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

[DRAFT UNAPPROVED]

Local authorities covered	Dudley MBC, Sandwell DC, Walsall MBC, Wolverhampton CC
Main contact	Dan Bowden
Version control	4.1

Created By	Daniel Bowden, Principal Consultant (AECOM)
Reviewed By	Duncan Urquhart, Principal Consultant (AECOM)
Approved By	Geoff Clarke, Regional Director (AECOM)

Glossary of Terms

Emissions Factor Toolkit (EFT)	(a Defra built tool to enable the analysis of air quality emissions based on traffic volumes and speed) to provide NO_X emissions.
NO_X	Nitrogen Oxide Emissions
NO_2	Nitrogen Dioxide
Euro IV/V/VI	European standards that impose limits on the level of emissions that can be issued per km or per KWh. The higher the Euro number, the lower the limits
Selective Catalytic Reduction (SCR)	An emissions treatment process that sprays ammonia into the exhaust. The ammonia reacts with the NO_X to produce steam, which is emitted from the tailpipe.
Gating	The holding of traffic in one area to allow traffic to move in another. This is usually done through signals rather than physical barriers
HGV	Heavy Goods Vehicle – any vehicle with a gross weight over 7.5 tonne
PSV	Passenger Service Vehicle – such as a bus or a coach
Selective Vehicle Detection (SVD)	A system enabling vehicles to interact with traffic signals via transponder. It allows authorities to give certain vehicles such as buses or emergency

	service vehicle priority at signals.

1 Part 1: Understanding the problem

Acting collectively as the Black Country Local Authorities, this submission covers the three Metropolitan boroughs of Dudley, Sandwell and Walsall and the City of Wolverhampton.

The following road links within the Black Country area have been identified in the Department for Environment, Food and Rural Affairs (Defra) PCM National Model as having projected exceedances of the annual mean nitrogen dioxide (NO_2) National Air Quality Objective (NAQO) of 40 micrograms per cubic meter (μgm^{-3} subsequently referred to as 'the threshold'):

Table 1.1: Summary of links in exceedance

Census ID	Location	Local Authority	Description	Est Year of Compliance
17142	A457 Oldbury	Sandwell	Roundabout with the A4034 and roundabout linking the A4031	2019
99155	A41, J1 M5 West Bromwich	Sandwell	Between the roundabout with M5 Junction 1 & the local authority boundary with Birmingham City Council	2020
99397	A41 Black Country Route at Wednesbury	Sandwell	Roundabout with the A4037 and the roundabout with A461 at Wednesbury	2020
16330	A34 Great Barr	Sandwell	Junction at A4041 Newton Road and the M6 at junction 7	2019
28464	A4150 Ring Road	Wolverhampton	St David's between Broad Street and Bilston Street Island	2020
57739	A4150 Ring Road	Wolverhampton	St George's between Bilston Street Island and Snow Hill Junction	2021
99402	A463 Black Country Route (BCR)	Wolverhampton	Between Wolverhampton Street and Black Country New Road	2020
99404	A463 Black Country Route (BCR)	Wolverhampton	Between Oxford Street and Coseley Road	2019
27202	A454 Black Country Route (BCR)	Walsall	Running westwards from J10 M6 towards A463 Black Country Route	2021
38201	A454 Wolverhampton Road / A4148 Wolverhampton Street	Walsall	Wolverhampton Road A454/ Pleck Road A4148 junction into Wolverhampton Street into Blue Lane West A4148 to junction with Green Lane A34 /Court Way A4148	2020
74559	A461	Dudley	Cinderbank Island to Castlegate Island / Duncan Edwards Way	2020
17611	A461	Dudley	Castlegate Island to Burnt Tree Junction / Birmingham Road	2020
57205:	A491, High Street, Wordsley	Dudley	Lawnswood Road to Church Road	2021+

Table 1.1 summarises the PCM modelled exceedances of the European Union (EU) Limit/NAQO value for these road links, whilst Table 1.2 compares this to available, local air quality monitoring. Further discussion of these data are provided in subsequent sections of Part 1.

Reference is made to documentation published by Defra relating to the exceedances, to the ADMS Urban Road Traffic NO_2 model, run by Walsall MBC and the council's statutory reports compiled in fulfilment of Local Air Quality Management (LAQM) obligations. It also draws upon traffic count information sourced from the authorities' own traffic count data and the Department for Transport (DfT).

Roads in exceedance	Local Authority	Census ID	Defra PCM Annual Mean NO_2 Concentration ($\mu g/m^3$)					Emission Source apportionment (%)
			2017	2018	2019	2020	2021	
A457 Oldbury	Sandwell	17142	43	41	39	37	35	Regional Bg: 5, Urban Bg (non traffic): 19, Urban Bg (traffic): 23, Diesel Cars: 16, Petrol Cars: 4, Diesel LGVs: 15, Petrol LGVs: 0, HGVr: 9, HGVa: 5, Buses: 4,
A41, J1 M5 West Bromwich	Sandwell	99155	46	44	42	39	37	Regional Bg: 4, Urban Bg (non traffic): 13, Urban Bg (traffic): 13, Diesel Cars: 22, Petrol Cars: 5, Diesel LGVs: 17, Petrol LGVs: 0, HGVr: 11, HGVa: 7, Buses: 7,
A41 Black Country Route at Wednesbury	Sandwell	99397	47	44	42	39	37	Regional Bg: 4, Urban Bg (non traffic): 13, Urban Bg (traffic): 13, Diesel Cars: 22, Petrol Cars: 5, Diesel LGVs: 17, Petrol LGVs: 0, HGVr: 11, HGVa: 7, Buses: 7,
A34 Great Barr	Sandwell	16330	43	41	39	37	35	Regional Bg: 5, Urban Bg (non traffic): 9, Urban Bg (traffic): 24, Diesel Cars: 22, Petrol Cars: 5, Diesel LGVs: 15, Petrol LGVs: 0, HGVr: 9, HGVa: 5, Buses: 4,
A4150 Ring Road	Wolverhampton	28464	49	46	43	41	39	Regional Bg: 0.04, Urban Bg (non traffic): 17, Urban Bg (traffic): 16, Diesel Cars: 22, Petrol Cars: 5, Diesel LGVs: 11, Petrol LGVs: 0, HGVr: 9, HGVa: 3, Buses: 10,
A4150 Ring Road	Wolverhampton	57739	44	42	40	38	36	Regional Bg: 5, Urban Bg (non traffic): 20, Urban Bg (traffic): 18, Diesel Cars: 24, Petrol Cars: 6, Diesel LGVs: 14, Petrol LGVs: 0, HGVr: 9, HGVa: 2, Buses: 3,
A463 Black Country Route (BCR)	Wolverhampton	99402	49	46	43	41	38	Regional Bg: 4, Urban Bg (non traffic): 8, Urban Bg (traffic): 11, Diesel Cars: 19, Petrol Cars: 4, Diesel LGVs: 15, Petrol LGVs: 0, HGVr: 23, HGVa: 15, Buses: 1,
A463 Black Country Route (BCR)	Wolverhampton	99404	43	41	39	37	34	Regional Bg: 4, Urban Bg (non traffic): 11, Urban Bg (traffic): 14, Diesel Cars: 19, Petrol Cars: 4, Diesel LGVs: 15, Petrol LGVs: 0, HGVr: 10,

Roads in exceedance	Local Authority	Census ID	Defra PCM Annual Mean NO_2 Concentration (µg/m^3)					Emission Source apportionment (%)
			2017	2018	2019	2020	2021	
								HGVa: 12, Buses: 10,
A454 Black Country Route (BCR)	Walsall	27202	50	47	44	41	38	Regional Bg: 3, Urban Bg (non traffic): 7, Urban Bg (traffic): 11, Diesel Cars: 18, Petrol Cars: 4, Diesel LGVs: 12, Petrol LGVs: 0, HGVr: 21, HGVa: 22, Buses: 2,
A454 W'hampton Road / A4148 W'hampton Street	Walsall	38201	47	44	42	40	38	Regional Bg: 4, Urban Bg (non traffic): 15, Urban Bg (traffic): 15, Diesel Cars: 25, Petrol Cars: 6, Diesel LGVs: 16, Petrol LGVs: 0, HGVr: 10, HGVa: 9, Buses: 2,
A461	Dudley	74559	45	43	41	38	36	Regional Bg: 5, Urban Bg (non traffic): 19, Urban Bg (traffic): 23, Diesel Cars: 16, Petrol Cars: 4, Diesel LGVs: 15, Petrol LGVs: 0, HGVr: 9, HGVa: 5, Buses: 4,
A461	Dudley	17611	45	43	41	38	36	Regional Bg: 4, Urban Bg (non traffic): 13, Urban Bg (traffic): 13, Diesel Cars: 22, Petrol Cars: 5, Diesel LGVs: 17, Petrol LGVs: 0, HGVr: 11, HGVa: 7, Buses: 7,
A491, High Street, Wordsley	Dudley	57205:	52	51	49	48	47	Regional Bg: 4.9, Urban Bg (non traffic): 7.5, Urban Bg (traffic): 9.2, Diesel Cars: 18.5, Petrol Cars: 4.3, Diesel LGVs: 10.5, Petrol LGVs: 0, HGVr: 5.1, HGVa: 1.3, Buses: 4.3,

Table 1.2 Summary of PCM Road Link Exceedances in the Black Country Administrative Area

1.1 Baseline Air Quality Monitoring

Air quality monitoring is undertaken at sites in close proximity to a number of the census locations identified by the Joint Air Quality Unit (JAQU) as having or previously having exceedances. Monitoring is undertaken using a network of passive NO_2 diffusion tubes as well as chemiluminescence, OPSIS continuous monitoring and AQ Mesh equipment at locations identified as having a specific air quality (AQ) problem. Table 1.3 identifies these sites:

Table 1.3: Local Air Quality Monitoring results

Roads in exceedance[1]	Local Authority	Census ID	Defra PCM Annual Mean NO_2 Concentration (μgm^{-3})				
			2013	2014	2015	2016	2017
A457 Oldbury	Sandwell	17142	42	42	42	40	36
A41, J1 M5 West Bromwich	Sandwell	99155	Not Available				
A41 Black Country Route at Wednesbury	Sandwell	99397	Not Available-				
A34 Great Barr	Sandwell	16330	33	32	27	31	-
A4150 Ring Road	Wolverhampton	28464	Not Available				
A4150 Ring Road	Wolverhampton	57739	Not Available				
A463 Black Country Route (BCR)	Wolverhampton	99402	Not Available				
A463 Black Country Route (BCR)	Wolverhampton	99404			40	43	38
A454 Black Country Route (BCR)	Walsall	27202	Not Available				
A454 Wolverhampton Road / A4148 Wolverhampton Street	Walsall	38201	40	40	39	42	34
A461	Dudley	74559	Not Available				
A461	Dudley	17611	46	46	43	48	43
A491, High Street, Wordsley	Dudley	57205:	59	60	50	53	52

[1] Figures are at the analyser rather than at the nearest relevant receptors as determined by distance fall-off

For the sites where data is available, the links appear to be meeting the AQ limits by 2017, with the exception of site 17611. Further detail around the links is set out below.

1.2 Road Links Detail:

Figure 1 shows each of the links highlighted Defra's PCM model relative to Local Authority are boundaries. Blue routes are on the Strategic Road Network (SRN) (Highways England (HE) Managed) links. Green routes are Local Authority managed and therefore within the scope of this submission, Yellow routes are with Defra for eview

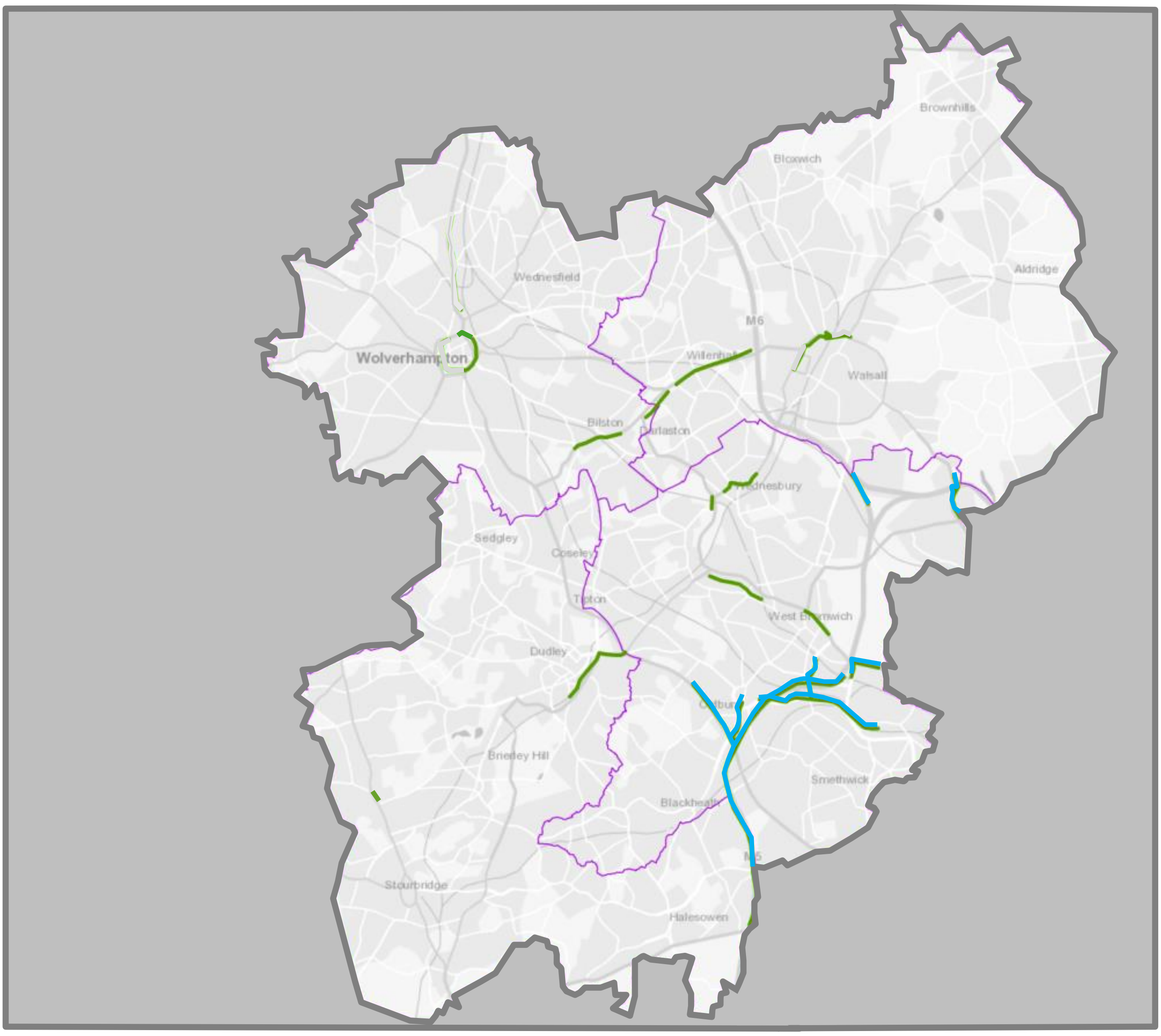
The following sections provide greater detail around the location and characteristics of each link as well as the level of reductions required in order to meet AQ thresholds.

- Description
- AQ PCM vs AQM reductions required
- Exposure
- Traffic Data & Source Apportionment

Government Traffic Data: The section uses Department for Transport (DfT) Annual Average Daily Traffic counts and source apportionment from both Department for the Environment, Food and Rural Affairs (Defra)'s PCM Model and the Emissions Factor Toolkit.

Black Country ADMS Urban Road Traffic NO_2 model: The section also compares the government's data against the localised modelling undertaken by Walsall MBC and on behalf of other Black Country Local Authorities

Figure 1 Road Links with Projected Exceedances in the Black Country Administrative Area



1.3 DUDLEY MBC

1.3.1 Road Link 74559: Cinderbank Island to Castlegate Island / Duncan Edwards Way (A461)

This link is the A461 Dudley Southern bypass route (figure 2), designed to direct traffic around Dudley town centre to ease congestion & the associated air quality issues both within and around Dudley centre.

Figure 2: Map to show area of exceedance

This road link was designed specifically to exclude pedestrians; there are no continuous footways located adjacent to the highway, no bus stops & hence no bus routes along this road link. The only pedestrian contact is via crossing facilities that effectively join the roads severed by the construction of the road link and provide access from residential areas to Dudley Town centre.

NO_2 Reductions Required to meet AQ Thresholds (Defra/JAQU)

Table 1.4: NO_2 Reductions Required

	Data Source	2017	2018	2019	2020	2021
DfT/Defra	Forecast	45	43	41	38	36
	Reduction Required %	11.1%	7.0%	2.4%	-	-

Relevant Exposure

The Council considers exposure to be limited to some short stretches of pavement closer than 15m to the roadway as well as residential property at Claughton Road. Pedestrian contact is also via footbridge crossings that effectively join the roads severed by the construction of the road link and provide access from residential areas to Dudley Town centre. The exposure potential for pedestrians using these crossings is therefore very low.

There is no evidence of frequently queuing traffic on the carriageway located nearest to the property in Claughton Road

Traffic Volume and Source Apportionment

Table 1.5 shows the source apportionment for the link, discounting the regional background, sources are primarily from road traffic.

There is a plan to build a new development, known as Portesfield including links off the bypass and a metro stop. Signalised access will be created from the bypass and the road section will become part of the bus route. This is scheduled to occur in 2020/2021and therefore could potentially increase emissions above PCM forecasts. However if Modal shift towards the tram occurs, this may will have a positive effect on emissions.

Table 1.5: Source Apportionment – DfT/Black Country Model Comparison

Data Source	Total Traffic	Diesel Car	Petrol Car	LGV	HGVr	HGVa	PSV
Defra/DfT	38971	40%	6%	27%	21%	4%	2%

It can be seen that diesel cars are the most prolific in terms of traffic types, though the percentage of HGV and LGV vehicles is higher than average. As such, should they be deemed required, any interventions should focus on general car traffic and potentially targeting freight and logistics operations. The low apportionment of PSV reflects that no buses use this route.

1.3.2 Road Link 17611: Castlegate Island to Burnt Tree Junction / Birmingham Road (A461)

This link consists of the A461 Birmingham Road dual carriageway linking the Castlegate Island access point to Dudley Town Centre with the A4123 New Birmingham Road (see figure 2), which links Wolverhampton to Birmingham.

NO2 Reductions Required to meet AQ Thresholds (Defra/JAQU)

Table 1.6 NO_2 Reductions Required

	Data Source	**2017**	**2018**	**2019**	**2020**	**2021**
DfT/Defra	Forecast	45	43	41	38	36
	Reduction Required %	11.1%	7.0%	2.4%	-	-

Relevant Exposure

Air quality had been improving on this stretch of road, but following the construction of a nearby superstore and completion of a major highways scheme at Burnt Tree Junction, whereby signalisation was introduced in close proximity to the monitoring location an increase in the annual average NO_2 concentrations has been recorded

The carriageway from Burnt Tree to Castlegate has adjacent residential accommodation along much of its length on the southern side; however, much of the residential property is elevated & separated from the carriageway by a significant retaining wall.

The monitoring point is at the façade of a block of four terraced buildings located at 76 – 82 Birmingham Road, three of the buildings are used for residential accommodation. There was likely to have been relevant exposure at the three residential properties up to and including 2017. This road link is provided with footways along its entire length, mostly positioned immediately adjacent to the highway. There are numerous bus services utilising this road link as a gateway into and out of Dudley Metropolitan Borough.

Traffic Volume and Source Apportionment

Table 1.7: Source Apportionment – DfT/Black Country Model Comparison

Data Source	Total Traffic	Diesel Car	Petrol Car	LGV	HGVr	HGVa	PSV
Defra/DfT	39,206[2]	37%	5%	24%	16%	3%	13%

It can be seen that similar to the previous link, the most frequent vehicle is the diesel car, along with a higher than average proportion of LGVs and rigid HGVs, therefore any interventions should look to address general traffic flow or potentially goods vehicles. The high level of PSV sources reflects the intensity of this route in terms of buses with 98 vehicles using the route, creating 600 2 way departures per day. Table 1.8 shows the services running on the route.

Table 1.8 Bus Services Using the Link

Operator	Services	Buses
National Express (NX)	87	25
NX	74	29
NX	11/13	10
NX	42/43	9
Diamond	**229**	3
NX	**126**	22

[2] Specific count not available – adjacent road section used (74559).

1.3.3 Road Link 57205: A491, High Street, Wordsley

The section of road provides part of the strategic network within the borough and is a congested narrow road with gradients and high building façades. The section in question concerns the link between Lawnswood Road/Blandford Drive and Church Road. Figure 3 shows the layout.

This was not identified by Defra/JAQU in their PCM model. However local monitoring equipment, approved under EU guidelines has identified the section of road as being well in exceedance of the 40µg^{-3} threshold. The decision has been taken in conjunction with JAQU that it should be included within the feasibility study.

Figure 3: Area of exceedance around Wordsley High Street.

NO_2 Reductions Required to meet AQ Thresholds (Defra/JAQU)

The PCM data for this link shows it well below the 40 µgm^{-3} threshold, however, historical, local AQ data presents a contrasting picture, with levels well in excess of 50 µgm^{-3}. Future trends have been derived using straight line regression methods set out in figure 4.

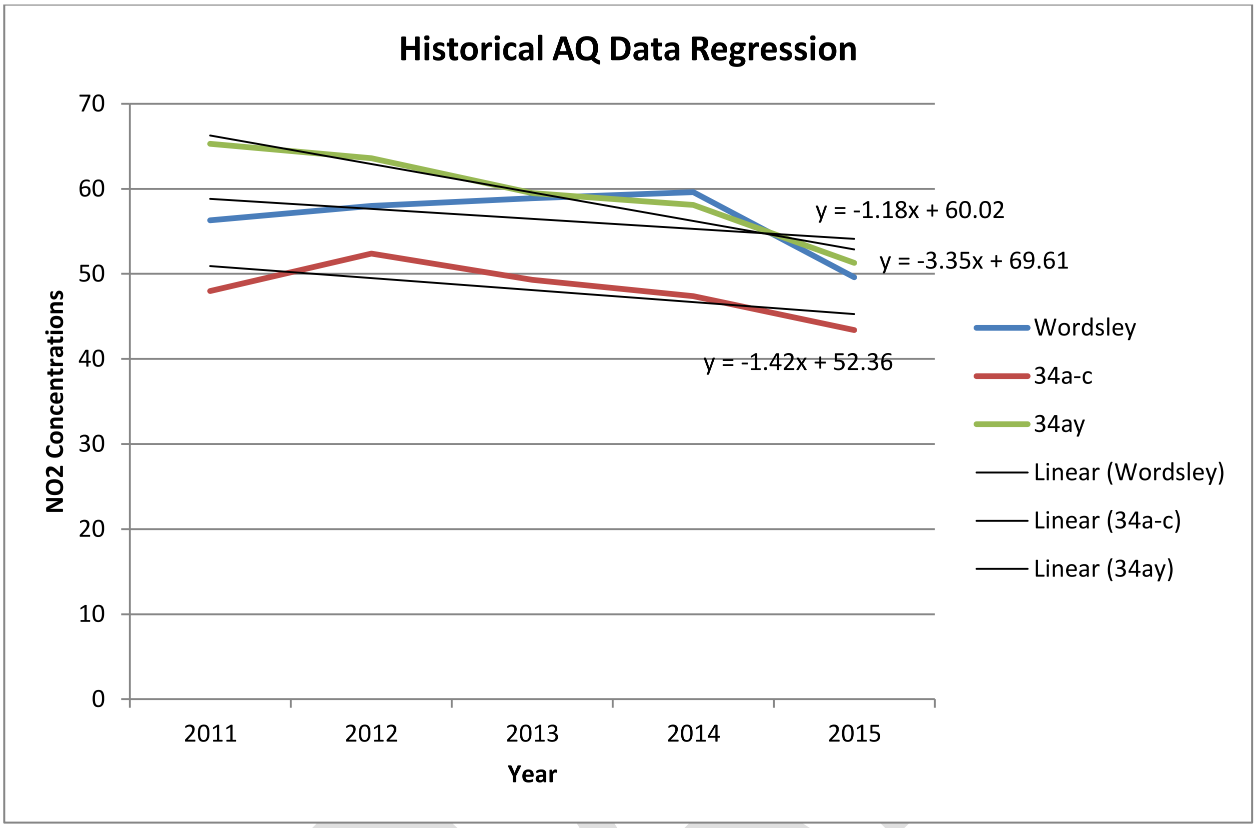


Figure 4: AQ data Regression

Future trends are set out in table 1.9, which shows that all three of the sensor points are likely to remain in exceedance in 2018, two becoming marginally compliant in 2019 and one sensor remaining well in exceedance past 2021, still requiring a 15% reduction in NO_2 and finally reaching the threshold in 2027. Meeting it in 2019 will require a 19% reduction in concentrations.

Site ID	NO_2 Annual Mean Concentration (µgm^{-3})												
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	…	2027	2028
Wordsley	56.3	58	58.9	59.6	49.6	*52.94*	*51.76*	*50.58*	*49.4*	*48.22*	*47.04*	…	*39.96*	*38.78*
34a-c	48.0	52.4	49.3	47.4	43.4	*43.84*	*42.42*	*41.00*	*39.58*	*38.16*	*36.74*	…	*28.22*	*26.8*
34ay	65.3	63.6	59.5	58.1	51.3	*49.51*	*46.16*	*42.81*	*39.46*	*36.11*	*32.76*	…	*12.66*	*32.76*
34h					30									
34d	41.6	38.2												

Table 1.9 NO_2 modelling

<u>Relevant Exposure</u>

The exceedances are identified as extending for 110m indicated on the plan above, where there is relevant exposure with residential property above the shops, there are also footways either side of the road with residential and commercial frontages within the 15m exposure zone of the road. The Wordsley AQMS results also demonstrate exceedances of the short term hourly average, on five occasions in 2015 and 17 occasions in 2013.

Traffic Volume and Source Apportionment

Count data shows there is a bidirectional flow of greater than 25,000 vehicles per day, though estimated DfT data suggests this is nearer 20,000 annual average daily traffic, likely due to these only being 12 hour counts. Excluding background emissions, table 1.10 states the following in terms of source apportionment based on averages from the three monitoring points:

Data Source	Total Traffic	Diesel Car	Petrol Car	LGV	HGVr	HGVa	PSV
Local Conts/EFT	25,000[3]	32.43%	4.17%	16.53%	6.13%	1.57%	13.37%

Table 1.10 Source Apportionment

Diesel cars and LGVs are clearly high contributors to emissions, similarly PSV contributions are also high, reflecting the 31 buses using the route, creating 100 2-way departures. Table 1.11 shows the services using the High Street.

Operator	Service	Buses
Diamond	226	6
National Express	256/257	21
Diamond	257	2
Diamond	267	1
Diamond	657	1

Table 1.11: Bus services using the link

[3] Specific count not available – adjacent road section used (74559).

1.4 SANDWELL MBC

There are seven road links situated within Sandwell where the annual mean concentration of NO_2 is projected to exceed 40 μgm^{-3} beyond 2018.

There are four road links that are under local authority control and 3 road links managed by Highways England. Appendix 1 contains the links associated with the Local Authority)

1.4.1 General Points

The A34, A457 and A41 are all experiencing high levels of traffic associated with diversion due to maintenance/upgrade works to the Oldbury viaduct, part of the M5. These roads have been adversely affected from spring 2017 and this is due to continue through to spring 2019

1.4.2 Road Link 17142 (A457) Birmingham Road Oldbury)

This road link (show in figure 5) is a 1.9km length of the A457 in Oldbury. The start point is a roundabout with the A4034 which is a dual carriageway leading to Junction 2 of the M5 and the end point is the roundabout with the A4031, a road that connects to the A41 at West Bromwich (A41) and the M5 via A4182 (Kenrick Way).

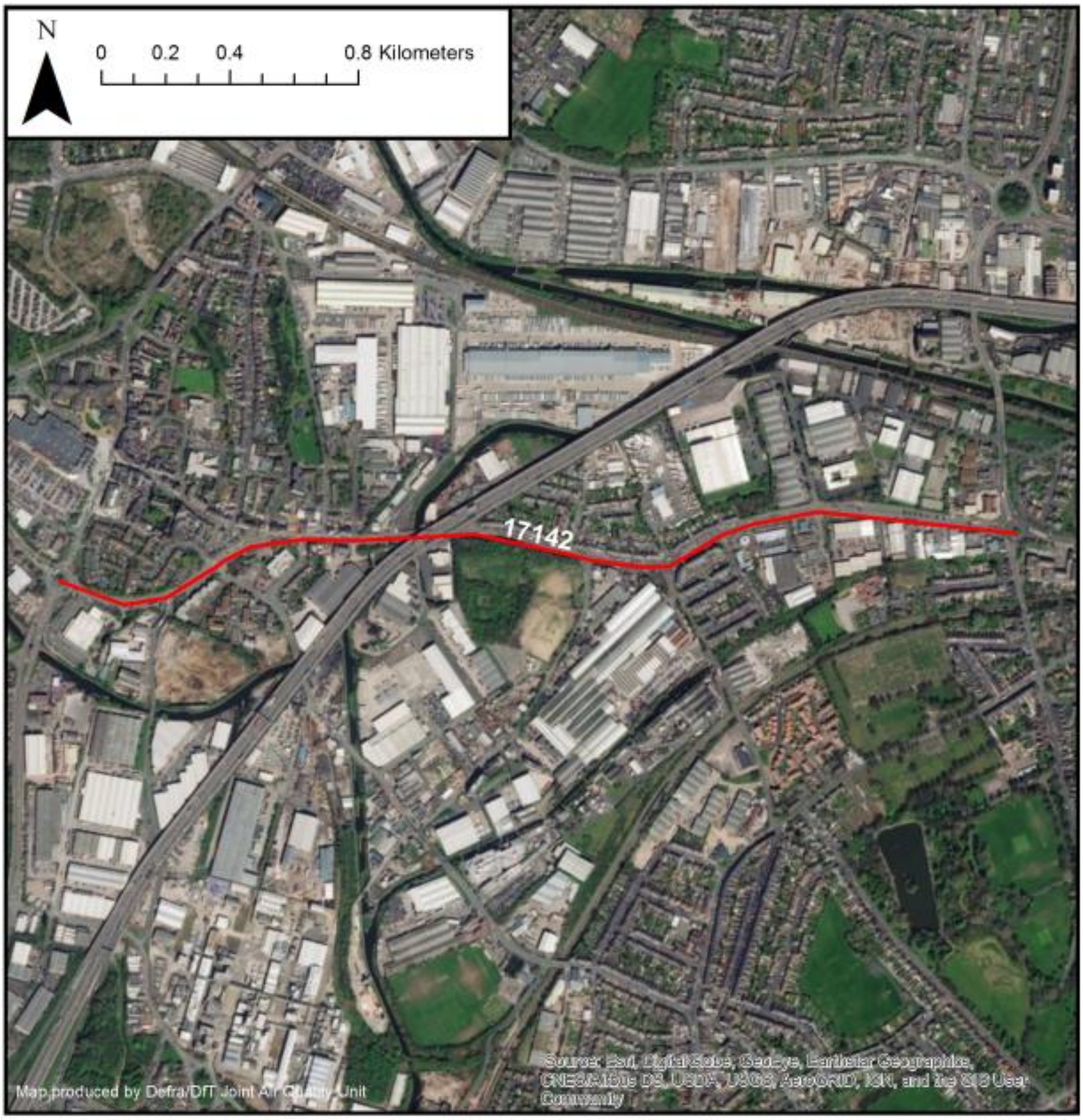


Figure 5: Map showing area of exceedance

The A457 runs under M5 Oldbury viaduct at the junction with Blakeley Hall Road. The 3km Oldbury viaduct is undergoing repairs and the A457 is a recognised diversion route during these major works, although much of the long-distance traffic remains on the M5. During this period, there could be some local re-routing where traffic normally joining the M5 at junctions 1 or 2 could instead use the local road network to join the M5 at alternative junctions. Road users may perceive time savings which can be made due to the 30mph speed limit through the M5 roadworks. The contra-flow lane restrictions on the M5 which commenced in July 2017 will be lifted in autumn/winter 2018 and replaced by three narrow lanes in each direction until spring 2019 when the work will be complete.

NO_2 Reductions Required to meet AQ Thresholds (Defra/JAQU)

Table 1.12 NO_2 Reductions Required

	Data Source	2017	2018	2019	2020	2021
DfT/Defra	Forecast	43	41	39	37	35
	Reduction Required %	7.0%	2.4%	-	-	-

Defra data shows compliance by 2019 and therefore there are limited interventions that are able to further bring forward this compliance

In addition, local AQ monitoring, part of the Automatic Urban Rural Network (AURN) also indicates that the site has already met the threshold limits since 2016, with 2017 levels as low as 36 μgm^{-3}. Further details are contained in the 2018 Air Quality Annual Status Report (ASR), which will be submitted to Defra in due course.

As such, it is proposed that this section of road is declared out of scope.

Relevant Exposure

The Council considers that the western section of the road is subject to residential and commercial uses. The number of bus services which use the section to the west of the M5 is greater than the section to the east. There could also be an imbalance in relation to the sections which are used by lorries and vans associated with the major DPD depot.

There are terraced properties situated on the Eastern stretch of the road link. There are also commercial and industrial uses along this length of the road with a major steel premises being built opposite the terraced properties on the corner of Popes Lane.

The surrounding area comprises residential houses, shops and some industry. The M5 motorways lies approximately 140 m to the North.

Traffic Volume and Source Apportionment

Excluding regional background, the source of emissions from road transport traversing along the corridor, table 1.13 shows the apportionment between vehicle types.

Table 1.13: Source Apportionment – DfT/Black Country Model Comparison

Data Source	Total Traffic	Diesel Car	Petrol Car	LGV	HGVr	HGVa	PSV
Defra/DfT	27081	40%	6%	30%	15%	3%	5%

The source apportionment of the route is reflective of the wider network, with the greatest share given to diesel cars. There is also a higher than average count of LGVs and HGVr, likely as a result of the nearby DPD depot. The 5% source apportionment from PSVs is not necessarily reflective of the 53 buses and resultant 410 departures and this may largely be due to the relatively modern fleet operating on the route. Table 1.14 sets out the services

Operator	**Service**	**Buses**
Diamond	21	1
National Express (NX)	87	25
NX	120	9
NX	120A	7
Diamond	122	1
NX	128	10

Table 1.14: Bus services travelling on the link

As such any interventions should address the general traffic flow as well as work with DPD to look at potential fleet changes towards lower emission vehicles. We will also look reduce the emissions from PSVs.

1.4.3 Road Link 16330 (A34) Birmingham Road Great Barr

The road link (see figure 6) is a 0.7 km length of dual carriageway between the busy road junction at A4041 Newton Road and the M6 at junction 7. See attached image showing the full length of the road link (Appendix 5) and north and south sub sections (Appendices 6 and 7)

Figure 6: Map to show area of exceedance

The road forms the main link between Walsall and Birmingham and carries significant volumes of M6 related traffic with origins and destinations in the centre of Birmingham, Walsall and around West Bromwich.

