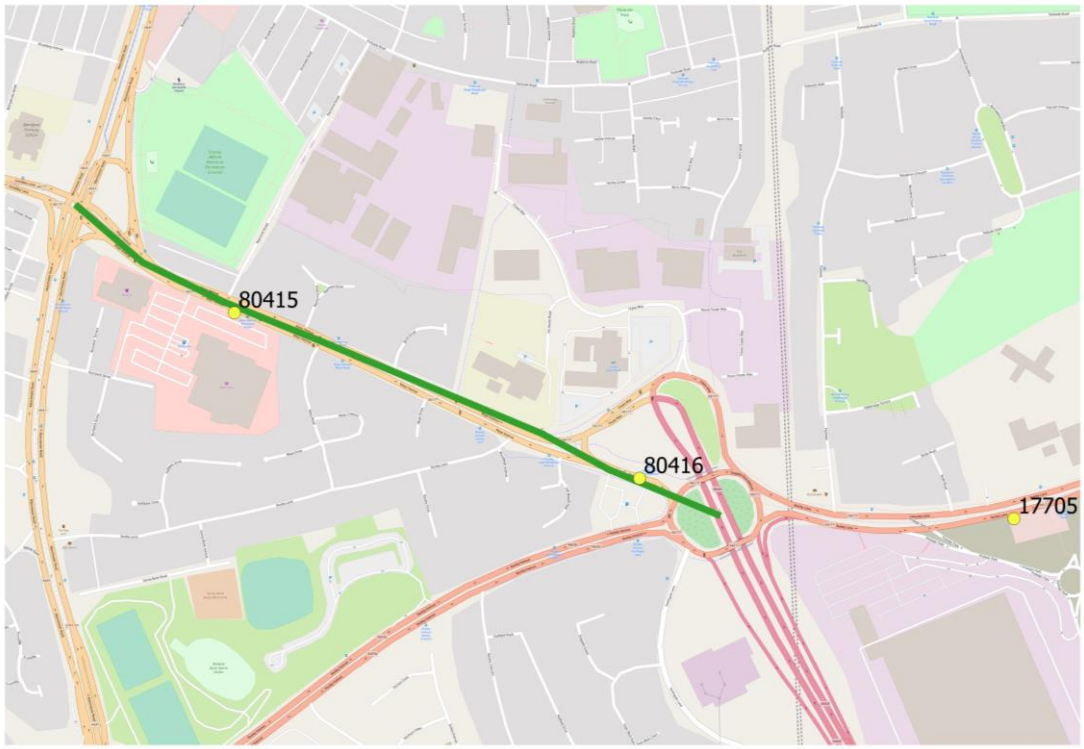
Additional road links to include in the NO_2 feasibility study – Mayo Avenue

A new AURN station was installed in Mayo Avenue in July 2015 which measured an annual average NO_2 concentration of 46 µg/m^3 in 2016. The national model did not identify the links on this road as being in exceedance of the air quality standard (Table 7, Figure 5). However, this site is a relevant receptor for Air Quality Directive purposes, located next to residential properties and in a pre-existing Air Quality Management Area therefore it has been included in the Feasibility study.

Table 7: Predicted concentrations of NO_2 on the A6188 Mayo Avenue road links for 2017 – 2021 (Defra national PCM model). Cells highlighted in red exceed the NO_2 limit value, while green cells show the road links are compliant.

Census ID of road link	2017	2018	2019	2020	2021
80415	40	38	36	35	33
80417	31	30	29	27	26
80416	31	30	29	27	26

Figure 5: Location of additional links on Mayo Avenue that will be include in the Feasibility study.



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The counts made by DfT on Mayo Avenue are shown in Table 8. Census ID 80415 showed a reduction in total traffic of 1 % between 2015 and 2016, while Census ID 80416 showed an increase in traffic by 3 % for the same year.

Table 8: Traffic counts at DfT sites along the A6177 Mayo Avenue road links of interest for 2012 – 2016

80415					
Year	**Total traffic**	**Cars**	**LGV**	**HGV**	**Bus**
2012	31202	25151	4494	1267	185
2013	31086	25008	4546	1253	174
2014	31553	24749	5176	1332	185
2015	34085	27395	4782	1690	139
2016	33758	26769	5138	1633	139
80416					
Year	**Total traffic**	**Cars**	**LGV**	**HGV**	**Bus**
2012	14368	11055	2397	747	134
2013	14639	11571	2241	543	94
2014	15084	11885	2396	530	90
2015	15406	12120	2513	515	97
2016	15896	12409	2699	538	97

The source apportionment from the PCM model (2015) for these links are shown in Table 9. Cars are the largest contributor to total NO_x concentrations on the Mayo Avenue Census ID80415 (24 % diesel and 6 % petrol), followed by HGVs (13 % rHGV and 8 % aHGV). The road links being investigated on the A6177 are also directly accessible from the M606. The large proportion of cars suggest these links are used for personal journeys such as commuting or leisure activities. There

is also a further large superstore and retail outlet located alongside these links which could be a frequent journey destination. The high proportion of total NO_x from HGV's suggest this route is also a major route in the movement of goods into and out of the city.

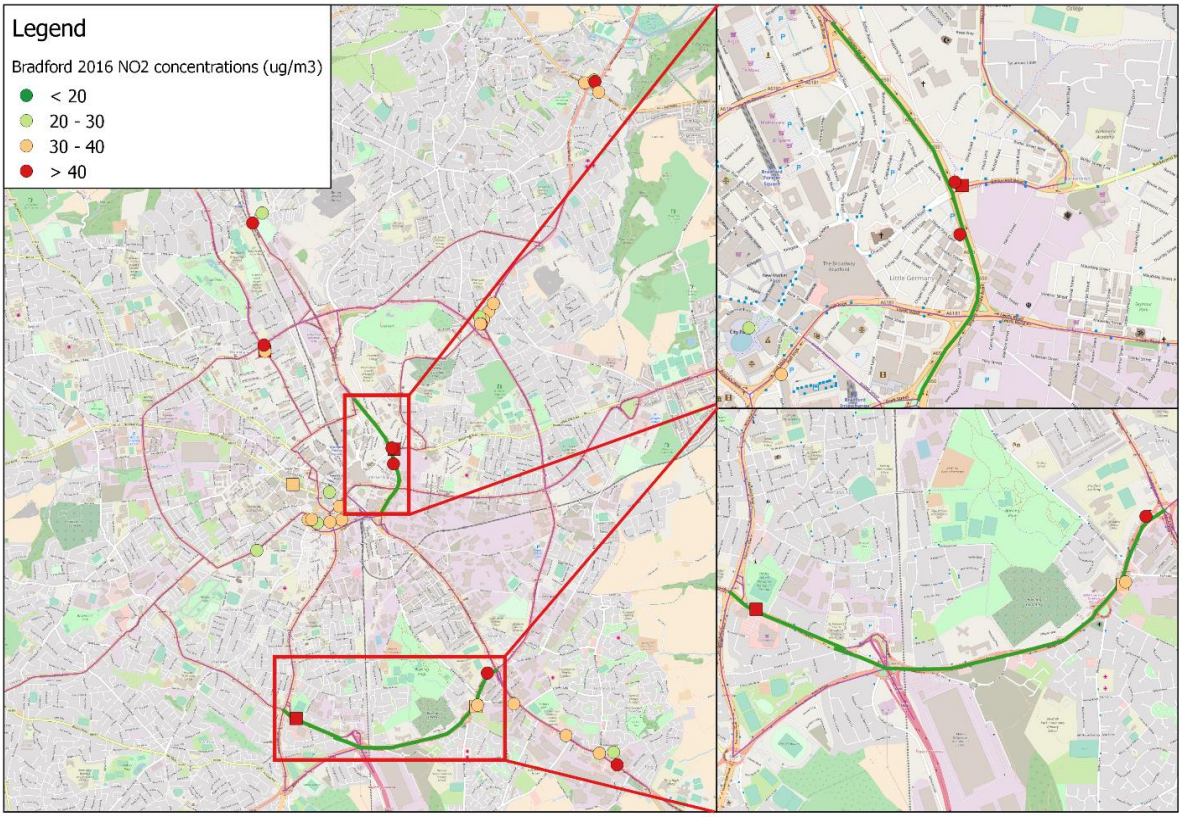
Table 9: Source apportionment for total NO_x (%) from Defra PCM model for non-compliant links on the A6177

Census ID	Regional BG	Urban BG (non-traffic)	Urban BG (traffic)	Diesel Cars	Petrol Cars	Diesel LGV	Petrol LGV	rHGV	aHGV	Bus
80415	6	13	14	24	6	16	0	13	8	3
80416	6	13	14	14	3	11	0	5	3	2

Air quality measurements in Bradford

Bradford Metropolitan District Council deploy 42 passive diffusion tubes and have 7 automatic monitors measuring NO_2 concentrations across the district (Figure 6). The non-compliant road links on the A650 have 3 measurement sites adjacent to the road, with an average concentration measured in 2016 of 60 µg/m^3 [52, 58 and 69 µg/m^3 for the three sites], an automatic analyser station located at Shipley Airedale Road measured an average concentration in 2016 of 52 µg/m^3. There are also three sites on the non-compliant road links on the A6177, which measured an average concentration of 39 µg/m^3 in 2016 [44, 38 and 36 µg/m^3 NO_2 measured at each site]. An automatic analyser station is located on Mayo Avenue which measured an annual average concentration of 46 µg/m^3 in 2016.

Figure 6: Map showing Bradford Metropolitan District Council NO_2 monitoring locations (squares denote automatic monitoring sites, while circles denote passive measurement locations). Concentrations shown are for 2016. The inset maps show the measurements alongside the non-compliant links on the A650 and A6177.



Low Emissions Strategy

Bradford Metropolitan District Council published a Low Emissions Strategy in 2013 to support measures in the Local Transport Plan and seek to reduce emissions. This includes promotion of sustainable transport, improved cycling infrastructure, planning and development control and included funds for a feasibility study investigating the potential for a Low Emissions Zone (LEZ) in the city.

The scenarios included in the LEZ feasibility study focused on the impacts on future concentrations if buses, LGVs and/or HGVs were retrofitted to lower emission vehicles, and reduced numbers of cars as a result of a shift in transport to more sustainable means. The most cost-effective options identified in this study were enforcement of buses to a Euro VI standard on/and within the Outer Ring road.

It should be noted that the LEZ study data indicated that Bradford generally has an older vehicle fleet profile than the national figures may suggest, resulting in the possibility that the forward projections for air quality improvement may not be realised.

Measures that could impact modelled concentrations (introduced after 2015)

Bradford Metropolitan District Council carried out a Low Emissions Zone Feasibility study in 2012. As part of this study, ANPR traffic counts were carried out in the city to establish an accurate estimate of the fleet composition, and showed that the fleet composition in Bradford was older than that used in the national model. This could lead to higher modelled concentrations from the local model compared to the national model.

