CITY OF LEICESTER – TARGETED FEASIBILITY STUDY TO DELIVER NITROGEN DIOXIDE CONCENTRATION COMPLIANCE IN THE SHORTEST POSSIBLE TIME

Local authorities covered	Leicester City Council

Part 1: Understanding the problem

Overview

Three road links within Leicester City Council's administrative boundary have been forecast by the Government's Joint Air Quality Unit (JAQU) to exceed the statutory average annual limit of 40 micrograms per cubic metre (µg/m^3) for nitrogen dioxide (NO_2) until 2019 or 2020. These forecasts are based on use of the Department for Environment, Food & Rural Affairs (DEFRA) Pollution Climate Mapping (PCM) model. The PCM provides modelled average annual roadside concentration outputs for around 9,000 road links across the UK, together with a 1x1 km grid of background concentrations.

The three road links of concern identified by JAQU are listed in Table 1-1 below and are illustrated in Figure 1-1. Local Air Quality Management (LAQM) monitoring is currently undertaken by Leicester City Council at five locations across the city. The 2017 monitoring data from the LAQM monitoring identifies exceedances of the statutory annual mean limit value only at those sites immediately adjacent to the three road links of concern identified within Leicester by JAQU's PCM modelling, as shown in Table 1-1 (the Melton Road monitoring site having just attained compliance in 2017 at 39.66 µg/m^3). However, it should be noted that the 2017 measured concentrations along Glenhills Way (representative of Soar Valley Way) and Vaughan Way are significantly higher than the PCM-predicted concentrations.

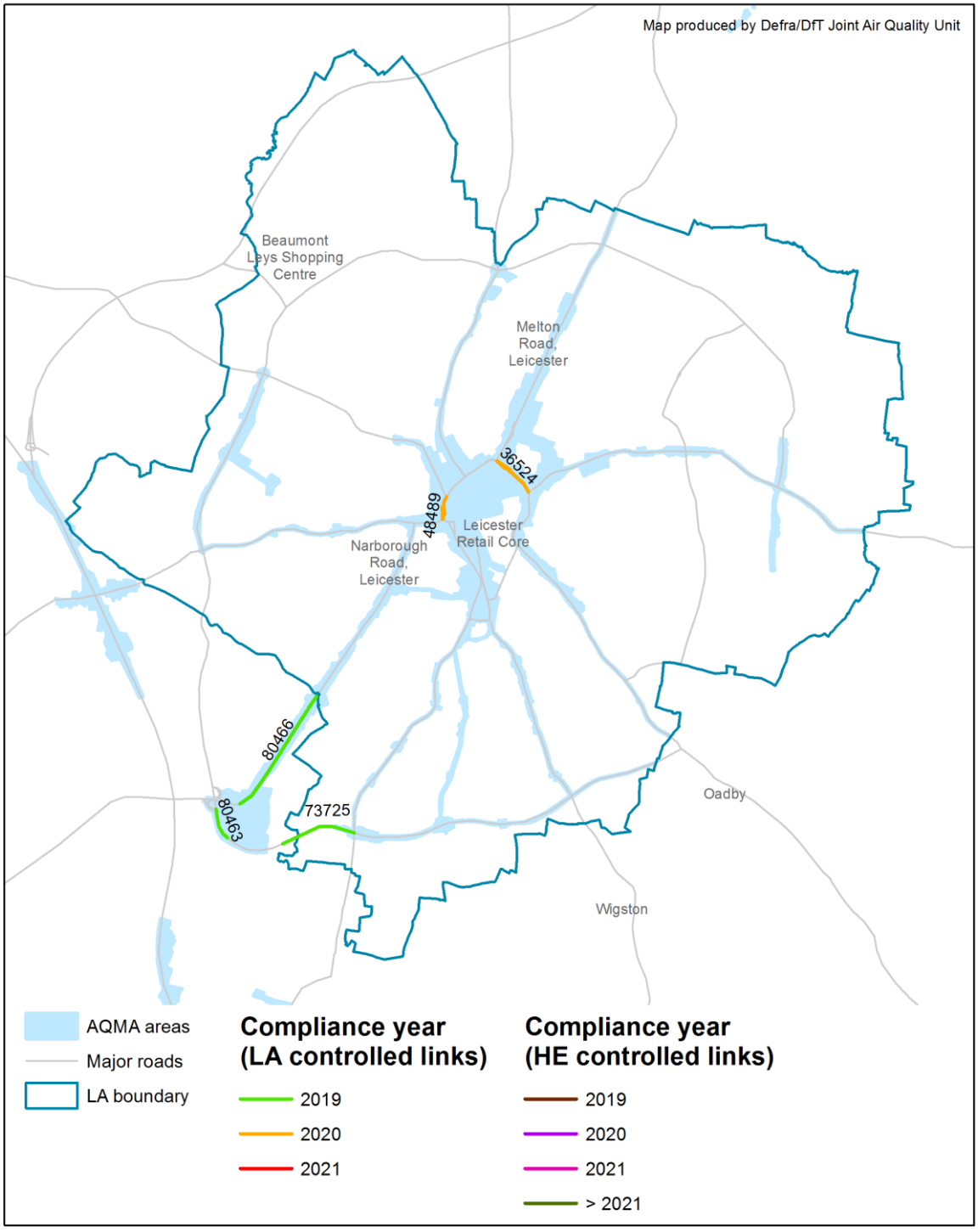
Further details on each link are provided after Figure 1-1.