NO_2 Reductions Required to meet AQ Thresholds (Defra/JAQU)

Table 1.15 NO_2 Reductions Required

	Data Source	2017	2018	2019	2020	2021
DfT/Defra	Forecast	43	41	39	37	35
	Reduction Required %	7.0%	2.4%	-	-	-

Defra data shows compliance by 2019 and therefore there are limited interventions that are able to further bring forward this compliance

In addition, local AQ monitoring tubes on the route, as shown in figure 7 also indicates that the site has already met the threshold limits since 2016, as shown in table 1.16

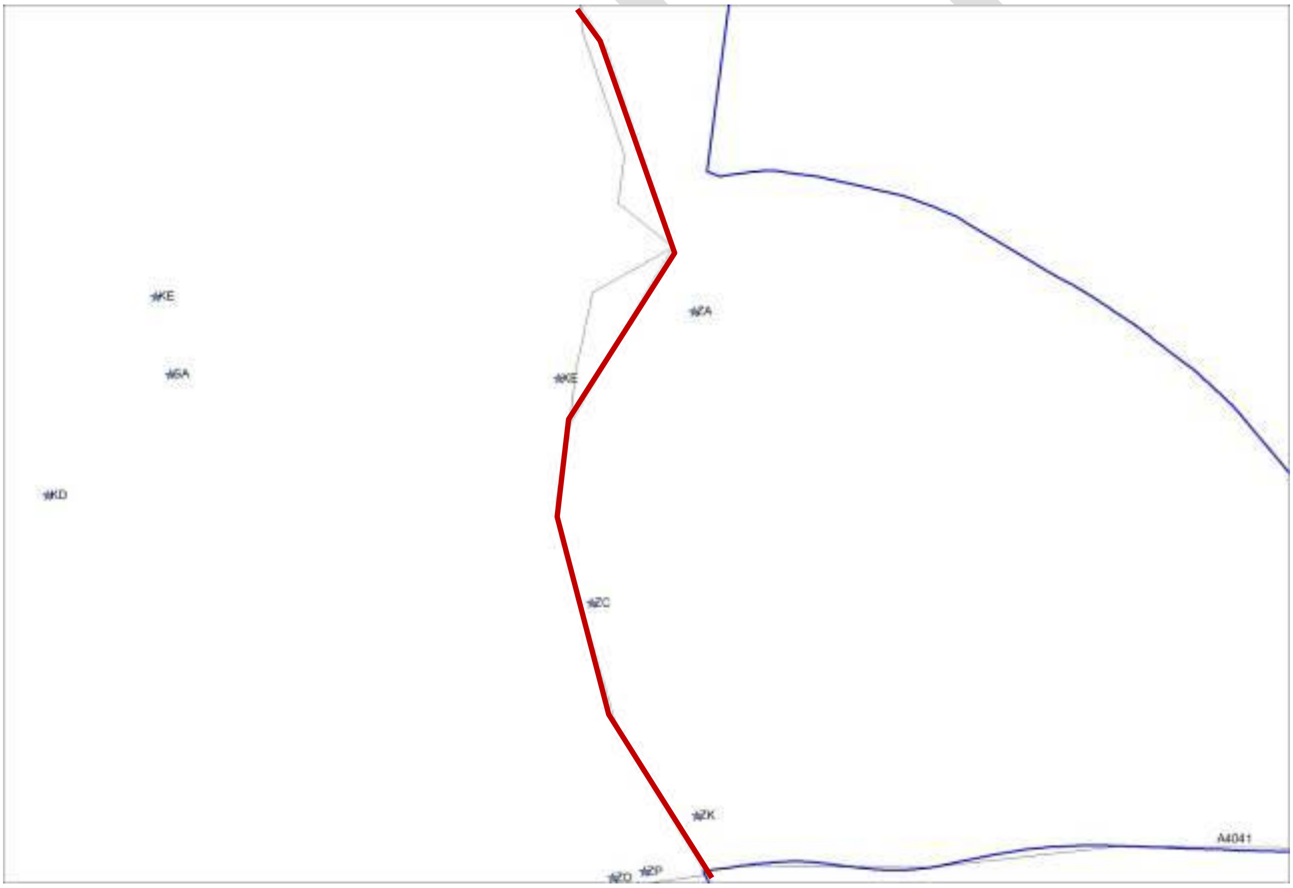


Figure 7: Diffusion tube Locations on the A34

Table 1.16: Local diffusion tube monitoring

Roads in exceedance	Tube ID	Defra PCM Annual Mean NO_2 Concentration (μgm^{-3})				
		2013	2014	2015	2016	2017
A457 Oldbury(A34) Birmingham Road Great Barr	XE	33	32	27	31	-
	ZA	36	36	30	29	
	ZC	32	26	27	31	
	ZK	32	29	29	31	

Relevant Exposure

The Council considers that the area is predominantly residential housing on the Northern section with a more diverse range of uses (residential, retail and commercial) on the southern section particularly the junction with the Newton Road (A4041). Residential properties are set back from the road and the nearest residential properties being within 13 metres of the centre of the carriage way.

A frequent bus service operates between Walsall and Birmingham, along with a limited-stop service. This will be supplemented by a Sprint service connecting Walsall and Birmingham ahead of the Commonwealth Games in 2022, but probably after 2021.

Traffic Volume and Source Apportionment

Excluding regional background, the source of emissions is primarily from road transport traversing along the corridor. Table 1.17 shows the apportionment between vehicle types.

Table 1.17: Source Apportionment – DfT/Black Country Model Comparison

Data Source	Total Traffic	Diesel Car	Petrol Car	LGV	HGVr	HGVa	PSV
Defra/DfT	34986	45%	6%	27%	12%	3%	6%

The source apportionment is reflective of the wider network and any interventions should reflect on general traffic flow as well as the flow of light and rigid goods vehicles.

Traffic conditions on this section of road are largely influenced by the signalised (Scott Arms) junction with the A4041, which also carries significant volumes of traffic along an east-west corridor. Much work has been carried out to increase the capacity of the junction by making the signals work as efficiently as possible, which may account for the lower AQ readings seen on local monitoring. Without any significant re-configuration of the junction however, or indeed significant changes in modal share or trip-making, no further capacity gains can be made from signalisation-based improvements.

The bus services using the A34 all terminate in Birmingham therefore the buses are either already at Euro VI standard or will be retro-fitted by 2020. The two-way total bus traffic in a weekday daytime hour is 52 buses, creating 410 individual 2-way departures. This number includes 14 buses which use the (east-west) A4041 the emissions from which therefore affect the southern end of this section of the A34. Table 1.18 shows the services on this corridor

Operator	**Service**	**Buses**
Green Bus	851	1
National Express (NX)	51	19
Claribels	424	5
NX	X51	21
Diamond	40	6

Table 1.18: Bus services travelling on the link

1.4.4 Road Link 99155 (A41) Birmingham Road West Bromwich

It is a **0.65km** stretch of road between the roundabout with M5 Junction 1 the local authority boundary with Birmingham City Council and the end point is the roundabout at M5 Junction (see figure 8)

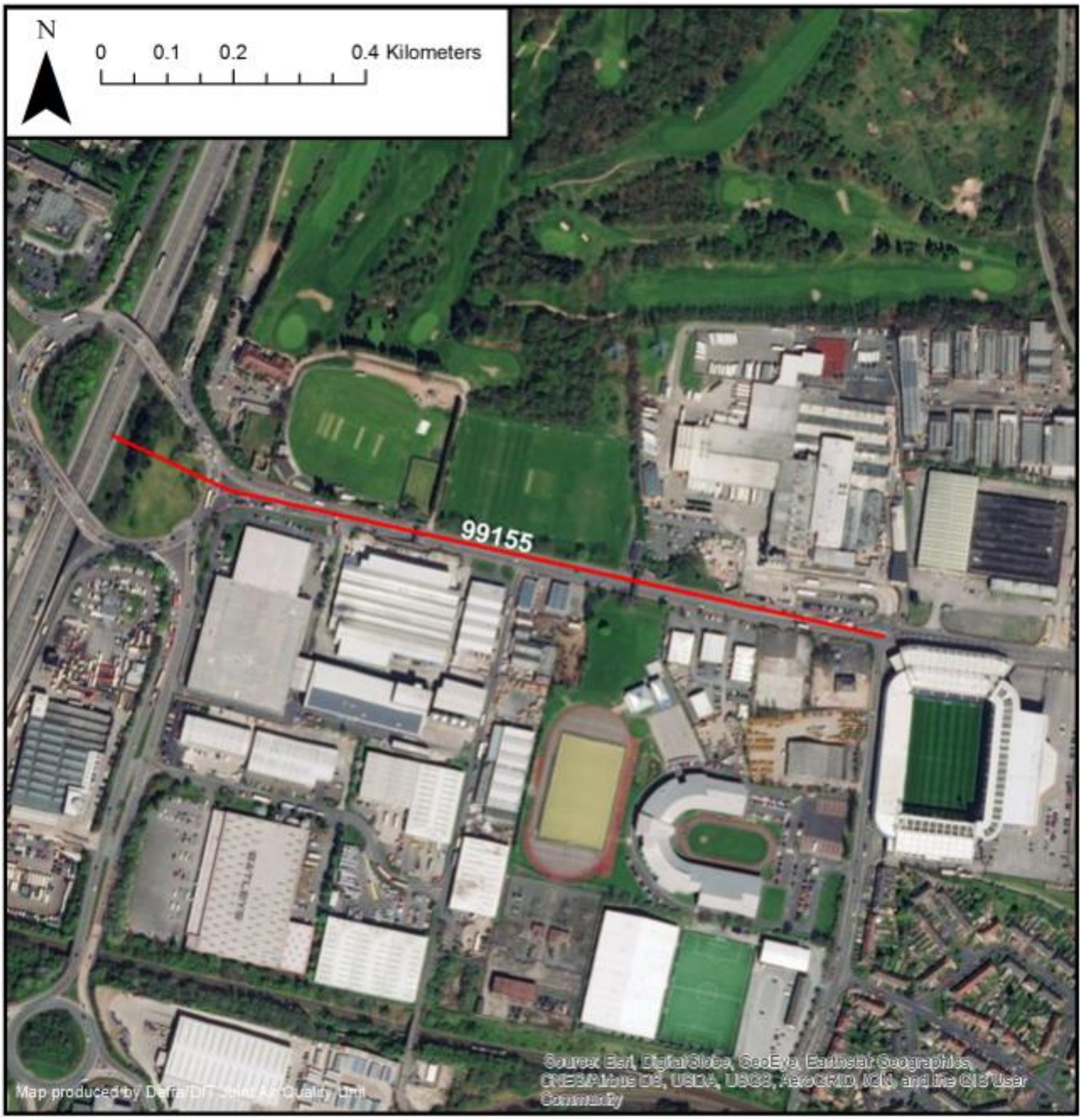


Figure 8: Map to show area of exceedance

NO_2 Reductions Required to meet AQ Thresholds (Defra/JAQU)

Table 1.19 NO_2 Reductions Required

	Data Source	2017	2018	2019	2020	2021
DfT/Defra	Forecast	46	44	42	39	37
	Reduction Required %	13.0%	9.1%	4.8%	-	-

Defra data shows compliance by 2020 and therefore there may be scope to put in place additional interventions in order to accelerate forecast compliance, congestion is a significant problem particular

The A41 is currently the main sign-posted route from M5 junction 1 towards the centre of Birmingham, passing through Handsworth and experiences high levels of congestion on a daily basis. Traffic congestion is therefore high at M5 junction 1 during both the AM and PM peaks, which is affected to some extent by the traffic signals which control access to the roundabout at junction 1.

Short term congestion on this section also occurs on days when West Bromwich Albion Football Club plays home matches at their ground on the eastern corner of Halford's Lane and A41, Birmingham Road. Temporary traffic management, which can reduce carriageway capacity in the evening peak, helps to accommodate the large volumes of pedestrians walking to the football ground from nearby parking areas. Weekend matches cause less disruption.

Proposals exist to down grade the A41 between M5, Junction 1 and Birmingham City Centre to B Road status with traffic being signed via the A457 instead. This can only occur following improvements to the Birmingham section of the A457 which are to be funded through the Birmingham & Solihull LEP and currently awaiting completion of land acquisition. Whilst this would lead to some reduction in traffic flows on the A41, traffic modelling suggests that this is unlikely to be significant as the existing constraints at Soho Road already act as a disincentive.

Relevant Exposure

The Council considers land uses along this section to include recreational/sports grounds, commercial/industry, food manufacturing and Sandwell Academy, the main entrance for which is on Halford's Lane (the main school building is 150m from the A41). There are little or no residential land uses. There are footways on either side of the road as well as bus stops.

The bus service using the A41 terminates in Birmingham therefore the buses are either already at Euro VI standard or will be retro-fitted by 2020. The two-way total bus traffic in a weekday daytime hour is 16 buses.

Traffic Volume and Source Apportionment

Excluding regional background, the source of emissions is primarily from road transport traversing along the corridor. Table 1.20 shows the apportionment between vehicle types.

Table 1.20: Source Apportionment – DfT/Black Country Model Comparison

Data Source	Total Traffic	Diesel Car	Petrol Car	LGV	HGVr	HGVa	PSV
Defra/DfT	31483	41%	6%	27%	14%	3%	8%

The source apportionment is reflective of the wider network and any interventions should reflect on general traffic flow as well as the flow of light goods vehicles.

It is possible that traffic volumes on this section of the A41 have been affected by some local re-routing where traffic normally joining the M5 at junctions 1 or 2 instead uses the local road network to join the M5 at alternative junctions. Road users may perceive time savings which can be made due to the 30mph speed limit through the M5 roadworks. The contra-flow lane restrictions on the M5 which commenced in July 2017 will be lifted in autumn/winter 2018 and replaced by three narrow lanes in each direction until spring 2019 when the work will be complete.

Repair work to the M5 Oldbury viaduct involves the replacement of deteriorated concrete superstructure and the drainage system, waterproofing and lighting upgrades. It is the largest concrete repair project ever undertaken in the UK, therefore over a period of two years there will be a significant impact on both the 120,000 vehicles per day which use this 3km stretch of motorway and local traffic.

The 8% source apportionment with PSV is also worthy of investigation and reflects 30 buses operating through the link creating 360 2-way departures. Table 1.21 shows the services accessing the link.

Operator	Service	Buses
National Express	74	29
Green Bus	851	1

Table 1.21: Bus services travelling on the link

1.4.5 Road Link 99397(A41) Black Country Route at Wednesbury

The road is a **0.3km** length of dual carriageway on the A41 Black Country Route, the start point is the roundabout with the A4037 and the end point is the roundabout with A461 at Wednesbury. (see figure 9)

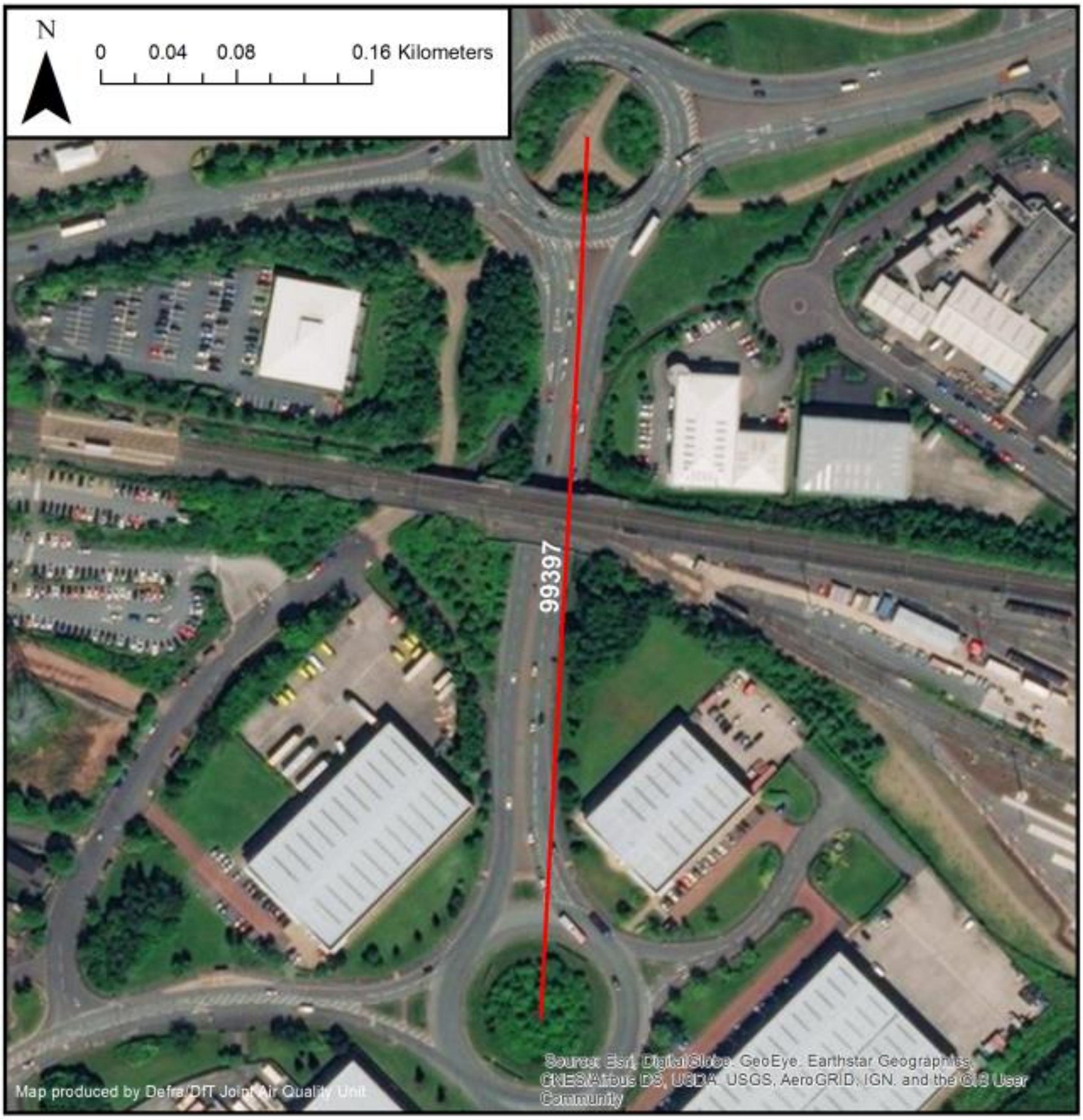


Figure 9

The road forms a link between Wednesbury to the north and east and West Bromwich and Tipton to the south and west, crossing the Midland Metro tram line.

NO_2 Reductions Required to meet AQ Thresholds (Defra/JAQU)

Table 1.22 NO_2 Reductions Required

	Data Source	2017	2018	2019	2020	2021
DfT/Defra	Forecast	47	44	42	39	37
	Reduction Required %	14.9%	9.1%	4.8%	-	-

Defra data shows compliance by 2020 and therefore there may be scope to put in place additional interventions in order to accelerate forecast compliance.

Relevant Exposure

The Council considers that there are no building frontages along this section. Mature bushes and trees, plus bridge abutments for the tram line and a pedestrian footway on the eastern side of the road, are main land uses. Behind the trees and bushes there are industrial units, a gym and two tram stations. On the west side of the road there are pedestrian and cycle links to the Wednesbury Parkway tram station, Wednesbury town centre and industrial land uses.

Traffic Volume and Source Apportionment

Excluding regional background, the source of emissions is primarily from road transport traversing along the corridor. Table 1.23 shows the apportionment between vehicle types.

Table 1.23: Source Apportionment – DfT/Black Country Model Comparison

Data Source	Total Traffic	Diesel Car	Petrol Car	LGV	HGVr	HGVa	PSV
Defra/DfT	39255	39%	6%	30%	15%	3%	7%

The source apportionment is reflective of the wider network and any interventions should reflect on general traffic flow as well as the flow of light goods vehicles and rigid HGVs The bus services using the A41 access areas in Wednesbury and Tipton. Few if any buses are either already at Euro VI standard or will be retro-fitted by 2020. The two-way total bus traffic in a weekday daytime hour is 17 buses, creating 190 two-way departures. Table 1.24 shows the services using the link. As such, measures will be reviewed to lower bus emissions.

Operator	Service	Buses
National Express	11/13	10
igo	22	5
Diamond	23	2

Table 1.24: Bus services travelling on the link

1.5 WALSALL MBC

1.5.1 Road Link 27202 A454

This concerns the 2.48 KM stretch of the Black Country Route A454 running westwards of M6 junction 10 into the Black Country Route A463 above the A462 Midland Road, Willenhall. (see figure 10)

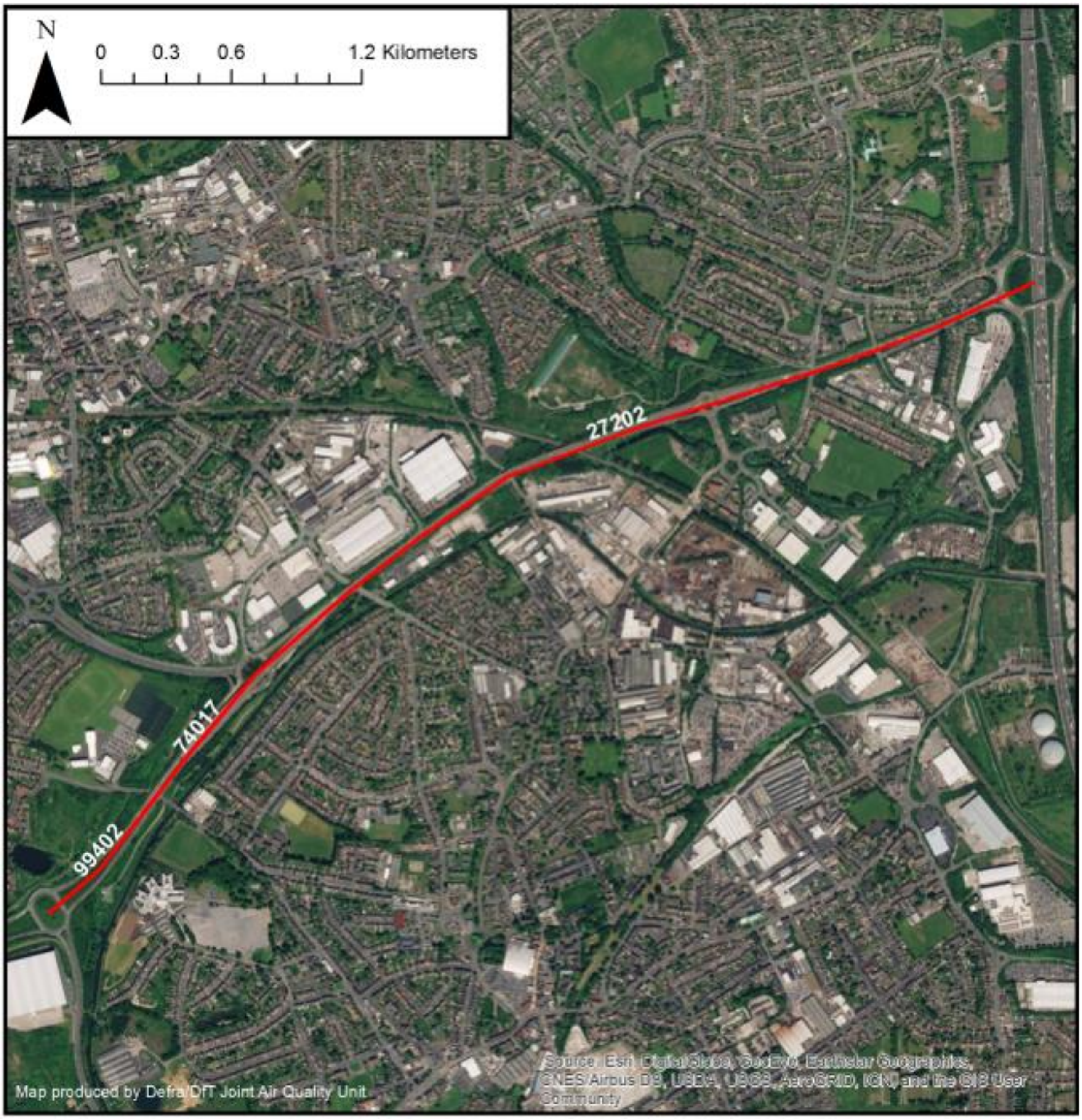


Figure 10

NO_2 Reductions Required to meet AQ Thresholds (Defra/JAQU)

Defra data forecasts compliance by 2021 and so there could be significant opportunity for interventions to bring forward the date of compliance.

Table 1.24 NO_2 Reductions Required

	Data Source	2017	2018	2019	2020	2021
DfT/Defra	Forecast	50	47	44	41	38
	Reduction Required %	20.0%	14.9%	9.1%	2.4%	-

Relevant Exposure

The Council considers there is relevant exposure for a length of 600m west of junction 10 of the M6 owing to residential properties sited on the junction and along the A454 BCR. No further exposure is apparent.

Traffic Volume and Source Apportionment

Excluding regional background, the source of emissions is primarily from road transport traversing along the corridor. Table 1.25 shows the apportionment between vehicle types.

Table 1.25: Source Apportionment – DfT/Black Country Model Comparison

Data Source	Total Traffic	Diesel Car	Petrol Car	LGV	HGVr	HGVa	PSV
Defra/DfT	41712	35%	5%	26%	27%	6%	2%

The source apportionment is reflective of the wider network and any interventions should reflect on general traffic flow as well as the flow of light goods vehicles and rigid HGVs. The junction is a key interchange within the Black Country and is the primary access route between Walsall, Wolverhampton and the M6. It suffers from considerable congestion, particularly at peak times and is a considerable constraint on traffic throughout the region.

M6 junction 10 has been granted planning permission for reconstruction to be delivered jointly by Highways England and Walsall Council, forming part of Highways England Area nine investment programme. The scheme will replace highways infrastructure including bridge spans to increase the capacity of junction 10 and improve traffic flow, doubling the number of running lanes as well as widening some of the existing lanes, improving vehicle flow. This is scheduled to commence in 2019 with a programmed duration of two years.

The Council is conscious that there will be a need for additional traffic management which may increase short term congestion. There may be scope however, for additional improvements to UTC function as well as hatching alongside CCTV enforcement to prevent the gyratory becoming blocked. PSV sources apportionment is low, and this reflects the fact that no buses use this link.

1.5.2 Road Link 74017 A463 (referred to as A4148 in Defra Info)

This section of the A463 runs between Darlaston Lane and over the Midland road Flyover, where it joins with link 27202 described above. It forms a key part of the Black Country Route, providing access to Walsall and Wolverhampton City from M6 Junction 10.

This section has now been removed from the study further to email dated 18th May 2018 from Faye Williams confirming a review has been carried out by Defra's experts and this Census ID was no longer required to be considered for stage 2 onwards.

1.5.3 Road Link 38201 Wolverhampton Road A454 into Wolverhampton Street A4148

This concerns Wolverhampton Road A454/Wolverhampton Street A4148 into Blue Lane West A4148 to the Junction with Green Lane A34. It forms part of the Class A (PU) principal road in an urban area. It has a length of 0.31 miles (0.49KM).

Part of this section (Pleck Road to Wolverhampton Road/Wolverhampton Street) has been removed from the list of exceedances by Defra. Local AQ monitoring has shown that this stretch of road is compliant both at a kerbside monitoring locations and using distance-corrected calculations to nearest residential receptors. Major junction and highways improvements were commissioned at this intersection in 2009. (see Figure 9). No further intervention measures are consequently proposed. Walsall Council will submit further evidence concerning modelling for Census ID 38201.

Figure 11

Table 1.26 Local AQ monitoring results (at analyser)

Data Source	2013	2014	2015	2016	2017
Reference Method Monitoring[4]	37.4	37	33.3	36.2	30.8

[4] Distance adjusted concentration to nearest relevant receptor as per LAQM TG 09/(09)/16

NO_2 Reductions Required to meet AQ Thresholds (Defra/JAQU)

Table 1.27 NO_2 Reductions Required

	Data Source	2017	2018	2019	2020	2021
DfT/Defra	Forecast	47	44	42	40	38
	Reduction Required %	14.9%	9.1%	4.8%		-

Table 1.27 shows compliance by 2020 so offering some opportunity for medium to long term interventions to reduce AQ emissions.

Relevant Exposure

The council considers there is relevant exposure for a number of residential and commercial frontages within 15m of the highway as well as pavements and cycleways.

Traffic Volume and Source Apportionment

Counts have been undertaken at the junction with Vicarage Terrace, providing an average traffic count of 14,841 vehicles. Table 1.28 shows the source apportionment.

	Data Source	Total Traffic	Diesel Car	Petrol Car	LGV	HGVr	HGVa	PSV
38201	Defra/DfT	14841	38%	5%	28%	22%	5%	1%

Table 1.28 NO_2 Vehicle Source Apportionment.

A high proportion of HGVR and LGV shows there may be opportunities to address these markets specifically was well as addressing general traffic. PSV figures are low for this stretch of road, reflecting that this is not a bus route.

1.6 WOLVERHAMPTON

1.6.1 Road Link 28464, A4150 Ring Road St David's between Broad Street and Bilston Street Island

&

Road Link 57739, A4150 Ring Road St George's between Bilston Street Island and Snow Hill Junction.

These sections cover the eastern third of the Wolverhampton City Centre ring road. This is a 40 mph urban dual Carriageway, forming the central hub of the Key Route Network across the city. Census ID 28464 (0.6 Km in length) is the busiest section of road in the and Census ID 57739 (0.5 KM in length) is the 5th busiest. (see figure 10)

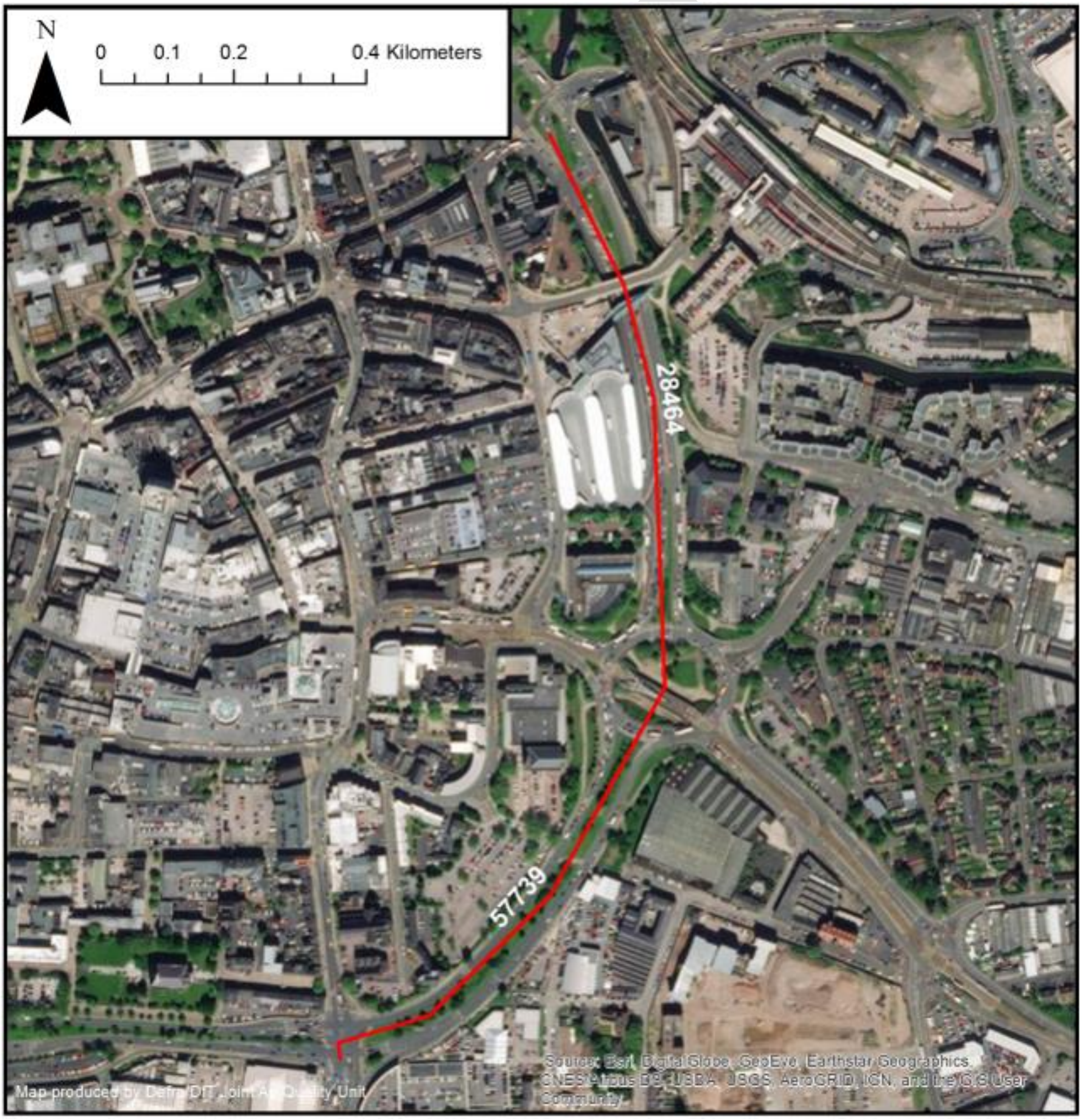


Figure 12

NO_2 Reductions Required to meet AQ Thresholds (Defra/JAQU)

Table 1.31 NO_2 Reductions Required

28464	Data Source	2017	2018	2019	2020	2021
DfT/Defra	Forecast	49	46	43	41	39
	Reduction Required %	18.4%	13.0%	7.0%	2.4%	-

Table 1.32 NO_2 Reductions Required

57739	Data Source	2017	2018	2019	2020	2021
DfT/Defra	Forecast	44	42	40	38	36
	Reduction Required %	9.1%	4.8%	-		-

Table 1.31 shows compliance by 2019 on 28464 offering significant opportunity for interventions to reduce AQ emissions, whereas table 1.32, covering 57739 forecasts compliance by 2019, meaning there may be some opportunity to accelerate compliance. Given that they cover two consecutive stretches of road, the council intend to treat this as one corridor and applying any interventions to both sections.

Relevant Exposure

From Broad Street the road travels under bridges serving the Railway Station. The only exposure at this section is a short section of footway on the western edge. It is parallel until it nears the bridges where it rises in relative height from the road. There is a bus station (separated by glass) and a bus contraflow lane to the East. The road rises to meet Bilston Street Island, which is a traffic signalled gyratory. This island also shares space with the Midland Metro Tram line. There is a hotel, offices and a parallel footway at road side East and the Court buildings to the West.

Following the Island in to Ring Road St George's (57739), this road link includes roadside footways, car dealerships, and one mixed use office/residential unit at the road side.

Traffic Volume and Source Apportionment

Excluding regional background, the source of emissions is primarily from road transport traversing along the corridor. Table 1.33 shows the apportionment between vehicle types.

Table 1.33: Source Apportionment – DfT/Black Country Model Comparison

	Data Source	Total Traffic	Diesel Car	Petrol Car	LGV	HGVR	HGVA	PSV
28464	Defra/DfT	43432	48%	7%	24%	10%	2%	8%
57739	Defra/DfT	33846	49%	7%	26%	11%	2%	4%

The most recent traffic surveys were undertaken in March 2018 and the results are included in Appendix 1. Note that this includes detailed speed and vehicle class data.

These sections have some of the highest proportions of diesel cars across the Black Country and therefore interventions should focus on addressing general traffic flow, particularly of cars as well as LGVs where possible.

PSV apportionment differs, ranging from 8%-4% reflecting that the top section (28464) provides immediate access to Wolverhampton Bus Station and as such creating 1000 2-way departures, serviced by over 200 buses. As such, actions to reduce emissions from buses on this route will be looked at. Table 1.34 shows the services on each link.

Operator	**Service**	**Buses**
igo	22	5
Diamond	530	1
National Express (NX)	126	22
NX	2	13
NX	*5/A*	*6*
NX	*6/A*	*10*
Arriva	9	4
Arriva	10/A/B	5
NX	11	8
Travel Expres	11	8
Travel Expres	32	5
NX	32/33	7
igo	50	1
NX	54/A	5
NX	59	14
Diamond	63	1
Diamond	64	1
Diamond	65	1
NX	69	7
NX	89	10
NX	255/A	21
NX	529	16
Banga	891	5

Operator	Service	Buses
NX	81	5
NX	79	16
igo	530	1
Banga	545	*8*

Table 1.34 bus services accessing the links(s)

1.6.2 Road Link 99402 A463 Black Country Route (BCR) between Wolverhampton Street and Black Country New Road

&

Road Link 99404 A463 between Oxford Street and Coseley Road.