	NAEI fleet composition 2012 (%)				ANPR Bradford fleet composition (%)			
	Car (petrol, diesel)	Bus	LGV (petrol, diesel)	HGV (rigid, artic)	Car (petrol, diesel)	Bus	LGV (petrol, diesel)	HGV (rigid, artic)
Pre Euro 1	0.1, 0	0.4	1.1, 0.1	0, 0	0.9, 0.1	0	19.1, 0.2	0.2, 0
Euro 1	1.3, 0.5	1.2	3.6, 0.3	0, 0	1.5, 0.3	2.2	10.6, 1.1	1.2, 0
Euro 2	8.9, 2.5	10.7	27.2, 3.5	5.9, 0.9	12.0, 2.5	20.0	16.6, 3.8	2.0, 4.6
Euro 3	35.1, 23.8	34.8	32.4, 16.9	29.9, 14.4	43.3, 23.6	27.2	36.4, 27.0	22.2, 21.3
Euro 4	34.2, 40.8	18.6	30.0, 53.6	23.1, 19.9	31.2, 48.9	36.4	14.1, 44.5	32.8, 38.5
Euro 5	19.7, 32.4	34	5.8, 25.6	41.1, 64.8	11.1, 24.6	10.9	3.2, 23.3	41.6, 35.6
Euro 6	0, 0	0	0, 0	0, 0	0, 0	0	0, 0	0, 0

An area action plan is in place (introduced in December 2017) in the north of the non-compliant links on the A650. The area is set to undergo extensive development including the building of 3100 homes, businesses and retail facilities, all of which could impact future air quality. However, these new developments will be delivered with air quality mitigation strategies in place to minimise the impacts.
Other existing changes to the infrastructure in Bradford since 2015 which could have led to improvements in air quality on the road links in question are listed below:

- Retrofit of 26 Euro III commercial buses and 165 Euro III school buses with particle traps and selective catalytic reduction in 2016.
- Cycle super-highway between Bradford and Leeds opened in July 2016, promoting

sustainable transport.

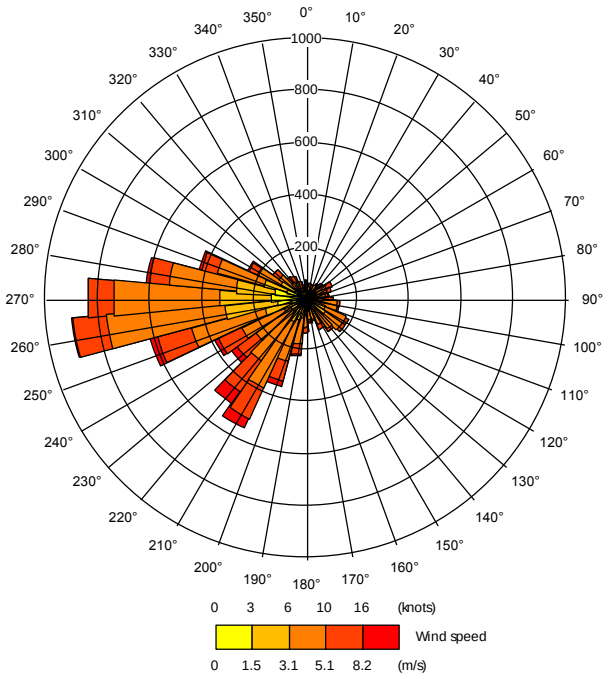
- 5000 electric vehicle recharging plugs secured on new developments since 2016.

Dispersion modelling

Dispersion model details

ADMS-Roads version 4.0.1 was used, with meteorological data collected during 2017 at Bingley, to model the target roads (Figure 7). Further information on meteorological parameters is available on request.

Figure 7: Wind rose plot of meteorological data used in dispersion model.



A number of diffusion tubes deployed by Bradford Metropolitan District Council have identified local exceedances (Figure 8). The study area has been increased to include road links adjacent to the tubes monitoring exceedances.

Defra's modelled 2017 NO_x background concentrations with a 2015 base year were used. The primary road contribution was removed to prevent double counting main roads included in the dispersion model.

Gridded outputs from ADMS were created using source-orientated gridding system, meaning a greater density of points were located close to the road sources. Due to the size of the study area, the minimum grid spacing possible to be modelled using ADMS was: 64 m (x) and 79 m (y). A subset of receptors were modelled at a higher resolution following siting guidelines issued by JAQU (4 m from kerbside, 10 m spaced and 2 m height). Concentrations at this subset of receptors was used to determine any compliance gap.

Traffic data

The AADT for the link was obtained from the DfT traffic counts for the roads in the study area. The

latest count data available was for 2016, and therefore the counts were scaled from 2016 to 2017 (and 2019) using the respective local factors derived from TEMPro to obtain estimates of the fleet in Bradford.

The ANPR data collected during 2012 as part of the Council's Low Emissions Zone feasibility study highlighted the whole vehicle fleet in Bradford was older than that used in national modelling. The fleet composition obtained from the 2012 ANPR data was projected forward to 2017 using the vehicle fleet composition projections from the National Atmospheric Emissions Inventory (NAEI). This assumes that the change in the fleet composition between 2012 and 2017 in Bradford is in line with national levels.

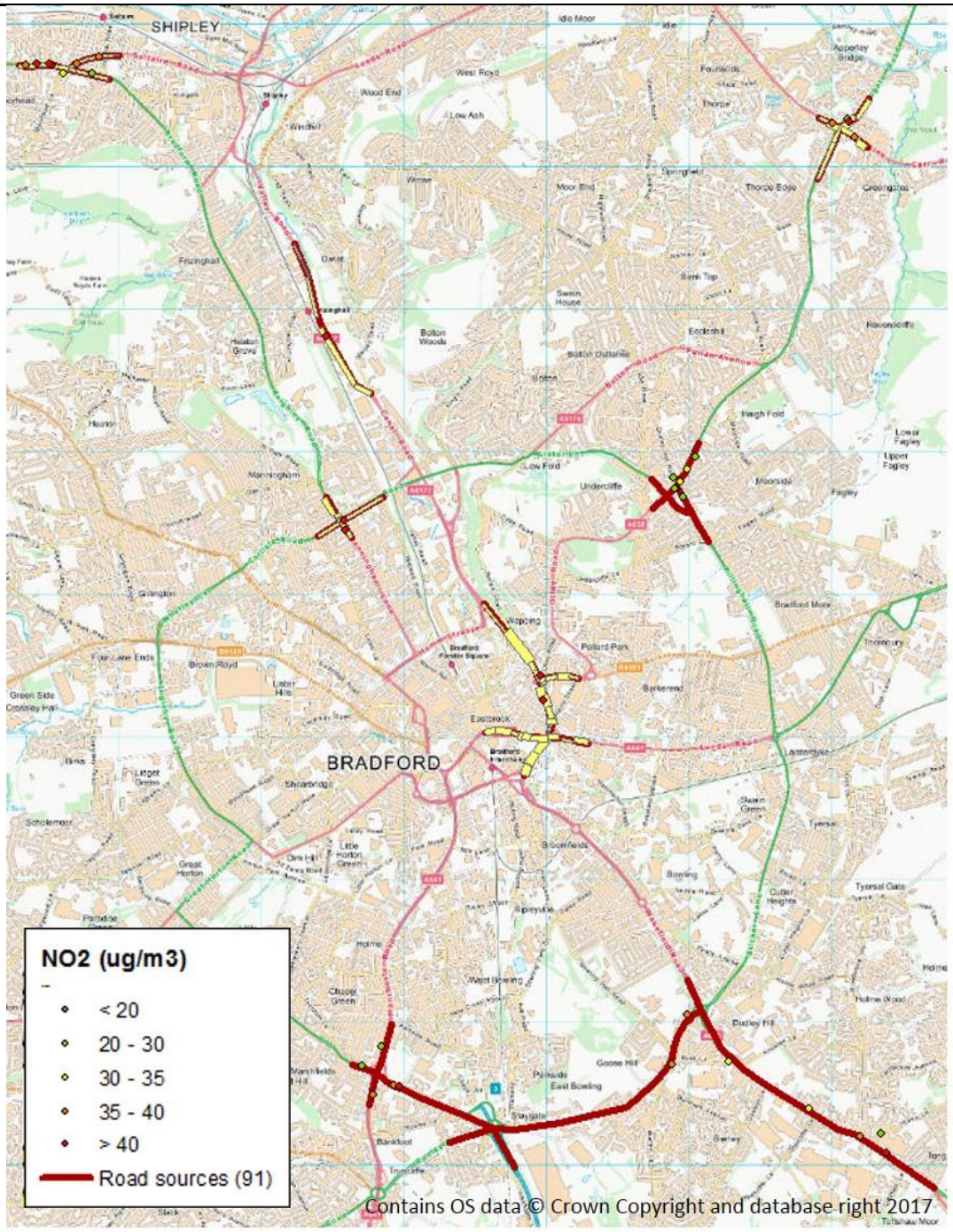
The fleet composition of buses in Bradford in 2016 was available and was included in preference to the scaled ANPR data (Table 13). The composition of buses in Bradford was assumed to be the same between 2017 and 2016, and additionally between 2017 and 2019 (no fleet upgrades are currently planned in the next 12-18 months).

Table 13: Fleet composition of buses in Bradford used in baseline 2017 and 2019 modelled.

	% Bradford buses 2016
Euro 1	1
Euro 2	23
Euro 3	21
Euro 4	27
Euro 5	24
Euro 6	3

NO_x emissions were estimated on the links in the study area using Ricardo's PyCOPERT model which is based on COPERT 5 emission factors. The road links included in the dispersion model are shown in Figure 8.

Figure 8: Location of roads included in dispersion model, and monitoring receptor locations used in model validation. Those locations where the advanced canyon model identified canyons are highlighted in yellow.



Canyon details

The Advanced Street Canyon Module in ADMS was used to identify and account for canyon effects in Bradford. A map showing the location of the street canyons identified in the advanced canyon module GIS interface is shown in Figure 8.

Model validation

LAQM.TG (16) guidance was followed with a total of 31 monitoring locations being used for model verification and calibration.

On link 8580 (Shipley Airedale Road) an automatic monitoring station (CM6) and a diffusion tube

site (DT12) are located within 10 m of one another. The concentrations measured by the diffusion tube have been historically higher than the automatic analyser, anticipated to be a result of restricted airflow around site DT12 due to the proximity of buildings, while the airflow to analyser CM6 is unrestricted (Figure 9). The concentrations measured by automatic site CM6 were therefore expected to be a more representative of link 8580 and were used in preference to DT12 for validation at this road link. The 2017 concentrations for CM6 were unavailable therefore 2016 concentrations were used as a conservative estimate of concentrations at the site.

Figure 9: Locations of automatic monitor (CM6) and passive diffusion tube (DT12) on Shipley Airedale Road.