Table 1-1: Road links forecast to exceed statutory average annual limit values for NO_2 concentrations

Road number	**Road name**	**Census identifier**	**Annual mean NO_2 concentration in µg/m^3** (40 µg/m^3 is the statutory annual mean limit value)					
			2017		**2018**	**2019**	**2020**	**2021**
			PCM Model	**LAQM Monitor**	**PCM Model**	**PCM Model**	**PCM Model**	**PCM Model**
A594	Vaughan Way	48489	45	52.57	44	42	40	38
A594	St Matthews	36524	44	43.73	43	41	39	38

	Way							
A563	Soar Valley Way	73725	43	52.86[1]	42	40	38	36

Figure 1-1: Map of Leicester showing road links of concern identified by the JAQU PCM modelling (NB Links 80463 and 80466 lie in Blaby District)

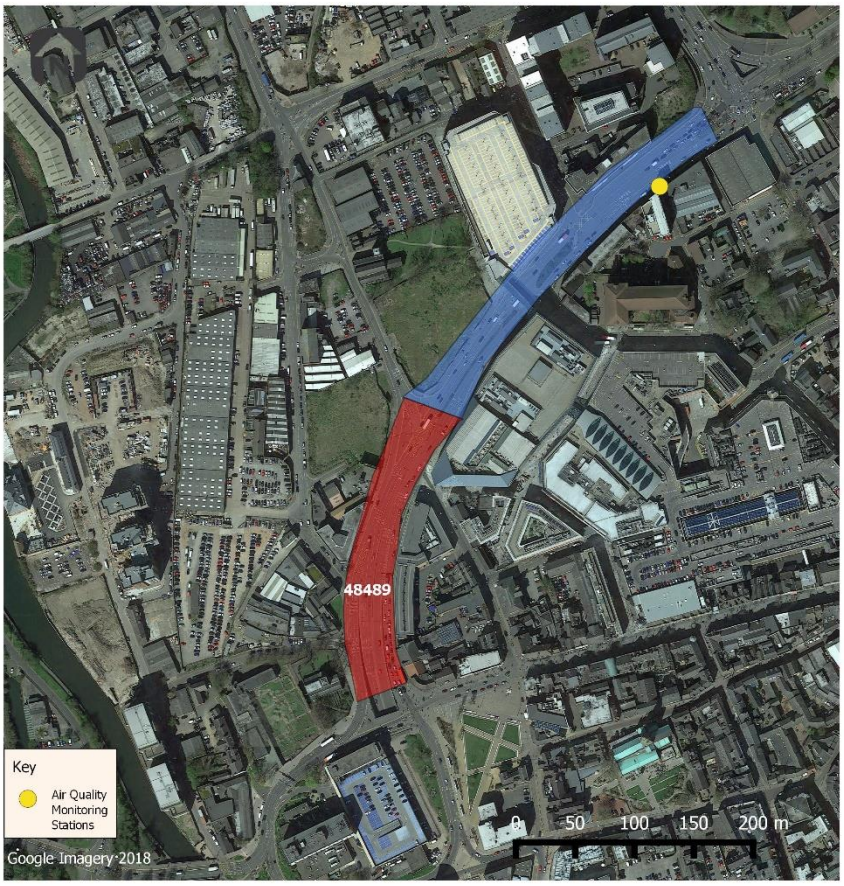


Vaughan Way (48489)