This is an urban dual carriageway with 50 mph (99402 0.5 Km in length) and 40 mph (99404 0.9 Km in length) speed limits. This forms part of the Key Route Network and is a major link between commercial areas of the borough and Junction 10 of the M6 and further into Walsall. It is likely to form part of the Major Route Network. Both links are included within the 2nd busiest section of road within the City with an AADF of 35700. (see Figure 13a and Figure 13b)

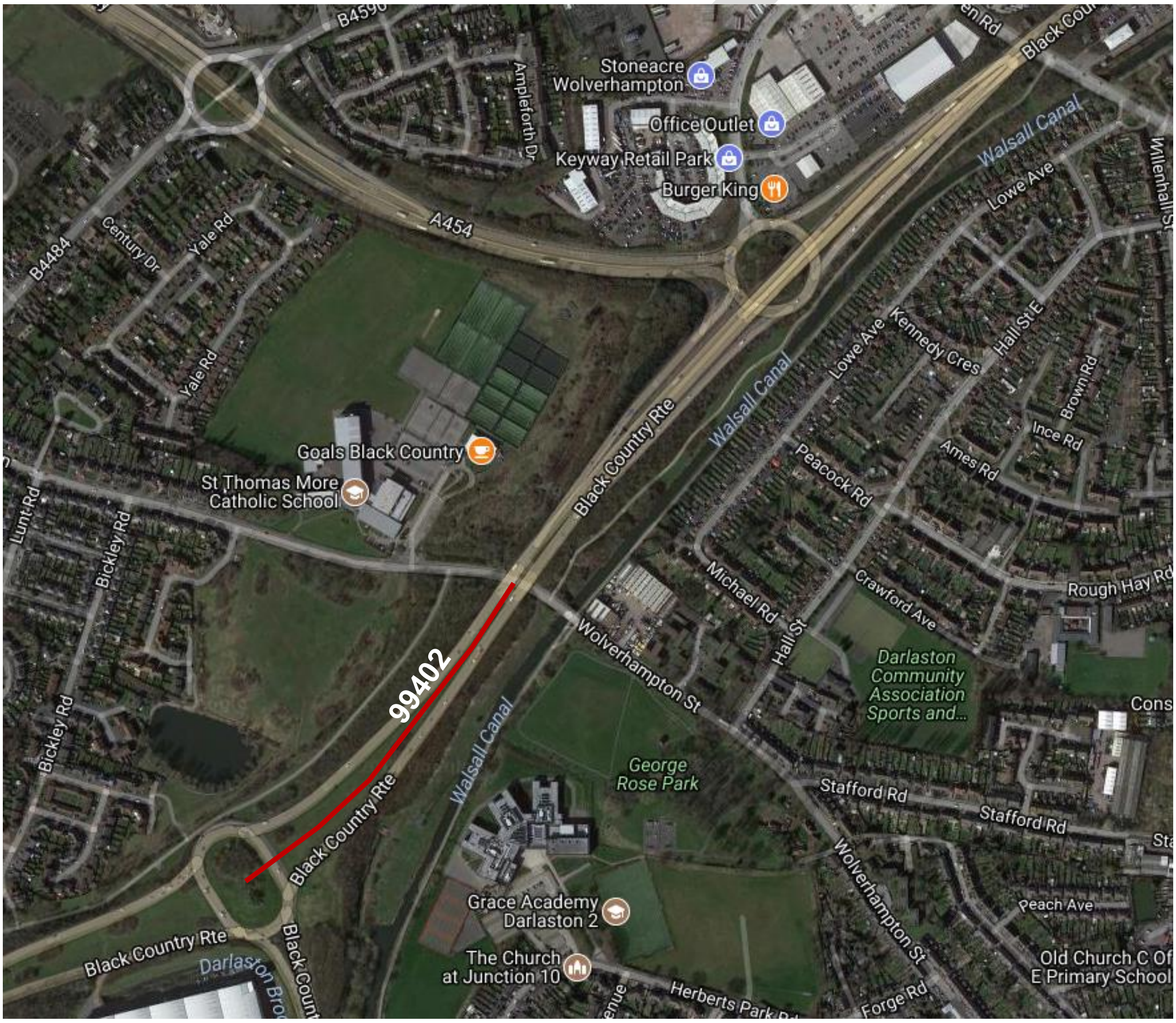


Figure 13a Map of exceedance area for 99402

Figure 13b Map of exceedance area for 99404

NO_2 Reductions Required to meet AQ Thresholds (Defra/JAQU)

Table 1.35 NO_2 Reductions Required

99402	Data Source	2017	2018	2019	2020	2021
DfT/Defra	Forecast	49	46	43	41	38
	Reduction Required %	18%	13%	7.0%	2.4%	-

Table 1.36 NO_2 Reductions Required

99404	Data Source	2017	2018	2019	2020	2021
DfT/Defra	Forecast	43	41	39	37	34
	Reduction Required %	7.0%	2.4%	-	-	-

Table 1.35 shows compliance by 2021 on 99402 offering significant opportunity for interventions to reduce AQ emissions, whereas table 1.36, covering 99404 forecasts compliance by 2019, meaning there may be some opportunity to accelerate compliance. Given that they cover two consecutive stretches of road, the council intend to treat this as one corridor and applying any interventions to both sections.

<u>Relevant Exposure</u>

99402 is surrounded by green space. The areas directly next to the carriageway are not used by or generally accessible to the public. There is one public footpath that is greater than 15m away from the carriageway for all but one small section next to the traffic island. The potential exposure of the general public here is remote and is not considered relevant by City of Wolverhampton Council. 99404 is bounded by commercial and retail premises, footways and a leisure centre. There is a Pelican crossing on the road which is well used.

Traffic Volume and Source Apportionment

Excluding regional background, the source of emissions is primarily from road transport traversing along the corridor. Table 24 shows the apportionment between vehicle types.

Table 1.37: Source Apportionment – DfT/Black Country Model Comparison

	Data Source	Total Traffic	Diesel Car	Petrol Car	LGV	HGVr	HGVa	PSV
99402	Defra/DfT	41367	36%	5%	30%	22%	5%	1%
99404	Defra/DfT	32350	43%	6%	28%	13%	3%	6%

Table 1.37 shows that source apportionment is generally reflective of the wider Black Country region. However, 99404 shows a particularly high proportion of diesel cars and buses, reflective of the 72 buses providing 400 2-way daily departures along the route Table 1.38 shows the services.

Operator	Service	Buses
Diamond	23	2
igo	57	2
National Express (NX)	25	7
Diamond	26A	1
Walsall CT	30	1
NX	34	20
NX	42/43	9
Diamond	43	2
igo	53	4
igo	80	1
NX	82	10
Diamond	223	2
Diamond	224	2
Diamond	229	3
Banga	530	5
Diamond	530	1

Table 1.38 Bus services using 99404

Other sources include LGVs. Interventions should therefore focus on improving general traffic flow as well as LGVs

Summary of Source Apportionment (excluding regional background):

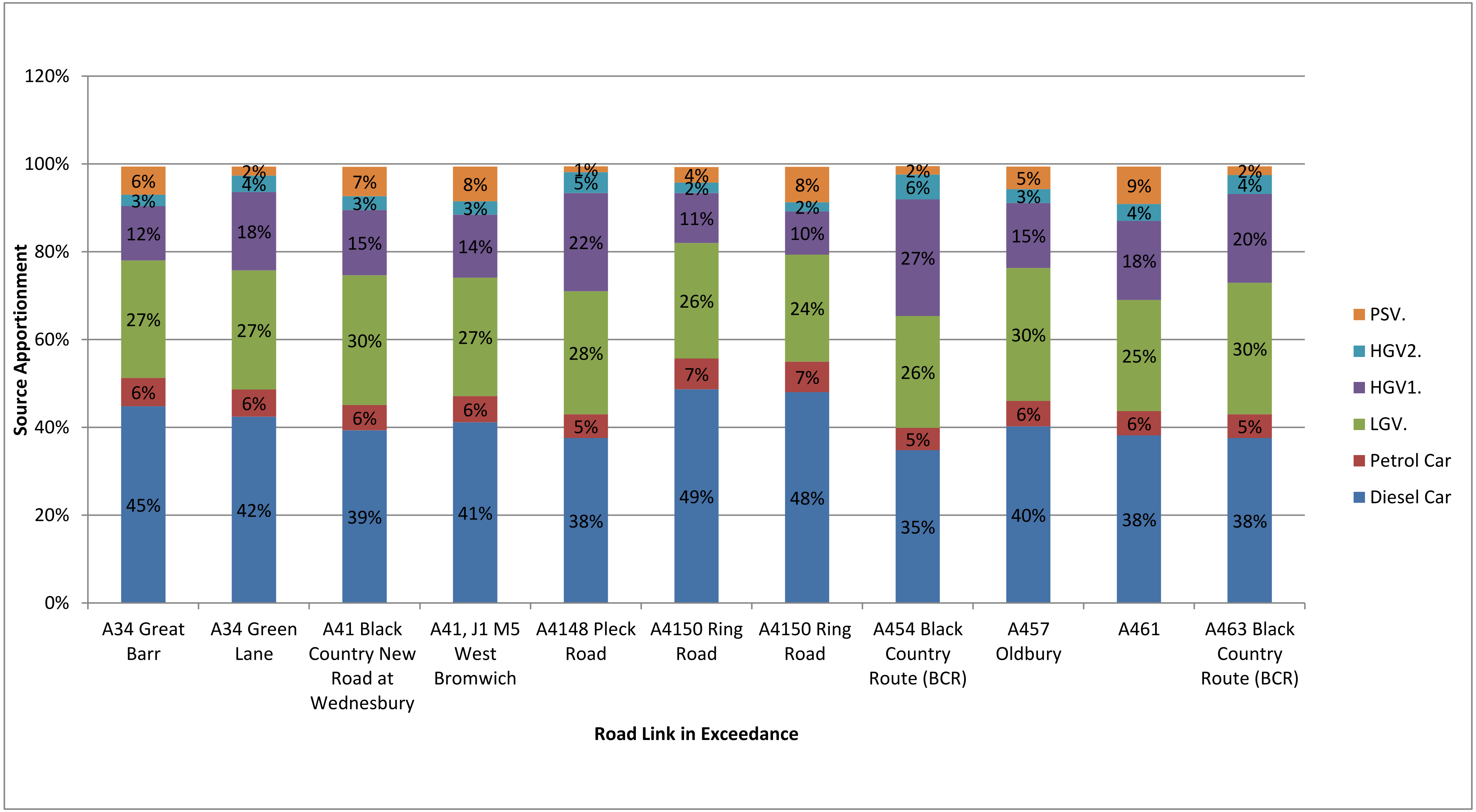


Figure 14: Summary of Source Apportionment

Figure 14 shows a summary of vehicle apportionment across each of the links identified within the Black Country Local Authority Region and shows the common theme of diesel cars being prolific in the generation of emissions, accounting for between 35% and 45% of emissions. LGVs and HGVs were also significant emitters across all the links identified, though show greater levels of variance.

These values are based on the nominal national fleet emissions taken from the EFT, although there is uncertainty about the Euro-classification profile for vehicles in the region.

Interventions therefore will attempt to focus on these sources where possible, whilst combining the need to have them specifically related to the links in question and able to be delivered within the necessary timescales.

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

In order of compliance, table 2.1 outlines each link and the year it's expected to be compliant and therefore dictate the sort of interventions that may be appropriate.

Table 2.1: Link Compliance Forecast (comments in brackets based on AQ monitoring)

Road Link ID	Road Name	Borough	Due to be Compliant
74559	A461	Dudley	2020
17611	A461	Dudley	2020
57205	A491, High Street, Wordsley	Dudley	2027
17142	A457 Oldbury	Sandwell	2019 (currently indicating compliance)
16330	A34 Great Barr	Sandwell	2019 (currently indicating compliance)
99155	A41, J1 M5 West Bromwich	Sandwell	2020
99397	A41 Black Country New Road at Wednesbury	Sandwell	2020
38201	A454/A4148 Wolverhampton Road / Wolverhampton Street/ Blue Lane WestA4148 Pleck Road	Walsall	2020 (currently indicating compliance)
27202	A454 Black Country Route (BCR)	Walsall	2021
57739	A4150 Ring Road	Wolverhampton	2019
99404	A463 Black Country Route (BCR)	Wolverhampton	2019
28464	A4150 Ring Road	Wolverhampton	2021
99402	A463 Black Country Route (BCR)	Wolverhampton	2021

The following list sets out the long list of possible interventions in order to improve air quality or accelerate compliance with the threshold value of 40 μgm^{-3}

2.1 Bus Interventions common across all links:

(i) Selective Vehicle Detection for buses (all links where traffic signal optimisation identified)
(ii) review bus usage on this link to establish possible alternative routes – unlikely to happen as we have access standards to adhere to and it's a commercial network – remove
(iii) Bus stop infrastructure improvements, including wayfinding, information and branding – this has a cost :benefit ratio 4:1 and positive impact for patronage (KPMG Buses, devolution and the growth agenda, Feb 2015 report)
(iv) Contactless capped ticketing – NX and Diamond both offer contactless ticketing but this is not capped or cross-operator. Making it easier for people to pay for the bus.
(v) Bus upgrades on all the links identified to ensure consistency through the document

2.2 DUDLEY

2.2.1 Road Link 74559: Cinderbank Island to Castlegate Island / Duncan Edwards Way (A461)

Actions Taken since 2015:
None

Other Potential Interventions

(i) Review of signalling/UTC on gyratories Pedestrian crossing upgrades where applicable to allow for variable timing or refinement of dead time on crossings
(ii) Graduated Speed changes on approach/exits to roundabout (50/40/30) & average speed enforcement
(iii) Review cycling and walking provision on this link to encourage modal shift away from the use of privately owned vehicles.
(iv) Review bus usage on this link to establish possible alternative routes
(v) Review bus usage on this link to encourage modal shift away from the use of private vehicles.
(vi) Consider the potential for bus retrofit or provision of low emission buses on this link to reduce emissions to air.

2.2.2 Road Link 17611: Castlegate Island to Burnt Tree Junction / Birmingham Road (A461)

The Council has considered a range measures which could reduce emissions from vehicle types using this stretch of road with an emphasis on HGV and LGV diesel vehicles and diesel cars.

Actions Taken since 2015:
None

Longer Term Interventions

(i) Review the operation of the traffic signals that control the exit from the Tesco fuel station site to Birmingham Road to minimise associated vehicle emissions at this location.
(ii) Review the operation of the traffic signals that control the A4123 Birmingham New Road/Burnt Tree Junction with a view to minimising the effect that these signals have on vehicle emissions associated with the signals detailed in point 1 above.
(iii) Speed Reductions from 50-40 mph & average speed enforcement in order to smooth traffic flow
(iv) Review potential of gating traffic on non-exceedance roads at junctions in order to improve flow on exceeding link
(v) Review cycling and walking provision on this link to encourage modal shift away from the use of privately owned vehicles.
(vi) Review bus usage on this link to encourage modal shift away from the use of private vehicles.
(vii) Consider the potential for bus retrofit or provision of low emission buses on this link to reduce emissions to air.

2.2.3 Road Link 57205: A491, High Street, Wordsley

Actions Taken since 2015:
None

Longer Term Interventions
(i) Review of signalling/UTC to look at adaptive timing in order to ease congestion.
(ii) Review bus usage on this link to encourage modal shift away from the use of private vehicles.
(iii) Consider the potential for bus retrofit or provision of low emission buses on this link to reduce emissions to air.
(iv) Review cycling and walking provision on this link to encourage modal shift away from the use of privately owned vehicles.

2.3 SANDWELL

2.3.1 Road Link 17142 (A457) Birmingham Road Oldbury)

The Council has considered a range measures which could reduce emissions from vehicle types using this stretch of road with an emphasis on HGV and LGV diesel vehicles and diesel cars. Although buses are contributing 4% of the total NO_2 concentrations we have included bus related measures these have been included in the long list to ensure a range of measures that could improve air quality are assessed

Actions taken since 2015

(i) Implementation of Black Country SPD on Air Quality incorporates air quality mitigation measures for example electric vehicle charging points within new developments to offset the incremental creep in pollutant emissions, present various options for site specific mitigation to protect future occupiers from poor air and how such measures will be secured and delivered; and confirm where a damage calculation is required and payment made to the local authority where mitigation is not appropriate

(ii) Engineering works to improve capacity via the revision of lane markings and turning movements based on traffic modelling to alleviate congestion from M5 works.

Longer term interventions

Future actions already identified in draft Air Quality Action Plan 2018- 2023

The consultation closed on the 1 May and it is intended to bring the revised plan back to cabinet for final approval once all comments have been evaluated.

(i) Devise plan for council services to switch to using low emission vehicles where possible including partial replacement of the council's grey fleet for business related travel

(ii) Work with taxi licensing to devise plan to encourage taxi drivers to switch to low emission vehicles.

(iii) Promotion and facilitation of cycling and walking with reference to Sandwell's Local Cycling and Walking Infrastructure Plans (LCWIP)

(iv) Promotion of the carsharsandwell.com Liftshare website

(v) Engagement with schools and employers to develop travel plans using the Modeshift STARS and STARS for online platforms, including the use of Section 106 agreements to ensure travel plan measures are implemented at proposed workplace developments.

List of Other Measures

(vi) The WMCA's successful application to the Clean Bus Technology Fund 2017-2019, to retrofit 468 vehicles to Euro VI emissions standard, will result in the conversion of almost all buses used on all services using the A457 by 2019 (excepting 2 vehicles)
(vii) Urban Traffic Control systems, signalling improvement, congestion management and possible bus priority. However, as this section of the A457 is predominantly roundabouts, UTC is probably not appropriate and neither is bus priority is likely to be implemented.
(viii) Engagement with freight and delivery operators, for example the major DPD depot which is accessible from the A457, could encourage deliveries out of hours
(ix) Work with operators to upgrade to electric/alternative fuel delivery vans
(x) freight consolidation centres, route management plans, strategic routing strategies for HGVs, delivery and service plans, freight partnerships
(xi) Encourage the take up of low emission vehicles by the public and help to facilitate an increase in the availability of electric charging points in public places.
(xii) Bike Share scheme due to be introduced in mid-late 2018

2.3.2 Road Link 16330 (A34) Birmingham Road Great Barr

We have considered a range of measures which could reduce emissions from vehicle types using this stretch of road with an emphasis on HGV and LGV diesel vehicles and diesel cars. Although buses are contributing 6% of the total NOx concentrations bus related measures these have been included in the long list to ensure a wide range of measures that could improve air quality are assessed

Actions taken since 2015

(i) Signalling improvements were carried out at the junction with the A34 and A4041 (Newton Road) in 2017 however further work is required to connect it to the Black Country Urban Traffic Control Centre.
(ii) Implementation of Black Country SPD on Air Quality (electric charging points incorporated into new developments etc).
(iii) Introduction of new Platinum standard bus services on the X51, improving bus journey time reliability, air quality and passenger comfort

Longer term interventions

Future actions already identified in draft Air Quality Action Plan 2018- 2023

(i) Devise plan for council services to switch to using low emission vehicles where possible (reference to draft revised action plan and is currently subject to consultation), including partial replacement of the council's grey fleet for business related travel
(ii) Devise plan to encourage taxi drivers to switch to low emission vehicles.
(iii) Promotion and facilitation of cycling and walking with reference to Sandwell's Local Cycling and Walking Infrastructure Plans (LCWIP)
(iv) Promotion of the carsharsandwell.com Liftshare website
(v) Engagement with schools and employers to develop travel plans using the Modeshift STARS and STARS for online platforms, including the use of Section 106 agreements to ensure travel plan measures are implemented at proposed workplace developments.

List of Other Measures

(vi) Further bus priority as part of the introduction of SPRINT bus rapid transit by 2022
(vii) Engagement with freight and delivery operators, could encourage deliveries out of hours, freight consolidation centres, route management plans, strategic routing strategies for HGVs, delivery and service plans, freight partnerships
(viii) Encourage the take up of low emission vehicles by the public and help to facilitate an increase in the availability of electric charging points in public places.
(ix) Bike Share
(x) Sprint rapid bus route using low emission vehicles.

2.3.3 Road Census Link 99155 (A41) Birmingham Road West Bromwich

The source apportionment information suggests that Diesel HGVs/LGVs and diesel cars are significant contributors to $NO2$ emissions on this link road. Although buses are contributing 7% of the total NO_x concentrations bus related measures have been included in the long list to ensure a wide range of measures that could improve air quality are assessed

Actions taken since 2015

(i) Implementation of Black Country SPD on Air Quality (electric charging points incorporated into new developments etc)

Longer term interventions

Future actions already identified in draft Air Quality Action Plan 2018- 2023

(i) Devise plan for council services to switch to using low emission vehicles where possible including partial replacement of the council's grey fleet for business related travel
(ii) Devise plan to encourage taxi drivers to switch to low emission vehicles.
(iii) Promotion and facilitation of cycling and walking with reference to Sandwell's Local Cycling and Walking Infrastructure Plans (LCWIP)
(iv) Promotion of the carsharsandwell.com Liftshare website
(v) Engagement with schools and employers to develop travel plans using the Modeshift STARS and STARS for online platforms, including the use of Section 106 agreements to ensure travel plan measures are implemented at proposed workplace developments.

List of Other Measures

(vi) The bus service using the A41 terminates in Birmingham therefore the buses are either already at Euro VI standard or will be retro-fitted by 2020.
(vii) Urban Traffic Control systems, signalling improvement, congestion management.
(viii) Engagement with freight and delivery operators, could encourage deliveries out of hours, freight consolidation centres, route management plans, strategic routing strategies for HGVs, delivery and service plans, freight partnerships
(ix) Encourage the take up of low emission vehicles by the public and help to facilitate an increase in the availability of electric charging points in public places.
(x) Bike Share

2.3.4 Road Census Link 99397(A41) Black Country Route at Wednesbury

The source apportionment information suggests that Diesel HGVs/LGVs and diesel cars are significant contributors to NO2 emissions on this link road.

Actions taken since 2015 (subject to confirmation)

(i) Implementation of Black Country SPD on Air Quality (electric charging points incorporated into new developments etc)
(ii) CBTF funding also brought forward on this link

Longer term interventions

Future Actions already planned

(i) Strategic Transport Projects: The Wednesbury to Brierley Hill Metro Extension aims to overcome the lack of direct rail service between urban centres; reduce congestion within sub-regional centres; reduce poor air quality resulting from road transport emissions; and improve links with the wider transport network, especially for commuter journeys. There are currently funding commitments for initial development (from the Black Country Local Enterprise Partnership and the West Midlands Combined Authority) and widespread support from local authorities and the business community. It is anticipated that construction of the extension will begin in 2022.

Future actions identified in draft Air Quality Action Plan 2018- 2023

(ii) Devise plan for council services to switch to using low emission vehicles where possible (reference to draft revised action plan and is currently subject to consultation), including partial replacement of the council's grey fleet for business related travel
(iii) Devise plan to encourage taxi drivers to switch to low emission vehicles.
(iv) Promotion and facilitation of cycling and walking with reference to Sandwell's Local Cycling and Walking Infrastructure Plans (LCWIP)
(v) Promotion of the carsharsandwell.com Liftshare website
(vi) Engagement with schools and employers to develop travel plans using the Modeshift STARS and STARS for online platforms, including the use of Section 106 agreements to ensure travel plan measures are implemented at proposed workplace developments.

List of Other Measures

(vii) The WMCA's successful application to the Clean Bus Technology Fund 2017-2019, to retrofit 468 vehicles to Euro VI emissions standard, does not currently cover the conversion of buses currently using this section of the A41. The possibilities of extending the conversion programme to this section of road would need to be explored with the WMCA.
(viii) Engagement with freight and delivery operators, could encourage deliveries out of hours, freight consolidation centres, route management plans, strategic routing strategies for HGVs, delivery and service plans, freight partnerships

(ix) Encourage the take up of low emission vehicles by the public and help to facilitate an increase in the availability of electric charging points in public places.
(x) Bike Share

2.4 WALSALL

2.4.1 Current Authority wide Air Quality Interventions

(i) Adoption of the Black Country Air Quality Supplementary Planning Document
(ii) West Midlands Low Emissions Town and Cities Programme Good Practice Air Quality Planning Guidance, May2014
(iii) West Midlands Low Emissions Town and Cities Programme Good Practice Air Quality Planning Guidance, September 2014
(iv) West Midlands Low Emissions Town and Cities Programme (proposed) Low Emissions Vehicle Strategy
(v) West Midlands Low Emissions Town and Cities Programme (proposed) Low Emissions Feasibility Study
(vi) OLEV Go Ultra Low City Status Scheme
(vii) Black Country Ultra Low Emissions Vehicle Strategy, January 2017
(viii) Darlaston Strategic Development Area road junction improvement schemes
(ix) Local sustainable transport initiatives 2014-2020
(x) M6 Active Traffic Management – Birmingham Box
(xi) Junction 10 M6 Motorway Improvement Scheme
(xii) Chase Lane Walsall to Rugeley Electrification Scheme
(xiii) Walsall Red Route Network Bus Lane Prioritisation
(xiv) Local Sustainable Transport Fund
(xv) Managing Shorter Trips Fund
(xvi) A Stars Schools Programme
(xvii) Walsall & Black Country Cycle Network
(xviii) Walsall 20mph Zones
(xix) Walsall Cycle to Work Scheme
(xx) Walsall Town Centre Transport Package
(xxi) Bus Lane, Pedestrian Crossings and School Clearways Vehicle Enforcement
(xxii) Workplace Travel Plans
(xxiii) Emergency Service, Local Media and Bus Operator advanced notification of highway disruption
(xxiv) Public Health Notification
(xxv) Walsall Council Driver CPC Training
(xxvi) Walsall Council ‘Take Responsibility’ Campaign (vehicle fleet efficiency, driver training and eco-driving aids)
(xxvii) Walsall Council Voluntary speed limiters
(xxviii) Walsall Council Greener Fleet Review (and vehicle replacement)
(xxix) Walsall Town Centre Area Action Plan and Site Allocation Document
(xxx) West Midlands UTC Major Projects Variable Message Signs
(xxxi) West Midlands UTC Major Projects ANPR journey time monitoring system

(xxxii) West Midlands UTC Major Projects road traffic camera deployment
(xxxiii) West Midlands UTC Major Projects upgrading traffic system communication infrastructure
(xxxiv) West Midlands UTC Major Projects UTC Common database
(xxxv) West Midlands UTC Major Projects traffic signal upgrades
(xxxvi) Black Country Core Strategy 2011
(xxxvii) Black Country Road Safety Strategy (Draft)
(xxxviii) Black Country Strategic Economic Plan 2014
(xxxix) Black Country Walking and Cycling Strategy and Implementation Plan 2017
(xl) Midlands Connect Growth Strategy
(xli) Movement for Growth: The West Midlands Strategic Transport Plan 2016
(xlii) Walsall Air Quality Action Plan 2009
(xliii) Walsall Highway Maintenance Strategy 2015-2018
(xliv) Walsall Joint Health and Wellbeing Strategy 2013-2016 (including 2014-2015 refresh)
(xlv) Walsall rights of way improvement plan 2009
(xlvi) Walsall Sustainable Modes of Travel Strategy 2017 to 2022
(xlvii) West Midlands Physical Activities Strategy 2017to 2030
(xlviii) Walsall to Wolverhampton Rail Link/West Midlands Rail Franchise 2017-2026

Removed from Study

2.4.2 Road Link: 27202 A454

Actions Taken since 2015:
None

Longer Term Interventions

(i) Re-evaluation of alternative walking cycling routes – taking pedestrians away from the AQ hotspot
(ii) Junction 10 M6 Motorway Improvement Scheme -Bringing forward the construction work as TM may slow traffic and improve flow of the junction sooner
(iii) Speed Reductions & average speed enforcement
(iv) Review of signalling/UTC on M6 Junction 10 Gyratory

2.4.3 Road Link 7661 and 38201 A4148

Actions Taken since 2015:
Engineering and junction remodelling works

Agreed with Defra that 7661 no longer in exceedance
Exceedances with 38201 are disputed and further information is to be submitted.

2.5 WOLVERHAMPTON

2.5.1 Local Authority area works and schemes already undertaken or are to be delivered/in development:

(i) Wolverhampton Interchange Project Phase 1: This multi-modal interchange will provide a hub of sustainable travel options (national rail network, Metro, bus station, and direct access to national cycle routes and the forthcoming Bike Share)

(ii) Wolverhampton to Walsall Rail Link/West Midland Rail Franchise 2017-2026: including two new rail stations

(iii) Midland Metro City Centre extension: This is now well in progress and will provide a direct link between the metro and national rail station.

(iv) Wolverhampton City Centre Scheme: This includes junction improvements, cycle and bus lane provision and enhancements, pedestrianisation works. Over £1 million has been spent improving cycle routes across the City

(v) Urban Traffic Control Major Scheme: Modernisation of the traffic signals and CCTV capability allows for maximising junction capacities, smoothing flows and minimising congestion.

(vi) Railway Station access improvements and smart traffic control systems to manage peak flow traffic volumes exiting rail station multi storey on to Ring Road St David's

(vii) Advanced quality bus partnership (AQBP): This is currently under consultation and proposes to introduce stringent emission (and other) standards for any buses entering the ring road after 2020/2021.

(viii) Highways improvements: Making the most of the large investment opportunities to improve transport and roads, recognising where there are clear Air Quality benefits.

(ix) Promotion of ultra-low emission vehicles: This includes ongoing programmes to install vehicle charging infrastructure (£350K OLEV grant being delivered in 2018).

(x) Junction 10 project:. This has the potential to improve Eastern traffic flows on the BCR.

(xi) Ongoing Network Development Planning: – outline programme attached showing workstreams and areas of focus/development.

(xii) Workplace Travel Planning: including Wiggle on the BCR and Bilston Area through LSTF.

(xiii) Wolverhampton Car Share Scheme: (Major employers including City of Wolverhampton Council)

(xiv) Black Country Supplemental Planning Policy on Air Quality: now in force and being pursued, delivering mitigation measures on developments including EV charging infrastructure.

(xv) Black Country Core Strategy 2011 and draft

(xvi) Expansion of UTC major scheme Bluetooth Journey Time monitoring to assist signal optimisation.

Equipment to be deployed on routes:

- Extension of MESH communication devices.
- Quad Radio Bluetooth Detector featuring Multi-Radio enhanced Bluetooth Detection,
- WiFi Detection, iBeacon Support (iOS/Android app connectivity, possibility of alert drivers through App Development)
- Nitrogen Dioxide Sensor featuring Advanced electro-chemical gas sensor with accurate readings from 10 ppb to 20000 ppb (19 µg/m3 to 38000 µg/m3), High capacity O3 filtering, preventing ozone from affecting sensor readings. Development of the App may well link into T-Trig trials and other potential congestion apps to share network information to influence road users choice to avoid hotspots on the network.

  We hope to complete the roll out and commissioning of the equipment by 8th June 2018

(xvii) Introduction of Swift Payment apps across Combined Authority Area,
(xviii) Enforcement of Bus Lanes all to increase the public transport offer.
(xix) Bikeshare Scheme – To be implemented throughout WM region from 2018.

2.5.2 Road Link ID 28464/57739: A4150 Ring Road St David's between Broad Street and Snow Hill Junction

Interventions since 2015

(i) Filter Lane installed at bottom of broad street
(ii) UTC upgrades including CCTV
(iii) Taxi Ultra Low Emissions Vehicle (ULEV) Scheme

Walking and cycling infrastructure investment impacting on the link(s):

(iv) • Princess St/Market St/Garrick St contraflow cycling route (2016)
(v) • Mainline Canal Towpath – resurfacing from Aldersley Junction to Dixon St (2016) as part of strategic cycling network
(vi) • City Centre - Cycle route St George's Parade (2016) and additional cycle parking to provide alternatives to driving into the city centre
(vii) • Springfield Campus phase 1 - (2017) improvements to walking and cycling to and from the city centre
(viii) • Ring Road St George's and St Patrick's – conversion of footpath to shared use (2017-18), building on the local cycling network
(ix) • Wyrley and Essington Canal - resurfacing from Bentley Bridge to City Centre (2018) as part of strategic cycling network
(x) • Springfield Campus – Work ongoing to improve walking and cycling to and from the city centre including work including alongside the ring road sections in question. (managing Shorter trip funding)

(xi) • Railway Drive and Bilston Street – cycle route improvements to be delivered as part of Metro Extension work.

Longer term interventions

(xii) Speed Reductions & average speed enforcement
(xiii) Traffic Calming measures to limit acceleration and deceleration on approach/exit from gyratories
(xiv) Review and expansion of cycle highways forming corridors throughout city
(xv) Review of signalling/UTC including VMS signage & SCOOT in order to smooth traffic flow
(xvi) Upgrade of Bus fleet to Euro VI through vehicle replacement and retrofitting

2.5.3 Road Link ID 99402: A463 Black Country Route (BCR) between Wolverhampton Street and Black Country New Road

Interventions since 2015

(i) Bilston Urban Village local cycling network built into development (2016) including links to town centre and leisure centre

Walking and cycling infrastructure investment impacting on the link(s):

(i) LSTF Cycling and walking routes to city centre (2014)
(ii) Bilston Urban Village local cycling network built into development (2016) including links to town centre and leisure centre
(iii) Bradley Arm canal towpath – resurfacing (2017) as part of the local cycling network
(iv) Mainline Canal completion of resurfacing Wolverhampton to Birmingham (2018)
(v) Walsall - NPIF funding secured to resurface Walsall Canal towpath alongside BCR Moxley to Darlaston as part of strategic cycling network (2019-20)
(vi) Cycle Route Improvements on A454 corridor at varying stages of development including M6J10 provision for cyclists
(vii) Construction of new foot and cycle way to connect Wiggle

Longer term interventions

(viii) Explore potential to relocating short stretch of footway near traffic island on This would limit potential exposure but could incur significant costs
(ix) Further consideration of taxi licensing conditions in order to improve emissions from taxis.
(x) Specific traffic signalled junctions to be surveyed and assessed for optimisation.
(xi) Assessment and construction of footway screening to limit exposure. This would be a short term measure allowing more sustainable, longer term

measures to take effect.

(xii) Deployment of VMS signage providing motorists with the optimum flow conditions for the traffic flow (connected via SCOOT/UTMS) as well as advanced warning of any significant delays could further improve general traffic flow as well as reduce stop/start conditions and attendant acceleration and braking.

2.5.4 Road Link ID 99404: A463 between Oxford Street and Coseley Road

Interventions since 2015

(i) Investment in Highway maintenance: including circa £7m+ in Key Route Network over the last 3 years. Census ID 99404 was resurfaced and relined April 2018.

Longer term interventions

(i) Review of signalling/UTC review in order to potentially optimise traffic flow, particularly on gyratories

(ii) Speed Reductions & average speed enforcement. Reducing speeds down from 50 to 40 or even 30 miles per hour could potentially produce direct benefits, particularly given the high proportion of emissions from diesel vehicles. Outside of this, a reduction in posted speed limit could also improve traffic flow provided average speeds are currently above this level. A thorough review and assessment would need to take place

(iii) Deployment of VMS signage (see 99402)

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

The following sections provide a shortlist of interventions based on discussions with officers in Local Authorities on an individual basis as well as in a Black Country Workshop. It sets out timelines and any constraints.

Other possible interventions have been eliminated as they were not specific and/or measurable in terms of their contribution to Air Quality emissions reduction. Other interventions will continue to be deployed through Local Air Quality Action Plans/Strategies but do not fall within the scope of this study.

3.1 Review of signalling/UTC - Ped crossing upgrades where applicable UTMC including VMS signage & SCOOT

A UTMC may be used to actively prioritise air quality by redistributing congestion and slow-moving traffic away from areas of concern, even where it may lead to longer journey times. Where road capacity is made available through successful implementation of the UTMC, it could be utilised for alternative transport. It may also help to smooth the flow of traffic and inform road users about delays, or optimum speeds.