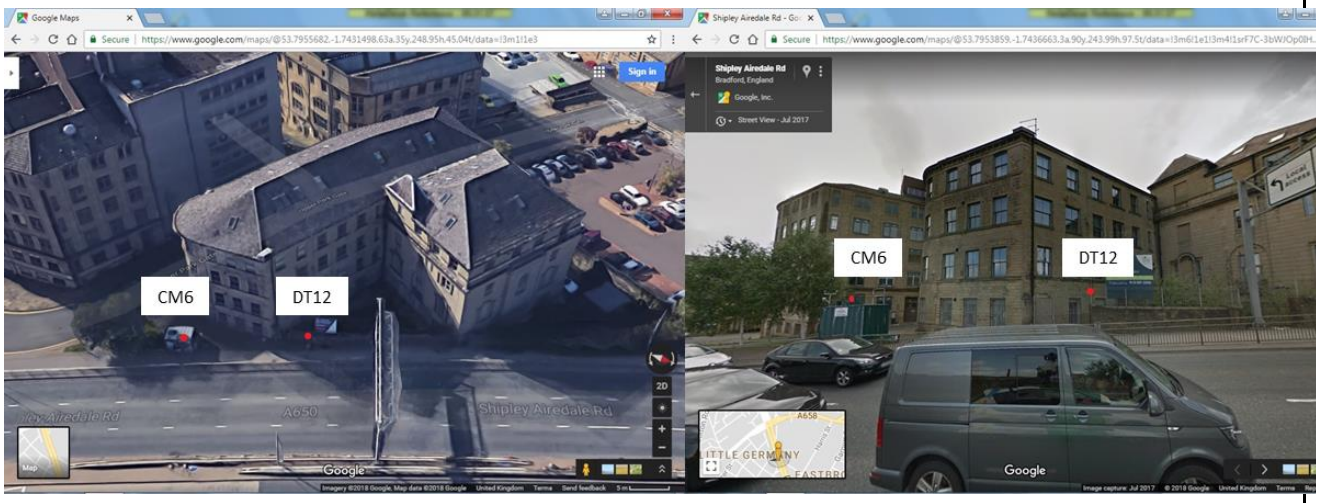
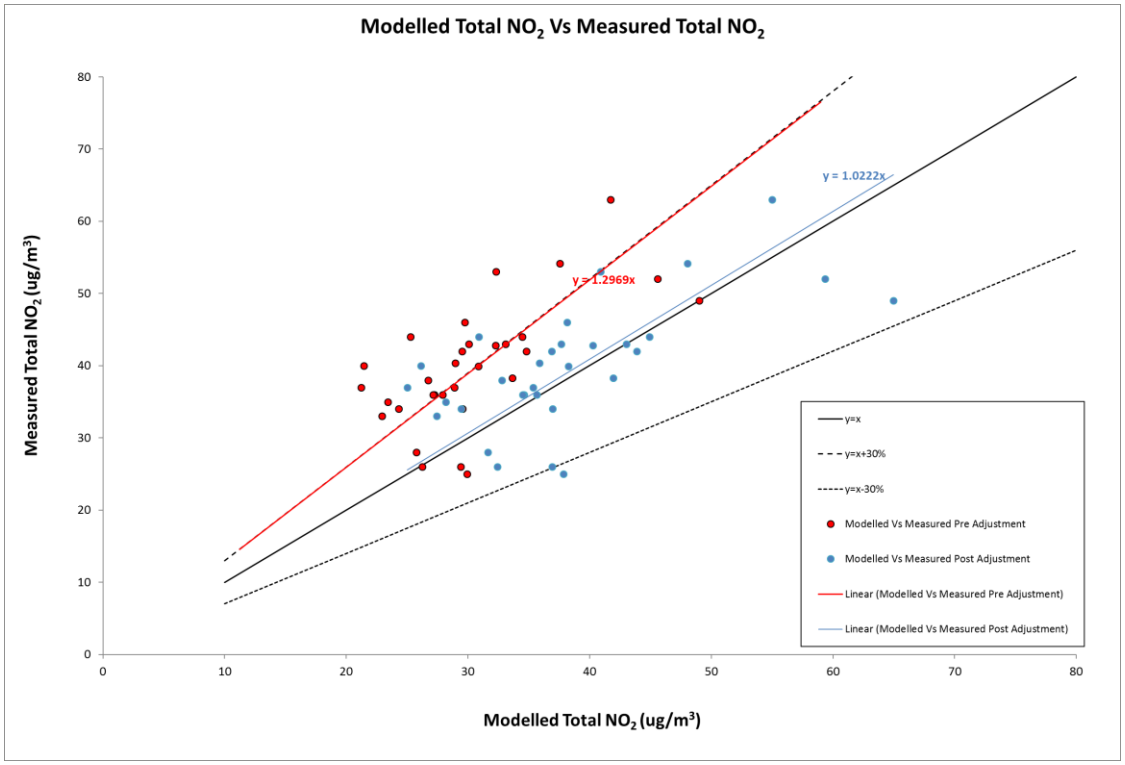


Table 14 provides evaluation of the statistics for the 2017 baseline model, and Figure 10 shows the validation plot between measured and modelled concentrations.

Table 14: Dispersion model calibration

Process in Verification	No Adjustment	With Primary Road NO_x adjustment
No. sites	31	31
Modelled NOx Roads v Monitored NOx Rd Factor	*na*	1.5622
Root Mean Square Error	11.5	7.4

Figure 10: Model verification



The gridded outputs from ADMS were used to generate contour plots for the 2017 and 2019 baseline models (Figure 11 and 12 respectively).

Figure 11: Contour plot of 2017 modelled NO_2 concentrations

Figure 12: Contour plot of 2019 modelled NO_2 concentrations

The subset of receptors generated at 4 m from the kerb, 10 m spacing and 2 m height were used to compare the local model to the national model concentrations. Any receptors falling within 25 m of a junction, or other feature where emissions were unlikely to reflect the road e.g. pedestrian crossings, were removed from the subset of receptors. The highest concentration receptor for each road link was reported.

Table 15 compares the local and national model results for the roads included in this model. An estimate of concentrations in 2018 was made by interpolation between the 2017 and 2019 concentrations as this year was not explicitly modelled in this study. Additionally, estimates of future year (beyond 2019) NO_2 concentrations on the links have been made using Defra Roadside NO_2 Projection Factors.

Table 15: NO_2 concentrations on PCM links predicted by the local and national models. Census ID with (Target Link (TL)) show those links identified in Part 1 of this report to be non-compliant.

Census ID	National PCM Model NO_2 ($\mu g/m^3$)			Local Model NO_2 ($\mu g/m^3$) 2017 and 2019 were modelled and all years beyond 2019 were calculated using the Roadside NO2 projection factors										
	2017	2018	2019	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
74396	37	35	34	40	38	36	34	32	31	29	28	26	25	24
37991	28	27	26	31	30	29	27	26	24	23	22	21	20	19
80419	30	29	27	36	34	32	30	28	27	25	24	23	22	21
80417	31	30	29	34	32	30	29	27	26	24	23	22	21	20
80416	31	30	29	34	32	30	28	27	25	24	23	22	21	20
80415	40	38	36	41	38	36	34	32	30	29	27	26	25	24
74525 (TL)	**47**	**45**	**43**	**42**	**40**	**38**	**36**	**34**	**32**	**31**	**29**	**28**	**27**	**25**
74397 (TL)	**47**	**44**	**42**	**45**	**43**	**40**	**38**	**36**	**34**	**32**	**31**	**29**	**28**	**27**
58269	40	39	37	45	43	41	39	36	34	33	31	30	28	27
58268	26	25	24	40	39	39	37	35	33	31	30	28	27	26
56848	36	34	33	38	38	38	36	34	32	31	29	28	27	25
47807	35	33	32	31	29	28	26	25	23	22	21	20	19	18
47428	33	31	30	39	36	34	32	31	29	27	26	25	24	23
28710 (TL)	**43**	**41**	**40**	**44**	**42**	**40**	**38**	**36**	**34**	**32**	**31**	**29**	**28**	**27**
17705 (TL)	**45**	**43**	**41**	**35**	**34**	**32**	**31**	**29**	**27**	**26**	**25**	**23**	**22**	**21**
8580 (TL)	**44**	**43**	**41**	**59**	**55**	**52**	**49**	**47**	**44**	**42**	**40**	**38**	**36**	**35**
7421	30	29	28	39	38	36	35	33	31	29	28	27	25	24
27431	34	33	31	37	35	33	32	30	28	27	25	24	23	22
7853	32	31	30	38	36	34	33	31	29	28	26	25	24	23
17365	30	29	28	42	40	39	37	35	33	32	30	29	27	26
27440	32	30	29	31	30	28	27	25	24	23	22	21	20	19
57732	31	30	29	38	36	35	33	31	30	28	27	25	24	23

75174	41	39	37		38	36	34	32	31	29	27	26	25	24	23
47968	37	35	33		31	29	27	26	25	23	22	21	20	19	18
7413	**35**	**33**	**32**		**64**	**61**	**58**	**55**	**52**	**49**	**47**	**45**	**42**	**41**	**39**
37487	**33**	**32**	**31**		**55**	**52**	**49**	**47**	**44**	**42**	**40**	**38**	**36**	**34**	**33**
80860	38	36	35		44	42	40	38	36	34	32	31	29	28	27
257940	34	33	32		39	37	36	34	32	30	29	27	26	25	24
73115	29	28	27		37	35	34	32	30	28	27	26	24	23	22

To summarise:

- The local model predicts link 74525 to be in compliance by 2018, which is three years before the national model predictions meet compliance (compliance met in 2021 in national model).
- Link 74397 is predicted in the local model to be compliant in 2019, which is a year before the national model predicts compliance.
- Both the local and national model predict link 28710 to meet compliance in 2019.
- Link 17705 is modelled to be in compliance in the local model, while the national model predicts exceedances on this link.
- Link 8580 is modelled in both national and local modelled to have exceedances, with the local model concentrations being much greater. The local model concentrations are similar to concentrations measured by local monitoring in 2017 on this link (52 $\mu g/m^3$).
- Link 80415 is modelled to be compliant in 2018 in both local and national models.
- Link 80416 is modelled to be compliant in 2017 in both local and national models.
- Link 80417 is modelled to be compliant in 2017 in both local and national models.

Part 2: Developing a long list of measures for addressing the exceedances

This section should provide a long list of possible measures to be considered for each road link. Local authorities should consider the source apportionment set out in part 1.

The information gathered in Part 1 has been used to identify a list of measures that have the potential to bring forward the year of compliance for the road links targeted in this study. The majority of these measures are applicable to both the A650 and A6177 links, however where a measure is specific to one or the other links this has been stated. The source apportionment data highlighted cars (specifically diesel vehicles) as the main contributor to the non-compliance on the A650 and A6177, but that HGVs also significantly contribute to the problem. Buses have also been identified as a significant contributor in other parts of the City.