[1] Measured at Glenhills Way junction with Soar Valley Way and Lutterworth Road

Vaughan Way forms part of the western side of the Inner Ring Road in Leicester city centre. The exact location forecast by JAQU as being non-compliant until 2020 is shown in Figure 1-2 shaded red. This runs between the junction with the A50 (High Cross Street) in the north to the road going into an underpass under St Nicholas's Circle in the south. An additional stretch of Vaughan Way, where local air quality monitoring suggests a current exceedance of the annual mean limit value for NO_2, is shaded blue in Figure 1-2.

Figure 1-2: Vaughan Way



The road section of concern is a heavily trafficked multi-lane highway (annual average daily traffic (AADT) of 61,200 vehicles in 2016) that forms an integral part of the city centre road network and carries vehicles around the city centre core area. Like many of the roads in the central area it suffers from congestion during morning and evening peak periods. At its southern end the road section heads into an underpass under St Nicholas's Circle (see Figure 1-3), and to the north of the northern end there is a large car park, which can be clearly seen in Figure 1-2.

Figure 1-3: Underpass at south end of link

Council officers undertook a source apportionment exercise in 2014, when developing the city's Air Quality Action Plan[2]. The relative contributions of different types of vehicle on Vaughan Way, together with JAQU's background sources, are shown in Figure 1-4. It can be seen from this that diesel-fuelled cars and light goods vehicles (LGVs) are the biggest contributors, with buses, heavy goods vehicles (HGVs) and petrol cars making similar smaller contributions.

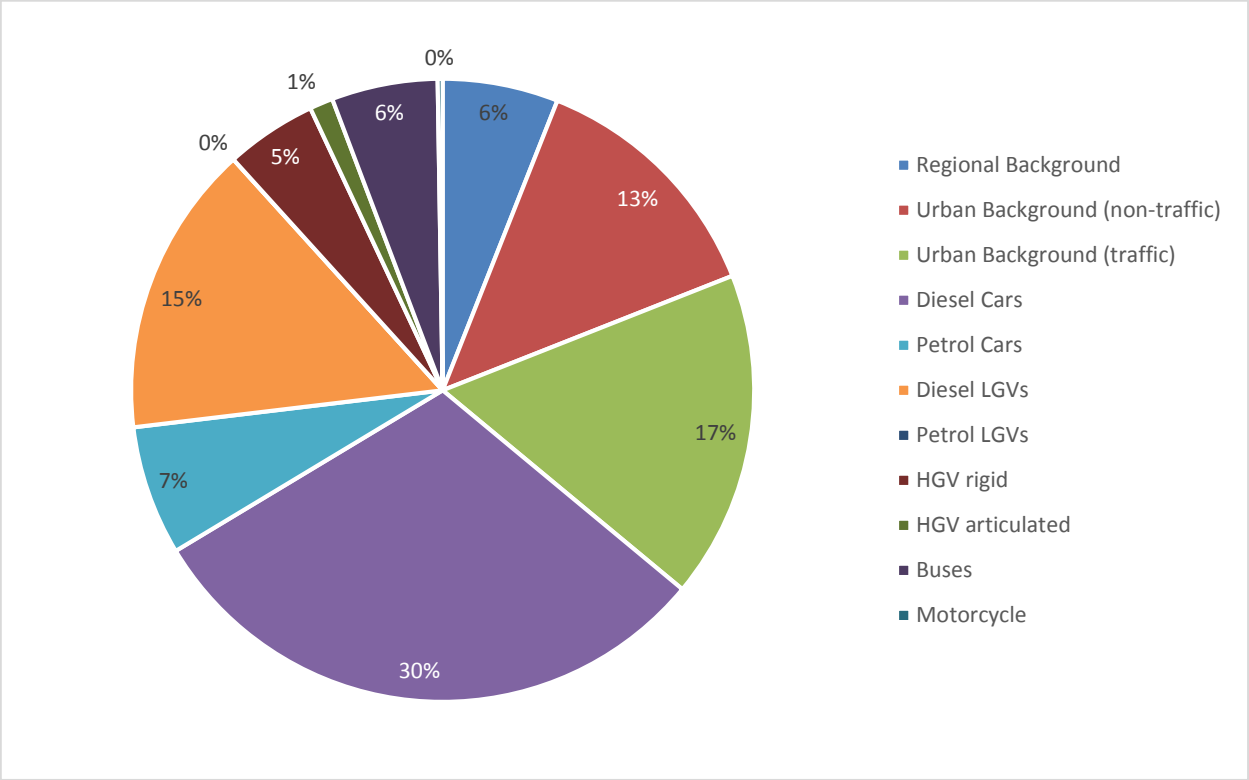
As shown in Table 1-1, NO_2 roadside concentrations on Vaughan Way are forecast by JAQU's PCM modelling to be 4 µg/m^3 above the annual mean limit value of 40 µg/m^3 in 2018, reducing to comply with the limit value in 2020. However, there is clearly some uncertainty with any model output and there therefore has to be an acknowledgement that it is possible that actual concentrations experienced at the roadside may be higher or lower than the modelled values.