Table 3.1: UTC Interventions

County		Road Link	Description	Intervention Info	Timeline	Constraints
Dudley	17611	A461	Castlegate Island to Burnt Tree Junction / Birmingham Road	Review of timing on roundabout signals – and optimise where possible	1-3 months for review	None
	74559	A461	Cinderbank Island to Castlegate Island / Duncan Edwards Way	Review of timing on signals – and optimise where possible Review of pedestrian crossing timings/upgrade to PUFFIN (?)	1-3 months for review 12 months for pedestrian crossing upgrades	None

	57205	A491	A491, High Street, Wordsley	Review of timing on signals – and optimise where possible	3 months for review 12 months for pedestrian crossing upgrades	None
Sandwell	16330	A34 Great Barr	Junction at A4041 Newton Road and the M6 at junction 7	Review of timing on signals – and optimise where possible Review of pedestrian crossing timings/upgrade to PUFFIN (?)	1-3 Months for Review 12 months for implementation of SCOOT	Signalisation upgrade as of 2017. However not in SCOOT system
	99155	A41, J1 M5 West Bromwich	Between the roundabout with M5 Junction 1 & the local authority boundary with Birmingham City Council	Review of timing on gyratory signals – and optimise where possible Review of timing on Halfords road signals –	1-3 months 12 months for upgrade of signals at pedestrian crossings	None

	17459	A457 Oldbury	Roundabout with the A4034 and roundabout linking the A4031	Review of pedestrian crossing timings/upgrade to PUFFIN (?)	1-3 months for review 12 months for upgrade of signals at pedestrian crossings	None
Walsall	27202	A454 Black Country Route (BCR)	A454 Black Country Route (BCR) running westwards from J10 M6 towards A463 Black Country Route	Review of timing on gyratory signals – and optimise where possible Alongside box junctions to maintain exit clearances at J10 gyratory	1-3 Months 3-6 months for box junctions	Requires approval from senior executive and agreement with Highways England Sign off of box junctions required
	38201	A4148 Wolverhampton Street	Wolverhampton Road A454/ Pleck Road A4148 junction into Wolverhampton Street into Blue Lane West A4148 to junction with Green Lane A34 /Court Way A4148	Review of signal timings at Green Lane and Lichfield Street	1-3 months for review	None
Wolverhampt on	28464	A4150 Ring Road	St David's between Broad Street and Bilston Street Island	Review of timing on gyratory signals – addition of VMS equipment	1-3 months for review 12 months for VMS	None

	57739	A4150 Ring Road	St George's between Bilston Street Island and Snow Hill Junction	Review of timing on gyratory signals – and optimise where possible at keyway intersection addition of VMS equipment	1-3 months for review 12 months for VMS	None

3.2 Speed Reductions & average speed enforcement

Vehicle speeds directly affect the drive-cycle efficiency and emissions, where low speeds, idling and accelerating can significantly affect emissions. Using traffic controls to ensure that movement is relatively ‘smooth’, with a constant speed to limit acceleration, would minimise emissions. Depending on the existing average speed it can also create greater capacity. We aim to enforce this accordingly with average speed cameras. In the near term infrastructure can be installed which may create a behavioural change, however they are unlikely to be enforced in the short term due to lack of police personnel. The Authorities will continue to look at funding options alongside Transport for West Midlands.

Potential mechanisms would be to

- increase the red / green times on the traffic lights
- introduce traffic calming measures on roads leading into the areas of concern
- achieve very low speed limits to reduce stop-start movement

Table 3.2: Speed Interventions

County	Link ID	Road Link	Description	Intervention Info	Timeline	Constraints
Dudley	17611	A461	Castlegate Island to Burnt Tree Junction / Birmingham Road	Reduction of limit from 50-40 or lower	12 months	Average Speed dependent
	74559	A461	Cinderbank Island to Castlegate Island / Duncan Edwards Way	Graduated speed changes on approach/exit from roundabouts	12 months	None
	57205	A491	A491, High Street, Wordsley	Traffic Calming on approach to crossing	12	Gradient/Queueing traffic

County	Link ID	Road Link	Description	Intervention Info	Timeline	Constraints
Sandwell	17142	A457 Oldbury	Roundabout with the A4034 and roundabout linking the A4031	Reduce speed limits down to 30mph to ensure constant speed	12 months	Average Speed dependent – may already be stop/start
Walsall	27202	A454 Black Country Route (BCR)	A454 Black Country Route (BCR) running westwards from J10 M6 towards A463 Black Country Route	Reduction of limit from 50-40 or lower	12 months	Average Speed dependent – modelled to have low impact individually(< 1µgm-3)
Wolverhampton	28464	A4150 Ring Road	St David's between Broad Street and Bilston Street Island	Reduce speed limits down to 30mph to ensure constant speed	12 months	Average Speed dependent
	57739	A4150 Ring Road	St George's between Bilston Street Island and Snow Hill Junction	Reduce speed limits from 40 down to 30mph to ensure constant speed	12 months	Average Speed dependent
	99404	A463 Black Country Route (BCR)	Between Oxford Street and Coseley Road	Reduce speed limits from 40 down to 30mph to ensure constant speed	12 months	Average Speed dependent

3.3 Retrofitting Buses with SCR Technology

Improving bus fleet emissions can have a measurable impact on air quality. The Clean Vehicle Retrofit Accreditation Scheme (CVRAS) is a robust certification scheme for manufacturers of retrofit emissions reduction technology that addresses the air pollution emissions from buses to achieve Euro VI performance. This will enable Clean Air Zone (CAZ) compliance of legacy fleet vehicles. This certification scheme supports the operation of Clean Air Zones and is accredited by the Energy Saving Trust.

As such, manufacturers must seek this accreditation before it can be added to the list of approved devices available to vehicles. This ensures that approved filters meet minimum technical standards and that vehicles fitting these approved emission reduction systems meet the national emissions standards. All approved systems have met emission reduction systems and technologies and demonstrated robust technical performance in order to be eligible for approval and manufacturers are required to operate quality management systems to certified standards

Though unlikely, should the timescale required for retrofitting the vehicles exceed the deadline for compliance, the most feasible approach may be to determine whether the bus routes that travel through the areas with the worst air quality, and prioritise these routes for vehicles that have already been upgraded. Consultation with the bus operators will be required to determine what routes could be modified based on the available fleet.

Table 3.3: Bus Interventions

County	Link ID	Road Link	Description	Intervention Info	Timeline	Constraints
Dudley	17611	A461	Castlegate Island to Burnt Tree Junction / Birmingham Road	Bus Upgrade/retrofitting	12-24 months	Funding/Fleet age/Type Buses would need to be prioritised on affected routes Could cascade older buses to other areas

	57205	A491	High St Wordsley	Bus Upgrade/retrofitting	12-24 months	Funding/Fleet age/Type Buses would need to be prioritised on affected routes Could cascade older buses to other areas
Sandwell	16330	A34 Great Barr	Junction at A4041 Newton Road and the M6 at junction 7	Bus Upgrade/retrofitting	12 months	Funding/Fleet age/Type Buses would need to be prioritised on affected routes Could cascade older buses to other areas
	99155	A41, J1 M5 West Bromwich	Between the roundabout with M5 Junction 1 & the local authority boundary with Birmingham City Council	Bus Upgrade/retrofitting	12 months	Funding/Fleet age/Type Buses would need to be prioritised on affected routes Could cascade older buses to other areas

	99397	A41 Black Country New Road at Wednesbury	Roundabout with the A4037 and the roundabout with A461 at Wednesbury	Bus Upgrade/retrofitting	12 months	Funding/Fleet age/Type Buses would need to be prioritised on affected routes Could cascade older buses to other areas
	17142	A457 Oldbury	Roundabout with the A4034 and roundabout linking the A4031	Bus Upgrade/retrofitting	12 months	Funding/Fleet age/Type Buses would need to be prioritised on affected routes Could cascade older buses to other areas
Wolverhampton	28464/ 57739	A4150 Ring Road	St David's between Broad Street and Bilston Island	Bus Upgrade/retrofitting	12 months	Funding/Fleet age/Type Buses would need to be prioritised on affected routes Could cascade older buses to other areas

	99404	A463 Black Country Route (BCR)	Between Oxford Street and Coseley Road	Bus Upgrade/retrofitting	12 months	Funding/Fleet age/Type Buses would need to be prioritised on affected routes Could cascade older buses to other areas

3.4 Traffic Calming

Vehicle speeds directly affect the drive-cycle efficiency and emissions, where low speeds, idling and accelerating can significantly affect emissions. Using traffic controls to ensure that movement is relatively ‘smooth’, with a constant speed to limit acceleration, would minimise emissions.

Potential mechanisms would be to

- increase the red / green times on the traffic lights
- introduce traffic calming measures on roads leading into the areas of concern
- achieve very low speed limits to reduce stop-start movement
- Change road surfaces on approach to gyratories such as rough/high grip surfaces and rumble strips

Table 3.4: Traffic Calming Interventions

County	Link ID	Road Link	Description	Intervention Info	Timeline	Constraints
Dudley	57205	A491	A491, High Street, Wordsley	Traffic Calming on approach to junctions	3-6 months	Gradient/Queuing Traffic
Sandwell	99155	A41, J1 M5 West Bromwich	Between the roundabout with M5 Junction 1 & the local authority boundary with Birmingham City Council	Traffic calming on approach to gyratories, high grip surface, rumble strips	3-6 months	Dependent on peak traffic conditions
	99397	A41 Black Country Route at Wednesbury	Roundabout with the A4037 and the roundabout with A461 at Wednesbury	Traffic calming on approach to gyratories, high grip surface, rumble strips	3-6 months	Dependent on peak traffic conditions
	17142	A457 Oldbury	Roundabout with the A4034 and	Traffic calming on	3-6 months	Dependent on

County	Link ID	Road Link	Description	Intervention Info	Timeline	Constraints
			roundabout linking the A4031	approach to gyratories, high grip surface, rumble strips		peak traffic conditions
Wolverhampton	28464	A4150 Ring Road	St David's between Broad Street and Bilston Street Island	Traffic calming on approach to gyratories, high grip surface, rumble strips	3-6 months	Dependent on peak traffic conditions
	57739	A4150 Ring Road	St George's between Bilston Street Island and Snow Hill Junction	Traffic calming on approach to gyratories, high grip surface, rumble strips	3-6 months	Dependent on peak traffic conditions
	99402	A463 Black Country Route (BCR)	Between Wolverhampton Street and Black Country New Road	Traffic calming on approach to gyratories, high grip surface, rumble strips	3-6 months	Dependent on peak traffic conditions

3.5 Re-evaluation of alternative walking cycling routes

The implementation of this measure would need to focus on a shift towards changing the perception of how the roads are used, and actively discouraging the use of private vehicles in favour of cycling and walking. TfWM is taking a corridor approach to walking and cycling, understanding the key routes used by active transport users and ensuring provision is in place. As part of this review, local authorities will also look to minimise exposure to air quality emissions by diverting some footways away from emitters whilst maintaining or improving connectivity for active travel users.

Table 3.5: Walking/Cycling Interventions

County	Link ID	Road Link	Description	Intervention Info	Timeline	Constraints
Walsall	27202	A454 Black Country Route (BCR)	A454 Black Country Route (BCR) running westwards from J10 M6 towards A463 Black Country Route.	HE/Walsall cycling and walking plan proposed as part of J10 upgrades. Provide better crossing facilities	12-24 months	Funding not currently available
Wolverhampton	28464	A4150 Ring Road	St David's between Broad Street and Bilston Street Island	Review and expand cycle superhighways in line with cycling strategy	12-24 months	None

Sandwell	99397	A41 Black Country Route at Wednesbury	Roundabout with the A4037 and the roundabout with A461 at Wednesbury	As part of wider walking/cycling corridor review, divert footway to ensure/improve connectivity whilst reducing exposure	12-24 months	None
Wolverhampton	99402	A463 Black Country Route (BCR)	Between Wolverhampton Street and Black Country New Road	As part of wider walking/cycling corridor review, divert footway to ensure/improve connectivity whilst reducing exposure	12-24 months	Significant earthworks required

3.6 Screening of the Footway

The implementation of this measure would focus around putting up barriers between roads and footpaths and this can be achieved through planting trees or green walls along the identified routes to reduce the impact of vehicle emissions to pedestrians and cyclists. This is not seen as a permanent or sustainable measure but buys time in the short term to allow longer term, more strategic interventions to come on stream

Table 3.6: Screening Interventions

County	Link ID	Road Link	Description	Intervention Info	Timeline	Constraints
Sandwell	99397	A41 Black County Route at Wednesbury	Roundabout with the A4037 and the roundabout with A461 at Wednesbury	Screening at key junctions/pedestrian crossing where traffic likely to be standing	6-12 months depending on nature of barrier	Road Safety Review Required
Sandwell	16330	A34 Great Barr	Junction at A4041 Newton Road and the M6 at junction 7	Screening of pavement with Abbotsford Avenue –additional tree planning	6-12 months depending on nature of barrier	Road Safety Review Required
Walsall	38201	A4148	From Court Way A4148 junction with Green lane A34 running east, including Stafford Street B4210 into Day Street into Wisemore, east into Littleton Street West A4148 into Littleton Street East A4148 to junction with Broadway/Lichfield Street A461	Screening at key junctions/pedestrian crossing where traffic likely to be standing	6-12 months depending on nature of barrier	Road Safety Review Required

County	Link ID	Road Link	Description	Intervention Info	Timeline	Constraints
Wolverhampton	99402	A463 Black Country Route (BCR)	Between Wolverhampton Street and Black Country New Road	Screening of footway close to gyratory with A41	6-12 months depending on nature of barrier	Road Safety Review Required

3.7 Driver Training

The periodic training of drivers, potentially alongside the use of telematics has been demonstrated to reduce incidents of harsh braking and acceleration, idling and access speed as well as improving road safety. All of these help to improve congestion and have a further benefit to the drivers/operators by reducing fuel usage and therefore costs. Training schemes can quickly be delivered but needs the cooperation of vehicle operators freeing up both drivers and vehicles for the training to take place.

Table 3.7: Training Interventions

County	Link ID	Road Link	Description	Intervention Info	Timeline	Constraints
Sandwell	17142	A457 Oldbury	Roundabout with the A4034 and roundabout linking the A4031	Working with logistics employers on driver training/anti idling/fleet review, leading with DPD, Ryder, Royal Mail, Metsec and other centres off the A457	3-12 Months	None

3.8 Travel Planning

Travel planning has been proven to be successful provided they are maintained. A well designed travel plan highlights options and facilitates a change of behaviour for people travelling to and from destinations such as businesses and schools. Selective assistance in the development , review and update travel plans for workplace/schools along the routes in question could provide rapid benefits

Table 3.8: Planning Interventions

County	Link ID	Road Link	Description	Intervention Info	Timeline	Constraints
Sandwell	99397	A41, J1 M5 West Bromwich	Between the roundabout with M5 Junction 1 & the local authority boundary with Birmingham City Council	Work with Sandwell College, bus operators and other businesses to develop/update and act upon their travel plan	6-12 months	Funding for Local Authority (LA) support
	17142	A457 Oldbury	Roundabout with the A4034 and roundabout linking the A4031	Working with logistics employers on driver travel plans, leading with DPD, Ryder, Royal Mail, Metsec, bus operators and other centres off the A457	6-12 months	Funding for LA support

Wolverhampton	99404	A463 Black Country Route (BCR)	Between Oxford Street and Coseley Road	Working with Ormiston SWB Academy, bus operators and VW Active in addition to key businesses on the retail park or indeed the retail park management	6-12 months	Funding for LA support

3.9 Highway Upgrades

A number of major upgrades are due to take place across the Black Country, often in cooperation with the Highways England These are often related to pinch points such as M6 Junction 10. These improvements will in the long term help to relieve congestion and help generate additional capacity, though the required TM may worsen the situation in the short term.

Table 3.9 Highway Interventions

County	Link ID	Road Link	Description	Intervention Info	Timeline	Constraints
Walsall	27202	A454 Black Country Route (BCR)	A454 Black Country Route (BCR) running westwards from J10 M6 towards A463 Black Country Route	Bringing forward the construction work as TM may slow traffic and improve flow of the junction sooner	2 Years	Funding shortfall

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

Part 4 is split into three sections, in order to achieve the objectives sought in the guidance. The sections are as follows:

1) Summarises the level of reduction required to achieve compliance on each link, as set out in section 1
2) Looks at the effectiveness of each intervention independently from the road network based on either historical data or a Rapid Evidence Assessment to determine its impact on journey time reduction/speed increases, volume increases or straight emissions reduction.
3) Applies the level of effectiveness to each of the links where such intervention is deemed appropriate as set out in section three, in order to determine this meets the requirements and brings each of the link's emissions below the threshold. Each intervention will be assessed according to its implementation time, the shortest being assessed first. That way longer term measures will only be introduced if the short term measures do not achieve the required results.

4.1 Emissions Reductions Required

Table 4.1 summarises the emissions currently modelled and the percentage NO_2 savings required for each link. Note, forecast figures are rounded.

Link ID	Local Authority	Data Source	2017	2018	2019	2020	2021
17142	Sandwell	Forecast	43	41	39	37	35
		Reduction Required	7.0%	2.4%	-	-	-
99155	Sandwell	Forecast	46	44	42	39	37
		Reduction Required	13.0%	9.1%	4.8%	-	-
99397	Sandwell	Forecast	47	44	42	39	37
		Reduction Required	14.9%	9.1%	4.8%	-	-
16330	Sandwell	Forecast	43	41	39	37	35
		Reduction Required	7.0%	2.4%	-	-	-
28464	Wolverhampton	Forecast	49	46	43	41	39
		Reduction Required	18.4%	13.0%	7.0%	2.4%	-

Link ID	Local Authority	Data Source	2017	2018	2019	2020	2021
57739	Wolverhampton	Forecast	44	42	40	38	36
		Reduction Required	9.1%	4.8%	-		-
99402	Wolverhampton	Forecast	49	46	43	41	38
		Reduction Required	18%	13%	7.0%	2.4%	-
99404	Wolverhampton	Forecast	43	41	39	37	34
		Reduction Required	7.0%	2.4%	-	-	-
27202	Walsall	Forecast	50	47	44	41	38
		Reduction Required	20.0%	14.9%	9.1%	2.4%	-
38201[5]	Walsall	Forecast	47	44	42	40	38
		Reduction Required	14.9%	9.1%	4.8%		-
74559	Dudley	Forecast	45	43	41	38	36
		Reduction Required	11.1%	7.0%	2.4%	-	-
17611	Dudley	Forecast	45	43	41	38	36
		Reduction Required	11.1%	7.0%	2.4%	-	-
57205	Dudley	Forecast	52	51	49	48	47
		Reduction Required %	23.1%	21.6%	18.4%	16.7%	14.9%

Table 4.1: Summary of emissions reductions required.

[5] Currently disputed by Walsall/Defra/JAQU regarding monitoring location. Walsall to provide additional information from an alternative monitoring location.

4.2 Efficacy of Interventions

4.2.1 Traffic Signals Optimisation

Reviewing the signal timings, alongside the installation of adaptive signalling and where appropriate SCOOT/UTC has been found to be effective in improving traffic congestion significantly.

A study undertaken in 1993 of five cities, shows the potential journey time and delay improvements across 5 UK cities.

Location		Previous Control	% Reduction in journey time			% Reduction in delay		
			AM Peak	Off Peak	PM Peak	AM Peak	Off Peak	PM Peak
Glasgow		Fixed-time	-	-	-	-2	14	10
Coventry	Foleshill	Fixed-time	5	4	8	23	33	22
(1981)	Spon End	Fixed-time	3	0	1	8	0	4
Worcester (1986)		Fixed-time	5	3	11	11	7	0
		Isolated V-A*	18	7	13	32	15	23
Southampton (1984,5)		Isolated V-A*	18	-	26	39	1	48
London	(1985)	Fixed-time	Average 8% cars, 6% buses			Average 19%		

Table 4.2: Traffic Signal Optimisation Improvements

These studies, along with a more recent 2016 study by Siemens, shows improvements in journey time/delay of between 12% and 20%[6]

As such, we are estimating the impact of any traffic signal optimisation to result in a 16% improvement in journey time/delay.

In order to understand the impact on air quality we looked at journey speeds for link 57739, a section of the A4150 ring road in Wolverhampton, for which detailed, hourly data speed data was available. This was used to create a template for speed distribution as a percentage of average speed during each hour and is shown in table 40

[6] https://www.streetlightdata.com/wp-content/uploads/2018/06/Siemens-and-StreetLight_SCOOT-White-Paper_161005.pdf [accessed 19/06/18]

% of Average Speed	0-17%	17-33%	33-50%	50-67%	67-83%	83-100%	100-117%	117-133%	133-150%	150-167%	167-183%	183-200%	200-333%
0000	0.00%	0.00%	0.12%	0.58%	4.27%	21.80%	38.64%	23.99%	7.15%	2.19%	0.58%	0.58%	0.12%
0100	0.00%	0.00%	0.21%	0.43%	6.21%	22.27%	36.83%	24.63%	6.42%	1.93%	0.43%	0.43%	0.21%
0200	0.00%	0.00%	0.00%	0.00%	4.80%	19.95%	34.34%	26.26%	12.12%	1.77%	0.25%	0.00%	0.51%
0300	0.00%	0.00%	0.00%	0.21%	4.16%	17.26%	40.75%	24.12%	10.60%	1.46%	0.62%	0.42%	0.42%
0400	0.00%	0.00%	0.00%	0.11%	3.49%	18.08%	37.47%	28.00%	9.69%	2.07%	0.87%	0.11%	0.11%
0500	0.00%	0.00%	0.10%	0.96%	4.85%	23.01%	39.05%	21.61%	7.73%	2.02%	0.48%	0.19%	0.00%
0600	0.25%	2.83%	5.11%	8.23%	13.01%	24.55%	25.99%	14.81%	3.85%	1.14%	0.15%	0.08%	0.00%
0700	0.31%	4.59%	12.11%	16.03%	18.81%	21.11%	17.34%	7.46%	1.72%	0.42%	0.09%	0.02%	0.00%
0800	0.17%	2.08%	9.36%	17.66%	25.22%	23.27%	15.29%	5.10%	1.28%	0.46%	0.07%	0.02%	0.03%
0900	0.02%	0.70%	3.09%	10.19%	24.16%	30.08%	21.88%	7.53%	1.79%	0.49%	0.04%	0.04%	0.00%
1000	0.05%	0.70%	2.83%	10.52%	21.81%	32.37%	21.97%	7.55%	1.61%	0.38%	0.14%	0.04%	0.04%
1100	0.04%	0.45%	3.24%	10.92%	26.06%	29.99%	20.39%	7.18%	1.35%	0.23%	0.12%	0.02%	0.02%
1200	0.02%	1.69%	6.59%	15.45%	26.58%	26.46%	16.73%	5.15%	1.04%	0.22%	0.07%	0.02%	0.00%
1300	0.07%	1.34%	4.80%	14.34%	27.52%	28.48%	16.76%	5.48%	0.96%	0.19%	0.05%	0.00%	0.00%
1400	0.09%	1.08%	5.74%	15.40%	25.01%	27.58%	17.47%	5.82%	1.39%	0.34%	0.07%	0.02%	0.00%
1500	0.07%	1.76%	7.07%	16.13%	24.81%	25.59%	16.81%	6.03%	1.18%	0.40%	0.09%	0.02%	0.03%
1600	0.10%	4.31%	11.77%	19.18%	23.08%	21.04%	14.68%	4.63%	0.87%	0.24%	0.09%	0.02%	0.00%
1700	0.22%	4.44%	11.68%	15.03%	19.74%	23.56%	16.97%	6.23%	1.47%	0.47%	0.09%	0.05%	0.04%
1800	0.00%	0.72%	2.53%	10.15%	19.64%	30.32%	23.92%	9.43%	2.14%	0.91%	0.18%	0.04%	0.02%
1900	0.00%	0.28%	1.08%	6.15%	16.09%	31.50%	27.47%	12.39%	3.63%	1.06%	0.14%	0.14%	0.05%
2000	0.00%	0.00%	0.31%	0.86%	10.01%	30.80%	34.00%	17.68%	4.40%	1.48%	0.37%	0.09%	0.00%
2100	0.00%	0.00%	0.00%	0.78%	6.77%	28.40%	36.19%	19.99%	5.79%	1.37%	0.43%	0.12%	0.16%
2200	0.00%	0.00%	0.11%	0.73%	5.65%	25.92%	35.91%	22.19%	7.28%	1.81%	0.23%	0.06%	0.11%
2300	0.00%	0.00%	0.08%	0.15%	3.78%	22.65%	38.37%	23.50%	8.78%	1.62%	0.77%	0.23%	0.08%

Table 4.3: Template Traffic Speed Distribution: 57739 A4150 as a percentage of the average speed

The template can then be applied to provide an hourly distribution based on the average speed and traffic flow of each link and therefore modelled within the Emissions Factor Toolkit (EFT)

It can be seen from the distribution that the majority of traffic centres around the average speed and represents a normal distribution, with significant slowdowns in the peak hours as would be expected. Figure 15 shows the speed distribution for 8am (AM peak), 5pm (PM peak) and 8pm (off peak).

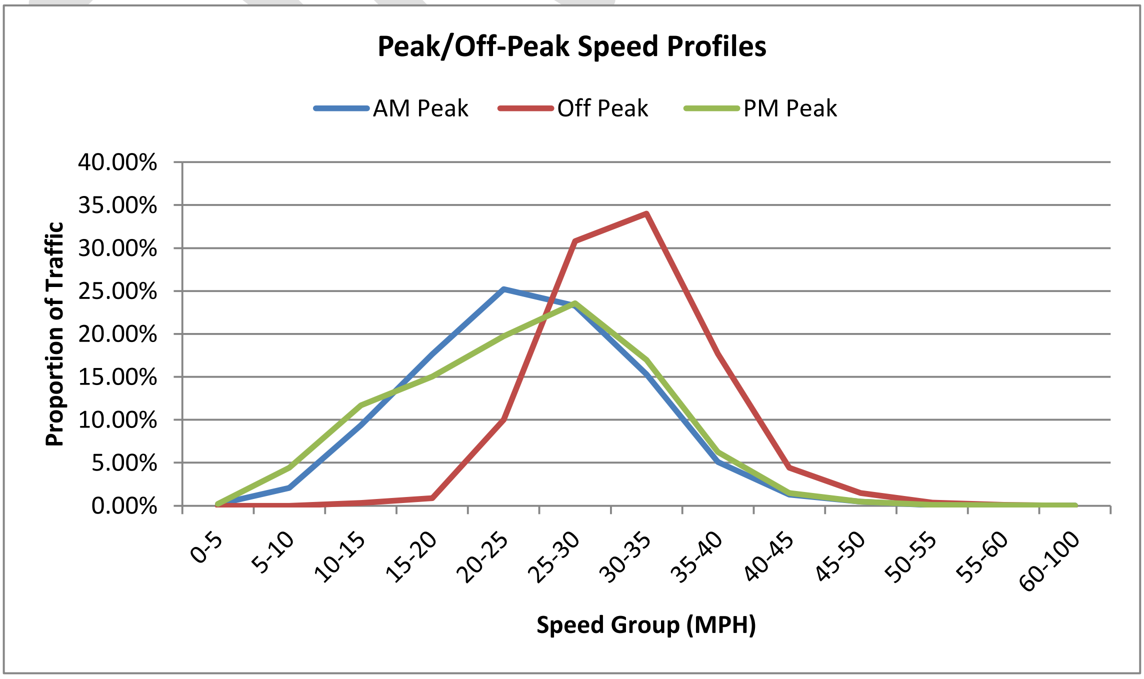


Figure 15: Speed Profile template

Taking the midpoints between each of the speed groups we can target the hours where the average does not exceed the posted speed limit of the road and apply a 16% improvement to the delay of vehicles.

However rather than increase speeds by 16%, which would also result in an increase of traffic volume, which for every 10% increase in speed (or decrease in travel time) could be as much as a 5% increase in volumes due to induced demand.[7]

Such increases in volume are likely to negate any benefits as a result of improvements in vehicle speeds. As such it has been assumed that traffic will be gated on side roads in order to prevent increases in volume. Gating involves the adjustment of red signal timings in order to hold traffic on roads with no exceedance in order to relieve congestion on the link with an Air Quality issue. Bluetooth NO_X sensors could be installed to make this more dynamic by providing baseline emissions information, eventually feeding into a dynamic model linked to the UTMC.

We have assumed that optimisation will smooth the flow, reducing incidents of particularly high speed and low speed, effectively narrowing the distribution towards the centre and thus reducing stop/start or accelerating/decelerating traffic, without greatly increasing the overall average speed and therefore reducing emissions as a result. Figure 16 shows the difference between the baseline and optimised traffic for the AM peak hour.

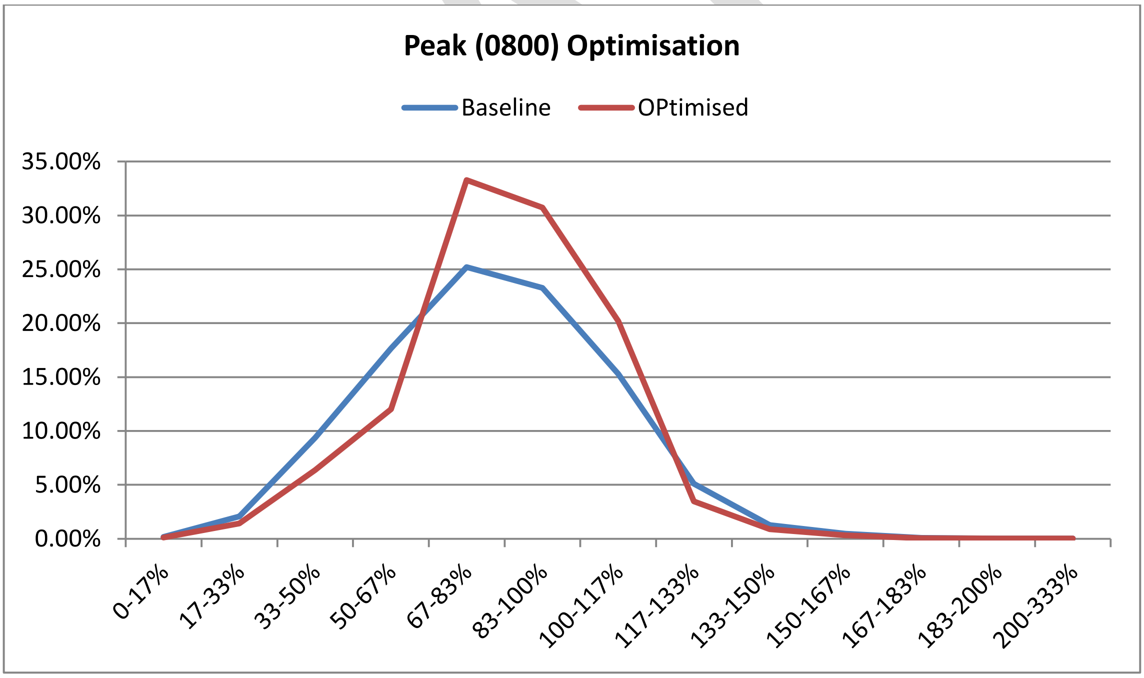


Figure 16 Peak Hour Optimisation

This new distribution is therefore fed into the Emission Factor Toolkit (EFT) to produce an estimate of emissions reductions from 2019 through to 2021 for each of the roads based on their own average speed and volume information, taken from either real life data in the case of Wolverhampton or from the Black Country Air Quality Model.

[7] Phil **Goodwin** (1996), "Empirical Evidence on Induced Traffic," *Transportation*, Vol. 23, No. 1, pp. 35-54.

4.2.2 Speed Limit Reduction

The introduction of speed limit reductions, enforced by average speed cameras was discussed as a possibility for a number of links. To model this, a speed reduction 10 mph speed reduction on the current posted speed will be modelled and inputted using the same speed distribution outlined in the traffic signal optimisation, thus reflecting changes in posted speed on the average speeds of that link, with 60% of vehicles with an average speed within 5mph of the posted speed during the off peak and 40% of vehicles during peak.

Demand Elasticity also needs to taken into account so based on documented evidence would also decrease flow by 5% for every 10% speed decrease (or increase in travel time). For the purposes of measuring this intervention[8]

Baseline speed limits (in KPH) and volumes for each of the roads are showin in Table 4.4. These will be fed into the EFT for each affected road link to gain forecasts between 2019 and 2021.

Link ID	**Road Name**	**Authority**	**Posted Speed**	**Volume**
			KPH	AADT
17142	A457 Oldbury	Sandwell	64.37	27,081.00
99155	A41, J1 M5 West Bromwich	Sandwell	48.20	31,483.00
99397	A41 Black Country New Road at Wednesbury	Sandwell	64.37	39,255.00
16330	A34 Great Barr	Sandwell	48.20	34,986.00
28464	A4150 Ring Road	Wolverhampton	64.37	43,432.00
57739	A4150 Ring Road	Wolverhampton	64.37	33,846.00
99402	A463 Black Country Route (BCR)	Wolverhampton	48.20	35,141.00
99404	A463 Black Country Route (BCR)	Wolverhampton	48.20	35,141.00
27202	A454 Black Country Route (BCR)	Walsall	48.20	41,712.00
74559	A461	Dudley	80.46	39,206.00
17611	A461	Dudley	64.37	38,971.00

Table 4.4: Baseline Speeds and Volumes for affected links

[8] Phil **Goodwin** (1996), “Empirical Evidence on Induced Traffic,” *Transportation*, Vol. 23, No. 1, pp. 35-54.

4.2.3 Retrofitting of buses with SCR Technology

Transport for West Midlands have commenced a rolling programme of retrofitting older buses with selective catalytic reduction (SCR) technology. This effectively converts older Euro III, Euro IV or Euro V buses to meet the Euro VI standard for NO_X by chemically changing the NO_X into steam through a reaction with ammonia that is sprayed into the exhaust. . This programme is ongoing as well as being undertaken by a number of other local authorities. As such considerable funding is required, with each retrofit costing around £18,000 Evidence suggests that concerns around the capacity of suppliers of retrofit technology are not founded and the market has responded to the increase in demand. The ability of bus operators to release buses for the retrofit may be an issue, though to date this issue has not been realised, as such delivery risk is minimised.

Progress in clean diesel bus technology has dramatically exceeded diesel car technology. Real world testing of Euro VI diesel buses demonstrates a 95% reduction in NOx emissions compared with Euro V[9]. Currently a journey by a Euro 6 diesel car emits 10 times the per passenger NOx of a comparable journey by a Euro VI diesel bus[10]. This will be achieved as all retrofit systems fitted are accredited and approved by the EST.

Table 4.5 based on standard EFT forecasts shows that SCR will reduce emissions by around 50% compared to its non-retrofit equivalent which is significant, but this much less than seen in tests to date, which show results nearer the Euro VI column. Emissions will vary with topography, driving style and weather however and they will also be impacted by the number of vehicles operating along the affected links that have been retrofitted. Transport for West Midlands advises that there are 374 buses running on routes that use the affected network links and all would be required. Figure 17 shows the profile of the fleet according to its emissions.

% Reduction	EFT Predictions	Euro VI
Euro III	-49.85%	-95.36%
Euro IV	-49.78%	-93.29%
Euro V_EGR	-49.73%	-91.65%
Euro VI		0.00%

Table 4.5: Efficacy of SCR retrofit

As such, the study will take the EFT figures in order to calculate the likely impact of bus retrofit. However, this is likely to provide a conservative estimate of any reductions.