Existing measures applicable to both A650 and A6177 road links:

- Partnership with Bradford bus companies to encourage reduction in bus emissions
- Eco stars scheme
- Low emission planning
- Bus retrofit programme
- Electric taxi scheme
- Council fleet commitments
- Cycle super highway and other cycling infrastructure (mainly targeting A650 links 28710, 8580 and 74525)
- New railway stations opened since 2015 when national PCM model was generated (Apperley Bridge, Low Moor)
- Speed review (20 mph zones)
- Anti-idling policy
- Travel planning
- Air quality and health research
- West Yorkshire electric vehicle strategy
- City car club
- Taxi licensing – emission controls
- Travel plans for council staff
- Low emission vehicles encouraged in Delivery and Servicing Plans

Possible new measures:

- Low emission vehicle lease/salary sacrifice scheme to target the worst polluting vehicles (such as privately-owned diesel cars)
- Rail based park and ride
- Increase parking fares in city centre to encourage people to utilise public transport instead of cars and therefore reduce the number of cars entering the city
- Designated low emission parking areas to discourage more polluting vehicles entry into the city-centre car parks, or alternatively parking incentives such as reduced fares for low emission vehicles
- Development of park and ride facilities on the outskirts of the city to promote the use of public transport to access the city centre and consequently reduce the number of private vehicles on the A6177 ring road and the A650
- Intelligent transport management systems to minimise congestion on the non-compliant links.
- Traffic management systems prioritising buses to encourage increased public transport use through faster journey times
- HGV routing and signage review
- Restrict delivery times to the city centre to prevent LGV and HGV (all or the more polluting goods vehicles) deliveries during peak traffic times
- Freight consolidation centres and freight partnership arrangements
- Promotion of Eco driving for all vehicles, members of the public and deliveries
- HGV standards for deliveries into the city centre

- HGV charging scheme on these road links
- Retrofit scheme for LGV, HGV or buses to convert to low emission vehicle
- More public engagement promoting sustainable transport including public transport use, walking / cycling, and the encouragement of car-sharing (lift share)
- Subsidising public transport to encourage higher uptake
- Encourage / facilitate home-working to reduce journeys into the city centre
- Congestion charging/ Road user charging (charge for short trips)
- Reduction of speed limits on the links, or implementation of active speed limits which can be regulated depending on the traffic flow on the links
- City gas station for Council fleet, buses and other private users
- City centre diesel ban
- LEV bus lane use (until trigger point reached)
- Voluntary CAZ, incorporating business engagement
- Electric vehicle demonstration scheme for new developments and businesses (to compliment new charging infrastructure)
- Workplace parking levy

Part 3: Assessing deliverability/feasibility and delivering a short list

For each of the measures identified in part 2, local authorities should set out an assessment of deliverability including how long it would take to deliver each measure and whether it is practicably feasible to deliver. Based on this assessment of deliverability and feasibility, the local authority should develop a short list of measures to take forward to part 4 of the report.

A scoring matrix has been used to evaluate each of the measures in the long-list from Part 2. A higher overall score identifies measures that are most likely to be feasible (in terms of timescales) and provide the required reductions in emissions. The criteria the measures were scored against were: bring forward compliance; effective (at reducing emissions); timescale (reduce emissions in time); deliverable (are systems in place to implement e.g. legislation); achievable (acceptable to the community); co-benefits (e.g. noise benefits); likely uptake; positive benefits (e.g. road safety/journey times); and negative benefits (e.g. social inequality or economic impacts). The scoring matrices have been generated for each of the A650 and A6177 links separately as the magnitude of the scoring may differ between the road links (Tables 10 and 11).

The scoring matrix and the process in general have not allowed the council to take into account the bigger picture of national infrastructure and connectivity in and through the district. The council has limited control over a significant amount of traffic flow with a number of roads which have been highlighted as having air quality issues heading to and from the motorway. The council would like to request more collaboration within government departments including more support from funds such as Transforming Cities Fund. The Leeds City Region, through the West Yorkshire Combined Authority (WYCA), recently submitted a bid to the Government's Transforming Cities Fund (TCF). The Leeds City Region is one of the UK's largest economy and population centre outside of London, with an estimated total population of over three million and working population of 1.9 million - the largest workforce in northern England. The TCF aims to improve productivity and spread prosperity through strategic investments in public and sustainable transport across England's major cities.

The TCF bid, as well as other collaborative efforts involving the City of Bradford MDC and its strategic partners across the Leeds City Region, will provide opportunities to transform transport connectivity across and beyond the city region by leveraging investments in sustainable and technology-enabled transport interventions. A successful TCF bid (alongside other transport investment priorities that will be funded via the West Yorkshire Plus Transport Fund) would help achieve a number of strategic outcomes for Bradford MDC and its partners. These outcomes include alleviating congestion along major highway corridors, increased patronage of public transport (rail and bus) and adoption of other sustainable travel choices, active and healthy lifestyles through walking and cycling, improved mobility and accessibility, inclusive growth

particularly in deprived communities, as well as reduction in harmful transport-related emissions and noise pollution.
Some changes imposed by central government have the potential to increase air pollution such as those leading to councils being required to pay for the whole of concessionary fares for buses, this change could result in more use of private transport exacerbating our air quality issues. Support is required to ensure that outcomes which improve air quality form part of the wider solution for the flow of people and goods through the district. To fully understand the issue we request support with transport modelling which can take a significant amount of time and money but would help the authority understand and mitigate any negative impact from our near neighbours in Leeds implementing a Clean Air Zone
A discussion of the rationale for the scoring measures is provided below:

- Partnership with Bradford bus companies to encourage reduction in bus emissions – the proportion of NOx emissions attributed to buses travelling on the links identified by Defra modelling are relatively small (between 1-3 % depending on the link). Therefore, for these specific links, the reduction of emissions from buses is unlikely to bring forward compliance. However, in other areas of the city, where the local authority has identified exceedances of the objectives, the contribution of buses to the total emissions can be significant. Bradford Metropolitan District Council has obtained funding for bus retrofit and will be carrying out this work over the next 18 months.

- Eco stars scheme – This encourages HGV, LGV and taxi fleets to have cleaner fleets. The HGV fleet composition on the target road links is substantial and this measure has the potential to reduce emissions on the links. However, it is a voluntary scheme and therefore the uptake may be low and any improvements may not be in time to bring forward compliance. It is also difficult to quantify the number of Eco Star vehicles travelling on the target road links to identify the potential emissions improvements.

- Low emission planning – while planning is important to ensure future levels of pollution do not increase as a result of specific developments, this will not improve pollution concentrations on the target road links within the timescales.

- Bus retrofit programme – As discussed above, funding is in place to retrofit Bradford buses over the next 18 months. The proportion of emissions attributed to buses is low on the target road links identified by Defra modelling. Although the improvements in emissions as a result of retrofit is not anticipated to reduce emission by an amount large enough to bring theses target roads into compliance, the impact may be more significant in other areas of the city where the Local Authority identified further exceedances of the objectives.

- Electric taxi scheme – the replacement of more polluting petrol or diesel taxis by electric vehicles is likely to improve the air pollution concentrations in Bradford. However, the timescales to obtain an electric taxi fleet and install the required infrastructure (e.g. vehicle charging points) is unlikely to make this option achievable in the timescales. The number of taxis travelling on these links is also challenging to identify, making the estimations of the magnitude of any improvements on these links from taxi fleet improvements difficult.

- Council fleet commitments – the Council are committed to improve their vehicle fleet to reduce their emissions. For example, the Council are looking to use gas-powered vehicles in their fleet which has lower emissions. The magnitude of the savings from council vehicles on the target road links is anticipated to be small as a result of the limited number of Council vehicles travelling on the links.

- Cycle super highway and other cycling infrastructure – A cycle path is present along the

side of Canal Road, however this requires more funding to complete the path. A Leeds-Bradford cycle-highway has been developed linking the two cities by bike. The benefits of active travel on public health are great, however in order to bring forward compliance a very large modal shift in transport from cars to bikes would be required on the target road links.

- New railway stations (Apperley Bridge, Low Moor) –The stations at Apperley Bridge and Low Moor have opened since the national modelling was carried out in 2015 (Apperley Bridge opened in 2015, and Low Moor in 2017). These stations are anticipated to reduce emissions on the target links as a result of fewer commuter vehicles, in addition to improving air quality and reducing congestion in the city centre. However, without a transport model, quantifying the effects of the opening of these stations on the target road links is not possible.

- Speed review (20 mph zones) – the reduction of speed limits on this link is unlikely to improve the concentrations on this link as the average traffic speeds on the target links does not currently exceed this value. The reduced speed may reduce congestion which could improve emissions due to improvements in stop-start traffic.

- Anti-idling policy – this is unlikely to improve the concentrations on the target road links as these roads contain free-flowing traffic without parking bay facilities. This measure may be effective in other areas of the city.

- Travel planning (business and council) – working with businesses and the Council to develop travel plans that minimise the amount of unnecessary travel, and focus on active or sustainable travel modes, is likely to improve the concentrations in the city. The impacts of Travel Planning are difficult to quantify and the measure would be anticipated to result in relatively small improvements unless there is mass uptake of the plans. However, the transport team at the Council are confident a large travel planning initiative targeting businesses located on the target road links could be implemented within the timescales and the impacts of the plan could be quantified.

- Air quality and health research – while research into this topic is crucial for understanding the consequences of air pollution, this is not going to improve concentrations on the target links within the timescales.

- West Yorkshire electric vehicle strategy – this aims to promote the uptake of electric vehicles for private and commercial use. This is likely to improve emissions as the uptake of electric vehicles is increased, however the uptake is unlikely to occur within the necessary timescales to bring forward compliance.

- City car club – this aims to reduce the numbers of individuals owning their own cars, which could in turn reduce the number of vehicles travelling on the Bradford roads. The uptake of this scheme would have to be exceptionally high in order to bring forward compliance on the target road links.

- Taxi licensing emission controls – it is likely that the target roads are used by taxis, and emission controls could improve emission from taxis. However, obtaining quantifiable data on the number of trips and vehicle types on each of the target roads is challenging.

- Low emission vehicles encouraged in Delivery and Servicing Plans – this could lead to improvements of emissions from LDV and HGV, and subsequent concentration improvements, on the target roads. The magnitude of improvements would depend on the number of vehicles with journey destinations in /around Bradford as those vehicles using the target links to travel to other councils would not be covered. The uptake of this scheme is likely to be small if it is a voluntary process.

- Low emission vehicle lease/salary sacrifice scheme to target the worst polluting vehicles (such as privately-owned diesel cars) – this is unlikely to improve emissions on the target road links within the required timescales as the uptake is likely to be low initially.

- Park and ride – The timescales to develop a park and ride scheme are too long to improve the date of compliance.

- Increase parking fares in city centre - this could reduce the number of vehicles travelling on the target links to enter the city centre. However, from local knowledge the traffic travelling on the target roads is generally through traffic. Increasing the cost of parking in the city-centre is politically challenging as there are many private parking spaces in the city which the Council does not control. A negative benefit of this measure could be the detrimental impact on businesses if individuals chose to shop elsewhere to avoid parking costs.