In relation to the Vaughan Way link, two major redevelopment projects are also currently taking place in that area, which are likely to affect traffic levels and NO_2 concentrations. The first scheme involves creating a new pedestrian and cycle 'super-crossing' at Vaughan Way, and a wider £50 million development involving refurbishing and bringing back into commercial use the former Great Central Station, building two new hotels, 35,000 sq. ft. of new office space and a new public realm open area. Great Central Street will eventually be closed to through traffic, although access to local businesses and the new car park for the development will remain. The second scheme involves creation of a new apartment complex of nearly 300 rooms at the junction of Highcross Street and Vaughan Way.

Based on the PCM-predicted exceedances along this link and the redevelopment projects in the area, there is consequently a good case for investigating measures that can increase the probability of Vaughan Way being brought into compliance with the limit value in 2020 or indeed that can bring the date forward for compliance to be achieved.

[2] Healthier Air for Leicester: Leicester's Air Quality Action Plan (2015-2026). Leicester City Council, 2015.

Figure 1-4: Source apportionment on Vaughan Way



St Matthew's Way (36524)

St Matthew's Way forms the north-east part of the Leicester Inner Ring Road. The exact location forecast by JAQU as being non-compliant until 2020 is illustrated in Figure 1-5.

Like Vaughan Way, St Matthew's Way is an integral part of the city centre road network and carries vehicles around the city centre core area. It is a heavily trafficked dual carriageway and experiences congestion during morning and evening peak periods. The western end of this section is part of a flyover (see Figure 1-6).