9 *The Journey of the Green Bus, Low CVP 2016*

10 *Low Carbon Vehicle Partnership 2017 analysis using COPERT Factors at 25km/h average speed, using average passenger loading (DfT)*

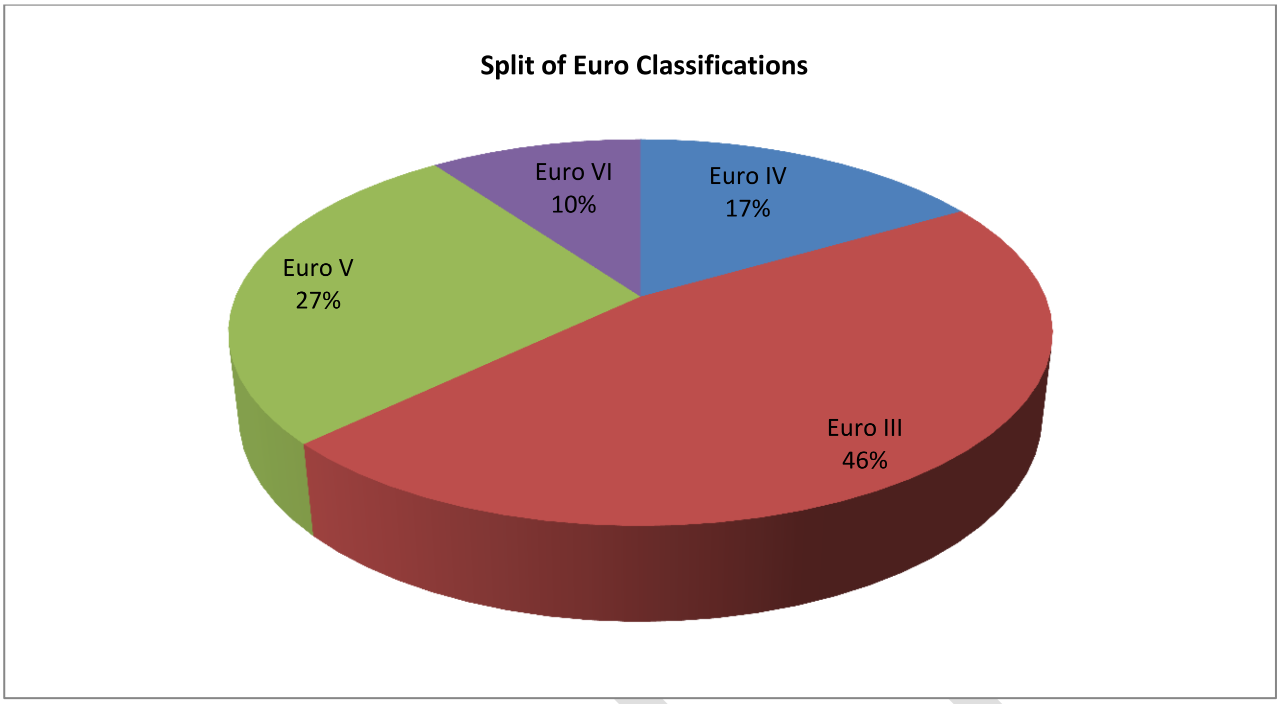


Figure 17 Black Country Bus Fleet, by emissions classification

Given the large number of buses and funding constraints dictating the speed at which vehicles can be retrofitted, the study has undertaken a sensitivity test looking at five uptake scenarios of a 10%, 25%, 50% 75%,100% retrofit by 2021. Given that we also know the percentage reduction required we will also state the minimum % of buses requiring retrofit to meet the $40\mu gm^{-3}$ target. All reductions will be based on a conservative reduction of 50% in terms of emissions and assumes that the buses currently serving the route will continue to do so post retrofit i.e. the Euro mix on each route will not change.

As such the formula for a reduction in emissions will be as follows:

$$\text{Reduction in Emissions} = 50\%\ \text{reduction} \times \text{Rate of Conversion} \times \text{Vehicle Apportionment}$$

<u>Traffic Calming</u>

Discussions with the highways and transport teams across the Black Country authorities looked at various traffic calming measures including speed humps, rumble strips and dynamic signage. For reasons such as noise due to rumble strips and speed humps potentially worsening the AQ problem as well as the nature of the roads being analysed, dynamic signage was the best option for traffic calming as it requires little alteration to the carriageway and can be flexible enough to address specific problems and even change the message depending on conditions.

Previous research has shown that display boards that activate when a vehicle approaches, often at or above a designated speed are effective in calming traffic[11] and have greatest

[11] Survey of Safety Professionals Regarding Traffic Calming Options (2007) Survey sponsored by Information Display Company
Author(s)

effectiveness on those doing more than 10MPH over the limit[12] and that average speeds were reduced by around 5- 9mph depending on their setting[13]

As such, for the purposes of the study, we will assume that where traffic calming interventions are installed, there shall be a 5mph reduction in average speed overall and those exceeding the limit by more than 10mph will reduce their speed to the posted limit. This will be fed into the EFT in order to assess its impact on emissions between 2019 and 2021

4.2.4 Methods to Reduce Exposure (Screening, Footway Diversion and Footway Closure)

As per communication with Defra on 12th June via Huddle, Defra advised that measures to reduce exposure rather than emissions are not within the scope of the study. As such, they have been excluded from further analysis.

However, a previous study, outlined in table 4.6 indicate the potential efficacy of various types of screening in reducing concentrations of NO_2

Study Name	Author	Date	Screen Type	% NO_2 Reduction
The impact of a green screen on concentrations of nitrogen dioxide at Bowes Primary School, Enfield	Anja H. Tremper and David C. Green Kings College, London	Jan 2018	Green Foliage	22-23

Table 4.6: Studies into the efficacy of screening to reduce emissions

Driver Training

Driver training has been shown in a number of studies to reduce fuel consumption by around 5%[14] and this is likely to in turn reduce NO_X emissions. Putting a measurable figure on it however is difficult as it depends on myriad factors such as terrain, weather and engine temperature. One study[15] estimates a reduction in emissions by 8% and showed that drivers decreased the time spent in excessive speed and excessive engine speed by 24% and 38% respectively. A reduction in the number of events such as extreme accelerations and decelerations was also observed. The results indicated an average 4.8% fuel consumption decrease.

---

[12] (2006) Effectiveness of photo-radar and speed display boards, Road Injury Prevention & Litigation, Journal Volume 1973

[13] Ullman, G Rose, E (2006) Evaluation of Dynamic Speed Display Signs, Journal of the Transportation Research Board, Transportation Research Board of the National Academies, Volume 1918 / 2005

[14] Beusen, B., et al. (2009). Using on-board logging devices to study the longer-term impact of an eco-driving course. Transportation Research
Zarkadoula, M., Zoidis, G., & Tritopoulou, E. (2007). Training urban bus driver
pilot program. Transportation Research Part D, Volume 12 (pp. 449-541).
Part D: Transport and Environment, Volume 14, Issue 7, October 200 (pp. 514-520)

[15] Rolim et al (2014) Impacts of on-board devices and training on Light Duty Vehicle Driving Behaviour, Procedia - Social and Behavioral Sciences 111 (2014) 711 – 720

However, it should be noted that the study compared a control group and an experimental group and the control group were aware they were being monitored. This may mean that the control group would naturally look to increase the standard of driving as a result of the monitoring and so real world improvements could be even greater.

As such the study will take the 8% figure in terms of reduction in NO_X and apply that to driver training.

Part 3 of the study identified key locations to target both travel planning and driver training initiatives, the study will assume that the apportionment of journeys to work will reflect the apportionment of buses to cars on the network in question as well as an indication of take up for the driver training; which, if the site in question get behind the initiative could be high therefore we will assume 75%. As such the formula for calculating emissions reductions will be as follows:

$$\text{Reduction in Emissions} = \frac{\text{number of employees} \times 0.75 \times \text{passenger vehicle apportionment} \times \text{level of uptake/reduction}}{\textit{Average Annual Daily Traffic}}$$

For sites that also employ fleets, the fleet size will also be added – assuming 1 journey per vehicle per day. Given the relatively low number of journeys this may affect, the measure is likely to be complimentary rather than a standalone measure to meet thresholds.

4.2.5 Travel Planning

A Defra review of measures to reduce NO_X emissions highlighted the SUSTRANS (2013)[16] and DfT (2008)[17] Studies that pointed out travel planning, particularly personalised travel planning (PTP) can reduce car use by up to 11% and can also result in walking, cycling and public transport use increasing by 15-33%, though uptake may be lower than something driven directly by company policy. Previous research[18] estimates a take up of around 5%, though this can be increased depending on the strategy used and cooperation from organisations involved. It is also evident that the level of take-up is not necessarily a signal to the overall success of a travel planning scheme.

As such, our study will take an 11% reduction in car use and a 15% increase in public transport/Cycling (split evenly) though this is assumed to be incorporated within existing supply. Similarly to driver training, a number of key businesses have been identified in part 3 of the study and therefore the number of employees within these businesses will be identified and the reductions applied. As such the formula for emissions savings due to travel planning will be:

---

[16] SUSTRANS 2013. Personalised Travel Planning. Available: http://www.sustrans.org.uk/our-services/what-wedo/personalised-travel-planning

[17] DEPARTMENT FOR TRANSPORT 2008. Making Personal Travel Planning Work: Practitioners' Guide. Available: http://webarchive.nationalarchives.gov.uk/20101124142120/http:/www.dft.gov.uk/pgr/sustainable/travel plans/ptp/practictionersguide.pdf

[18] Personalised travel planning: evaluation of 14 pilots part funded by DfT, http://www.fietsberaad.nl/library/repository/bestanden/document000097.pdf [accessed 28/06/2018]

$$\text{Reduction in Emissions} = \frac{\text{number of employees} \times \text{passenger vehicle apportionment} \times \text{level of uptake/reduction}}{\textit{Average Annual Daily Traffic}}$$

4.2.6 Walking & Cycling

As stated in the previous section, the SUSTRANS (2013) study stipulates the investment in walking and cycling infrastructure can trigger a 10% drop in car use, though it should be noted that this is as an area measure as opposed to specifically along certain routes, as a function of better connectivity but also potentially in terms of lost road space, triggering further congestion though this varies depending on where the cycle lanes are implemented[19], which in itself may create increases in emissions.. There's also uncertainty around where the car passengers go, do they switch to active travel or adopt public transport

Without looking at traffic assessments for the specific infrastructure as well as survey work around modal shift attitudes this is difficult to model.

As such AECOM will undertake a sensitivity test looking at a 2.5%, 5% and 10% reduction in traffic. Such traffic reductions will then be put through the EFT to determine their impact on NO_X emissions between 2019 and 2021. We will also outline the percentage reduction in cars required to ascertain the reduction in AQ required. Due to this uncertainty, unless the impact is overwhelming despite small percentage changes in traffic, it will be a complimentary, rather than singular measure brought forward to part five.

4.2.7 Junction 10 Upgrade

Junction 10 has already been assessed by Mott MacDonald 2017 to determine the impact of the work on air quality both in terms of the operational phase and the construction phase.

AECOM will run the forecasted speeds and flows identified in the environmental impact assessment through the latest version of the EFT to ensure they remain consistent.

4.2.8 NO_X to NO_2 Conversion

The percentage savings in terms of NO_X emissions are generated using the Emissions Factor Toolkit version 8. These percentage savings are then fed into version 6.1 of the NO_X to NO_2 conversion model operated by Bureau Veritas, AECOM and NPL. This takes into account the percentage savings in NO_X, background concentrations of NO_2 for a given area, (taken from the PCM model) and calculates the proportion of NO_2 generated for each gram of NOx created.

The projected further concentrations of roadside Total-NO_2 is obtained from the Defra PCM projections for the appraised road links. The Total-NO_2 is converted into Total-NO_X and Road-NO_X concentrations using the NO_X to NO_2 calculator specified above.

[19] Civitas(2016) THE ROLE OF WALKING AND CYCLING IN REDUCING CONGESTION A PORTFOLIO OF MEASURES, http://h2020-flow.eu/uploads/tx_news/FLOW_REPORT_-_Portfolio_of_Measures_v_06_web.pdf

The change of Road-NO_X emissions for each scenario was calculated using the EFT, and the change converted to a percentage relative to the projected non-intervention scenario.

The percentage change in Road-NO_X emissions was used to adjust the Road-NO_X concentration by the same proportion at the roadside compliance location. This adjusted Road-NO_X concentration was then converted back to Total-NO_2 using the NO_X to NO_2 calculator.

This method converted all of the values to NO_X, and so the proportional change in the emissions from road sources could be applied to the roadside concentration attributed to those sources. This ensured that the non-linear relationship between NO_X and NO_2 was maintained correctly, and that the key difference between 'concentration' and 'emissions' was translated through the use of percentage change of road sources. This method has previously been accepted in Annual Status Reports and Air Quality Action Plans submitted to Defra.

4.3 Impact to Links

4.3.1 Road Link 17142: A457 Oldbury

NO_2 concentrations need to be reduced on this link by around **2.4%** compared to 2018 levels and is forecast by the EFT to be compliant by 2019 as a result of wider AQ measures.

As a result any methods will need to be extremely short term in order to accelerate compliance further. However they will also support long term AQ reduction ambitions and provide further backup should the effects modelled in the EFT not materialise.

Traffic Signal Optimisation

A number of signals on the link have already been optimised along with some junction design adaptations. As such, it is forecasted to have the following impact based on the methodology described in the previous section. Table 4.7 provides the impact assessment

SourceID	Traffic Flow	% Change	All Vehicles (g/km/s)	All LDVs (g/km/s)	All HDVs (g/km/s)	Petrol Cars (g/km/s)	Diesel Cars (g/km/s)	Petrol LGVs (g/km/s)	Diesel LGVs (g/km/s)	Rigid HGVs (g/km/s)	Artic HGVs (g/km/s)	Buses/Coaches (g/km/s)
Baseline	27081		14,493.67	10,369.87	4,123.80	778.73	5,728.55	9.39	3,796.97	2,595.88	603.96	916.19
Traffic Light Optimisation	28909	102.2%	14,816.49	10,737.02	4,079.46	809.15	5,887.94	9.86	3,971.51	2,574.43	590.79	906.62
Traffic Light Optimisation (gated)	27081	95.8%	13,879.61	10,058.10	3,821.51	757.98	5,515.63	9.24	3,720.39	2,411.65	553.44	849.30

Table 4.7 Savings as a result of Traffic Signal Optimisations

The optimisation without gating may create additional volume impacts though these may be mitigated by other road design changes. If gating is implemented as a result of this study, there is a potential **4.2% saving** in NO_X to be made. **This equates to a 1.8% saving in NO_X**

Driver Training:

Based on the methodology outlined in the previous section and targeting DPD, Metsec, Ryder and Royal Mail the following reductions are estimated in table 4.8:

Business Identified	Est Employees	Est. Fleet size	Takeup	Emissions Reduction per journey	**Pax Vehicles**	**Vans**
DPD	2000	200	75%	8%	0.52%	0.40%
Ryder	50	100	75%	8%	0.01%	0.20%
Royal Mail	45	25	75%	8%	0.01%	0.05%
Metsec	50	10	75%	8%	0.01%	0.02%
TOTAL Savings					**0.55%**	**0.67%**

Table 4.8: Savings as a result of driver training interventions

NO_X emissions could reduce by **1.23%** from the car and van sectors**,** taking into account both commuting and business use of vehicles accessing the link. **This equates to a 0.5% saving in NO_2 concentrations**

Travel Planning

Looking at similar businesses as candidates for driver training, travel planning could deliver a further benefit, though the level of uptake predicted has meant that overall savings could be quite small in the context of the whole road link. However this could be increased through the use of dedicated personnel and targeted marketing to ensure everyone gets chance to meet with a travel consultant. Table 4.9 shows potential savings

Business Identified	Est Employees	Est. Fleet size	Take-up	Reduction in Car Use	% Savings as a result
DPD	2000	200	5%	11%	0.0426%
Ryder	50	100	5%	11%	0.0011%
Royal Mail	45	25	5%	11%	0.0010%
Metsec	50	10	5%	11%	0.0011%
TOTAL					**0.0457%**

Table 4.9: Savings due to travel planning

Reductions are limited due to the low take-up predicted, to the extent that impacts on air quality would be negligible, with a total **0.046%** reduction in NO_X emissions, **or a 0.03% saving in NO_2 concentrations.**

Speed Reductions

Based on the methodology set out, the implementation of speed reductions shows that changes in emissions due to alteration of speeds is outweighed by the volume changes that would occur as a result. Nominally, AQ emissions will increase due to the lower speeds due to moving from a 40mph to a 30 mph speed limit, however this is largely offset due to a decrease in traffic volume. Table 4.10 shows the changes.

SourceID	Traffic Flow	Speed (kph)	% Change	All Vehicles	Petrol Car	Diesel Cars	Petrol LG	Diesel LGV	Rigid HGVs	Artic HGVs	Buses/Coa	Motorcycl
Baseline	27,094.00	38.5		12,571.83	710.29	5,037.52	8.93	3,562.95	2,031.86	450.35	711.94	15.51
Optimised Speed	23,709.00	28.9	101.1%	12,709.68	682.45	5,022.31	8.23	3,326.78	2,278.94	530.49	804.39	13.32

Table 4.10: Impact of changes in speed

The intervention forecasts that NO_X emissions will **increase by 1.1%** as a result of the change and as such **will not be carried forward as a recommendation**

Retrofitting of Buses with SCR Technology

Based on the methodology set out in the previous section Table 4.11 shows the potential impact across the fleet based on the sensitivity scenarios and existing mix of buses using the route.

	17142					
	Baseline	10%	25%	50%	75%	100%
All Vehicles (g/km)	14,154.43	14,083.25	13,976.49	13,798.55	13,620.61	13,442.67
All LDVs (g/km)	9,805.60	9,805.60	9,805.60	9,805.60	9,805.60	9,805.60
All HDVs (g/km)	4,348.83	4,277.65	4,170.89	3,992.95	3,815.01	3,637.07
Petrol Cars (g/km)	716.97	716.97	716.97	716.97	716.97	716.97
Diesel Cars (g/km)	5,561.44	5,561.44	5,561.44	5,561.44	5,561.44	5,561.44
Taxis (g/km)	-	-	-	-	-	-
Petrol LGVs (g/km)	7.68	7.68	7.68	7.68	7.68	7.68
Diesel LGVs (g/km)	3,445.21	3,445.21	3,445.21	3,445.21	3,445.21	3,445.21
Rigid HGVs (g/km)	2,155.42	2,155.42	2,155.42	2,155.42	2,155.42	2,155.42
Artic HGVs (g/km)	469.61	469.61	469.61	469.61	469.61	469.61
Buses/Coaches (g/km)	1,716.46	1,645.28	1,538.52	1,360.58	1,182.64	1,004.71
% Saving		99.50%	98.74%	97.49%	96.23%	94.97%

Table 4.11: Impact of Bus Retrofit

However at a 10% uptake, NO_X emissions savings are around **0.5%** moving to a **5.03%** reduction once all vehicles are fitted. This gives an equivalent **saving of between 0.2% and 2.1% of NO_2 concentrations**

Conclusion

Implementing all the interventions available for this link creates a total reduction in NO_X emissions of between **5.93% and 10.50% or between 2.5% and 4.4% savings in NO_2** concentrations based on 2018 levels. Implementing all these interventions has the potential to put emissions over the threshold.

			2018				2019		
17142	TOTAL NO_2		40.9				38.9		
	R-NOX Reduction	R-NOX 2018	Total NO_2	Road NO_2	% Change in total NO_2	R-NOX 2019	Total NO_2	Road NO_2	% Change in total NO_2
Traffic Signal Optimisation	4.20%	39.7	40.1	18.0	1.8%	36.9	38.3	16.9	1.8%
Bus Retrofit Min	0.50%	39.7	40.8	18.6	0.2%	36.9	38.9	17.5	0.2%
Bus Retrofit Max	5.03%	39.7	40.0	17.9	2.1%	36.9	38.1	16.8	2.1%
Driver Training	1.23%	39.7	40.7	18.5	0.5%	36.9	38.7	17.4	0.5%
Travel Planning	0.05%	39.7	40.9	18.7	0.0%	36.9	38.9	17.6	0.0%
Speed Reduction	-1.10%	39.7	41.1	18.9	-0.5%	36.9	39.1	17.8	-0.5%
Total Min	**5.93%**	39.7	**39.8**	**17.7**	**2.5%**	36.9	**38.0**	**16.6**	**2.5%**
Total Max	**10.50%**		**39.1**	**16.9**	**4.4%**	36.9	**37.2**	**15.9**	**4.4%**

Table 4.12 Future Year Reductions

Table 4.12 shows how concentrations change between 2018 and 2019, when the link is scheduled to be compliant.

The table shows that the impact is maintained due to the nature of the interventions and short time duration.

4.3.2 Road Link 99155 A41 J1 M5, West Bromwich

Modelled to be compliant by 2020 based on wider AQ measures and technological improvements, the link has greater scope for interventions that take longer to implement. However NO_2 concentrations need to reduce by a significant **9.1%** based on 2018 levels in order to reach compliance.

Traffic Signal Optimisation

As per the methodology set out in the previous section, signal optimisation has the potential to increase traffic flow and in turn improve emissions. However this can be potentially compromised by increased volumes of traffic now able to access the link. To prevent this, traffic can be gated in non-exceedance areas. As such table 4.13 shows the impact of the optimisation both with and without gating i.e. no flow increase, vs flow increase.

SourceID	Traffic Flow	% Change	All Vehicles (g/km/s)	All LDVs (g/km/s)	All HDVs (g/km/s)	Petrol Cars (g/km/s)	Diesel Cars (g/km/s)	Petrol LGVs (g/km/s)	Diesel LGVs (g/km/s)	Rigid HGVs (g/km/s)	Artic HGVs (g/km/s)	Buses/Coaches (g/km/s)
Baseline	27081		14,493.67	10,369.87	4,123.80	778.73	5,728.55	9.39	3,796.97	2,595.88	603.96	916.19
Traffic Light Optimisation	28909	102.2%	14,816.49	10,737.02	4,079.46	809.15	5,887.94	9.86	3,971.51	2,574.43	590.79	906.62
Traffic Light Optimisation (gated)	27081	95.8%	13,879.61	10,058.10	3,821.51	757.98	5,515.63	9.24	3,720.39	2,411.65	553.44	849.30

Table 4.13: Impact of Traffic Optimisation

Table 4.13 shows that the without gating creates a **2.2% increase** in emissions due to the increased traffic volumes accessing the link. However, with gating, the model forecasts a **4.2% decrease** in NO_X emissions based on 2018 levels or a **2.0% reduction in NO_2 concentrations**

Minor optimisation has already taken place on the link so it’s likely that some of the savings are already being realised. However optimisation must ensure that volume is prevented from increasing on the link.

Retrofitting of Buses with SCR Technology

Based on the methodology set out in the previous section, table 4.14 shows the potential impact across the fleet based on the sensitivity scenarios and existing mix of buses using the route. It should be noted that savings are expected to be relatively minor compared to other interventions. Across the links identified as suitable for bus retrofit, buses account for an average 1.2% of traffic and around 4% of emissions. As such, whilst per bus emissions are significant; in the context of overall traffic their impact is minimal.

	99155					
	Baseline	10%	25%	50%	75%	100%
All Vehicles (g/km)	16,260.94	16,239.99	16,199.27	16,148.07	16,075.93	16,013.20
All LDVs (g/km)	11,084.25	11,084.25	11,084.25	11,084.25	11,084.25	11,084.25
All HDVs (g/km)	5,176.68	5,155.74	5,115.02	5,063.82	4,991.68	4,928.95
Petrol Cars (g/km)	849.31	849.31	849.31	849.31	849.31	849.31
Diesel Cars (g/km)	6,588.04	6,588.04	6,588.04	6,588.04	6,588.04	6,588.04
Taxis (g/km)	-	-	-	-	-	-
Petrol LGVs (g/km)	7.92	7.92	7.92	7.92	7.92	7.92
Diesel LGVs (g/km)	3,552.29	3,552.29	3,552.29	3,552.29	3,552.29	3,552.29
Rigid HGVs (g/km)	2,419.20	2,419.20	2,419.20	2,419.20	2,419.20	2,419.20
Artic HGVs (g/km)	527.08	527.08	527.08	527.08	527.08	527.08
Buses/Coaches (g/km)	2,217.38	2,196.43	2,155.71	2,104.51	2,032.37	1,969.64
% Saving		99.87%	99.62%	99.31%	98.86%	98.48%

Table 4.14: Impact of Bus Retrofit

91% of the vehicles serving this route are already Euro V and so the potential savings are limited compared to other routes. However at a 10% uptake, NO_X emissions savings are around **0.13%** moving to a **1.52%** reduction once all vehicles are fitted. This gives an equivalent **saving of between 0.1% and 0.7% of NO_2 concentrations**

It is unknown what level of retrofit will be achieved within the time limits set out by Defra. However, the bus quality partnership may help accelerate the rate of fleet renewal between now and 2021.

Travel Planning

Travel planning could provide a benefit but in the wider context of overall traffic flow its impact will be relatively minor. We have focussed on Sandwell College as this is an immediate target with an estimated 3,700 students and staff. Based on the similar 5% take up, table 4.15 outlines the potential savings.

Business Identified	Est Employees	Est. Fleet size	Take up	Reduction in Car Use	**% Saving as a Result**
Sandwell College	3,700		5%	11%	0.08%

Table 4.15: Forecast savings as a result of travel planning.

As indicated, the savings are relatively minor. Based on 2018 levels a **0.08%** saving in NO_X emissions can be expected, the equivalent of **0.05% in NO_2 concentrations**. As a result further interventions will be required and unless additional businesses can be identified, this may not be worth taking forward.

Conclusion

Due to the nature of the road, the number of interventions at the site is limited, in this case to bus retrofit and signal optimisation. Combined, the two interventions are forecast to produce a potential reduction in NO_X emissions between **4.41% and 5.8%,** the equivalent of between **2.05% and 3.75% savings** in NO_2 concentrations resulting in levels of NO_2 between 42.7µgm^{-3} and 42.4 µgm^{-3} based on 2018 levels. Table 4.16 shows the impact of the interventions in 2018 and 2019, after which the link is forecast to be compliant

			2018				2019		
99155	TOTAL NO_2		43.6				41.5		
	R-NOX Reduction		Total NO_2	Road NO_2	% Change in total NO_2	R-NOX 2019	Total NO_2	Road NO_2	% Change in total NO_2
Traffic Signal Optimisation	4.20%	49.5	42.7	22.1	2.0%	46.3	40.7	20.9	2.0%
Bus Retrofit Min	0.13%	49.5	43.6	22.9	0.1%	46.3	41.5	21.7	0.1%
Bus Retrofit Max	1.52%	49.5	43.3	22.6	0.7%	46.3	41.2	21.4	0.7%
Total Min	**4.33%**	49.5	**42.7**	**22.1**	**2.0%**	46.3	**40.7**	**20.9**	**2.0%**
Total Max	**5.72%**	49.5	**42.4**	**21.8**	**2.7%**	46.3	**40.4**	**20.6**	**2.7%**

Table 4.16 Effect of interventions in future years

It can be seen that the effectiveness of the interventions have maintained their effectiveness given the short timescales and relatively minor changes in baseline data.

4.3.3 Road Link 99397 A41 Black Country New Road at Wednesbury

Modelled to be compliant by 2020 based on wider AQ measures, NO_2 concentrations need to reduce by a significant **9.1%** based on 2018 levels in order to reach compliance.

Traffic Calming

Given the relationship journey time, speed and volume as shown in figure 18 and the impacts shown in speed reduction modelling, this measure is likely to further increase emissions and will not be looked at further

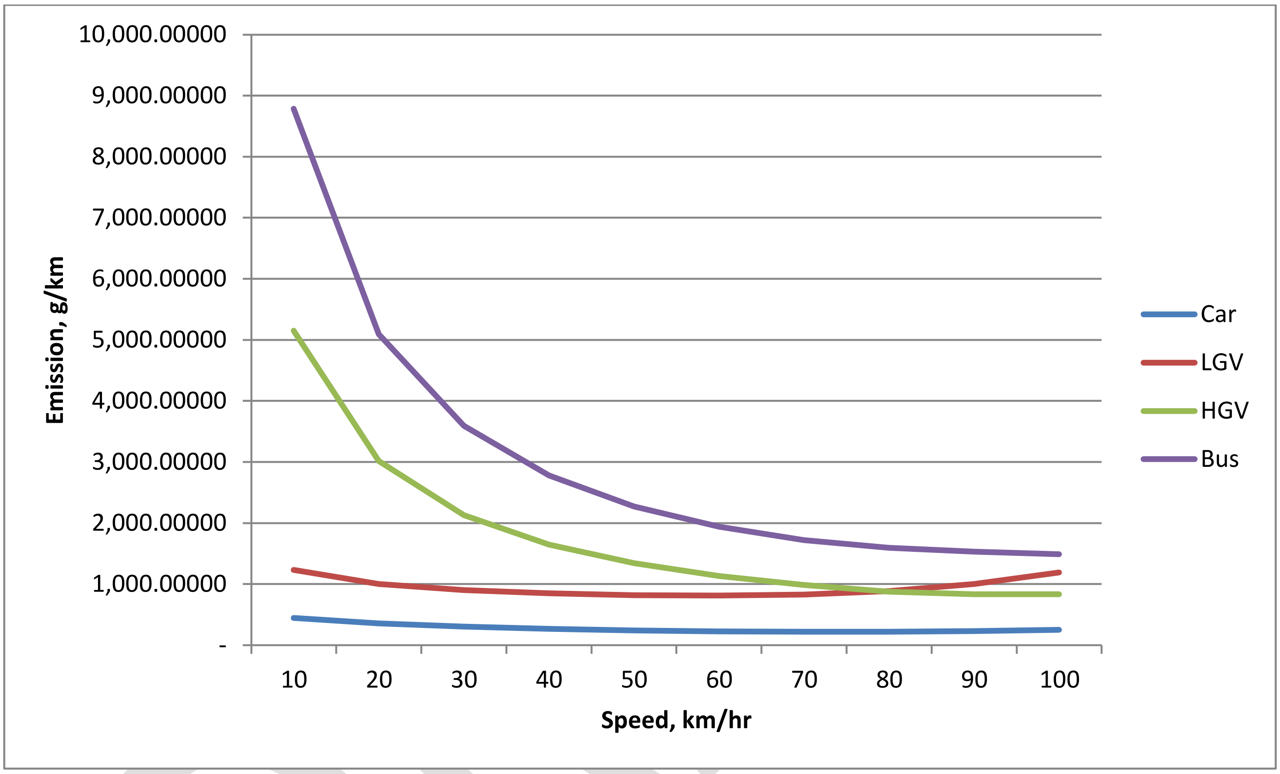


Figure 18: Speed – Emissions Relationships

Retrofitting of Buses with SCR Technology

Based on the methodology set out in the previous section, table 4.17 shows the potential impact across the fleet based on the sensitivity scenarios and existing mix of buses using the route.

99397					
Baseline	**10%**	**25%**	**50%**	**75%**	**100%**
15,486.13	15,413.56	15,304.71	15,123.30	14,941.88	14,760.46
11,511.01	11,511.01	11,511.01	11,511.01	11,511.01	11,511.01
3,975.12	3,902.56	3,793.71	3,612.29	3,430.87	3,249.45
849.57	849.57	849.57	849.57	849.57	849.57
6,095.06	6,095.06	6,095.06	6,095.06	6,095.06	6,095.06
-	-	-	-	-	-
10.12	10.12	10.12	10.12	10.12	10.12
4,440.87	4,440.87	4,440.87	4,440.87	4,440.87	4,440.87
1,830.43	1,830.43	1,830.43	1,830.43	1,830.43	1,830.43
359.21	359.21	359.21	359.21	359.21	359.21
1,776.43	1,703.86	1,595.01	1,413.59	1,232.18	1,050.76
	99.53%	98.83%	97.66%	96.49%	95.31%

Table 4.17: Impact of Bus Retrofit.

Table 4.17 shows a **reduction in NO_X emissions of between 0.47% and 4.69%** against 2018 emissions levels depending on the level of retrofit undertaken. In terms of NO_2 concentrations, this equates a **reduction of 0.23% and 2.26%.**

Walking & Cycling Infrastructure

Based on interventions being complete in 2019, a sensitivity test has been set up to ascertain potential levels of reduction in NO_X emissions. Table 4.18 shows the potential savings as a result

2019 Baseline	2.50%	5%	10%	Required % Reduction	Resultant Traffic Reduction Required
100%	98.88%	97.75%	95.50%	5%	11%

Table 4.18 Forecast savings as a result of walking and cycling

It can be seen that at the most optimistic scenario, NO_X emissions can **reduce by between 1.12% and 4.5%** or an equivalent of **between 0.5% and 2.2% reduction in NO_2 concentrations**. An 11% shift in traffic would be required to meet the threshold in 2019

Conclusion

There is limited scope for interventions within this link, traffic calming may in fact increase emissions. Travel Planning as well as strong walking and cycling measures may help to reduce emissions slightly with both interventions at a worst case able to reduce NO_X emissions by around **1.1% or 0.6% in terms of NO_2 concentrations.** Through targeted marketing as well as strong stakeholder engagement may increase the effectiveness of both measures, forecasting a maximum saving in NO_X of **4.53% or 2.15% NO_2**, reducing absolute concentrations to between 43.92 μgm^{-3} and 42.3 μgm^{-3}

Based on these percentage reductions, table 50a looks at the impact on future years as the overall NO_X/NO_2 position changes.

			2018					2019		
99397	TOTAL NO_2	2018	44.3					42.1		
	R-NOX Reduction	Bknd NO2	Total NO_2	Road NO_2	% Change in total NO_2		R-NOX 2019	Total NO_2	Road NO_2	% Change in total NO_2
Walking/Cycling Min	1.12%	20.3	44.0	23.8	0.5%		47.9	41.9	22.2	0.5%
Walking/Cycling Max	4.50%	20.3	43.3	23.0	2.2%		47.9	41.2	21.6	2.1%
Bus Retrofit Min	0.47%	20.3	44.2	23.9	0.2%		47.9	42.0	22.4	0.2%
Bus Retrofit Max	4.69%	20.3	43.3	23.0	2.3%		47.9	41.2	21.5	2.2%
Travel Planning	0.08%	20.3	44.3	24.0	0.0%		47.9	42.1	22.4	0.0%
Total Min	**1.20%**	20.3	**43.9**	**23.6**	**0.8%**		47.9	**41.8**	**22.1**	**0.8%**
Total Max	**4.58%**	20.3	**42.3**	**22.0**	**4.5%**		47.9	**40.2**	**20.6**	**4.4%**

Table 4.19: Impact of interventions in future years

Table 4.19 shows a slight reduction in effectiveness of around 0.1% as overall NO_2 concentrations decline.

4.3.4 Road Link 16330 A34 Great Barr

Due to be compliant by 2019, this also limits the sort of interventions that may be effective in such a short time period. A **2.4% reduction** in NO_2 concentration is required based on 2018 levels

Traffic Signal Optimisation

Table 4.20 shows the baseline, without gating and with gating signal optimisation scenarios for the A34 Great Barr.

SourceID	Traffic Flow	% Change	All Vehicles (g/km/s)	All LDVs (g/km/s)	All HDVs (g/km/s)	Petrol Cars (g/km/s)	Diesel Cars (g/km/s)	Petrol LGVs (g/km/s)	Diesel LGVs (g/km/s)	Rigid HGVs (g/km/s)	Artic HGVs (g/km/s)	Buses/Coaches (g/km/s)
Baseline	34986		14,973.60	11,504.04	3,469.56	948.04	6,691.09	9.50	3,785.85	1,990.77	438.13	1,032.34
Traffic Light Optimisation	37348	102.4%	15,326.18	11,901.93	3,424.25	982.75	6,859.31	10.01	3,976.77	1,970.30	426.21	1,019.65
Traffic Light Optimisation (gated)	34986	95.9%	14,357.08	11,149.35	3,207.73	920.60	6,425.58	9.37	3,725.31	1,845.72	399.26	955.18

Table 4.20: Potential emissions savings as a result of signal optimisation

It can be seen that the non-gated scenario results in a **2.4% increase** in emissions due to the additional traffic flow forecasted, whereas a gating solution yields a **4.1% reduction** in NO_X emissions or a **2.1% reduction in NO_2 concentrations** based on 2018 levels.. Optimisation has already taken place on the key Scott Arms junction. Additionally, traffic has already diverted off the link to surrounding roads due to works by Highways England on Junctions 1 and 2. Thus the link may already be compliant.