- Designated low emission parking areas – Similar issues as above in that the Council do not own all of the spaces within the city centre so the impacts of low emissions parking spaces are likely to be small as more polluting vehicles can park elsewhere without penalisation.

- Intelligent transport management systems – Bradford Metropolitan District Council has funding in place to develop SCOOT systems on their roads. This could be used to minimise congestion on the non-compliant links, thus increasing speeds on the links and reducing the emissions.

- Traffic management systems prioritising buses – this is important to encourage the modal shift from private cars to public transport. However, on our target road links the impacts of this is anticipated to be low due to the low numbers of buses using the route.

- HGV routing and signage review – HGV's are a main contributor to emissions on the target road links. Rerouting the HGV's is likely to bring forward compliance and reduce the concentrations on the road, however this is likely to shift the problem elsewhere to e.g. neighbouring roads on residential streets where public exposure is larger, which is not acceptable (politically or from public health).

- Restrict delivery times to the city centre to prevent LGV and HGV – this would reduce congestion during peak times and could increase traffic speeds, leading to reduced concentrations (in combination with reduced concentrations as no LGV/HGV traffic). However, the LGV/HGV will access the city centre at a different time of day and therefore the overall change in emissions and concentrations is expected to be negligible.

- Freight consolidation centres – this is likely to reduce the number of HGV's travelling on the roads (and there could be a potential to enforce the use of cleaner HGV's travelling on the target roads). However, this would rely on having access to a large space of land to develop a consolidation centre, which is not achievable in the timescales.

- Promotion of Eco driving – this is likely to improve emissions, as well as benefits for individuals such as lower fuel costs. The magnitude of reductions as a result of eco driving is anticipated to be small as the likely uptake is low.

- HGV standards for deliveries into the city centre – this would be hard to enforce and would require additional infrastructure to be developed to support this. This infrastructure is unlikely to be in place in the available timescales.

- HGV charging scheme on these road links – similar to delivery standards, additional

infrastructure would be required which is unachievable in the available timescales.

- Retrofit scheme for LGV, HGV or buses – bus retrofit scheme is already in place for Bradford. Retrofit of LGV and/or HGV is challenging for the target road links due to the use of the road as a means to travel to larger areas making targeting companies to retrofit difficult.

- More public engagement promoting sustainable transport – this is important to improve overall concentrations in the study areas (including our target road links) and public health improvements for active travel. Engagement alone is unlikely to give the required reductions in emissions in the available timescales.

- Subsidising public transport to encourage higher uptake – the impact of this on the target roads would be difficult to quantify, and is anticipated to be small as a result of limited numbers of buses travelling along the route.

- Encourage / facilitate home-working to reduce journeys into the city centre – difficult to quantify the impact of this on emissions on the target links.

- Congestion charging/ Road user charging (charge for short trips) – this would require significant amounts of new infrastructure to be installed on the road links, which is unlikely to be achievable within the available timeframes.

- City gas station for Council fleet, buses and other private users – the impact of this on the target road will be difficult to quantify.

- City centre diesel ban – this is an important step for city-centre air quality, which could impact the target road links as fewer diesel vehicles would be travelling on the links into the city-centre. This would be difficult to quantify as the destination of the traffic on the target road links would need to be known in order to identify the likely change in the fleet as a result of a diesel ban.

- LEV bus lane use (until trigger point reached) – this is unlikely to improve emissions on the target link due to the low numbers of buses travelling at any given time, and therefore a bus lane is not present. Installation of a bus lane is likely to increase concentrations on the link as a result of more congestion as fewer lanes would be available to general traffic.

- Voluntary CAZ – this is unlikely to be implemented within the timescales necessary to bring forward compliance.

- Electric vehicle demonstration scheme for new developments and businesses (to compliment new charging infrastructure) – this is likely to help the uptake of electric vehicles in the long term but is unlikely to lead to a drastic increase in the number of electric vehicles (hence decrease in diesel or petrol vehicles) in the necessary timescales.

- Workplace parking levy – similar to increasing parking costs, implementation of this would be politically challenging due to the large number of privately owned parking spaces and would require significant engagement from local businesses.

Based on the discussions above, the scoring matrices completed, and advice and feedback from JAQU the following measure packages are suggested for the short list for further investigation

1. Congestion reduction only plan, focusing on improvements from optimisation of traffic using SCOOT traffic management systems:
   a. 2019 Baseline

b. SCOOT optimisation alone (leading to an 8 % increase in link speeds[1])
c. SCOOT optimisation and peak hour HGV restriction (assumed to change diurnal profile of emissions dispersion and improve link speeds by 1 kph as a result of the HGV restrictions)

2. Congestion and traffic flow reduction plan, focusing on improved link speeds and reduced AADT (Annual Average Daily Traffic):
   a. SCOOT optimisation, peak hour HGV restriction and rerouting of 50 % of HGVs on the target links in the centre of Bradford (links 28710, 8580, 74525, 80415, 80416, 80417, 17705 and 74397)
   b. SCOOT optimisation, peak hour HGV restriction, rerouting of 50 % of HGVs on the target links in the centre of Bradford, and low impact travel planning and active travel (defined by a 1 % reduction in car AADT)
   c. SCOOT optimisation, peak hour HGV restriction, rerouting of 50 % of HGVs on the target links in the centre of Bradford, and high impact travel planning and active travel (defined by a 5 % reduction in car AADT)
3. Congestion and traffic flow reduction plan and a low emission plan, which is a variation on measure 2 this time including an improvement in bus emissions:
   a. SCOOT optimisation, peak hour HGV restriction, rerouting of 50 % of HGVs on the target links in the centre of Bradford, and low emission buses (all buses Euro VI)
   b. SCOOT optimisation, peak hour HGV restriction, rerouting of 50 % of HGVs on the target links in the centre of Bradford, low travel planning/active travel, and low emission buses (all buses Euro VI)
   c. SCOOT optimisation, peak hour HGV restriction, rerouting of 50 % of HGVs on the target links in the centre of Bradford, high travel planning/active travel, and low emission buses (all buses Euro VI)
4. Low emission strategy targeting the roads in the centre of Bradford (bounded by the outer ring road i.e. including the target links from Part 1). In this measure all petrol vehicles travelling on the roads Euro 4 or above, and all diesel vehicles Euro 6.
5. A strategy in line with Bradford Metropolitan District Council's priorities to improve Public Health and reduce exposure across all the roads in the city: SCOOT optimisation, low emission buses (all buses Euro VI) and low travel planning/active travel uptake.

[1] http://www.its.leeds.ac.uk/projects/konsult/private/level2/instruments/instrument014/l2_014c.htm

Table 10: Scoring of the long-list of measures for the A650 Inner Ring road links (links 28710, 8580 and 74525)

A650 Inner Ring Road	Compliance	Effective	Timescale	Deliverable	Achievable	Co-Benefits	Likely uptake	Positive benefits	Negative benefits	Total score
Intelligent transport management systems	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**-1**	**18**
Travel planning	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**-1**	**17**
Cycle super highway /other cycling infrastructure	**1**	**1**	**1**	**3**	**3**	**3**	**2**	**3**	**-1**	**16**
Restrict delivery times to the city centre	2	2	2	2	2	2	2	2	-2	14
City centre diesel ban	2	2	1	2	2	2	2	2	-1	14
Eco stars scheme	1	2	2	2	2	2	1	2	-1	13
Low emission planning	3	1	1	2	2	1	2	2	-1	13
Retrofit scheme for LGV, HGV or buses	2	2	1	2	2	2	2	2	-2	13
Travel plans for council staff	1	1	2	2	2	2	2	2	-2	12
Development of park and ride facilities	2	2	1	1	2	2	2	2	-2	12
More public engagement promoting sustainable transport	2	1	1	2	2	2	1	2	-1	12
Low emission vehicles encouraged in Delivery and Servicing Plans	1	1	1	2	2	2	1	2	-1	11
HGV standards for deliveries into the city centre	1	1	1	2	2	2	2	2	-2	11
Bus retrofit programme	1	1	1	1	2	1	2	2	-1	10
Council fleet commitments	1	1	1	1	2	1	2	2	-1	10
Anti-idling policy	1	1	1	2	2	2	1	2	-2	10
West Yorkshire electric vehicle strategy	1	1	1	1	2	2	1	2	-1	10
Increase parking fares in city centre	2	2	1	2	1	2	1	2	-3	10
Workplace parking levy	2	2	1	1	1	2	1	2	-2	10
Partnership to reduce bus emissions	1	1	1	2	2	1	1	1	-1	9
Electric taxi scheme	1	1	1	1	1	2	1	2	-1	9
Speed review (20 mph zones)	1	1	2	2	2	1	2	1	-3	9
Low emission vehicle lease/salary sacrifice scheme	1	1	1	1	2	2	1	2	-2	9
Voluntary CAZ	1	1	1	1	1	2	2	2	-2	9
New railway stations	1	2	1	1	1	2	1	1	-2	8
Taxi licensing – emission controls	1	1	1	1	2	1	1	2	-2	8
Designated low emission parking areas	1	1	1	1	1	2	1	2	-2	8
Traffic management systems prioritising buses	1	1	1	1	1	1	2	2	-2	8
Freight consolidation centres	1	1	1	1	1	2	1	2	-2	8
HGV charging scheme on these road links	2	2	1	1	1	1	1	1	-2	8
Subsidising public transport	1	1	1	1	1	2	1	2	-2	8
Congestion charging	1	1	1	1	1	2	1	2	-2	8
City gas station for Council fleet, buses and other private users	1	1	1	2	1	1	1	2	-2	8
LEV bus lane use	1	1	1	1	1	2	2	2	-3	8
Air quality and health research	1	1	1	1	1	1	1	1	-1	7

City car club	1	1	1	1	1	1	1	1	-1	7
HGV routing and signage review	2	2	1	1	1	1	1	1	-3	7
Electric vehicle demonstration scheme	1	1	1	2	2	1	1	1	-3	7
Rail based park and ride	1	1	1	1	1	1	1	1	-2	6
Promotion of Eco driving	1	1	1	1	1	1	1	1	-2	6
Encourage / facilitate home-working	1	1	1	1	1	1	1	1	-3	5
Reduction of speed limits / active limits	1	1	1	1	1	1	1	1	-3	5

Table 11: Scoring of the long-list of measures for the A6177 Outer Ring road links (links 17705, 74397 80415, 80416 and 80417)