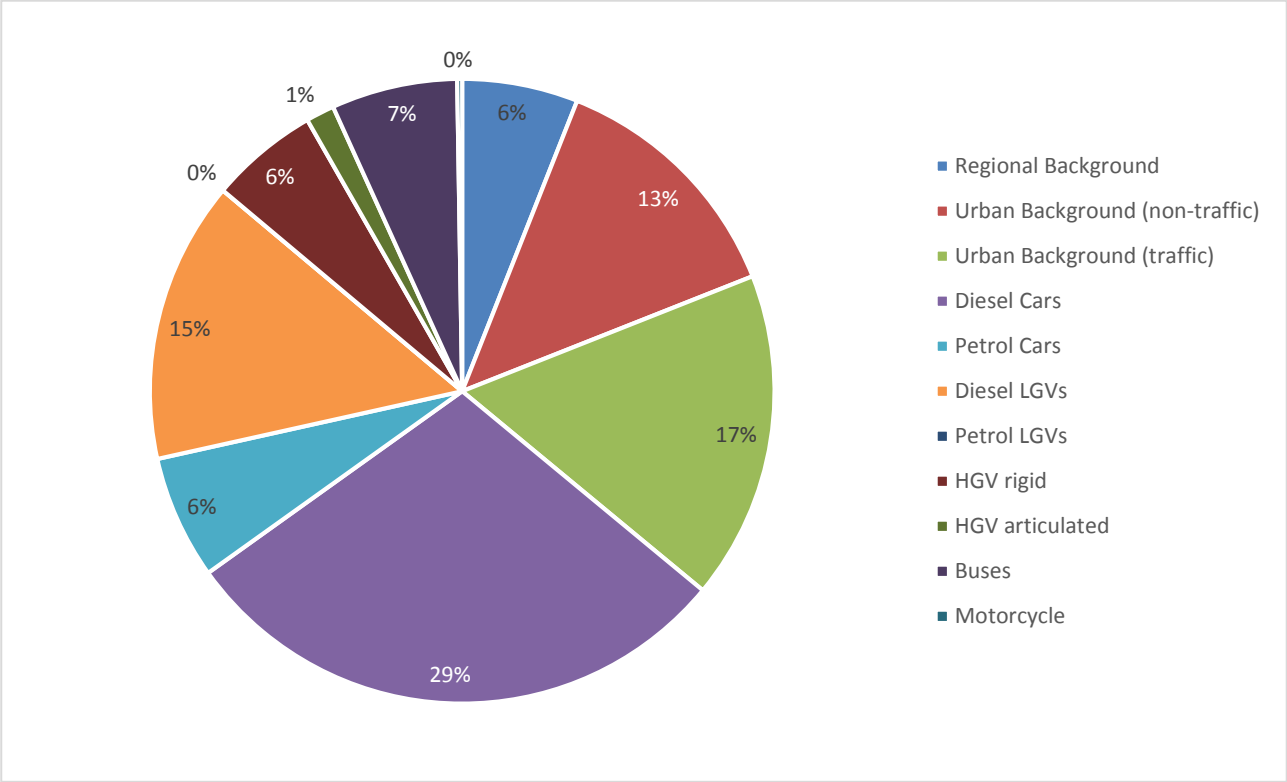
The output of the Council's 2014 source apportionment exercise on road traffic's contribution to NO_x concentrations on St Matthew's Way, together with JAQU's background sources, is shown in Figure 1-7. This shows a very similar picture to that for Vaughan Way – perhaps unsurprisingly since they are both part of the Inner Ring Road and relatively close to each other. Again, diesel-fuelled cars and LGVs are the biggest contributors, with buses, HGVs and petrol cars making similar smaller contributions.

As shown in Table 1-1, NO_2 roadside concentrations on St Matthew's Way are forecast by JAQU's PCM modelling to be 3 µg/m^3 above the annual mean limit value of 40 µg/m^3 in 2018, reducing to comply with the limit value in 2020. However, as noted above for Vaughan Way, there is a possibility that actual concentrations experienced at the roadside may be higher or lower than the modelled values. There is therefore again a good case for looking at measures that can increase the probability of St Matthew's Way being brought into compliance with the limit value in 2020 or that can bring the date forward for compliance to be achieved.

Figure 1-5: St Matthew's Way

Figure 1-6: Burleys Flyover at west end of St Matthew's Way

Figure 1-7: Source apportionment on St Matthew's Way



Soar Valley Way (73725)

Soar Valley Way (AADT of 50,600 in 2016) forms a busy part of Leicester's outer ring road towards the Fosse Park area leading to Junction 21 of the M1. The exact location forecast by JAQU as being non-compliant until 2019 is illustrated in Figure 1-8. The area around Junction 21 and Fosse Park is a well-known congestion hotspot. There are also further development proposals around that area that may impact traffic volumes, congestion and air quality in future.

JAQU has undertaken a source apportionment exercise for Soar Valley Way. The output from this exercise is shown in Figure 1-9. Leicester City Council has not yet completed a source apportionment using local data for this link.