Retrofitting of Buses with SCR Technology

Table 4.21 shows the level of emissions attributable to buses on the A34 as well as potential for reductions in NO_X emissions as a result of bus retrofit. 50% of the buses are already Euro V, though there is a large spread vehicle age on this route, offering potential for reductions

	16330					
	Baseline	10%	25%	50%	75%	100%
All Vehicles (g/km)	14,042.64	14,022.09	13,991.26	13,939.87	13,888.49	13,840.28
All LDVs (g/km)	10,915.63	10,915.63	10,915.63	10,915.63	10,915.63	10,915.63
All HDVs (g/km)	3,127.01	3,106.46	3,075.63	3,024.24	2,972.86	2,924.65
Petrol Cars (g/km)	874.40	874.40	874.40	874.40	874.40	874.40
Diesel Cars (g/km)	6,499.04	6,499.04	6,499.04	6,499.04	6,499.04	6,499.04
Taxis (g/km)	-	-	-	-	-	-
Petrol LGVs (g/km)	7.79	7.79	7.79	7.79	7.79	7.79
Diesel LGVs (g/km)	3,443.77	3,443.77	3,443.77	3,443.77	3,443.77	3,443.77
Rigid HGVs (g/km)	1,632.09	1,632.09	1,632.09	1,632.09	1,632.09	1,632.09
Artic HGVs (g/km)	338.32	338.32	338.32	338.32	338.32	338.32
Buses/Coaches (g/km)	1,148.74	1,128.18	1,097.35	1,045.97	994.59	946.38
% Saving		99.85%	99.63%	99.27%	98.90%	98.56%

Table 4.21: Impact of Bus Retrofit

The table shows there are potential savings in NO_X emissions between **0.15% and 1.44%** or **0.09% and 0.74% in terms of NO_2 concentrations** depending on the level or retrofit. Given that this route is part of the Commonwealth Games network, it's likely that the fleet serving this route will need to be prioritised. The bus quality partnership may also help accelerate the rate of fleet renewal between now and 2021

Conclusion

Implementing all the interventions will lead to **a reduction** in NO_X emissions of **between 4.25% and 5.54%** or NO_2 concentrations **between 2.2% and 2.5%** significantly improving the baseline emissions forecast and reducing absolute NO_2 levels to between 40.3µgm^{-3} and 40.0µgm^{-3} This link is forecast to be compliant by 2019 so no future years have been assessed. Table 4.22 shows the breakdown of intervention effectiveness.

16330	TOTAL NO_2		41.2		
	R-NOX Reduction		Total NO_2	Road NO_2	% Change in total NO_2
Traffic Signal Optimisation	4.10%	50.2	40.3	22.7	2.1%
Bus Retrofit Min	0.15%	50.2	41.1	23.5	0.1%
Bus Retrofit Max	1.44%	50.2	40.9	23.2	0.7%
Total Min	**4.25%**	50.2	**40.3**	**22.6**	**2.2%**
Total Max	**5.54%**	50.2	**40.0**	**22.4**	**2.8%**

Table 4.22: Intervention Summary Table

4.3.5 Road Link 28464: A4150 Ring Road St David's between Broad Street and Bilston Street Island

Due to be compliant by 2021, it forms part of the Wolverhampton ring road, the busiest link on the Black Country Network. However it requires a significant reduction in NO_2 concentration of **13%** based on 2018 levels. However, it provides maximum scope for interventions.

Traffic Signal Optimisation

Table 4.23 shows the baseline, without gating and with gating, scenarios for traffic signal optimisation

SourceID	Traffic Flow	% Change	All Vehicles (g/km/s)	All LDVs (g/km/s)	All HDVs (g/km/s)	Petrol Cars (g/km/s)	Diesel Cars (g/km/s)	Petrol LGVs (g/km/s)	Diesel LGVs (g/km/s)	Rigid HGVs (g/km/s)	Artic HGVs (g/km/s)	Buses/Coaches (g/km/s)
Baseline	43432		15,342.66	12,486.19	2,856.46	1,084.07	7,367.18	9.91	3,929.63	1,405.46	286.83	1,153.46
Traffic Light Optimisation	46364	103.6%	15,901.31	13,077.33	2,823.98	1,128.56	7,637.98	10.54	4,198.06	1,391.64	277.25	1,144.58
Traffic Light Optimisation (gated)	43432	97.1%	14,895.84	12,250.43	2,645.41	1,057.20	7,155.02	9.88	3,932.61	1,303.64	259.72	1,072.20

Table 4.23: Potential emissions savings as a result of signal optimisation

It shows that without gating, the optimisation results in a **3.6% increase** in emissions, whereas with gating of traffic, a **2.9% decrease** in NO_X emissions or a **1.4% decrease in NO_2 concentrations.**

Speed Reduction & Enforcement

Table 4.24 below shows the impact on NO_X emissions as a result of a speed reduction from 40 to 30mph and the corresponding volume changes as a result.

SourceID	Traffic Flow	Speed(kph)	All Vehicles (g/km)	All LDVs (g/km)	All HDVs (g/km)	Petrol Cars (g/km)	Diesel Cars (g/km)	Petrol LGVs (g/km)	Diesel LGVs (g/km)	Rigid HGVs (g/km)	Artic HGVs (g/km)	Buses/Coaches (g/km)
Baseline	43,444.00	38.3	18,250.15	14,214.56	4,035.59	1,230.70	8,736.67	10.40	4,150.94	1,964.64	436.04	1,621.72
Optimised Speed	38,181.00	28.9	18,435.55	13,880.82	4,554.73	1,184.66	8,718.19	9.61	3,886.75	2,199.05	511.89	1,828.26

Table 4.24: Potential emissions savings as a result of speed reductions

The intervention forecasts that NO_X emissions will **increase by an average of 0.7%** as a result of the change and as such **will not be carried forward as a recommendation**

Retrofitting of Buses with SCR Technology

Table 4.25 sets out the possible savings by retrofitting buses along this route. With 60% of the fleet at Euro III and accounting for 4% of emissions, there is a higher potential for savings on this route and the adjoining corridor 57739

	28464					
	Baseline	10%	25%	50%	75%	100%
All Vehicles (g/km)	12,063.09	12,037.46	12,000.06	11,938.06	11,876.07	11,813.03
All LDVs (g/km)	9,907.56	9,907.56	9,907.56	9,907.56	9,907.56	9,907.56
All HDVs (g/km)	2,155.53	2,129.90	2,092.49	2,030.50	1,968.50	1,905.47
Petrol Cars (g/km)	821.56	821.56	821.56	821.56	821.56	821.56
Diesel Cars (g/km)	5,981.55	5,981.55	5,981.55	5,981.55	5,981.55	5,981.55
Taxis (g/km)	-	-	-	-	-	-
Petrol LGVs (g/km)	6.84	6.84	6.84	6.84	6.84	6.84
Diesel LGVs (g/km)	3,004.50	3,004.50	3,004.50	3,004.50	3,004.50	3,004.50
Rigid HGVs (g/km)	1,182.48	1,182.48	1,182.48	1,182.48	1,182.48	1,182.48
Artic HGVs (g/km)	238.25	238.25	238.25	238.25	238.25	238.25
Buses/Coaches (g/km)	731.44	705.81	668.41	606.41	544.42	481.38
% Saving		99.79%	99.48%	98.96%	98.45%	97.93%

Table 4.25: Impact of Bus Retrofit

It shows that for a 10% conversion, overall NO_X emissions reduce by approximately **0.2%** whereas for 100% conversion, a **2.1%** reduction is possible. In terms of NO_2 concentrations, **savings of between 0.1% and 0.74%** could be expected.

It is unknown what level of retrofit will be achieved. However, the bus quality partnership may help accelerate the rate of fleet renewal between now and 2021

Traffic Calming

See Link ID 99397

Walking & Cycling Infrastructure

Based on interventions being complete in 2019, a sensitivity test has been set up to ascertain potential levels of reduction in NO_X emissions. Table 4.26 shows the potential savings as a result

2019 Emissions Base	2.50%	5%	10%	Required % Reduction	Resultant Traffic Reduction Required
100%	98.63%	97.25%	94.50%	7%	13%

Table 4.26: Potential emissions savings as a result of walking and cycling

Worst case, based on a 2.5% up take, NO_X emissions reduce by around 1.37%. With a 10% shift, NO_X emissions reduce by 5.5% based on 2019 levels. In terms of NO_2 concentrations, **savings of between 0.7% and 2.7%** can be expected, so even at the most optimistic estimates, further interventions will be required. Modelling suggests that a shift away from cars of 13% would be enough to reach the threshold based on 2019 levels

Conclusion

A combination of measures clearly offers a significant potential to reduce emissions, collectively, and assuming no interference or crossover between the interventions, NO_X emissions **savings** could vary between **4.48% and 10.47%** based on the level of bus retrofitting and modal shift to walking and cycling. In term of NO_2 concentrations this equates to a **saving of between 2.1% and 5.1**%. This reduces absolute NO_2 levels to between 44.3µgm^{-3} and 42.5µgm^{-3} based on 2018 emissions levels. Table 4.27 shows the impact of interventions in future years as NO_2 concentrations reduce.

			2018				2019				2020		
28464	TOTAL NO_2		45.3				43.3				41.0		
	R-NOX Reduction		Total NO_2	Road NO_2	% Change in total NO_2	R-NOX 2019	Total NO_2	Road NO_2	% Change in total NO_2	R-NOX 2020	Total NO_2	Road NO_2	% Change in total NO2
Traffic Signal Optimisation	2.90%	53.2	44.7	23.8	1.4%	49.7	42.7	22.6	1.4%	45.9	40.5	21.1	1.4%
Bus Retrofit Min	0.44%	53.2	45.2	24.4	0.2%	49.7	43.2	23.1	0.2%	45.9	40.9	21.6	0.2%
Bus Retrofit Max	4.41%	53.2	44.3	23.5	2.1%	49.7	42.4	22.3	2.1%	45.9	40.2	20.8	2.1%
Speed Reduction	-0.70%	53.2	45.4	24.6	-0.3%	49.7	43.4	23.3	-0.3%	45.9	41.2	21.8	-0.3%
Walking/Cycling Min	1.37%	53.2	45.0	24.2	0.7%	49.7	43.0	22.9	0.6%	45.9	40.8	21.4	0.7%
Walking/Cycling Max	5.50%	53.2	44.1	23.3	2.7%	49.7	42.1	22.0	2.6%	45.9	39.9	20.6	2.6%
Total Min	**4.71%**	53.2	**44.3**	**23.5**	**2.1%**	49.7	**42.3**	**22.2**	**2.1%**	45.9	**40.1**	**20.8**	**2.1%**
Total Max	**12.81%**	53.2	**43.0**	**22.2**	**5.1%**	49.7	**41.1**	**21.0**	**5.0%**	45.9	**39.0**	**19.6**	**5.0%**

Table 4.27: Impact of interventions in future years

It can be seen that interventions impacts reduce 0.1% in future years as the baseline decreases.

4.3.6 Road Link 57739: A4150 Ring Road Wolverhampton St George's between Bilston Street Island and Snow Hill Junction

Due to be compliant by 2019, it forms the south easterly section of the Wolverhampton Ring Road. It provides an opportunity for longer term interventions to take place such as walking and cycling enhancements as well as bus retrofit. It requires a **4.8%** reduction on 2018 NO_2 concentration in order to be compliant.

Traffic Signal Optimisation

Table 4.28 shows the baseline, without gating and with gating, scenarios for traffic signal optimisation

SourceID	Traffic Flow	% Change	All Vehicles (g/km/s)	All LDVs (g/km/s)	All HDVs (g/km/s)	Petrol Cars (g/km/s)	Diesel Cars (g/km/s)	Petrol LGVs (g/km/s)	Diesel LGVs (g/km/s)	Rigid HGVs (g/km/s)	Artic HGVs (g/km/s)	Buses/Coaches (g/km/s)
Baseline	33846		12,649.52	10,428.58	2,220.94	889.77	6,157.76	8.32	3,298.27	1,453.89	309.93	453.57
Traffic Light Optimisation	36131	102.9%	13,022.61	10,830.78	2,191.82	923.02	6,326.07	8.79	3,481.78	1,438.62	300.70	448.26
Traffic Light Optimisation (gated)	33846	96.4%	12,199.16	10,145.93	2,053.23	864.66	5,926.06	8.23	3,261.62	1,347.66	281.68	419.92

Table 4.28: Potential emissions savings as a result of signal optimisation

Table 4.28 shows that without gating, signal optimisation creates a **2.9% increase** in NO_X emissions however, using gating techniques creates a **3.6% decrease** in emissions or a **1.6% decrease** in NO_2 concentrations, based on 2018 levels.

Speed Reduction & Enforcement

Table 4.29 below shows the impact on NO_x emissions as a result of a speed reduction from 40 to 30mph and the corresponding volume changes as a result.

SourceID	Traffic Flow	Speed(kph)	All Vehicles (g/km)	All LDVs (g/km)	All HDVs (g/km)	Petrol Cars (g/km)	Diesel Cars (g/km)	Petrol LGVs (g/km)	Diesel LGVs (g/km)	Rigid HGVs (g/km)	Artic HGVs (g/km)	Buses/Coaches (g/km)
Baseline	33,859.00	38.3	13,885.13	11,220.63	2,664.50	952.49	6,761.65	8.57	3,421.57	1,732.58	384.54	542.97
Optimised Speed	29,756.00	28.9	13,955.15	10,947.22	3,007.93	916.82	6,747.08	7.92	3,203.67	1,939.23	451.41	612.10

Table 4.29: Potential emissions savings as a result of speed reductions

The intervention forecasts that emissions will **increase by an average of 0.3%** as a result of the change and as such **will not be carried forward as a recommendation.**

Retrofitting of Buses with SCR Technology

Table 4.30 sets out the impact of retrofitting buses along this route, with 60% of the fleet at Euro III and accounting for 4% of emissions, there is a higher potential for savings on this route and the adjoining corridor 28464.

	57739					
	Baseline	10%	25%	50%	75%	100%
All Vehicles (g/km)	12,063.09	12,037.46	12,000.06	11,938.06	11,876.07	11,813.03
All LDVs (g/km)	9,907.56	9,907.56	9,907.56	9,907.56	9,907.56	9,907.56
All HDVs (g/km)	2,155.53	2,129.90	2,092.49	2,030.50	1,968.50	1,905.47
Petrol Cars (g/km)	821.56	821.56	821.56	821.56	821.56	821.56
Diesel Cars (g/km)	5,981.55	5,981.55	5,981.55	5,981.55	5,981.55	5,981.55
Taxis (g/km)	-	-	-	-	-	-
Petrol LGVs (g/km)	6.84	6.84	6.84	6.84	6.84	6.84
Diesel LGVs (g/km)	3,004.50	3,004.50	3,004.50	3,004.50	3,004.50	3,004.50
Rigid HGVs (g/km)	1,182.48	1,182.48	1,182.48	1,182.48	1,182.48	1,182.48
Artic HGVs (g/km)	238.25	238.25	238.25	238.25	238.25	238.25
Buses/Coaches (g/km)	731.44	705.81	668.41	606.41	544.42	481.38
% Saving		99.79%	99.48%	98.96%	98.45%	97.93%

Table 4.30: Impact of Bus Retrofit

It shows that for a 10% conversion, overall NO_X emissions reduce by approximately **0.2%** whereas for 100% conversion, a **2.1%** reduction is possible. In terms of NO_2 concentrations, this equates to a **saving of between 0.1% and 0.9%.**

It is unknown what level of retrofit will be achieved. However, the bus quality partnership may help accelerate the rate of fleet renewal between now and 2021

Traffic Calming

See Link ID 99397

Walking & Cycling Interventions

Based on interventions being complete in 2019, a sensitivity test has been set up to ascertain potential levels of reduction in NO_X emissions. Table 4.31 shows the potential savings as a result

2019 Emissions Base	2.5%	5%	10%	Required % Reduction	Resultant Traffic Reduction Required
100%	98.98%	97.95%	95.90%	7%	17%

Table 4.31: Potential emissions savings as a result of walking and cycling

Table 4.31 shows that the least optimistic scenario reduces NO_X emissions **by 1.02%** the most optimistic scenario reduces NO_X **by 4.1%**, with a 17% reduction on traffic required in order to meet the threshold. In terms of NO_2 concentrations, savings of between **0.5% and 1.9**% can be expected. As such the measure will have to further compliment others.

Conclusion

Again open to a multitude of possible interventions in order to achieve compliance. Taking the sum total of each and assuming that there is no cross over in terms of savings, the interventions offer a potential reduction in NO_X emissions **of between 4.83% and 9.77%.** This equates to savings in NO_2 concentrations of **between 2.2% and 4.5%.** This equates to absolute levels of NO_2 between 41.03µgm^{-3} and 40.09µgm^{-3} based on 2018 levels. Table 60a shows the impact of interventions for 2018 and 2019, with the link forecast to be compliant in 2020.

			2018				**2019**		
57739	**TOTAL NO_2**		42.0				40.4		
	R-NOX Reduction		**Total NO_2**	**Road NO_2**	**% Change in total NO_2**	**R-NOX 2019**	**Total NO_2**	**Road NO_2**	**% Change in total NO_2**
Traffic Signal Optimisation	3.60%	45.2	41.3	20.4	1.6%	42.8	39.7	19.6	1.6%
Bus Retrofit Min	0.21%	45.2	41.9	21.1	0.1%	42.8	40.3	20.2	0.1%
Bus Retrofit Max	2.07%	45.2	41.6	20.7	0.9%	42.8	40.0	19.9	0.9%
Speed Reduction	-0.30%	45.2	42.0	21.2	-0.1%	42.8	40.4	20.3	-0.1%
Walking/Cycling Min	1.02%	45.2	41.8	20.9	0.5%	42.8	40.2	20.1	0.4%
Walking/Cycling Max	4.10%	45.2	41.2	20.3	1.9%	42.8	39.6	19.5	1.9%
Total Min	**4.83%**	45.2	**41.0**	**20.2**	**2.2%**	42.8	**39.5**	**19.4**	**2.2%**
Total Max	**9.77%**	45.2	**40.1**	**19.3**	**4.4%**	42.8	**38.6**	**18.5**	**4.4%**

Table 4.32: Impact of interventions on future years.

Table 4.32 above shows the effectiveness of interventions on this link remain stable in 2019.

4.3.7 Road Link 99402: A463 Black Country Route (BCR)

Compliant by 2021, the route is forecast to require a **13%** reduction in concentrations of NO_2 when measured against 2018 levels in order to meet the threshold.

Traffic Calming

See Link ID 99397

Walking and Cycling Improvements

Based on interventions being complete in 2019, a sensitivity test has been set up to ascertain potential levels of reduction in NO_X emissions. Table 4.33 shows the potential savings as a result. It is unlikely that infrastructure will be at a developed enough stage to accelerate compliance any further, but could be undertaken to further support other shorter term interventions and ensure forecast reductions are realised.

2019 Emissions Base	2.50%	5%	10%	Required % Reduction	Resultant Traffic Reduction Required
100%	98.98%	97.95%	95.90%	0%	0%

Table 4.33: Potential emissions savings as a result of walking and cycling

A 2.5% take up could result in savings in NO_X emissions of 1.02%. The most optimistic case of a 10% modal shift away from cars could infer emissions are reduced by **4.5%**. This equates to savings in NO_2 concentrations of **between 0.6% and 2.3%**

Conclusion

Due to be compliant in 2019, there is **little that can be practically achieved** within the timescale on this link to further accelerate its compliance. Walking and cycling measures 02%will further help to support this. With extensive, targeted resource, walking and cycling could make a significant difference **saving up to 4.1% in NO_X emissions or 2.3%** in terms of NO_2 concentrations. This reduces absolute levels to between 41.7µgm^{-3} and 41.0µgm^{-3} based on 2018 concentrations. Table 4.34 shows the impact in future years based on the 10% take-up of walking and cycling.

			2018				2019				2020		
99402	TOTAL NO_2		46.1				43.4				40.7		
	R-NOX Reduction		Total NO_2	Road NO_2	% Change in total NO_2	R-NOX 2019	Total NO_2	Road NO_2	% Change in total NO_2	R-NOX 2020	Total NO_2	Road NO_2	% Change in total NO_2
Walking/Cycling Min	1.02%	64.8	45.9	29.3	0.6%	59.2	43.2	27.3	0.6%	54.0	40.5	25.2	0.6%
Walking/Cycling Max	4.10%	64.8	45.1	28.5	2.3%	59.2	42.4	26.5	2.3%	54.0	39.8	24.5	2.3%

Table 4.34: Impact of interventions in future years.

Table 4.34, shows that the interventions efficacy remains stable as overall NO_2 reduces as walking and cycling looks to undertake wholesale modal shift.

4.3.8 Road Link 99404: A463 Black Country Route (BCR)

Compliant by 2019, the link needs only a **2.4%** reduction against 2018 levels in order to meet the NO_2 concentration threshold target, therefore only allowing the very shortest term interventions to have an impact.

Travel Planning

Travel planning could provide a benefit but in the wider context of overall traffic flow its impact will be relatively minor. We have targeted three businesses Ormiston SWB, VW Active and the adjacent retail park, which we have collectively estimated to have around 2,750 members/students and staff. Based on the similar 5% take up, table 4.35 outlines the potential savings.

Business Identified	Est Employees	Est. Fleet size	Take up	Reduction in Car Use	**% Saving as a Result**
Omiston SWB	1250		5%	11%	0.0266%
VW Active	1000		5%	11%	0.0213%
Retail Park	500		5%	11%	0.0107%
TOTAL					0.0586%

Table 4.35: Forecast savings as a result of travel planning.

As indicated, the savings are relatively minor. Based on 2018 levels a **0.06%** saving I NO_X emissions is predicted. This equates to a **0.02%** saving in NO_2 concentrations. As a result further interventions will be required and unless additional businesses can be identified or take up increased, this may not be worth taking forward.

Retrofitting of buses with SCR Technology

Table 4.36 sets out the impact of retrofitting buses along this route, with a good spread of bus age, including 39% of buses at Euro VI, and 33% at Euro III there should be some scope for improvements to emissions

99404					
Baseline	**10%**	**25%**	**50%**	**75%**	**100%**
13,693.04	13,662.60	13,616.93	13,540.82	13,464.71	13,388.59
10,668.03	10,668.03	10,668.03	10,668.03	10,668.03	10,668.03
3,025.01	2,994.57	2,948.90	2,872.79	2,796.67	2,720.56
837.26	837.26	837.26	837.26	837.26	837.26
6,134.24	6,134.24	6,134.24	6,134.24	6,134.24	6,134.24
-	-	-	-	-	-
8.19	8.19	8.19	8.19	8.19	8.19
3,603.23	3,603.23	3,603.23	3,603.23	3,603.23	3,603.23
1,571.66	1,571.66	1,571.66	1,571.66	1,571.66	1,571.66
319.61	319.61	319.61	319.61	319.61	319.61
1,126.51	1,096.06	1,050.40	974.28	898.17	822.06
	99.78%	99.44%	98.89%	98.33%	97.78%

Table 4.36: Impact of bus retrofitting.

It can be seen that retrofitting is forecast to create a **reduction of between 0.22% and 2.22%** in NO_X emissions depending on the level of retrofit that can be achieved. In terms of NO_2 concentrations, **reductions of between 0.11% and 1.19%**

Speed Limit Reduction & Enforcement

Table 4.37 below shows the impact on NO_X emissions as a result of a speed reduction from 40 to 30mph and the corresponding volume changes as a result.

SourceID	Traffic Flow	All Vehicles (g/km)	Petrol Cars (g/km)	Diesel Cars (g/km)	Petrol LGVs (g/km)	Diesel LGVs (g/km)	Rigid HGVs (g/km)	Artic HGVs (g/km)	Buses/Coaches (g/km)	Motorcycles (g/km)
Baseline	35,152.00	18,064.07920	1,046.23453	7,699.51178	10.73104	4,339.97936	2,803.26202	652.54145	1,427.10782	17.47118
Optimised Speed	29,297.00	18,364.25384	974.34321	7,532.45521	9.63462	4,010.18129	3,267.73213	804.43286	1,682.24110	15.62748

Table 4.37: Impact of changes in speed

The intervention forecasts that emissions will **increase by 1.7%** as a result of the change and as such will not be carried forward

Conclusion

For this link, bus retrofit has been assessed as the only truly viable option, though travel planning, as a relatively low cost supporting measure is often worthwhile provided businesses can be accessed. Based on 2018 levels, total NO_X reductions are expected to **reduce between 0.28% and 2.28%,** resulting in **reductions in NO_2 concentrations of between 0.13% and 1.21%. Table 63a show the impact of interventions in 2019, at which point the link is scheduled to be compliant.**

			2018				2019		
99404	TOTAL NO_2		40.9				38.8		
	R-NOX Reduction		Total NO_2	Road NO_2	% Change in total NO_2	R-NOX 2019	Total NO_2	Road NO_2	% Change in total NO_2
Travel Planning	0.06%	52.5	40.9	24.7	0.0%	48.6	38.8	23.1	0.0%
Bus Retrofit Min	0.22%	52.5	40.9	24.6	0.1%	48.6	38.8	23.1	0.1%
Bus Retrofit Max	2.22%	52.5	40.4	24.2	1.2%	48.6	38.4	22.7	1.2%
Speed Reduction	-1.70%	52.5	41.3	25.0	-0.9%	48.6	39.2	23.5	-0.9%
Total Min	**0.28%**	52.5	**40.9**	**24.6**	**0.1%**	52.5	**38.8**	**23.1**	**0.1%**
Total Max	**2.28%**	52.5	**40.4**	**24.2**	**1.2%**	52.5	**38.3**	**22.7**	**1.2%**

Table 4.37: Impact of interventions in future years.

The table shows that there is little change in their effectiveness given the nature of the interventions and short timescales.

4.3.9 Road Link 27202: A454 Black Country Route (BCR)

Forecast to be compliant by 2021, the link requires a significant **14.9%** reduction based on 2018 levels of emissions in order to meet the threshold criteria. However it provides opportunities for the longer term interventions to come to fruition.

Traffic Signal Optimisation

Table 4.38 shows the baseline, without gating and with gating, scenarios for traffic signal optimisation

SourceID	Traffic Flow	% Change	All Vehicles (g/km/s)	All LDVs (g/km/s)	All HDVs (g/km/s)	Petrol Cars (g/km/s)	Diesel Cars (g/km/s)	Petrol LGVs (g/km/s)	Diesel LGVs (g/km/s)	Rigid HGVs (g/km/s)	Artic HGVs (g/km/s)	Buses/Coaches (g/km/s)
Baseline	41712		21,786.61	13,682.85	8,103.76	1,047.68	7,444.11	12.76	5,098.26	6,251.03	1,389.16	459.83
Traffic Light Optimisation	44528	101.7%	22,162.87	14,164.42	7,998.44	1,086.14	7,631.05	13.44	5,349.71	6,188.01	1,352.57	454.23
Traffic Light Optimisation (gated)	41712	95.3%	20,761.47	13,268.78	7,492.69	1,017.46	7,148.53	12.59	5,011.44	5,796.73	1,267.04	425.51

Table 4.38: Potential emissions savings as a result of speed reductions

Optimisation without gating shows a **1.7% increase** in emissions. Whereas with gating the model forecasts a **4.7% decrease** in NO_X emissions. This equates to a 2.6% decrease in NO_2 concentrations.

It is likely that any major changes will be addressed through the major scheme(see overleaf) which will replace all of the signal equipment enabled with 'intelligent operation' e.g. SCOOT, MOVA or combination of both.

However signal time plans and the manual intervention strategies for the junction could be revised in advance of the major scheme, it should be noted that this could only be achieved if it didn't endanger traffic queuing on the on- and off-slips. Similarly, any gating of the A454 would not be able to impede traffic on the M6 and gyratory for safety reasons to prevent it gridlocking, increasing the possibility of collisions.

There may be an opportunity to create box junctions in the near term that could improve driver behaviour to realise a proportion of the reductions. This could be further improved with CCTV enforcement.

Traffic Calming

See Link ID 99397

Walking & Cycling Infrastructure

Based on interventions being complete in 2019, a sensitivity test has been set up to ascertain potential levels of reduction in NO_X emissions. Table 4.39 shows the potential savings as a result.

2019 Baseline	2.50%	5%	10%	Required % Reduction	Resultant Traffic Reduction Required
100%	99.00%	98.00%	96.00%	9%	23%

Table 4.39: Potential emissions savings as a result of walking and cycling

A scheme to improve connectivity across the junction has already been proposed as a part of the J10 upgrade scheme

A 2.5% take up creates a **1% saving** in NO_X emissions. The most optimistic scenario of a 10% reduction in car traffic results in a **4%** reduction in NO_x emissions. This equates to between a **0.5% and 2.2% saving** in NO_2 concentrations. However, without any other interventions, a 9% reduction is required, equivalent to a 23% reduction in car traffic. As such other interventions will be required.

Highways Intervention

Based on Mott McDonald's Air Quality Environmental Statement for the junction upgrade, the following has been estimated:

"The 27202 A454 BCR, close to M6 J10, is likely to experience an increase of approximately 900 AADT (100 HDVs) on the eastbound carriageway and approximately 5500 AADT (870 HDVs) on the westbound carriageway during operation."

This was run through the EFT, resulting in an AADT increase of 6,400 vehicles and an increase in HDVs of around 1%. Table 4.40 shows the emissions impact of this.

Source Name	Flow	All Vehicles	All LDVs (g/km)	All HDVs (g/km)	Petrol Cars (g/km)	Diesel Cars (g/km)	Petrol LGVs	Diesel LGVs (g/km)	Rigid HGVs (g/km)	Artic HGVs (g/km)	Buses/Coaches (g/km)
New Junction	48,112.00	24,049.04	14,661.47	9,387.58	1,082.68	8,103.53	12.07	5,346.72	6,693.85	1,399.68	1,282.29
Baseline	41,712.00	17,219.42	11,942.85	5,276.57	893.82	6,485.28	10.14	4,455.60	4,134.59	828.54	310.71

Table 4.40: Potential Impact of Highways Intervention

The EFT forecasts an **up lift in NOx of 36%** on the A454 as a result of the junction upgrade once operational. However the impact statement estimates that the project will be neutral in terms of impact and therefore be offset by improvements to emissions from the M6.

Additionally, the programme is unlikely to be able to be brought forward as this is governed by legal and procedural timescales rather than funding issues or other items within Defra's or the authority's control. As such, we will not consider the intervention further within the context of the study

Conclusion

Highways upgrade aside, whilst the interventions here will not reduce NO_2 concentrations below the threshold insolation, collectively they could reduce emissions between **5.7% and 8.7%, equivalent to between a 3.2% and 4.8% reduction** in NO_2 concentrations**.** This reduces absolute levels of NO_2 to between 45.3µgm^{-3} and 44.5µgm^{-3} based on 2018 levels, table 4.41 shows the impact of interventions on future years

27202	NO_2 Concentrations	2018	46.7			2019	43.8			2020	40.9		
	R-NOX Reduction	Bknd NO2	Total NO_2	Road NO_2	% Change in total NO_2	Bknd NO2	Total NO_2	Road NO_2	% Change in total NO_2	Bknd NO2	Total NO_2	Road NO_2	% Change in total NO_2
Traffic Signal Optimisation	4.70%	17.0	45.52	28.54	2.60%	16.3	42.63	26.32	2.60%	15.6	39.82	24.21	2.58%
Highways Intervention	-36.00%	17.0	55.57	38.59	-18.90%	16.3	52.03	35.72	-18.88%	15.6	48.58	32.97	-18.85%
Walking/Cycling Min	1.00%	17.0	46.48	29.5	0.55%	16.3	43.53	27.22	0.54%	15.6	40.65	25.04	0.55%
Walking/Cycling Max	4.00%	17.0	45.7	28.72	2.21%	16.3	42.8	26.49	2.21%	15.6	39.98	24.37	2.19%
Total Min	**5.70%**	17.0	**45.27**	**28.28**	**3.15%**	16.3	**42.39**	**26.08**	**3.13%**	15.6	**39.60**	**23.98**	**3.13%**
Total Max	**8.70%**	17.0	**44.49**	**27.50**	**4.81%**	16.3	**41.66**	**25.35**	**4.80%**	15.6	**38.93**	**23.31**	**4.77%**

Table 4.41: Impact of interventions in future years.

The table shows that the interventions are table in their effectiveness as background NO_2 changes, it can be seen that there are minor reductions in effectiveness, though the interventions still retain the ability to make reductions between 4.7% and 4.8%.

4.3.10 Road Link 38201: A4148 Wolverhampton Road/Blue Lane West

Forecast to be compliant by 2020, it needs a **4.8%** reduction in NO_2 concentrations in order to meet the threshold. Medium term interventions however should be effective during this period.

Traffic Signal Optimisation

Table 4.42 shows the baseline, without gating and with gating, scenarios for traffic signal optimisation

Source Name	Volume	% Saving	All Vehicles (g/km)	Petrol Cars (g/km)	Diesel Cars (g/km)	Petrol LGVs (g/km)	Diesel LGVs (g/km)	Rigid HGVs (g/km)	Artic HGVs (g/km)	Buses/Coaches (g/km)	Motorcycles (g/km)
Baseline	32,302.00		19,172.38	791.18	7,772.04	10.07	4,396.56	3,278.88	2,554.83	295.81	19.45
Optimised Not Gated	34,470.64	102.9%	19,737.81	826.96	8,055.62	10.61	4,617.36	3,305.04	2,548.28	297.66	20.67
Optimised Gated	32,302.00	96.5%	18,496.05	774.94	7,548.82	9.94	4,326.87	3,097.11	2,387.96	278.94	19.37

Table 4.42: Potential emissions savings as a result of speed reductions

Table 4.42 shows that the non-gated scenario results in a potential **2.9% increase** in NO_X emissions due to additional volumes generated. However the gated scenario, which prevents additional traffic volume, shows a **potential reduction** in NO_X emissions of around **3.5% or 1.9%** in terms of NO_2 concentrations.

Retrofitting of buses with SCR Technology

Table 4.43 sets out the impact of retrofitting buses along this route, with a good spread of bus age, including 50% of buses at Euro V, there should be some scope for improvements to emissions

38201					
Baseline	10%	25%	50%	75%	100%
17,061.82	17,050.12	17,032.56	17,003.30	16,974.04	16,944.78
11,497.52	11,497.52	11,497.52	11,497.52	11,497.52	11,497.52
5,564.31	5,552.60	5,535.05	5,505.79	5,476.52	5,447.26
842.44	842.44	842.44	842.44	842.44	842.44
6,563.82	6,563.82	6,563.82	6,563.82	6,563.82	6,563.82
-	-	-	-	-	-
8.88	8.88	8.88	8.88	8.88	8.88
3,993.16	3,993.16	3,993.16	3,993.16	3,993.16	3,993.16
4,190.22	4,190.22	4,190.22	4,190.22	4,190.22	4,190.22
917.39	917.39	917.39	917.39	917.39	917.39
454.28	442.58	425.02	395.76	366.50	337.24
	99.93%	99.83%	99.66%	99.49%	99.31%

Table 4.43: Potential Impact of Bus Retrofit

It shows that for a 10% conversion, overall NO_X emissions reduce by approximately **0.1%** whereas for 100% conversion, a **0.7%** reduction is possible. In terms of NO_2 concentrations **savings of between 0.05% and 0.3%** are forecast, meaning relatively few improvements given the required spend.