A6177 Outer Ring Road	Compliance	Effective	Timescale	Deliverable	Achievable	Co-Benefits	Likely uptake	Positive benefits	Negative benefits	Total score
Intelligent transport management systems	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**-1**	**18**
Travel planning	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**-1**	**17**
Restrict delivery times to the city centre	2	2	2	2	2	2	2	2	-2	14
City centre diesel ban	2	2	1	2	2	2	2	2	-1	14
Eco stars scheme	1	2	2	2	2	2	1	2	-1	13
Low emission planning	3	1	1	2	2	1	2	2	-1	13
Retrofit scheme for LGV, HGV or buses	2	2	1	2	2	2	2	2	-2	13
Travel plans for council staff	1	1	2	2	2	2	2	2	-2	12
Development of park and ride facilities	2	2	1	1	2	2	2	2	-2	12
More public engagement promoting sustainable transport	2	1	1	2	2	2	1	2	-1	12
Low emission vehicles encouraged in Delivery and Servicing Plans	1	1	1	2	2	2	1	2	-1	11
HGV standards for deliveries into the city centre	1	1	1	2	2	2	2	2	-2	11
Bus retrofit programme	1	1	1	1	2	1	2	2	-1	10
Council fleet commitments	1	1	1	1	2	1	2	2	-1	10
Anti-idling policy	1	1	1	2	2	2	1	2	-2	10
West Yorkshire electric vehicle strategy	1	1	1	1	2	2	1	2	-1	10
Increase parking fares in city centre	2	2	1	2	1	2	1	2	-3	10
Workplace parking levy	2	2	1	1	1	2	1	2	-2	10
Partnership to reduce bus emissions	1	1	1	2	2	1	1	1	-1	9
Electric taxi scheme	1	1	1	1	1	2	1	2	-1	9
Speed review (20 mph zones)	1	1	2	2	2	1	2	1	-3	9
Low emission vehicle lease/salary sacrifice scheme	1	1	1	1	2	2	1	2	-2	9
Voluntary CAZ	1	1	1	1	1	2	2	2	-2	9
New railway stations	1	2	1	1	1	2	1	1	-2	8
Taxi licensing – emission controls	1	1	1	1	2	1	1	2	-2	8
Designated low emission parking areas	1	1	1	1	1	2	1	2	-2	8
Traffic management systems prioritising buses	1	1	1	1	1	1	2	2	-2	8
Freight consolidation centres	1	1	1	1	1	2	1	2	-2	8
HGV charging scheme on these road links	2	2	1	1	1	1	1	1	-2	8

Subsidising public transport	1	1	1	1	1	2	1	2	-2	8
Congestion charging	1	1	1	1	1	2	1	2	-2	8
City gas station for Council fleet, buses and other private users	1	1	1	2	1	1	1	2	-2	8
LEV bus lane use	1	1	1	1	1	2	2	2	-3	8
Air quality and health research	1	1	1	1	1	1	1	1	-1	7
City car club	1	1	1	1	1	1	1	1	-1	7
HGV routing and signage review	2	2	1	1	1	1	1	1	-3	7
Electric vehicle demonstration scheme	1	1	1	2	2	1	1	1	-3	7
Rail based park and ride	1	1	1	1	1	1	1	1	-2	6
Promotion of Eco driving	1	1	1	1	1	1	1	1	-2	6
Encourage / facilitate home-working	1	1	1	1	1	1	1	1	-3	5
Reduction of speed limits / active limits	1	1	1	1	1	1	1	1	-3	5

Part 4: Evidencing the short listed measures to identify options that could bring forward compliance

In this section, local authorities should set out the likely effectiveness of the shortlisted measures in bringing forward compliance. Local authorities should assess each option against the Primary Critical Success Factor.

The emissions for the shortlisted measures (measure packages 1-5 are defined in Part 3 of this study) were calculated and compared to the 2019 baseline model (Table 16). The results from the emissions calculations are discussed below. The measure with the greatest reduction in emissions was taken forward into the dispersion model.

Table 16: % change in NO_x emissions (g/km/s) on the target links between 2019 baseline and 2019 measures. The minimum, maximum and average change when all model links considered (as per fig.8) is also presented.

Census ID	% reduction between 2019 baseline and measure NO_x emissions									
	1b	1c	2a	2b	2c	3a	3b	3c	4	5
28710	-3.6	-5.3	-12.2	-12.8	-15.0	-17.0	-17.5	-19.7	-28.7	-9.1
8580	-3.4	-5.3	-16.3	-16.8	-18.7	-22.0	-22.5	-24.4	-36.0	-9.8
74525	-3.6	-4.7	-16.5	-16.9	-18.8	-22.4	-22.9	-24.7	-38.7	-10.1
80415	-4.2	-6.2	-15.3	-15.8	-17.7	-21.3	-21.7	-23.6	-32.7	-10.9
80416	-3.7	-4.8	-11.6	-12.0	-13.8	-22.8	-23.2	-25.0	-35.5	-15.4
80417	-3.8	-5.5	-14.3	-14.8	-16.7	-20.2	-20.7	-22.6	-32.2	-10.4
17705	-4.0	-5.2	-11.8	-12.3	-14.3	-18.8	-19.3	-21.3	-30.5	-11.6
74397	-4.2	-5.8	-14.3	-14.8	-16.8	-21.6	-22.1	-24.0	-32.7	-12.1
Max (all links)	-5.5	-12.8	-19.9	-20.3	-22.1	-58.8	-59.1	-60.1	-67.9	-58.6
Min (all links)	0.0	-3.0	-3.0	-3.2	-4.5	-7.8	-8.4	-10.9	0.0	-3.7
Average (all links)	-3.4	-5.8	-8.5	-8.9	-10.7	-25.7	-26.1	-27.8	-16.8	-21.4

Measures 3c and 4 had the greatest reduction in emission for the model links compared to the 2019 baseline. However, Measure 3b also demonstrated a significant emission reduction on the target links with smaller reductions in AADT as a result of active travel and transport planning measures (which are hard to quantify) than Measure 3c. Therefore, Measure 3b and Measure 4 were modelled in ADMS.
Measure 5 was also modelled in ADMS as this measure package includes measures that fall within the current priorities in the Council, meaning it is likely to have support within the community.

The NO_2 concentrations on the PCM roads for Measures 3b, 4 and 5 are shown in Table 17a. Table 17b contains forward projected NO_2 concentrations for these Measures derived using the Defra Roadside NO_2 Projection factors. Figure 13 shows the mapped NO_2 concentration in the study area after implementation of Measure 4 (the measure with the greatest improvements in NO_2 concentrations on the target road links).

Table 17a: NO_2 concentrations ($\mu g/m^3$) on PCM roads for the national model, local model and local model after implementation of Measures 3b, 4 and 5.

Census ID	National Model NO_2 ($\mu g/m^3$)			Local Model NO_2 ($\mu g/m^3$)			Measure 3b			Measure 4			Measure 5		
	2017	2018	2019	2017	2018	2019	2017	2018	2019	2017	2018	2019	2017	2018	2019
74396	37	35	34	40	38	36	40	36	32	40	38	36	40	36	32
37991	28	27	26	31	30	29	31	27	22	31	26	21	31	27	23
80419	30	29	27	36	34	32	36	33	29	36	33	30	36	33	30
80417	31	30	29	34	32	30	34	30	27	34	30	25	34	31	29
80416	31	30	29	34	32	30	34	31	28	34	31	28	34	31	28
80415	40	38	36	41	38	36	41	36	31	41	35	28	41	37	32
74525 (TL)	**47**	**45**	**43**	**42**	**40**	**38**	**42**	**38**	**33**	**42**	**36**	**30**	**42**	39	36
74397 (TL)	**47**	**44**	**42**	**45**	**43**	**40**	**45**	**40**	**34**	**45**	**39**	**32**	**45**	41	37
58269	40	39	37	45	43	41	45	39	34	45	40	36	45	40	35
58268	26	25	24	40	39	39	40	36	32	40	35	30	40	36	33
56848	36	34	33	38	38	38	38	35	31	38	38	37	38	35	32
47807	35	33	32	31	29	28	31	28	26	31	29	27	31	28	26
47428	33	31	30	39	36	34	39	32	26	39	31	23	39	33	26
28710 (TL)	**43**	**41**	**40**	**44**	**42**	**40**	**44**	**40**	**35**	**44**	**39**	**33**	**44**	41	37
17705 (TL)	**45**	**43**	**41**	**35**	**34**	**32**	**35**	**32**	**29**	**35**	**31**	**27**	**35**	33	30
8580 (TL)	**44**	**43**	**41**	**59**	**55**	**52**	**59**	**51**	**44**	**59**	**49**	**39**	**59**	53	48
7421	30	29	28	39	38	36	39	35	31	39	36	34	39	36	33
27431	34	33	31	37	35	33	37	34	30	37	35	33	37	34	30
7853	32	31	30	38	36	34	38	35	32	38	36	34	38	35	33
17365	30	29	28	42	40	39	42	37	32	42	40	39	42	38	34
27440	32	30	29	31	30	28	31	28	25	31	30	28	31	28	25
57732	31	30	29	38	36	35	38	35	32	38	36	35	38	36	34
75174	41	39	37	38	36	34	38	35	31	38	36	34	38	35	32
47968	37	35	33	31	29	27	31	28	25	31	29	27	31	28	26
7413	35	33	32	64	61	58	64	56	47	64	61	58	64	56	49
37487	33	32	31	55	52	49	55	49	43	55	52	49	55	51	46
80860	38	36	35	44	42	40	44	39	33	44	42	40	44	39	34
57940	34	33	32	39	37	36	39	34	30	39	37	36	39	35	30
73115	29	28	27	37	35	34	37	32	28	37	35	34	37	33	28

Table 17b: Forward projections of NO_2 concentrations on target links beyond 2019 model year (estimation of future concentrations calculated using Defra Roadside NO_2 Projection Factors)

Census ID	Measure 3b				Measure 4									Measure 5				
	2019	2020	2021	2022	2019	2020	2021	2022	2023	2024	2025	2026	2027	2019	2020	2021	2022	2023
74396	32	30	29	27	36	34	32	30	29	27	26	25	24	32	31	29	27	26
37991	22	21	20	19	21	20	19	18	17	16	16	15	14	23	21	20	19	18
80419	29	28	26	25	30	29	27	26	25	23	22	21	20	30	28	27	25	24
80417	27	26	24	23	25	24	23	22	21	20	19	18	17	29	27	26	24	23
80416	28	26	25	23	28	27	25	24	23	22	21	20	19	28	27	25	24	23
80415	31	29	27	26	28	27	25	24	23	22	21	20	19	32	31	29	27	26
74525	33	32	30	28	30	29	27	25	24	23	22	21	20	36	34	32	30	29
74397	34	33	31	29	32	31	29	27	26	25	24	22	22	37	35	34	32	30
58269	34	33	31	29	36	34	33	31	29	28	26	25	24	35	34	32	30	29
58268	32	30	29	27	30	28	27	25	24	23	22	21	20	33	31	30	28	27
56848	31	30	28	27	37	36	34	32	30	29	27	26	25	32	30	28	27	26
47807	26	24	23	22	27	25	24	22	21	20	19	18	18	26	25	23	22	21
47428	26	25	23	22	23	22	21	20	19	18	17	16	16	26	25	24	22	21
28710	35	34	32	30	33	31	30	28	27	25	24	23	22	37	35	33	31	30
17705	29	28	26	25	27	26	24	23	22	21	20	19	18	30	29	27	26	25
8580	44	42	39	37	39	37	35	33	32	30	29	27	26	48	46	43	41	39
7421	31	29	28	26	34	32	30	28	27	26	24	23	22	33	31	29	28	26
27431	30	29	27	25	33	32	30	28	27	25	24	23	22	30	29	27	26	24
7853	32	30	29	27	34	32	31	29	28	26	25	24	23	33	31	29	28	26
17365	32	30	28	27	39	37	35	33	32	30	29	27	26	34	33	31	29	28
27440	25	24	22	21	28	27	25	24	23	22	21	20	19	25	24	23	21	20
57732	32	31	29	27	35	33	31	29	28	27	25	24	23	34	32	30	29	27
75174	31	30	28	26	34	32	31	29	27	26	25	24	23	32	31	29	27	26
47968	25	24	23	22	27	26	25	23	22	21	20	19	18	26	25	23	22	21
7413	47	45	43	40	58	55	52	49	47	45	42	41	39	49	46	44	41	39
37487	43	41	39	37	49	47	44	42	40	38	36	34	33	46	44	42	39	37
80860	33	32	30	28	40	38	36	34	32	31	29	28	27	34	32	30	29	27
57940	30	28	27	25	36	34	32	30	29	27	26	25	24	30	29	27	26	24
73115	28	27	25	24	34	32	30	28	27	26	24	23	22	28	27	26	24	23