The JAQU source apportionment exercise shows that diesel cars are again the dominant source. However, diesel LGVs are responsible for a greater share of NOx pollution than the other two road links identified as non-compliant by JAQU. HGVs (rigid and articulated) are also responsible for a higher proportion of NOx pollution, while buses are responsible for a much lower proportion. This is commensurate with the peri-urban nature of the link, which carries strategic vehicle movements as well as local traffic.

As noted in Table 1-1, Leicester City Council has an automated air quality monitoring station on Glenhills Way (the blue shaded link in Figure 1-8) at the junction to the east of the Soar Valley Way section of the outer ring road. Readings from this monitoring station show annual mean values significantly above the annual mean limit value – although we understand that the PCM modelling does not identify this neighbouring road link as in exceedance and Government regards this data source as not being fully compliant with the Ambient Air Quality Directive (AAQD) criteria. As can be seen from Figure 1-1, the nearby links 80463 and 80466 that lie just outside the Leicester boundary are also forecast to be non-compliant until 2019.

In relation to the Soar Valley Way link, a major redevelopment project has been submitted in that area which is likely to affect traffic levels and NO_2 concentrations. This scheme is located along

Soar Valley Way and is within Blaby District Council's area of jurisdiction. The development comprises the comprehensive redevelopment of the existing Everards Brewery to create a total of approximately 32,250m^2 (GEA) of new comparison retail (A1) floor space as well as additional ancillary (A3/A4/A5) floor space. The development is proposed to include 834 car parking spaces which will feed directly into the site from Grove Way, located off Soar Valley Way (to the west of the image in Figure 1-8).

An air quality assessment was submitted to Blaby District Council assessing the impact of the development on nearby receptors for 2025, the proposed year of completion with all units operational. However, the traffic and consequent air quality impacts along Soar Valley Way were not quantified within the submitted Air Quality Assessment. Therefore, Leicester City Council is unable to determine the potential effects of this development on future air quality along Soar Valley Way due to incomplete data. Based on the proposed development completion date, JAQU's PCM modelling suggests that air quality compliance will have been achieved along this link prior to the development becoming operational. However, Leicester City Council's data indicates that this may well not be the case, and that air quality compliance may be further delayed by that development.

Taking all this into account, there is a clear case for identifying and exploring measures that can minimise the risk of extending the time to achieve air quality limit value compliance on the Soar Valley Way link and on other links nearby.