It is unknown what level of retrofit will be achieved. However, the bus quality partnership may help accelerate the rate of fleet renewal between now and 2021

Conclusion

Combining all the interventions and assuming there is no crossover there is a potential to **reduce NO_X emissions by between 3.6% and 4.2%,** this will contribute significantly to the 10% NO_2 reduction required, though won't reduce emissions below the threshold. In terms of NO_2 reductions between **1.7% and 1.9%** are forecast, reducing absolute levels to between 43.7µgm^{-3} and 43.6µgm^{-3} Based on 2018 levels. Table 4.44 shows the impact of interventions on future years.

			2018				2019				2020		
38201	TOTAL NO_2		44.4				42.5				40.3		
	R-NOX Reduction		Total NO_2	Road NO_2	% Change in total NO_2	R-NOX 2019	Total NO_2	Road NO_2	% Change in total NO_2	R-NOX 2020	Total NO_2	Road NO_2	% Change in total NO_2
Traffic Signal Optimisation	3.50%	49.8	43.7	22.3	1.6%	46.7	41.8	21.2	1.6%	43.4	39.7	19.9	1.6%
Bus Retrofit Min	0.10%	49.8	44.4	23.0	0.0%	46.7	42.4	21.8	0.0%	43.4	40.3	20.5	0.0%
Bus Retrofit Max	0.70%	49.8	44.3	22.9	0.3%	46.7	42.3	21.7	0.3%	43.4	40.2	20.4	0.3%
Total Min	**3.60%**	49.8	**43.7**	**22.3**	**1.7%**	46.7	**41.8**	**21.1**	**1.6%**	43.4	**39.6**	**19.9**	**1.7%**
Total Max	**4.20%**	49.8	**43.6**	**22.1**	**1.9%**	46.7	**41.6**	**21.0**	**1.9%**	43.4	**39.5**	**19.7**	**1.9%**

Table 4.44: Impact of interventions on future years

The table shows few changes in effectiveness in future years.

4.3.11 Road Link 74559: A461 Cinderbank Island to Castlegate Island / Duncan Edwards Way

Forecast to be compliant by 2020, it also requires a **7%** reduction in NO_2 concentrations in order to meet the thresholds.

Traffic Signal Optimisation

Table 4.45 shows the baseline, without gating and with gating, scenarios for traffic signal optimisation on the roundabouts.

SourceID	Traffic Flow	% Change	All Vehicles (g/km/s)	All LDVs (g/km/s)	All HDVs (g/km/s)	Petrol Cars (g/km/s)	Diesel Cars (g/km/s)	Petrol LGVs (g/km/s)	Diesel LGVs (g/km/s)	Rigid HGVs (g/km/s)	Artic HGVs (g/km/s)	Buses/Coaches (g/km/s)
Baseline	39206		16,867.49	12,218.16	4,649.33	966.22	6,699.08	11.25	4,465.66	3,606.42	771.33	269.46
Traffic Light Optimisation	41852	102.5%	17,283.97	12,698.10	4,585.87	1,002.18	6,879.55	11.89	4,711.13	3,568.52	748.55	266.27
Traffic Light Optimisation (gated)	39206	96.0%	16,191.07	11,895.18	4,295.89	938.81	6,444.54	11.14	4,413.24	3,342.87	701.22	249.44

Table 4.45: Potential emissions savings as a result of speed reductions

Table 4.45 shows that the non-gated scenario **increases** emissions by **2.5%** due to the increase in daily traffic flow by approximately 2,600 vehicles per day. However, the gated scenario, where volume does not increase creates a **saving of 4%** on NO_X emissions or **2.1% based on NO_2 concentrations**. based on 2018 levels.

Speed Limit Reduction

Table 4.46 below shows the impact on NO_X emissions as a result of a speed reduction from 50 to 30mph and the corresponding volume changes as a result.

SourceID	Traffic Flow	Speed (kph)	All Vehicles (g/km)	All LDVs (g/km)	All HDVs (g/km)	Petrol Cars (g/km)	Diesel Cars (g/km)	Petrol LGVs (g/km)	Diesel LGVs (g/km)	Rigid HGVs (g/km)	Artic HGVs (g/km)	Buses/Coaches (g/km)
Baseline	39,218.00	47.80	16,557.29	12,067.59	4,489.70	954.12	6,584.86	11.20	4,441.69	3,487.62	739.64	260.41
Optimised Speed	31,482.00	28.91	17,267.64	11,592.48	5,675.16	904.71	6,657.99	9.77	3,952.63	4,335.50	1,009.22	327.66

Table 4.46: Impact of changes in speed

The intervention forecasts that emissions will **increase by 3.9%** as a result of the change and as such **will not be carried forward as a recommendation.**

Conclusion

Due to the nature of the road, there is limited opportunity to reduce emissions within the timescale. However, signalling optimisation presents a potential opportunity **to reduce NO_X emissions by 4% or 2.1% based on NO_2 concentrations**; this puts absolute levels of NO_2 at around 41.9µgm^{-3} based on 2018 emissions. Table 4.47 shows the impact of interventions in future years

			2018				2019		
74559	TOTAL NO_2		42.7				40.6		
	R-NOX Reduction		Total NO_2	Road NO_2	% Change in total NO_2	R-NOX 2019	Total NO_2	Road NO_2	% Change in total NO_2
Traffic Signal Optimisation	4.00%	54.7	41.9	24.6	2.1%	50.9	39.8	23.2	2.1%
Speed Reduction	-3.90%	54.7	43.6	26.3	-2.0%	50.9	41.5	24.8	-2.0%
Total	**4.00%**	54.7	41.9	24.6	**2.1%**	50.9	39.8	23.2	**2.1%**

Table 4.47: Impact of interventions on future years

It can be seen that the efficacy of the interventions changes little, due to the short timeline and types of interventions available.

4.3.12 Road Link 17611: A461 Castlegate to Burnt Tree Junction

Forecast to be compliant by 2020, it requires a **7%** reduction in order to meet the NO_2 threshold target, it's a relatively average sized reduction, but with around 2 years to implement measures.

Traffic Signal Optimisation

Table 4.48 shows the baseline, without gating and with gating, scenarios for traffic signal optimisation on the roundabouts.

SourceID	Traffic Flow	% Change	All Vehicles (g/km/s)	All LDVs (g/km/s)	All HDVs (g/km/s)	Petrol Cars (g/km/s)	Diesel Cars (g/km/s)	Petrol LGVs (g/km/s)	Diesel LGVs (g/km/s)	Rigid HGVs (g/km/s)	Artic HGVs (g/km/s)	Buses/Coaches (g/km/s)
Baseline	38971		23,111.79	14,095.10	9,016.69	1,112.41	8,183.16	11.62	4,697.61	4,362.68	1,015.03	3,608.36
Traffic Light Optimisation	41602	101.7%	23,506.94	14,586.75	8,920.20	1,155.86	8,410.83	12.20	4,913.56	4,326.64	992.90	3,570.69
Traffic Light Optimisation (gated)	38971	95.3%	22,020.56	13,664.40	8,356.16	1,082.77	7,879.00	11.43	4,602.87	4,053.06	930.12	3,344.91

Table 4.48: Impact of changes in speed

It shows that without gating, it forecasts that signal optimisation will result in a **1.7% increase** in emissions, due to the additional traffic volumes. Where gating prevents access to additional traffic, there is a **4.7% reduction** in NO_X emissions or **2.5%** in terms of NO_2 concentrations .

Retrofitting of buses with SCR Technology

Table 4.49 sets out the impact of retrofitting buses along this route, 90% of buses are already at Euro VI, therefore there may be limited scope for improvements to emissions

17611					
Baseline	**10%**	**25%**	**50%**	**75%**	**100%**
19,577.32	19,573.44	19,567.63	19,557.94	19,548.25	19,538.56
13,355.89	13,355.89	13,355.89	13,355.89	13,355.89	13,355.89
6,221.43	6,217.55	6,211.74	6,202.05	6,192.36	6,182.67
1,024.18	1,024.18	1,024.18	1,024.18	1,024.18	1,024.18
7,944.44	7,944.44	7,944.44	7,944.44	7,944.44	7,944.44
-	-	-	-	-	-
9.50	9.50	9.50	9.50	9.50	9.50
4,262.42	4,262.42	4,262.42	4,262.42	4,262.42	4,262.42
3,622.43	3,622.43	3,622.43	3,622.43	3,622.43	3,622.43
789.24	789.24	789.24	789.24	789.24	789.24
1,780.86	1,776.98	1,771.17	1,761.48	1,751.79	1,742.10
	99.98%	99.95%	99.90%	99.85%	99.80%

Table 4.49 Impact of bus retrofit.

As is shown in the table above, benefits are limited in that savings in **NO_X emissions range between 0.02% and 0.2%**, resulting in reduction in **NO_2 concentrations of between 0.01% and 0.1%**

Speed Limit Reduction

Table 4.50 below shows the impact on NO_X emissions as a result of a speed reduction from 40 to 30mph and the corresponding volume changes as a result.

SourceID	Traffic Flow	Speed (kph)	All Vehicles (g/km)	All LDVs (g/km)	All HDVs (g/km)	Petrol Cars (g/km)	Diesel Cars (g/km)	Petrol LGVs (g/km)	Diesel LGVs (g/km)	Rigid HGVs (g/km)	Artic HGVs (g/km)	Buses/Coaches (g/km)
Baseline	38,983.00	38.26	19,789.62	12,746.23	7,043.38	1,016.97	7,219.40	11.05	4,413.95	3,435.98	762.60	2,821.85
Optimised Speed	34,261.00	28.91	20,355.56	12,405.96	7,949.60	978.94	7,204.25	10.22	4,133.09	3,846.02	895.27	3,181.29

Table 4.50: Impact of changes in speed

The intervention forecasts that emissions will **increase by 2.7%** as a result of the change and as such **will not be carried forward as a recommendation.**

Conclusion

Requiring relatively small reductions to meet the threshold and a relatively short time to improve compliance there are few short term measures available. However, signalling optimisation provides the opportunity for a **reduction in emissions of around 4.72% and 4.9%** or **2.52 and 2.61% in terms of NO_2 concentrations**. This puts absolute levels of NO_2 at between 41.67 µgm^{-3} and 41.63 µgm^{-3} based on 2018 emissions. Table 4.51 shows the impact of interventions on 2019, after which the link is forecast to be compliant.

			2018				2019		
17611	TOTAL NO_2		42.7				40.6		
	R-NOX Reduction		Total NO_2	Road NO_2	% Change in total NO_2	R-NOX 2019	Total NO_2	Road NO_2	% Change in total NO_2
Traffic Signal Optimisation	4.70%	55.5	41.7	24.8	2.5%	51.5	39.6	23.3	2.5%
Bus Retrofit Min	0.02%	55.5	42.7	25.8	0.0%	51.5	40.6	24.3	0.0%
Bus Retrofit Max	0.20%	55.5	42.7	25.7	0.1%	51.5	40.5	24.2	0.1%
Speed Reduction	-2.70%	55.5	43.4	26.4	-1.3%	51.5	41.2	24.9	-1.3%
Total Min	**4.70%**	55.5	**41.7**	**24.8**	**2.5%**	51.5	**39.6**	**23.3**	**2.5%**
Total Max	**4.90%**	55.5	**41.6**	**24.7**	**2.6%**	51.5	**39.6**	**23.2**	**2.6%**

Table 4.51: Impacts on interventions on future years.

The table above shows there’s no decrease in effectiveness in 2019 due to the short timescales involved

4.3.13 Road Link 57205: High Street, Wordsley

Not officially included by Defra and modelled to already be below the threshold by the PCM model, local monitoring stipulates levels in excess of 50 µgm^{-3} and the site will not be compliant before 2021. Based on 2018 NO_2 levels, a reduction of **21.6%** is required, the largest savings of any of the routes. It does however offer the opportunity for longer term interventions to accelerate the reduction.

Traffic Signal Optimisation

Table 4.52 shows the baseline, not gated and gated scenario for signalisations High Street, Wordsley.

Source Name	All Vehicles (g/km)	% Saving	Petrol Cars (g/km)	Diesel Cars (g/km)	Petrol LGVs (g/km)	Diesel LGVs (g/km)	Rigid HGVs (g/km)	Artic HGVs (g/km)	Buses/Coaches (g/km)	Motorcycles (g/km)
Baseline	11,753.78		624.76	5,979.97	6.20	2,682.38	759.10	572.00	1,059.03	21.89
Optimised Gated	12,013.38	102.2%	647.34	6,125.76	6.52	2,808.77	750.53	556.66	1,044.74	23.71
Optimised Not Gated	11,259.60	95.8%	606.72	5,741.40	6.11	2,632.54	703.44	521.73	979.19	22.22

Table 4.52: Impact of Traffic Signal Optimisation

It can be shown that the non-gated scenario yields a **2.2% increase** in NO_X emissions due to volume increases as a result of induced demand created by the reduced congestion, and this offsets and improvements in speed.

Looking at the gating scenario, which prevents access off additional volume, **a 4.2% saving** in NO_X emissions is possible based on 2018 levels, equating to an estimated **2.7%** saving in NO_2 concentrations.

Retrofitting of buses with SCR Technology

Table 4.53 sets out the impact of retrofitting buses along this route, 90% of buses on this route are Euro III and as such there is considerable opportunity for reductions in emissions. Table 60a shows the potential savings based on the level of uptake.

57205					
Baseline	**10%**	**25%**	**50%**	**75%**	**100%**
11,330.76	11,251.28	11,132.06	10,933.37	10,734.68	10,535.98
8,185.11	8,185.11	8,185.11	8,185.11	8,185.11	8,185.11
3,145.64	3,066.17	2,946.95	2,748.26	2,549.57	2,350.87
662.30	662.30	662.30	662.30	662.30	662.30
5,012.52	5,012.52	5,012.52	5,012.52	5,012.52	5,012.52
-	-	-	-	-	-
5.47	5.47	5.47	5.47	5.47	5.47
2,429.60	2,429.60	2,429.60	2,429.60	2,429.60	2,429.60
947.07	947.07	947.07	947.07	947.07	947.07
200.68	200.68	200.68	200.68	200.68	200.68
1,989.63	1,910.16	1,790.94	1,592.25	1,393.56	1,194.86
	99.30%	98.25%	96.49%	94.74%	92.99%

Table 4.53: Impact of bus retrofit technology

The table shows an opportunity to **reduce NO_X emissions by between 0.7% and 7.01%** depending on the level of retrofit undertaken. Given that the link has very high emissions and is not estimated to be compliant by 2021, prioritising services on this route would seem appropriate. In terms of NO_2, **it reduces concentrations by between 0.41% and 4.49%**

Conclusions

There is scope for interventions with this link due to its length, the gradient and narrow width of the carriageway. With the optimisation set out in the business case previously submitted to Defra (available on request), alongside bus retrofit technology, the interventions could generate considerable savings, reducing overall levels of NO_2 to 49.41 and 47.33.µgm^{-3} based on 2018 levels.

Tables 4.54 and 4.55 show the impact of interventions up until 2022, which based on the impact of similar changes and applying it to this site, suggests 2023 could trigger compliance, which is sooner than the regression method set out in section 1, though this is inherently uncertain given the timescale we are having to forecast ahead.

				2018				2019				2020	
57205	**TOTAL NO_2**		51.0	Estimate based on monitoing			48.4				45.7		
	R-NOX Reduction		**Total NO_2**	**Road NO_2**	**% Change in total NO_2**	**R-NOX 2019**	**Total NO_2**	**Road NO_2**	**% Change in total NO_2**	**R-NOX 2020**	**Total NO_2**	**Road NO_2**	**% Change in total NO_2**
Traffic Signal Optimisation	4.20%	88.43	49.6	38.0	2.7%	82.2117836	47.1	35.9	2.7%	75.91300069	44.4	33.7	2.7%
Bus Retrofit Min	0.70%	88.43	50.8	39.2	0.4%	82.2117836	48.2	37.0	0.4%	75.91300069	45.4	34.7	0.5%
Bus Retrofit Max	7.01%	88.43	48.7	37.1	4.5%	82.2117836	46.2	35.0	4.5%	75.91300069	43.6	32.8	4.6%
Total Min	**4.90%**	88.43	**49.4**	**37.8**	**3.1%**	82.2117836	**46.9**	**35.7**	**3.1%**	75.91300069	**44.2**	**33.4**	**3.2%**
Total Max	**11.21%**	88.43	**47.3**	**35.7**	**7.2%**	82.2117836	**44.9**	**33.7**	**7.2%**	75.91300069	**42.3**	**31.6**	**7.3%**

. **Table 4.54: Impact of interventions – 2018-2020**

		2021				2022		
57205	TOTAL NO_2	43.1				41.0		
	R-NOX Reduction	Total NO_2	Road NO_2	% Change in total NO_2	R-NOX 202	Total NO_2	Road NO_2	% Change in total NO_2
Traffic Signal Optimisation	4.20%	42.0	31.6	2.7%	65.2	39.9	29.5	2.7%
Bus Retrofit Min	0.70%	42.9	32.5	0.4%	65.1685	40.8	30.4	0.4%
Bus Retrofit Max	7.01%	41.2	30.8	4.6%	65.1685	39.1	28.7	4.5%
Total Min	**4.90%**	**41.8**	**31.4**	**3.2%**	65.1685	**39.7**	**29.3**	**3.1%**
Total Max	**11.21%**	**40.0**	**29.6**	**7.3%**	65.1685	**38.0**	**27.6**	**7.2%**

Table 4.55: Impact of interventions – 2021-2022

There are some fluctuations in the effectiveness depending on the outputs of the EFT though this is less certain due to the length of time we are trying to predict, however, the tables demonstrate that the interventions remain viable in future years.

5 Part 5: Setting out a preferred option

5.1 Introduction

The following section assesses each intervention estimated to have an effective impact on reducing nitrogen dioxide concentration in the Black Country. The interventions are assessed against the following criteria:

- Value for money
- Affordability
- Distributional impacts
- Strategic and wider air quality fit
- Supply side capacity and capability
- Achievability
- Displacement on other roads.

Out of 13 road links assessed, the number of links in which each intervention was deemed possible to be implemented is shown in the table 5.1 below. Also shown is the range in savings (percentage) of nitrogen dioxide for each intervention, which provides an indication of how effective each intervention is estimated to be.

Intervention	Number of links	Nitrogen dioxide saving (%)
Optimisation of traffic signals (with gating)	10	2.9 - 4.7
Bus retrofit (with 100% of buses fitted)	10	1.5 – 2.1
Travel planning	3	0.04 – 0.08
Driver training	1	1.2
Development of walking and cycling infrastructure (optimistic scenario)	5	4.0 – 5.5

Table 5.1: Efficacy of Interventions

Further sections look to score each intervention against those criteria set within the context of each specific link. From this we can look at the collective responses from specialists across the Black Country Local Authorities in order to put forward a package of recommendations.

5.2 Evaluating Interventions Against Secondary Success Factors

5.2.1 Optimisation of traffic signals

Value for money

We are estimating the impact of any traffic signal optimisation will result in a 16 percent improvement in journey time. DfT suggest this may be optimistic but is supported by evidence from previous studies of optimisation. In isolation, such intervention may ultimately create an increase in demand which will have a negative impact on air quality and congestion on the road link and its feeder roads, thus gating must also be implemented as part of this intervention which is assumed to prevent additional traffic from entering the road link from side roads. Gating was not included in the previous studies and so may further support the journey time improvement estimates. In the longer term changes to road design that limit capacity may mean that gating is not required

We have also assumed that optimisation will smooth the flow, reducing incidents of particularly high speed and low speed vehicles, effectively narrowing the distribution of speed towards the average and thus reducing stop/start or accelerating/decelerating traffic, without greatly increasing the overall average speed and therefore reducing emissions as a result.

An estimated saving in nitrogen dioxide emissions of between 2.9 and 4.7 percent on each road link that it is implemented on is relatively effective when compared to the other interventions.

Affordability

Costs in the range of between £5,000 and £30,000[20] per intersection could be expected depending on what’s required. Some existing signals can be electronically adjusted while others will require system upgrades and additional infrastructure.

Distributional impacts

Signal optimisation will impact on all road users however local road users are likely to incur the greatest dis-benefits as a result of gating on minor roads. Active travel may be slightly discouraged if traffic flow/speeds are improved on adjacent mainline carriageways.

Strategic and wider air quality fit

Bluetooth NO_X sensors could be installed to monitor the baseline emissions and feed into dynamic AQ models in order to adjust timings. This may also help the longevity of this intervention and allow it to be more adaptable to changing traffic demand into the future.

---

20 http://www.jctconsultancy.co.uk/Symposium/Symposium2015/PapersForDownload/Low%20Cost%20MOVA%20-%20Retrofitting%20MOVA%20to%20Existing%20SCOOT%20Controlled%20Signals%20for%20Increased%20Performance%20and%20Reduced%20Installation%20Costs.pdf

This option fits within the wider air quality structure outlined in the Black Country Air Quality Supplementary Planning Document (Air Quality SPD)[21].

Supply side capacity and capability

Where road capacity is made available through successful implementation of the UTMC, it could be utilised for alternative transport such as greater levels of walking/cycling provision

Achievability

Out of the 13 links identified with air quality issues, 10 have the potential to be improved through the use of UTMC. The main constraint to implementing this intervention is access to the funds required, though a review as well as some manual interventions could be easily completed in the extreme short term.

Displacement on other roads

An assumption that side roads will be gated to avoid any increase in traffic on associated roads is part of this intervention. This could redistribute some emissions over a wider area but reduce concentration of vehicles on the link in exceedance. It may also encourage traffic to divert onto more local roads and “rat run” in order to avoid delays accessing the link, the impact of this is difficult to model within the timescales provided.

[21] September 2016

5.2.2 Retrofitting Buses with SCR Technology

Value for money

Government financial support for bus retrofitting provides 15 times as much value as scrappage allowances for diesel cars to convert to Euro VI or electricity. Retrofits for buses can deliver Euro VI emission performance and are reliable with direct monitoring already in place and an approved accredited scheme. Though in reality, emissions can vary due to myriad factors such as weather, topography and driver behaviour.

Initial data from SCR schemes suggests reductions in NOx by 80 – 95 percent; however EFT states that the reduction is closer to 50 percent. The EFT estimates result in an estimated saving of 1.2 – 2.3 percent in NO_2 concentrations on road links where 100 percent of buses are converted. Conversions cost approximately £18,000 per bus which results in an indicative cost of approximately £87,000 per one percent saving in NO_2 for each link.

Affordability

The cost of converting all buses required to achieve the maximum NOx saving is £5.6m, An existing retrofit programme is being delivered across the West Midlands by 4 local bus operators using accredited CVRAS suppliers, so risks are known. These CVRAS suppliers have capacity within the local West Midlands market. Data suggests 72 local bus services, using approximately 374 buses circulate on links having exceedances, with 509 vehicles operating in total within the Black Country region. 18% are Euro VI, as such total costs for retrofit could be as high as £5.5 million.

Distributional impacts

Retrofitting can occur within existing bus scheduling, with a delivery timescale of one day per retrofit. There may be some potential negative impacts to bus scheduling and availability during the retrofitting process. Availability of buses could disproportionally affect low income groups.

Thus the impact of taking buses out of service for upgrading will need to be considered carefully for its impact on by bus operators.

Strategic and wider air quality fit

This intervention is aligned with the Air Quality SPD measure ‘low emission bus service provision’ and the West Midlands Low Emission Bus Delivery Plan.

Supply side capacity and capability

There are available accredited suppliers within the local market. Fleet management and bus scheduling may become more challenging for a short period during the process of retrofitting, but can be managed which may reduce capacity temporarily.

Achievability

The timescale required for retrofitting the vehicles is achievable, with 312 vehicles requiring upgrade, across six bus operators. With one retrofit taking one day to fit, this is achievable within a 12-18 month period, across the different operators.

Retrofit should be prioritised to the key routes and areas of worst air quality that may exceed the deadline for compliance, and so the most feasible approach may be to determine which bus routes travel through the areas with the worst air quality, and prioritise these routes for vehicles that have already been upgraded. Consultation with the bus operators will be required through the West Midlands Bus Alliance to determine what routes could be modified based on the available fleet and age. The speed of retrofit is unlikely to be accelerated beyond this due to requirements in terms of bus availability.

Displacement on other roads

As part of the upgrading, the entire bus fleet may be displaced from other locations, to ensure they can be upgraded, potentially cascading older vehicles onto other roads and moving the emissions elsewhere. This would likely to be limited however, given their overall source apportionment and the wider upgrades being made to the bus fleet. Retrofit to the bus fleet through this programme would see 15% of the overall West Midlands fleet improved. This is slightly less than the current 468 vehicle retrofit programme in 2018/19.

5.2.3 Travel planning

Value for money

Travel planning, particularly personalised travel planning (PTP) can reduce car use by up to 11% and can also result in walking, cycling and public transport use increasing by 15-33% However, savings of NO_x on the designated links have been estimated to be negligible given the relatively low take-up usually experienced. Their effectiveness and the level of take-up can be increased however, through the use of sustained marketing campaigns and engagement with the travelling public. Using an assumption that developing travel plans cost £500 each, an indicative cost per one percent saving of NO_x can be estimated at approximately £1 million.

Affordability

Funding for local authority support has been identified as a constraint for this intervention. The capital expenditure for this intervention is relatively low per plan however it does require a level of ongoing revenue spend which will require approval.

Distributional impacts

A well designed travel plan highlights options and facilitates a change of behaviour for people travelling to and from destinations such as businesses and schools. As such it benefits all travellers equally. By reducing car traffic it can improve the journeys for people using active travel and make public transport more reliable. However it could also increase patronage, which may have positive or negative consequences depending on the current level spare capacity in the system.

Strategic and wider air quality fit

One practical mitigation measure for emissions supported by the Air Quality SPD is the discouragement of high emissions vehicle use and the encouragement of a modal shift towards active transport through travel planning.

Supply side capacity and capability

Capacity is unlikely to be impacted by this intervention however demand may be eased if the intervention results in a modal shift away from private vehicles.

Achievability

Estimates of take up are around five percent, though this can be increased depending on the strategy used and cooperation from organisations involved. Selective assistance in the development, review and update of travel plans for workplace/schools along the routes in question could provide rapid benefits; however this could take time. Over all, implementation of this intervention is relatively achievable within a short time period, provided necessary funding is available.

Displacement on other roads

No displacement onto other roads is expected as a result of this intervention.

5.2.4 Driver training

Value for money

Measuring the impact of driver training on emissions is difficult as it depends on a myriad of factors such as terrain, weather and engine temperature. One study[22] estimates a reduction in emissions by eight percent and showed that drivers decreased the time spent in excessive speed and excessive engine speed by 24 percent and 38 percent respectively. A reduction in the number of events such as extreme accelerations and decelerations was also observed. The results indicated an average 4.8 percent fuel consumption decrease and an 8% reduction in NO_X emissions, though unpublished DfT evidence suggests this may be optimistic.

As such the study will take the eight percent figure in terms of reduction in NO_X and apply that to driver training. This results in an estimated saving of 1.23 percent on the road link which this intervention has been deemed potentially appropriate for, this could be applied to other links or additional businesses as they are identified. Using a cost of 100 pounds per driver, this corresponds to £65-130 thousand per one percent saving in NO_x.

Affordability

Some costs of driver training have been estimated at £50 for a 90 minute course or £100 for a day in terms of direct costs to employ specialist training providers. However businesses will have to account for both the cost of the driver being on the training rather than in work as well as the cost of a vehicle for the day in some cases.

Distributional impacts

The periodic training of drivers, potentially alongside the use of telematics has been demonstrated to reduce incidents of harsh braking and acceleration, idling and excess speed as well as improving road safety. All of these help to improve congestion and have a further benefit to the drivers/operators by reducing fuel usage and therefore costs. Therefore, this intervention is likely to impact positively on all road users.

Strategic and wider air quality fit

This intervention aligns with the Air Quality SPD as it aids in reducing NO_x emissions in specific problems areas (e.g. congested roads).

[22] Rolim et al (2014) Impacts of on-board devices and training on Light Duty Vehicle Driving Behaviour, Procedia - Social and Behavioral Sciences 111 (2014) 711 – 720

Supply side capacity and capability

One of the potential outcomes from this intervention is easing congestion which can aid in improving capacity on high demand roads during peak times. There are large numbers of driver training organisations able to undertake said training but engagement with businesses is required in order to get drivers signed up.

Achievability

Training schemes are relatively low cost and can be quickly delivered but they are most effective with the cooperation of vehicle operators freeing up both drivers and vehicles for the training to take place. However, businesses are unlikely to want to release too many staff to undertake the training at once and so his may take a number of months to get everyone through depending on the size of the workforce.

Displacement on other roads

No displacement is expected as a result of this intervention.

5.2.5 Development of walking and cycling infrastructure

Value for money

As stated in the previous section, the SUSTRANS (2013) study stipulates the investment in walking and cycling infrastructure can trigger a 10% drop in car use. It should be noted that this is as an often an area measure as opposed to being specifically implemented along certain routes, as such reductions are as a result of better connectivity but also potentially in terms of lost road space, triggering further congestion though this varies depending on where the cycle lanes are implemented[23].

Savings of up to 5.5% on some road links are estimated in the optimistic scenario. Depending on the link, an indicative cost per one percent saving of NO_X can be estimated anyway between £60 thousand and £330 thousand.

Affordability

Funding has been identified as a constraint on specific road corridors including the A454 and the A463. Cost estimates used in the West Midlands Strategic Cycle Network are approximately £660 per metre which includes the capital requirement only. Additional funding would be required for monitoring, maintenance, evaluation and signage etc.

Distributional impacts

The implementation of this measure would need to focus on a shift towards changing the perception of how the roads are used, and actively discouraging the use of private vehicles in favour of cycling and walking. However it will also improve connectivity for those already using active travel modes, improving low cost travel options in the Black Country.

Strategic and wider air quality fit

As part of this review, local authorities will also look to minimise exposure to air quality emissions by diverting some footways away from emitters whilst maintaining or improving connectivity for active travel users.

Supply side capacity and capability

Capacity for active transport along the corridor will increase however the addition of walking and cycling infrastructure may require some reallocation of road space which will limit capacity along the road corridor for motorised vehicles, though in the vast majority of cases this come from changes to roadside landscaping or upgrade of existing routes. To avoid capacity reductions, this intervention could be coupled with the traffic signal optimisation intervention.

[23] Civitas(2016) THE ROLE OF WALKING AND CYCLING IN REDUCING CONGESTION A PORTFOLIO OF MEASURES, http://h2020-flow.eu/uploads/tx_news/FLOW_REPORT_-_Portfolio_of_Measures_v_06_web.pdf

Achievability

TfWM is taking a corridor approach to walking and cycling, understanding the key routes used by active transport users and ensuring provision is in place. This will aid in ensuring the routes which would most benefit from this intervention will be prioritised.

Displacement on other roads

The desired result of this intervention would minimise any traffic displacement. However, it is possible that a reduction is capacity resulting from walking and cycling infrastructure may result in the redistribution of traffic onto other roads.

5.3 Scoring the Interventions

Based on the above overview, officers involved in the study, including signalling, traffic and highways engineers, air quality and public health officers were asked to score each link and the interventions proposed from -5 to +5 against each of the secondary success criteria (-5 being very poor, +5 being very good). This scoring, albeit subjective allows us to provide a collective view and therefore form recommendations based on the knowledge and experience of local officers rather than their forecasted efficacy alone. The following section presents the results of these scores as well as some high level cost estimates and timescales for implementation. Scores, where given are added together to provide a net overall recommendation. A full list of interventions is provided in appendix A, with those recommended to proceed immediately highlighted in green, those recommended to take forward as supporting measures in yellow and those not recommended highlighted in red. Similarly, each link is broken down by the following:

- Immediate recommendations, i.e. those that have a realistic possibility of accelerating compliance,
- Supporting Recommendations, i.e. those that may not be able to accelerate compliance based on current predictions but will nevertheless improve air quality over a longer period should forecasts be incorrect
- Not Recommended, i.e. impractical or not offering sufficient value for money given other interventions available.

It should be noted that given the relatively short deadlines involved to deliver this study cost estimates and timescales are provided based on discussions with technical leads and the typical costs of previous, similar activities rather than a detailed costing study. As such it is recommended that further, detailed cost-benefit analysis is undertaken prior to any further implementation activities. All timelines assume funding has been granted and allocated prior to work commencing. Delays in funding may extend these timescales.

5.3.1 Road Link 17142: A457 Oldbury

Table 5.2 shows a summary of the possible interventions and scores. The full table is included in Annex B.

ID	Name	Authority	Description	Est Year of Compliance	Capital Cost (rounded to nearest £1000)	Timeline	Value for Money	Affordability	Distributional Impacts	Strategic and Wider AQ fit	Supply side capacity	Achievability	Displacement on other roads	TOTAL
17142	**A457 Oldbury**	**Sandwell**	**Roundabout with the A4034 and roundabout linking the A4031**	**2019**										-
	Traffic Signal Optimisation		Manual review of all signals, upgrade of pedestrian crossings to PUFFIN where required, upgrade of sgnals at DPD junction/M5 flyover		81,000.00	3-12 month	1.25	0.75	-	0.75	-	1.00	-	**3.75**
	Driver Training		Working with local businesses e.g. DPD/Metsec to implement a programme of Eco-driver/SAFED training for employees to reduce fuel costs and emissions. Essentially the council would fund the training, with companies providing time and vehicle for drivers (unless undertaken in employees own vehicle)		161,000.00	6-12 month	1.50	- 0.50	-	0.50	- 0.50	0.50	-	**1.50**
	Travel Planning		Council to conduct personalised travel planning workshops with businesses and develop travelplans for those signing up.		108,000.00		- 1.75	-	0.50	0.50	- 0.50	-	-	**- 1.25**
	Retrofitting of Buses with SCR Technology		2 Vehicles - 2 Services		36,000.00	6 months	-	-	-	-	-	-	-	-

Table 5.2: Interventions summary table for 17142

Given that the link is due to be compliant in 2019, short term interventions need to be prioritised and this is reflected in the scoring with signal optimisation providing the greatest overall score, as well as forecasted as having the greatest level of effectiveness and value for money. Implementing these interventions in their fullest extent is unlikely given the timescales, though implementation through 2019 is possible.

Traffic Signals can be manually reviewed and optimised within 2018 providing adequate funding becomes available, however additional infrastructure such as the Bluetooth sensors and pedestrian crossing upgrades are unlikely to be implemented until 2019. Fully implemented, such an intervention is forecast to bring about a 1.8% saving in NO_2 concentrations but this is unlikely to be fully realised without the additional infrastructure.

Bus retrofitting has not been scored, but does provide good value for money, provided it can be achieved quickly.. Prioritisation of buses on this route can be undertaken and only two vehicles would need to be retrofitted with SCR kits. Provided funding can be made available, this could be easily done within 2018; however, other buses may traverse this route that may not be retrofitted. The measure offers a potential saving in NO_2 concentrations between 0.5% and 2.1%. An additional 2.4% reduction needs to be made by the end of 2018.

Combining both the initial signal optimisation work and the bus retrofit creates the potential to meet the threshold within 2018 depending on the effectiveness of the bus retrofit supported by limited interventions to the signals.

Travel planning and driver training are recommended to be dismissed given their value for money and uncertainty around their efficacy.