Figure 13: Contour plot of Measure 4 modelled NO_2 concentrations

The local modelling demonstrates that compliance can be brought forward from 2019 to 2018 on Link 28710 through implementation of Measure 3b (SCOOT optimisation, peak hour HGV restriction, re-routing of 50 % of HGVs on the target links in the centre of Bradford, low travel planning/active travel, and low emission buses) and Measure 4. Measure 5 is unable to bring forward compliance on the target link compared to the local baseline.

Compliance on target link 8580 can be brought forward from 2024 to 2019 through Measure 4 - an access restriction strategy targeting older vehicles, preventing petrol vehicles less than Euro 4 and diesel vehicles less than Euro 6 travelling on the target links.

Compliance can be brought forward from 2027 to 2022 on link 7413 by measure 3b and to 2023 with measure 5. Compliance can be bought forward on link 37487 from 2023 to 2021 with measure 3b and 2022 with measure 5. Measure 4 does not explicitly target these links in the low emission strategy, however it is anticipated that if a low emission strategy was introduced in the centre of Bradford, vehicles travelling along these links into Bradford would also be cleaner. Detailed transport modelling would be required to establish the likely changes in traffic on this route as a result of an introduction of a low emission strategy which is outside the scope of this study.

To conclude, the measures identified in this study with the ability to bring forward compliance on the target road links are a combination of intelligent transport systems, restriction of HGVs on links in peak times, 50 % reduction of HGVs on target links through re-routing, low impact travel planning/active travel and Euro VI buses; or a low emission strategy with access restrictions for older vehicles in central Bradford ensuring only less polluting vehicles travel on the target roads (petrol Euro 4 or greater, diesel Euro 6).

Part 5: Setting out a preferred option

In this section, local authorities should set out a summary of their preferred option to bringing forward compliance (where such measures exist). Where new measures have been identified that could bring forward compliance, local authorities should also assess a range of Secondary Critical Success Factors in order to identify the preferred option.

This section includes summary information in response to the primary Critical Success Factor:

The primary Critical Success Factor is to deliver a scheme that leads to compliance with NO_2 concentration limits in the shortest possible time. Only options that are estimated to lead to compliance as quickly as possible will pass the Critical Success Factor.

This will be followed by a position statement on measures to bring forward compliance and the assessment against the Secondary Critical Success Factors of:

***Value for money**: It is important for local authorities to think about options that deliver good value for money, considering all of the economic costs and benefits.*

***Affordability**: Local authorities should provide information on estimated financial costs for each option.*

***Distributional impacts**: Consideration should be given to the relative impacts on key groups, in order to determine whether there could be a disproportionate impact on one or a number of particular groups.*

***Strategic and wider air quality fit**: Local authorities should consider how each option interacts with other local policies already in place and what additional strategic aims it could help to achieve.*

***Supply side capacity and capability**: The success of the chosen option will depend on a number of external constraints, so local authorities should assess commercial capacity or capability limitations.*

***Achievability:** Local authorities should consider whether the option can be delivered given the potential resources available (for example staffing levels) and management structures in place.*

***Displacement**: Local authorities should consider the potential for displacement on other roads and in particular whether this displacement might cause other exceedances.*

A summary table for each road link is included in Table 20.

Introduction and summary results

Five road links were identified by the PCM national model as being non-compliant with the annual average NO_2 limit value in 2018. Compliance was predicted between 2019 and 2021. Three of these road links are on the A650 and two on the A6177.

To assess the compliance status using local data in a dispersion model, the Council included three additional road links on the A6177 beside an automatic monitoring station on Mayo Avenue, which is part of the national network. While compliance was achieved at these links in 2018, the measurement data were used to calibrate the dispersion model.

Measures were reviewed during a Council stakeholder workshop and 39 were identified as having the potential to improve air quality in Bradford along the specified road links. Four packages of measures were assessed, which also included variant sub-sets of measures.

Following new advice from JAQU, 21 additional local road links were added to the model which were of local interest. 29 road links were modelled in total. Of these additional 21 road links 3 were

in non-compliance according to the local model. In total, of the 29 road links, 7 were in non-compliance in 2018. The earliest date of expected compliance for these 7 road links is 2019 and the latest is 2027.

Table 18: Annual average NO_2 concentrations modelled for 2019 in non-compliance (µg m^{-3}) and expected year of compliance.

Road link ID	Road Name	PCM NO_2 (2019)	Local NO_2 (2019)	Expected year of compliance
58269	Leeds Rd	37	41	2020
8580	A650 Shipley Airedale Rd	41	52	2024
7413	A657 Shipley	32	58	2027
37487	Bradford Rd Shipley	31	49	2023

Two of the four packages of measures were modelled as these were identified as most effective (A and B below) or most feasible (C below) based on the emission reductions calculated using the PyCOPERT model developed by Ricardo Energy and Environment, which uses COPERT 5 emissions factors. During this assessment work a third package of measures was identified by the Council. These packages of measures were:

A. (Measure 3b in Part 4) Congestion and traffic flow reduction plan, with low emission plan: Specifically, this includes SCOOT traffic management system optimisation, peak hour HGV restriction on the identified road links; re-routing of 50% HGVs on the target links in Bradford centre; active transport and travel planning (as defined by a 1% reduction in car flows); and low emission buses (all buses Euro VI compliant)
B. (Measure 4 in Part 4) Low Emission Strategy – targeting the roads in the centre of Bradford as bounded by the ring road i.e. including the target links from Part 1 of this study). All petrol vehicles to be Euro 4/IV compliant and all diesel vehicles to be Euro 6/VI compliant.
C. (Measure 5 in Part 4). Congestion and traffic flow reduction plan, with low emission plan: Specifically, this includes SCOOT traffic management system optimisation, active transport and travel planning (as defined by a 1% reduction in car flows); and low emission buses (all buses Euro VI compliant)

The expected year of compliance with the three packages of measures above is given in Table 19. Package A is estimated to bring forward compliance to 2022; Package B to 2027; and Package C to 2023. As discussed in Part 4, Package B was applied only to the links in the city centre due to the absence of a traffic model to estimate wide impacts of the scheme. Links 7413 and 37487 are not explicitly targeted in Package B, however it is anticipated that the implementation of this package in the centre of Bradford would lead to vehicles travelling along these links into Bradford to be cleaner. Detailed transport modelling would be required to establish the likely changes in traffic on this route as a result of the introduction of a low emission strategy which is outside the scope of this study. Compliance on link 58269 can be brought forward through implementation of any of Packages A to C (assuming these can be implemented in suitable timescales), while compliance on link 8580 can be brought forward to 2021 (A), 2019 (B) or 2023 (C) assuming immediate implementation of the packages.

Table 19: Estimated year of compliance in the baseline and with the packages of measures

Road link ID	Baseline	Package A	Package B	Package C
58269	2020	2018	2018	2018
8580	2024	2021	2019	2023

7413	2027	2022	2027	2023
37487	2023	2021	2023	2022

Three additional links were identified to be compliant in 2019 but non-compliant in 2017. Extrapolation between the two modelled years highlighted exceedances in 2018 on links 74397, 28710 and 80860. The three packages of measures (A, B and C) cannot be implemented in the timeframe required to make a measurable difference to the annual average concentrations for 2018 and therefore compliance cannot be brought forward from 2019 on these links.

Feasibility of Measures and Wider Impacts

The Council put forward measures that could be implemented in Part 3 which included SCOOT, the Canal Road cycle path and voluntary business travel plans. The additional measures in Part 4 modelling were included following feedback from JAQU, and the Council put forward an initial assessment of a low emission strategy restricting access for older vehicles.

Regarding the potential for implementation of these measures, SCOOT optimisation is achievable during 2018 as this is a committed programme of work. Although this was not assessed on its own it was included as part of the packages of measure A and C above which had some success bringing forward compliance on the target links.

Measure C also includes a bus improvement scheme - the timescales to implement such a scheme are limited by studies identifying the cost of upgrading the fleet through retrofit or new vehicles, the availability of associated mechanisms for funding the upgrade, and the reception of such a scheme by bus operators – therefore it is not clear how much this measure can actually bring forward compliance. Additionally, consideration needs to be given to the length of time it takes to procure a bus fleet / retrofit a fleet in consultation with the bus operators.

The peak hour HGV restriction and 50% of HGV re-routing measures in package A above, appear to be effective in bringing forward compliance. However, more extensive feasibility studies using traffic modelling to investigate the feasibility of HGV re-routing and a peak hour HGV restriction is necessary to determine with confidence if these could be implemented without displacement or distributional or strategic in-depth considerations. **Currently, the expert view of the council transport planners is that this would not be feasible to implement.** There is no viable alternative route for HGVs to access the city and the preference is that they use the inner ring road rather than residential city streets. Use of the ring road by HGVs is viewed as being least harmful for public health.

Alternatively, the implementation of access restriction for older vehicles (Package B) appears to be effective in bringing forward compliance. It should be noted that the development and implementation of this package is likely to take several years and therefore any air pollution benefits of this scheme would not be realised until the scheme was operational. JAQU have suggested that this process could take 2-3 years, meaning the package could be operation in 2021. Working to this assumption, Package B would be able to bring forward compliance on link 8580 from 2024 to the year of operation (e.g. 2021). Two of the target road links were outside the zone boundary included in the modelling, and it is likely that concentrations would be brought forward on these links as a direct impact of the package in practice. Measure B has additional anticipated benefits of improving air quality in the whole city of Bradford as well as on the target links. Various boundary locations require analysis, along with vehicle type access restrictions in a more robust analysis of the options. This traffic and air quality modelling would then underpin a full business case in support of a preferred option on the type of access restrictions that could realistically be implemented and over what timeframe. **The Council's preferred option to bring forward compliance from 2027 is to implement city-wide access restrictions for older vehicles (Measure B), the details of which require further assessment and consideration**.