Immediate Recommendations

- Bus Retrofit to be taken forward immediately
- Manual optimisation of existing junction signalling to be completed immediately

Supporting Recommendations:

- Other signal optimisation work including infrastructure upgrades

Not Recommended:

- Travel Planning and Driver Training

5.3.2 Road Link 99155 – A41 J1 M5 West Bromwich

Table 5.3 shows the interventions identified for the A41

ID	Name	Authority	Description	Est Year of Compliance	Capital Cost (rounded to nearest £1000)	Timeline	Value for Money	Affordability	Distributional Impacts	Strategic and Wider AQ fit	Supply side capacity	Achievability	Displacement on other roads	TOTAL
99155	**A41, J1 M5 West Bromwich**	**Sandwell**	**Between the roundabout with M5 Junction 1 & the local authority boundary with Birmingham City Council**	**2020**			-	-	-	-	-	-	-	-
	Traffic Signal Optimisation		Manual review of all signals, upgrade of pedestrian crossings to PUFFIN where required, upgrade of sgnals at Park Lane junction, M5/A4168		71,000.00	3-12 month	1.25	0.75	-	0.75	-	1.75	-	4.50
	Travel Planning		Council to conduct personalised travel planning workshops with Sandwell college and develop travelplans for those signing up.		185,000.00	6-12 month	- 0.75	- 0.75	0.25	0.75	0.25	0.50	-	0.25
	Retrofitting of Buses with SCR Technology		0 Buses - covered by CBTF		-	12 months	1.25	1.00	-	0.75	0.25	0.75	- 0.25	3.75

Table 5.3: Interventions Summary Table for 99155

Similarly to 17142, traffic signal optimisation scored the highest in terms of value for money and achievability as well as being possible within a short period of time. Some optimisation has already taken place on the main gyratory, though this is currently insufficient to cope with the level of demand. It has been prioritised for a major upgrade scheme, but this is likely to be in the next 10 years rather than the short-medium term. Optimisation at other points on the link is possible between M5 Junction 1 and the Hawthorns stadium and may alleviate some congestion, provided latent demand is not created and is forecast to achieve a 2% saving in NO_2 concentrations.

Bus retrofit also scores well and could be delivered within 12 months, with funding already provided by the CBTF and is forecast to reduce NO_2 concentrations between 0.2% and 0.7%

Given the relatively high cost but low value in the form of a forecast 0.05% reduction in NO_2 concentrations from the travel planning activity it may be pertinent to drop this intervention unless substantial investment can be obtained.

No combination of interventions proposed for this link are effective enough to accelerate compliance by a complete year, however assuming implementation by the end of 2019, at which point a further 4.8% saving is forecast as required, a 2.2%-2.8% saving could accelerate compliance by around six months assuming a linear rate of reduction, allowing the link to hit the threshold in mid-2019.

Summary:

Immediate Recommendations:

- Traffic Signal Optimisation to be taken forward
- Continue with Bus Retrofit Programme

Supporting Recommendations:

- None

Not Recommended:

- Travel Planning

5.3.3 Road Link 99397 - A41 Black Country Route at Wednesbury

Table 5.4 provides a summary of possible interventions for the A41 at Wednesbury

ID	Name	Authority	Description	Est Year of Compliance	Capital Cost (rounded to nearest £1000)	Timeline	Value for Money	Affordability	Distributional Impacts	Strategic and Wider AQ fit	Supply side capacity	Achievability	Displacement on other roads	TOTAL
99397	**A41 Black Country Route at Wednes**	**Sandwell**	**Roundabout with the A4037 and the roundabout with A461 at Wednesbury**	**2020**			-	-	-	-	-	-	-	-
	Walking and Cycling Infrastructure		Develop a landscaped, segregated cycle route through the industrial area		670,000.00	24 months	- 1.75	- 1.25	- 0.75	- 0.50	-	-	-	- 4.25
	Retrofitting of Buses with SCR Technology		10 vehicles - covers 17611 link as well - prioritise		180,000.00	12 months	-	-	-	-	-	-	-	-

Table 5.4: Summary Table for 99397

Two interventions were listed, with Bus retrofit recently added and consequently not scored. Walking and cycling scored negatively in terms of deliverability as well as in terms of a wider strategic fit. It is also relatively expensive to return between a 0.5% and 2% reduction in NO_2, with the level of modal shift uncertain and could take two years to deliver, assuming funding can be obtained by the end of 2018 it is expected to come on stream by the end of 2020, at which point the link is forecast to be compliant. As such it is not recommended to take this forward.

Bus retrofit, although not scored does provide a better return on investment, with only 10 buses requiring retrofit and the ability to deliver within 12 months and a likely impact of greater than 2.2% in terms of NO_2 concentrations based on 100% retrofit and a conservative 50% reduction in NO_X emissions. A 4.8% reduction needs to be achieved by the end of 2019 to achieve compliance in 2020, assuming bus retrofit can take funded within the latter quarter of 2018, which is practical if prioritisation takes place, compliance could be accelerated by around 5 months, assuming a linear rate of reduction, meeting the threshold by mid-2019.

Summary

Immediate Recommendations:

- Bus retrofit technology to be taken forward immediately

Not Recommended

- Review walking and cycling infrastructure requirements after other interventions are in place

5.3.4 Road Link 16330 – A34 Great Barr

Table 5.5 provides a summary of possible interventions on the A34 at Great Barr which is forecast to be compliant by 2019

ID	Name	Authority	Description	Est Year of Compliance	Capital Cost (rounded to nearest £1000)	Timeline	Value for Money	Affordability	Distributional Impacts	Strategic and Wider AQ fit	Supply side capacity	Achievability	Displacement on other roads	TOTAL
16330	**A34 Great Barr**	**Sandwell**	**Junction at A4041 Newton Road and the M6 at junction 7**	**2019**			-	-	-	-	-	-	-	-
	Traffic Signal Optimisation		Scott Arms junction reviewed and optimised already. Pedestrian crossings to be upgraded to PUFFIN where necessary, review and upgrade of signals at M6 J7 onto A34		£20,000	0 months	3.00	-	-	-	-	5.00	-	**8.00**
	Retrofitting of Buses with SCR Technology		6 buses that are not covered by other schemes - prioritise		108,000.00	12 months	9.00	4.00	-	3.00	-	3.00	-	**19.00**

Table 5.5: Summary Table for 16330

Traffic signalling infrastructure is already in place but requires optimisation and this is likely to be possible within 2018 providing adequate funding becomes available; however additional infrastructure such as the Bluetooth sensors and pedestrian crossing upgrades may not be implemented until 2019. Such an intervention is forecast to bring about a 2.1% saving in NO_2 concentrations but this is unlikely to be fully realised before 2019

Bus retrofit also scored highly but will need to be prioritised given the short time available to provide any acceleration in meeting the air quality threshold and is forecast to yield between a 0.09% and 0.74% saving in NO_2 concentrations based on conservative estimates of a 50% reduction in NO_2 concentrations per bus. Provided funding is available quickly enough, upgrading all 10 buses is possible before the end of 2018 if prioritised

All options can be taken forward immediately, though given the timescale for review of the studies and allocation of funding process it is unlikely that compliance can be substantially accelerated beyond 3 months, assuming a linear rate of reduction.

Summary

Immediate Recommendations:

- All interventions to be taken forward provided funding can be obtained prior to the end of Q3 2018.

5.3.5 Road Link 28464 - A4150 Ring Road (North East Quadrant)

Table 5.6 provides a summary for the north east section of the A4150 Wolverhampton Ring Road.

ID	Name	Authority	Description	Est Year of Compliance	Capital Cost (rounded to nearest £1000)	Timeline	Value for Money	Affordability	Distributional Impacts	Strategic and Wider AQ fit	Supply side capacity	Achievability	Displacement on other roads	TOTAL
28464	**A4150 Ring Road**	**Wolverhampton**	**St David's between Broad Street and Bilston Street Island**	**2021**			-	-	-	-	-	-	-	-
	Traffic Signal Optimisation		Review/upgrade of lights at Bilston Island, Wednesfield Road and Broad Street		196,000.00	3-24 month	2.00	-	-	-	-	5.00	-	7.00
	Retrofitting of Buses with SCR Technology		167 vehicles to be prioritised		3,006,000.00	18 months	5.00	-	-	-	-	-	-	5.00
	Walking and Cycling Infrastructure		Resurfacing & Segregation where practical, enhance connectivity to springfield campus as well as Stafford St and Five Ways		504,000.00	24 months	- 4.00	-	-	-	-	-	-	- 4.00

Table 5.6: Summary Table for 28464

A very busy section of road and providing direct access to Wolverhampton Bus Station. Similarly to other links, signal optimisation and bus retrofit scores well.

Bus Retrofit is expensive as there are more than 160 buses requiring retrofit in order to attain 100% compliance, though this would lead to a reduction in NO_2 concentrations of 2.1%, albeit based on a conservative estimate and would also create wider benefits across the network. However given the length of time available to meet compliance it remains practical to achieve.

Walking and cycling infrastructure scored poorly, however it may offer better value per percentage reduction than bus retrofit, providing adequate modal shift can be obtained, though this is not certain. Some funds may already be allocated to enhance connectivity to Springfield campus. Typically a scheme such as this would take two years to complete and may be operational by the end of 2020 provided funding is available, again within the timescale but this is unlikely to accelerate compliance. Such an intervention is forecast to reduce NO_2 concentrations by between 0.7 and 2.7% depending on the level of uptake.

All interventions are unlikely to be enough to meet the threshold. Assuming signal optimisation and bus retrofit was on stream mid-2020, compliance could be accelerated by six months, assuming a linear rate of reduction, though this could be improved if bus retrofit happened sooner, or SCR proves to be more effective, in line with data from the manufacturers.

Summary:

Immediate Recommendations:

- Signal Optimisation to be taken forward
- Phased retrofit of buses to be taken forward, upgrading the oldest buses first.

Supporting Recommendations:

- Walking and cycling interventions to be reviewed pending outcome of other implementations

5.3.6 Road Link 57739 – A4150 Ring Road (South East Quadrant)

Table 5.7 provides a summary for the south east section of the A4150 Wolverhampton Ring Road

ID	Name	Authority	Description	Est Year of Compliance	Capital Cost (rounded to nearest £1000)	Timeline	Value for Money	Affordability	Distributional Impacts	Strategic and Wider AQ fit	Supply side capacity	Achievability	Displacement on other roads	TOTAL
57739	**A4150 Ring Road**	**Wolverhampton**	**St George's between Bilston Street Island and Snow Hill Junction**	**2019**			-	-	-	-	-	-	-	-
	Traffic Signal Optimisation		Review/upgrade of lights at Snow Hill gyratory (already upgraded since 2015		46,000.00	3-12 month	1.00	-	-	-	-	5.00	-	6.00
	Retrofitting of Buses with SCR Technology		See 28464				5.00	-	-	-	-	-	-	5.00
	Walking and Cycling Infrastructure		Resurface top section into Rabie St, extend route down to Dursley Junction, Connection between Cleveland Road and St Georges Parade		337,000.00	24 months	- 4.00	-	-	-	-	-	-	- 4.00

Table 5.7: Summary Table for 57739

Interventions are as per link 28464 in section 5.3.5, though with compliance on this section forecast to be met by 2019 it is unlikely that any interventions will accelerate compliance though signals have been upgraded since 2015 and therefore the savings (a 1.6% decrease in NO_2 concentrations could have already been realised.

Summary:

<u>Immediate Recommendations:</u>

- None

<u>Supporting Recommendations:</u>

- Initial feasibility/Preparatory works for signal optimisation to be taken forward immediately and reviewed pending 2018 AQ data
- Bus retrofit programme to continue as per 28464
- Walking/Cycling infrastructure to be reviewed pending 2019 AQ data

5.3.7 Road Link 99402 - A463 Black Country Route (BCR)

Table 5.8 provides a summary for the A463 Black Country Route.

ID	Name	Authority	Description	Est Year of Compliance	Capital Cost (rounded to nearest £1000)	Timeline	Value for Money	Affordability	Distributional Impacts	Strategic and Wider AQ fit	Supply side capacity	Achievability	Displacement on other roads	TOTAL
99402	**A463 Black Country Route (BCR)**	**Wolverhampton**	**Between Wolverhampton Street and Black Country New Road**	**2021**			-	-	-	-	-	-	-	-
	Walking and Cycling Infrastructure		Upgrade of adjacent Canal Tow path, general upgrades to surface condition		267,000.00	24 months	- 3.00	-	-	-	-	-	-	- 3.00

Table 5.8: Summary table for A463 Black Country Route

There are very limited interventions available for this link, this is further exacerbated by the link not being compliant until 2021 with a current NO_2 concentration of 46 μg^{-3}

Walking and cycling interventions are proposed, with a two year timeline, this could be achieved and still accelerate compliance, creating a maximum 2.28% reduction in NO_2 concentrations. However the amount of modal shift is uncertain and would require wider network connectivity. It is estimated to be complete by the end of 2020 provided funding can be secured within 2018. However this coincides with the link being forecast to be compliant without further intervention and as such is unlikely to significantly accelerate compliance.

Summary

Immediate Recommendations

- None

Supporting Recommendations

- Initial feasibility/Preparatory work to be undertaken on walking and cycling improvements, to be taken forward if a strong case can be achieved and constructed within the timescales.

5.3.8 Road Link 99404 – A 463 Black Country Route (Oxford Street and Coseley Road)

Table 5.9 provides a summary for the A463 Black Country Route. (Oxford Street and Coseley Road)

ID	Name	Authority	Description	Est Year of Compliance	Capital Cost (rounded to nearest £1000)	Timeline	Value for Money	Affordability	Distributional Impacts	Strategic and Wider AQ fit	Supply side capacity	Achievability	Displacement on other roads	TOTAL
99404	**A463 Black Country Route (BCR)**	**Wolverhampton**	**Between Oxford Street and Coseley Road**	**2019**			-	-	-	-	-	-	-	-
	Travel Planning		Council to conduct personalised travel planning workshops with businesses on Charnwood Retail Park as well as Ormiston Academy and develop travelplans for those signing up.		138,000.00	6-12 month	- 5.00	-	-	-	-	-	-	- 5.00
	Retrofitting of Buses with SCR Technology		62 vehicles to be prioritised		1,116,000.00	12 months	-	-	-	-	-	-	-	-

Table 5.9 99404 Summary Table

Compliant by 2019, only a 2.4% reduction in NO_2 concentrations is required to meet the threshold. As such, interventions are limited to those that can be achieved by the end of 2018 in order to have a further impact on meeting the threshold.

Travel planning has been proposed and can be implemented in a relatively short period and could be commenced within 2018. However its efficacy is uncertain and it scores poorly in terms of value for money only providing an estimated 0.02% reduction inNO_2 concentrations.

Bus retrofit has been introduced retrospectively and so hasn't been scored. TfWM anticipate retrofit is available within 12 months but is expensive as 62 buses serve that route, achieving a 1.1% reduction. This is likely to be a conservative estimate and retrofitting would also have air quality benefits over a wider area. However this is unlikely to be achieved prior to the end of 2018 given the number of buses to be retrofitted on this link and others within 2018.

Both interventions will also be insufficient to meet the threshold based on current estimates of their effectiveness.

Summary

Immediate Recommendations:

- None

Supporting Recommendations

- Commence prioritised bus retrofit programme

Not Recommended:

- Travel planning

5.3.9 Road Link 27202 - A454 Black Country Route (BCR)

Table 5.10 provides a summary for the A454 Black Country Route towards M6 J10.

ID	Name	Authority	Description	Est Year of Compliance	Capital Cost (rounded to nearest £1000)	Timeline	Value for Money	Affordability	Distributional Impacts	Strategic and Wider AQ fit	Supply side capacity	Achievability	Displacement on other roads	TOTAL
27202	**A454 Black Country Route (BCR)**	**Walsall**	**A454 Black Country Route (BCR) running westwards from J10 M6 towards A463 Black Country Route**	2021			-	-	-	-	-	-	-	-
	Traffic Signal Optimisation		Manual review of signals at M6 J10		10,000.00	3 months	5.00	5.00	-	-	-	- 10.00	- 3.00	- 3.00
	Walking and Cycling Infrastructure		Incorporate J10 Plan		1,313,000.00	24 months	-	- 3.00	3.00	3.00	-	3.00	-	6.00

Table 5.10: Summary Table for 27202

Two interventions have been proposed for the Black Country Route, this stretch of road, is one of the busiest in Walsall and provides the main access/egress from M6 Junction 10. As such any alterations to traffic on the A491 have to be considered in terms of their impact on the M6. This limits the opportunity to make adjustments that might be possible on other roads. A major upgrade of the junction is already planned within the next 12-18 months, evaluated as air quality neutral and will upgrade most of the signals at the junction. Acceleration of this scheme is unlikely as it is currently going through the planning process. It is unlikely to come on line before the end of 2020.

Traffic signal optimisation and improvements/upgrades to walking and cycling infrastructure have been proposed but as these will be carried out during the main infrastructure upgrade and have been discounted. Similarly, the existing signals have already been optimised to balance journey times on both the A454 and M6. Any manual adjustments to improve flow on the A454 are likely to have a detrimental impact to the M6, which could create safety concerns. This has therefore has also been discounted.

In terms of cycling and walking, an additional scheme that compliments and enhances the core provision contained within the upgrade has been outlined to increase connectivity across the junction gyratory and encourage greater levels of use by pedestrians and cyclists, potentially creating a 2.1% reduction in NO_2, though it is yet to receive formal support from the Local Authority and Highways England and as such is proposed as a possible intervention here, receiving strong backing from council officers. Despite this , as it’s part of the J10 upgrades, it will not be commissioned before then and as such is unlikely to accelerate reductions in NO_2 concentrations..

Summary:

Immediate Recommendations:

- None

Supporting Recommendations:

Feasibility/Preparatory work for additional walking/cycling plans.

Not Recommended:

- Traffic Signal Optimisation

•

5.3.10 <u>Road Link 38201 - A4148 Wolverhampton Street</u>

Table 5.12 provides a summary of interventions for the A4148 Wolverhampton Street

ID	Name	Authority	Description	Est Year of Compliance	Capital Cost (rounded to nearest £1000)	Timeline	Value for Money	Affordability	Distributional Impacts	Strategic and Wider AQ fit	Supply side capacity	Achievability	Displacement on other roads	TOTAL
38201	**A4148 Wolverhampton Road/Blue L**	**Walsall**	**A4148 junction with Green lane A34 running east to junction with Broadway/Lichfield Street A461 inc Day Street & Littleton Street East and West**	**2020**			-	-	-	-	-	-	-	-
	Traffic Signal Optimisation		Review/Upgrade of signals at Pleck Road/Blue Lane West, review and upgrade of pedestrian signalling to PUFFIN/TOUCAN standard, review/upgrade of signals at Green Lane, SCOOT already installed via NPF funding		55,000.00	3-12 month	5.00	5.00	-	-	-	5.00	-	15.00
	Bus Retrofit				288,000.00	12 months	8.00	3.00	-	3.00	-	3.00	-	17.00

Table 5.12: Interventions Summary Table

To optimise signalling at the junction as well as upgrades of pedestrian crossings to a PUFFIN/TOUCAN standard. The SCOOT infrastructure is already in situ and has been delivered since 2015 as part of National Planning Forum (NPF) funding. This may also have the bonus of optimising traffic flow at the same time as improving connectivity for the cycle infrastructure running alongside. As such part of the 1.9% reduction in NO_2 concentrations could already be realised, hence why local modelling suggests compliance.

Bus retrofit can be undertaken within 12 months for around 16 buses, though given the low levels of apportionment for this link, it may not be appropriate only resulting in a 0.3% reduction in NO_2 concentrations, based on 100% retrofitting, though this is based on conservative assumptions of SCR effectiveness. However it can be achieved by mid-2019, potentially bringing forward compliance by around 3 months.

Summary:

Immediate Recommendations:

- None

Supporting Recommendations:

- Signals upgrades already delivered – crossing upgrades to be taken forward provided funding can be taken forward by Q3 of 2018
- Review bus retrofit and consider if required or source apportionment increases

5.3.11 Road Link 74559 – A461, Cinderbank to Castlegate Island

Table 5.13 provides a summary of interventions for the A461, Cinderbank to Castlegate Island

ID	Name	Authority	Description	Est Year of Compliance	Capital Cost (rounded to nearest £1000)	Timeline	Value for Money	Affordability	Distributional Impacts	Strategic and Wider AQ fit	Supply side capacity	Achievability	Displacement on other roads	TOTAL
74559	**A461**	**Dudley**	**Cinderbank Island to Castlegate Island / Duncan Edwards Way**	**2020**			-	-	-	-	-	-	-	-
	Traffic Signal Optimisation		Review & upgrade of crossings to PUFFIN standard, Review & Upgrade of signals at Castlegate Island		146,000.00	3-12 month	4.00	5.00	5.00	1.00	4.00	8.00	2.00	29.00

Table 5.13: Interventions summary table for A461

Given the nature of the road, being a high speed dual carriage way, with limited exposure as well as no buses running on the route, there are few interventions that can make a positive impact on the link.

Traffic signal optimisation is possible on the gyratory, though the traffic management associated with the install would make this relatively difficult compared with similar schemes. It has been rated relatively well by officers however. It could achieve a 2.1% reduction in NO_2 concentrations, assuming this is in place by mid-2019, at which point a 2.4% reduction is required; it could bring compliance forward by 5 months assuming a linear reduction in emissions.

Summary:

Immediate Recommendations:

- Signal optimisation to be taken forward provided funding can be acquired by Q3 of 2018

5.3.12 Road Link 17611 – A461 Castlegate to Burnt Tree Island

Table 5.14 provides a summary of interventions for the A461, Castlegate to Burnt Tree Island

ID	Name	Authority	Description	Est Year of Compliance	Capital Cost (rounded to nearest £1000)	Timeline	Value for Money	Affordability	Distributional Impacts	Strategic and Wider AQ fit	Supply side capacity	Achievability	Displacement on other roads
17611	**A461**	**Dudley**	**Castlegate Island to Burnt Tree Junction / Birmingham Road**	**2020**			-	-	-	-	-	-	-
	Retrofitting of Buses with SCR Technology		Review/Upgrade of signals at Burnt Tree Junction, review of signals at Tesco junction		181,000.00	3-12 month	-	-	-	-	-		-
	Traffic Signal Optimisation		10 buses to be prioritised		180,000.00	12 months	3.00	5.00	3.00	4.00	3.00	3.00	1.00

Table 5.14: Interventions summary table for the A461

A more urban stretch of road there are a couple of options available, including further signal optimisation and bus retrofitting, though with the high number of Euro VI buses the impact is limited.

Signal optimisation offers a strong possibility of achieving savings (around 2.1% in NO2 concentrations) relatively quickly by mid-2019, accelerating compliance by around 5-6 months.

Bus retrofit could also be achieved by early 2019 but achieving only a 0.01% reduction in NO2 concentrations albeit based on conservative estimates of SCR efficacy.

<u>Summary:</u>

<u>Immediate Recommendations</u>

- Signal Optimisation to be taken forward

<u>Supporting Recommendations:</u>

- Bus retrofit to be reviewed if still required, provided capacity is available in the system.

5.3.13 Road Link 57205 – High Street, Wordsley

Table 5.15 provides a summary of interventions for High Street, Wordsley

ID	Name	Authority	Description	Est Year of Compliance	Capital Cost (rounded to nearest £1000)	Timeline	Value for Money	Affordability	Distributional Impacts	Strategic and Wider AQ fit	Supply side capacity	Achievability	Displacement on other roads	TOTAL
57205	**A491, High Street, Wordsley**	**Dudley**	**High St, Lawnswood Road to Church Road**	**2021+**			-	-	-	-	-	3.00	-	3.00
	Traffic Signal Optimisation		Review and upgrade of signals at High St/Lawnswood Road.		46,000.00	3-12 month	4.00	5.00	5.00	3.00	4.00	5.00	2.00	28.00
	Retrofitting of Buses with SCR Technology		31 buses to be prioritised		558,000.00	12 months	-	-	-	-	-	3.00	-	3.00

Table 5.15: Interventions Summary Table

Added as a result of local AQ monitoring, the link has the highest emissions of those targeted by the BC authorities, it is a narrow street with traffic lights and a gradient making it a hot spot for emissions. Similarly the facades close to the road can potentially trap those emissions, exacerbating exposure.

A detailed plan for traffic emissions and the impact of signal optimisation has been drawn up by the council but has not yet been able to go ahead. This could create a reduction in NO_2 of up to 2.7%.

The road is also on a bus route and the majority of buses are Euro III and therefore the potential for impact is high. A conservative estimate of a 4.49% reduction in NO_2 is forecast if all vehicles are retrofitted. Given the need to accelerate emissions reductions it would seem pertinent to deliver such interventions. Assuming signals and bus retrofit can be achieved by the end of 2019, it could bring compliance forward by 12 -18 months based on EFT predictions.

Summary

Immediate Recommendations

- Traffic Signal Optimisation to be taken forward
- Bus Retrofit to be taken forward.

Conclusion

It's clear from the feasibility study that interventions are possible on the vast majority of links identified in the study, some of which are forecast to reduce NO_2 concentrations significantly. The study also demonstrates, that the level of effort and investment in achieving such reductions is often high, in order to achieve fairly modest savings and the total cost per one percent reduction of NO_2 can be a six or seven figure sum. This does not mitigate the need to undertake the work given the impact of NO_2 on health, but illustrates the case for a focus on policies that prevent the emissions in the first instance rather than looking to reduce them retrospectively.

The nature of the approach to the study, given the immediacy of the interventions required, as well as the need to demonstrate impacts on specific links rather than over a wider region, greatly limits the possible interventions available and discounts a lot of the work already done by local authorities to reduce emissions since the PCM model baseline figures generated in 2015.

The Black Country could therefore benefit from an area wide air quality strategy that looks to address the issue across the region, rather than solely on specific links. By taking this integrated approach, interventions such as walking and cycling become much more effective and it enables longer term, strategic interventions such as electric vehicle charging infrastructure to be evaluated and to tie in with other initiatives such as Birmingham's proposed Clean Air Zone. Whilst there is a focus on reducing concentrations below the $40\mu gm^{-3}$ threshold set out in the UK Air Quality Directive, there are no safe levels of NO_2 and therefore work and interventions should not stop simply because roads are measuring below this threshold. This would therefore be the logical next step to reduce emissions with in the Black Country region.

6 Appendix A: Part 5 Scoring Sheet Including Assumptions

ID		Name	Authority	Description	Est Year of Compliance	Capital Cost (rounded to nearest £1000)	Timeline	Value for Money	Affordability	Distributional Impacts	Strategic and Wider AQ fit	Supply side capacity	Achievability	Displacement on other roads	TOTAL	Cost Assumptions
17142		**A457 Oldbury**	**Sandwell**	**Roundabout with the A4034 and roundabout linking the A4031**	**2019**										-	
		Traffic Signal Optimisation		Manual review of all signals, upgrade of pedestrian crossings to PUFFIN where required, upgrade of signals at DPD junction/M5 flyover		81,000.00	3-12 month	1.25	0.75	-	0.75	-	1.00	-	3.75	£5000 review + upgrade of two junctions @ £30000 + £16000 for Bluetooth detectors
		Driver Training		Working with local businesses e.g. DPD/Metsec to implement a programme of Eco-driver/SAFED training for employees to reduce fuel costs and emissions. Essentially the council would fund the training, with companies providing time and vehicle for drivers (unless undertaken in employees own vehicle)		161,000.00	6-12 month	1.50	-0.50	-	0.50	-0.50	0.50	-	1.50	2150 people x 75% x 100
		Travel Planning		Council to conduct personalised travel planning workshops with businesses and develop travelplans for those signing up.		108,000.00		-1.75	-	0.50	0.50	-0.50	-	-	-1.25	2150 people x 10% x £500
		Retrofitting of Buses with SCR Technology		2 Vehicles - 2 Services		36,000.00	6 months	-	-	-	-	-	-	-	-	2 x retrofits @ £18000 each
99155		**A41, J1 M5 West Bromwich**	**Sandwell**	**Between the roundabout with M5 Junction 1 & the local authority boundary with Birmingham City Council**	**2020**			-	-	-	-	-	-	-	-	
		Traffic Signal Optimisation		Manual review of all signals, upgrade of pedestrian crossings to PUFFIN where required, upgrade of signals at Park Lane junction, M5/A4168		71,000.00	3-12 month	1.25	0.75	-	0.75	-	1.75	-	4.50	£5000 review + upgrade of two junctions @ £30000+ £16000 for bluetooth detection
		Travel Planning		Council to conduct personalised travel planning workshops with Sandwell college and develop travelplans for those signing up.		185,000.00	6-12 month	-0.75	-0.75	0.25	0.75	0.25	0.50	-	0.25	3700 people x 10% x £500
		Retrofitting of Buses with SCR Technology		0 Buses - covered by CBTF		-	12 months	1.25	1.00	-	0.75	0.25	0.75	-0.25	3.75	Covered by CBTF
99397		**A41 Black Country Route at Wednesbury**	**Sandwell**	**Roundabout with the A4037 and the roundabout with A461 at Wednesbury**	**2020**			-	-	-	-	-	-	-	-	
		Walking and Cycling Infrastructure		Develop a landscaped, segregated cycle route through the industrial area		670,000.00	24 months	-1.75	-1.25	-0.75	-0.50	-	-	-	-4.25	1015m x £660 per metre
		Retrofitting of Buses with SCR Technology		10 vehicles - covers 17611 link as well - prioritise		180,000.00	12 months	-	-	-	-	-	-	-	-	10 x retrofits @ £18000 each
16330		**A34 Great Barr**	**Sandwell**	**Junction at A4041 Newton Road and the M6 at junction 7**	**2019**			-	-	-	-	-	-	-	-	
		Traffic Signal Optimisation		Scott Arms junction reviewed and optimised already. Pedestrian crossings to be upgraded to PUFFIN where necessary, review and upgrade of signals at M6 J7 onto A34		£20,000	0 months	3.00	-	-	-	-	5.00	-	8.00	Completion of optimisation for equipment already installed
		Retrofitting of Buses with SCR Technology		6 buses that are not covered by other schemes - prioritise		108,000.00	12 months	9.00	4.00	-	3.00	-	3.00	-	19.00	6 buses x £18000
28464		**A4150 Ring Road**	**Wolverhampton**	**St David's between Broad Street and Bilston Street Island**	**2021**			-	-	-	-	-	-	-	-	
		Traffic Signal Optimisation		Review/upgrade of lights at Bilston Island, Wednesfield Road and Broad Street		196,000.00	3-24 month	2.00	-	-	-	-	5.00	-	7.00	£5000 review + Upgrade of 5 intrsectns @ bilston island, 1 @ Wednesfield Rd 1 at Broad Street x £30,000 + £16000 for bluetooth detectors
		Retrofitting of Buses with SCR Technology		167 vehicles to be prioritised		3,006,000.00	18 months	5.00	-	-	-	-	-	-	5.00	167 buses (all those servicing routes to/from the bus station) x £18000 split between 28464 and 57739
		Walking and Cycling Infrastructure		Resurfacing & Segregation where practical, enhance connectivity to springfield campus as well as Stafford St and Five Ways		504,000.00	24 months	-4.00	-	-	-	-	-	-	-4.00	764 m x £660 per metre
57739		**A4150 Ring Road**	**Wolverhampton**	**St George's between Bilston Street Island and Snow Hill Junction**	**2019**			-	-	-	-	-	-	-	-	
		Traffic Signal Optimisation		Review/upgrade of lights at Snow Hill gyratory (already upgraded since 2015		46,000.00	3-12 month	1.00	-	-	-	-	5.00	-	6.00	£5000 review + Upgrade of 1 intersections @ Snow Hill @ £30000 + 16000 for bluetooth detectors
		Retrofitting of Buses with SCR Technology		See 28464				5.00	-	-	-	-	-	-	5.00	
		Walking and Cycling Infrastructure		Resurface top section into Rabie St, extend route down to Dursley Junction, Connection between Cleveland Road and St Georges Parade		337,000.00	24 months	-4.00	-	-	-	-	-	-	-4.00	511m x £300 per metre (only surface dressing and signage required)
99402		**A463 Black Country Route (BCR)**	**Wolverhampton**	**Between Wolverhampton Street and Black Country New Road**	**2021**			-	-	-	-	-	-	-	-	
		Walking and Cycling Infrastructure		Upgrade of adjacent Canal Tow path, general upgrades to surface condition		267,000.00	24 months	-3.00	-	-	-	-	-	-	-3.00	405m x £660 per metre
99404		**A463 Black Country Route (BCR)**	**Wolverhampton**	**Between Oxford Street and Coseley Road**	**2019**			-	-	-	-	-	-	-	-	
		Travel Planning		Council to conduct personalised travel planning workshops with businesses on Charnwood Retail Park as well as Ormiston Academy and develop travelplans for those signing up.		138,000.00	6-12 month	-5.00	-	-	-	-	-	-	-5.00	2750 people x 10% x £500
		Retrofitting of Buses with SCR Technology		62 vehicles to be prioritised		1,116,000.00	12 months	-	-	-	-	-	-	-	-	62 buses x £18000
27202		**A454 Black Country Route (BCR)**	**Walsall**	**A454 Black Country Route (BCR) running westwards from J10 M6 towards A463 Black Country Route**	**2021**			-	-	-	-	-	-	-	-	
		Traffic Signal Optimisation		Manual review of signals at M6 J10		10,000.00	3 months	5.00	5.00	-	-	-	-10.00	-3.00	-3.00	Review of intersections - £5000 + £5000 contingency for HE liaison
		Walking and Cycling Infrastructure		Incorporate J10 Plan		1,313,000.00	24 months	-	-3.00	3.00	3.00	-	3.00	-	6.00	1990m x £660 per metre
38201		**A4148 Wolverhampton Road/Blue Lane West**	**Walsall**	**A4148 junction with Green lane A34 running east to junction with Broadway/Lichfield Street A461 inc Day Street & Littleton Street East and West**	**2020**			-	-	-	-	-	-	-	-	
		Traffic Signal Optimisation		Review/Upgrade of signals at Pleck Road/Blue Lane West, review and upgrade of pedestrian signalling to PUFFIN/TOUCAN standard, review/upgrade of signals at Green Lane, SCOOT already installed via NPF funding		55,000.00	3-12 month	5.00	5.00	-	-	-	5.00	-	15.00	£5000 review + intersections @ Pleck Road and Green Lane
		Retrofitting of Buses with SCR Technology				288,000.00	12 months	8.00	3.00	-	3.00	-	3.00	-	17.00	
74559		**A461**	**Dudley**	**Cinderbank Island to Castlegate Island / Duncan Edwards Way**	**2020**			-	-	-	-	-	-	-	-	
		Traffic Signal Optimisation		Review & upgrade of crossings to PUFFIN standard, Review & Upgrade of signals at Castlegate Island		146,000.00	3-12 month	4.00	5.00	5.00	1.00	4.00	8.00	2.00	29.00	£5000 review + upgrade of 5 interchanges on Castlegate + 1 ped crossing upgrade @ £30000 each + £16000 for bluetooth detectors
17611		**A461**	**Dudley**	**Castlegate Island to Burnt Tree Junction / Birmingham Road**	**2020**			-	-	-	-	-	-	-	-	
		Retrofitting of Buses with SCR Technology		Review/Upgrade of signals at Burnt Tree Junction, review of signals at Tesco junction		181,000.00	3-12 month	-	-	-	-	-		-	-	£5000 review + interchange at tesco and Burnt Tree @ £30000 + TM costs @ £130000 + £16000 for bluetooth detectors
		Traffic Signal Optimisation		10 buses to be prioritised		180,000.00	12 months	3.00	5.00	3.00	4.00	3.00	3.00	1.00	22.00	10 buses retrofitted @ £18000 each
57205		**A491, High Street, Wordsley**	**Dudley**	**High St, Lawnswood Road to Church Road**	**2021+**			-	-	-	-	-	3.00	-	3.00	
		Traffic Signal Optimisation		Review and upgrade of signals at High St/Lawnswood Road.		46,000.00	3-12 month	4.00	5.00	5.00	3.00	4.00	5.00	2.00	28.00	£5000 review + upgrade of high street interchange @ £30000 + £16000 for bluetooth detectors
		Retrofitting of Buses with SCR Technology		31 buses to be prioritised		558,000.00	12 months	-	-	-	-	-	3.00	-	3.00	31 buses @ £18000 each

6.1 Annex A: Budget Tracker

Local authorities should use this section to provide an update of spend from the grant funding. This should be updated at each interim deadline.