Table 20: Summary of compliance status and measures for each road link

Road link	PCM identified link?	Summary of exceedance	Measures identified that could bring forward compliance	For any new measures, please set out costs and timeframe
74396	No – this link was identified as being close to exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 40 µg/m^3	NA	NA
37991	No – this link was identified as being close to exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 31 µg/m^3	NA	NA
80419	No – this link was identified as being close to exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 36 µg/m^3	NA	NA
80417	No – this link was identified as near to an AURN station to be used for model calibration. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 34 µg/m^3	NA	NA
80416	No – this link was identified as near to an AURN station to be used for model	We have updated the baseline data using our local modelled data	NA	NA

	calibration. data. A modelling checklist has been approved by JAQU	which shows that the link is now compliant. 2017 data: 34 µg/m^3		
80415	No – this link was identified as near to an AURN station to be used for model calibration. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link will be compliant in 2018. Summary of NO_2 concentration projections: 2017: 41 µg/m^3 2018: 38 µg/m^3	NA	NA
74525	Yes – this link was identified as having an exceedance in the national PCM modelling	We have updated the baseline data using our local modelled data which shows that the link will be compliant in 2018. Summary of NO_2 concentration projections: 2017: 42 µg/m^3 2018: 40 µg/m^3	NA	NA
74397	Yes – this link was identified as having an exceedance in the national PCM modelling	We have updated the baseline data using our local modelled data which shows that the link will be compliant in 2019. Summary of NO_2 concentration projections: 2017: 45 µg/m^3 2018: 43 µg/m^3 2019: 40 µg/m^3	NA	NA
58269	No – this link was identified as having an	We have updated the baseline data	We have identified three packages of	Our recommended measure that bring forward compliance

	exceedance using local modelling data. A modelling checklist has been approved by JAQU	using our local modelled data which shows that the link will be compliant in 2020. Summary of NO_2 concentration projections: 2017: 45 µg/m^3 2018: 43 µg/m^3 2019: 41 µg/m^3 2020: 39 µg/m^3	measures that equally bring forward compliance on this road link. In part 5 of our study we have assessed these packages against the secondary success criteria and have recommended package B which includes a low emission strategy restricting access for older vehicles.	is a low emission strategy across the city. A full impact assessment is required to support the preferred option e.g. HGV, Bus, taxi diesels to be Euro VI/6; petrol to be Euro IV/4 as minimum standards. The enforcement and need for complementary measures will be included in a more detailed impact assessment to underpin a full business case. While this measure could be implemented in time to bring forward compliance on road link 8580, 7413 and 37487 it is unlikely to bring forward compliance on 58269 road link. If Package A or C can be implemented in 2018, modelling indicates that compliance on link 58269 could be brought forward from 2020 to 2018.
58268	No – this link was identified as being close to exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 40 µg/m^3	NA	NA
56848	No – this link was identified as	We have updated the	NA	NA

	being close to exceedance using local modelling data. A modelling checklist has been approved by JAQU	baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 38 µg/m^3		
47807	No – this link was identified as being close to exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 31 µg/m^3	NA	NA
47428	No – this link was identified as being close to exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 39 µg/m^3	NA	NA
28710	Yes – this link was identified as having an exceedance in the national PCM modelling	We have updated the baseline data using our local modelled data which shows that the link will be compliant in 2019. Summary of NO_2 concentration projections: 2017: 44 µg/m^3 2018: 42 µg/m^3 2019: 40 µg/m^3	NA	NA
17705	Yes – this link was identified as having an exceedance in the national PCM modelling	We have updated the baseline data using our local modelled data which shows that the link is now compliant.	NA	NA

		2017 data: 35 µg/m^3		
8580	Yes – this link was identified as having an exceedance in the national PCM modelling	We have updated the baseline data using our local modelled data which shows that the link will be compliant in 2024. Summary of NO_2 concentration projections: 2017: 59 µg/m^3 2018: 55 µg/m^3 2019: 52 µg/m^3 2020: 49 µg/m^3 2021: 47 µg/m^3 2022: 44 µg/m^3 2023: 42 µg/m^3 2024: 40 µg/m^3	We have identified that package A brings forward compliance to 2021, package B to 2019 and package C to 2023. In part 5 of our study we have assessed these packages against the secondary success criteria and have recommended package B which includes a low emission strategy restricting access for older vehicles.	Our recommended measure that bring forward compliance is a low emission strategy across the city. A full impact assessment is required to support the preferred option e.g. HGV, Bus, taxi diesels to be Euro VI/6; petrol to be Euro IV/4 as minimum standards. The enforcement and need for complementary measures will be included in a more detailed impact assessment to underpin a full business case. This measure could be implemented in time to bring forward compliance from 2024. The full impact assessment would follow JAQU guidance and include a summary of the proposed approach to designing and implementing the measure including roles and responsibilities, key project milestones, any key dependencies including assumptions made regarding involvement

				of/actions taken by other stakeholders in scheme delivery beyond the local authority.
7421	No – this link was identified as being close to exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 39 µg/m^3	NA	NA
27431	No – this link was identified as being close to exceedance using local modelling data. A modelling checklist has been approved by	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 37 µg/m^3	NA	NA
7853	No – this link was identified as being close to exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 38 µg/m^3	NA	NA
17365	No – this link was identified as having an exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link will be compliant in 2018. Summary of NO_2 concentration projections: 2017: 42 µg/m^3 2018: 40 µg/m^3	NA	NA
27440	No – this link was identified as	We have updated the	NA	NA

	having an exceedance using local modelling data. A modelling checklist has been approved by JAQU	baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 31 µg/m^3		
57732	No – this link was identified as being close to exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 38 µg/m^3	NA	NA
75174	No – this link was identified as having an exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 38 µg/m^3	NA	NA
47968	No – this link was identified as being close to exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 31 µg/m^3	NA	NA
7413	No – this link was identified as having an exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link will be compliant in 2027. Summary of NO_2 concentration projections: 2017: 64 µg/m^3	We have identified that package A brings forward compliance from 2027 to 2022, package B does not bring forward compliance and package C brings forward compliance to 2023. In part 5 of	Our recommended measure that bring forward compliance is a low emission strategy across the city. A full impact assessment is required to support the preferred option e.g. HGV, Bus, taxi diesels to be Euro

		2018: 61 µg/m^3 2019: 58 µg/m^3 2020: 55 µg/m^3 2021: 52 µg/m^3 2022: 49 µg/m^3 2023: 47 µg/m^3 2024: 45 µg/m^3 2025: 42 µg/m^3 2026: 41 µg/m^3 2027: 39 µg/m^3	our study we have assessed these packages against the secondary success criteria and have recommended package B which includes a low emission strategy restricting access for older vehicles.	VI/6; petrol to be Euro IV/4 as minimum standards. The enforcement and need for complementary measures will be included in a more detailed impact assessment to underpin a full business case. Due to modelled traffic data being unavailable, the impact of a low emission strategy on this link could not be explicitly modelled. However, this link is on a key transport route into Bradford and therefore vehicles travelling along this link are anticipated to be cleaner after the implementation of the scheme and therefore the concentrations on this link would reduce, additionally this link could be included in the boundary of any future access restriction (this would need further modelling to identify the boundary, this is outside of the scope of this study) This measure could be implemented in time to bring forward compliance from 2027. The full impact assessment would follow JAQU

				guidance and include a summary of the proposed approach to designing and implementing the measure including roles and responsibilities, key project milestones, any key dependencies including assumptions made regarding involvement of/actions taken by other stakeholders in scheme delivery beyond the local authority.
37487	No – this link was identified as having an exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link will be compliant in 2023. Summary of NO_2 concentration projections: 2017: 55 µg/m^3 2018: 52 µg/m^3 2019: 49 µg/m^3 2020: 47 µg/m^3 2021: 44 µg/m^3 2022: 42 µg/m^3 2023: 40 µg/m^3	We have identified that Package A brings forward compliance from 2023 to 2021, package B to 2023 and package C to 2022. In part 5 of our study we have assessed these packages against the secondary success criteria and have recommended package B which includes a low emission strategy restricting access for older vehicles.	Our recommended measure that bring forward compliance is a low emission strategy across the city. A full impact assessment is required to support the preferred option e.g. HGV, Bus, taxi diesels to be Euro VI/6; petrol to be Euro IV/4 as minimum standards. The enforcement and need for complementary measures will be included in a more detailed impact assessment to underpin a full business case. Due to modelled traffic data being unavailable, the impact of a low emission strategy on this link could not be

				explicitly modelled. However, this link is on a key transport route into Bradford and therefore vehicles travelling along this link are anticipated to be cleaner after the implementation of the scheme and therefore the concentrations on this link would reduce. additionally this link could be included in the boundary of any future access restriction (this would need further modelling to identify the boundary, this is outside of the scope of this study) This measure could be implemented in time to bring forward compliance from 2023. The full impact assessment would follow JAQU guidance and include a summary of the proposed approach to designing and implementing the measure including roles and responsibilities, key project milestones, any key dependencies including assumptions made regarding involvement of/actions taken by other stakeholders in scheme delivery

				beyond the local authority.
80860	No – this link was identified as having an exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link will be compliant in 2019. Summary of NO_2 concentration projections: 2017: 44 µg/m^3 2018: 42 µg/m^3 2019: 40 µg/m^3	NA	NA
57940	No – this link was identified as being close to exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 39 µg/m^3	NA	NA
73115	No – this link was identified as being close to exceedance using local modelling data. A modelling checklist has been approved by JAQU	We have updated the baseline data using our local modelled data which shows that the link is now compliant. 2017 data: 37 µg/m^3	NA	NA

Preliminary Costings

1) Access Control implementation - Costs of this proposal total £3.02m. For an estimated breakdown of the costs see appendix 1. The costings are likely to be conservative as they are for the outer ring road alone (not extending through to Saltaire) and should be considered as conservative as only a high level of assessment has been undertaken on the potential crossing points of this cordon.
   An alternative (less expensive) ANPR roving enforcement option has also been investigated, however this could not be implemented unless the moving traffic violation powers are enacted for local authorities.

2) Targeted Travel Planning – Costs of this proposal total £0.4m, this is a key part of packages including the 1% reduction in car travel, this would complement any access restrictions. For a more detailed brief for this work see appendix 2

3) Canal Road bike path completion – Costs of this proposal total £0.2m, this is a key part of packages including the 1% reduction in car travel, this would complement any access restrictions. There is currently work already undertaken to provide a Canal Road Greenway. Section E which is the key link into the City Centre is currently unfunded (£0.2m estimated costs for completion of this section). For a plan of the section requiring further funding see appendix 3. This section of the route has the benefit of planning permission already in place so this proposal could be implemented relatively quickly if the funding were to become available.