Figure 1-8: Soar Valley Way

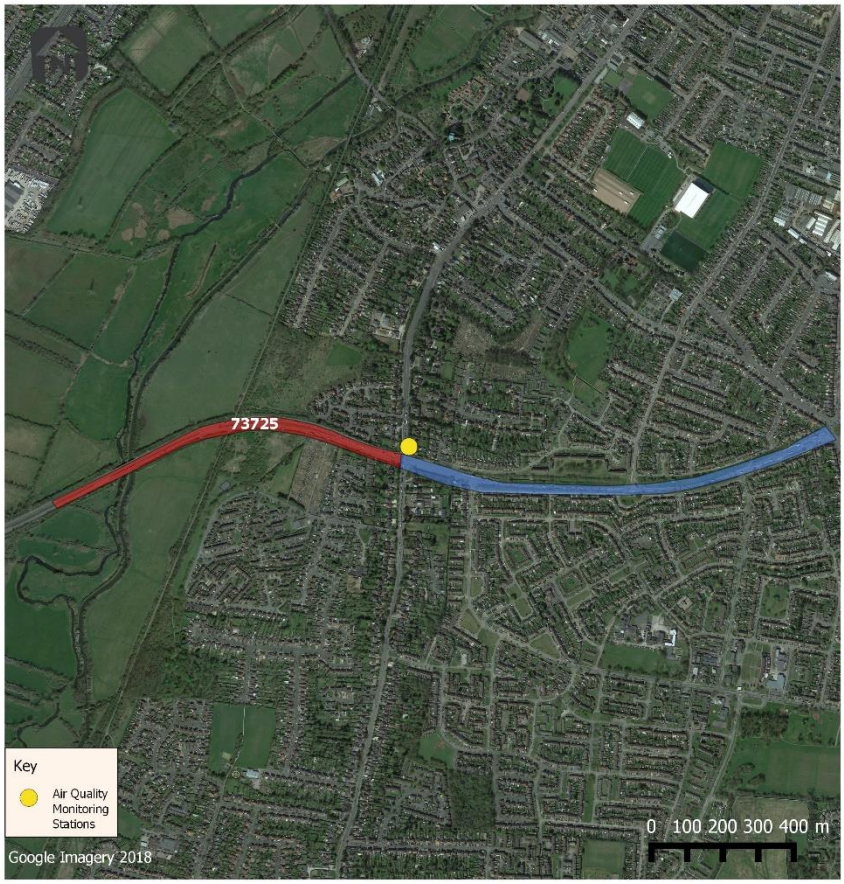
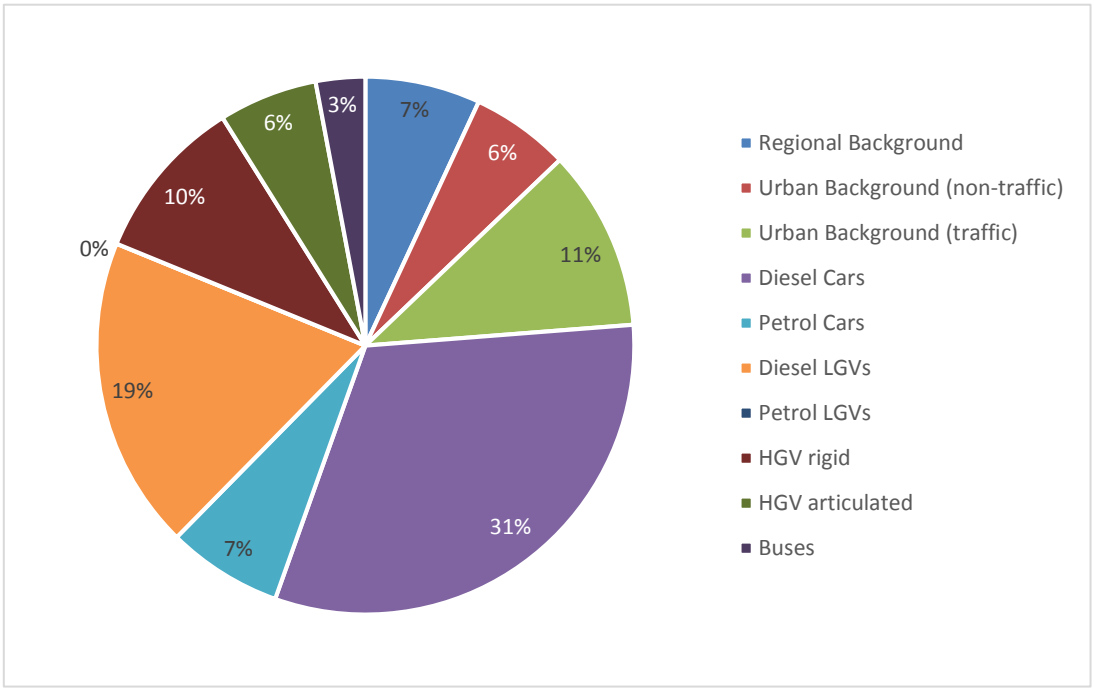


Figure 1-9: Source apportionment (by JAQU) on Soar Valley Way



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

Measures implemented since 2015

Some measures have been implemented in Leicester since 2015 (the base year used in the PCM modelling exercise) that may have helped reduce emissions in the city. These were not targeted solely on the particular road links where exceedances are forecast, but were intended to have an impact across Leicester's Air Quality Management Area. They should have had some impact on traffic volumes and congestion on the city's road network in general by encouraging mode switch away from the private car and towards lower emission modes such as cycling, walking and bus use. These are described below.

The new Leicester Haymarket bus station was opened in May 2016 (see Figure 2-1). This includes much improved waiting and interchange facilities and a real time information system, which together provide a greatly improved bus travel experience. This should attract more people to choose bus travel into the city centre rather than car travel. The bus station also reduces congestion on Charles Street.

Figure 2-1: The new Leicester Haymarket bus station

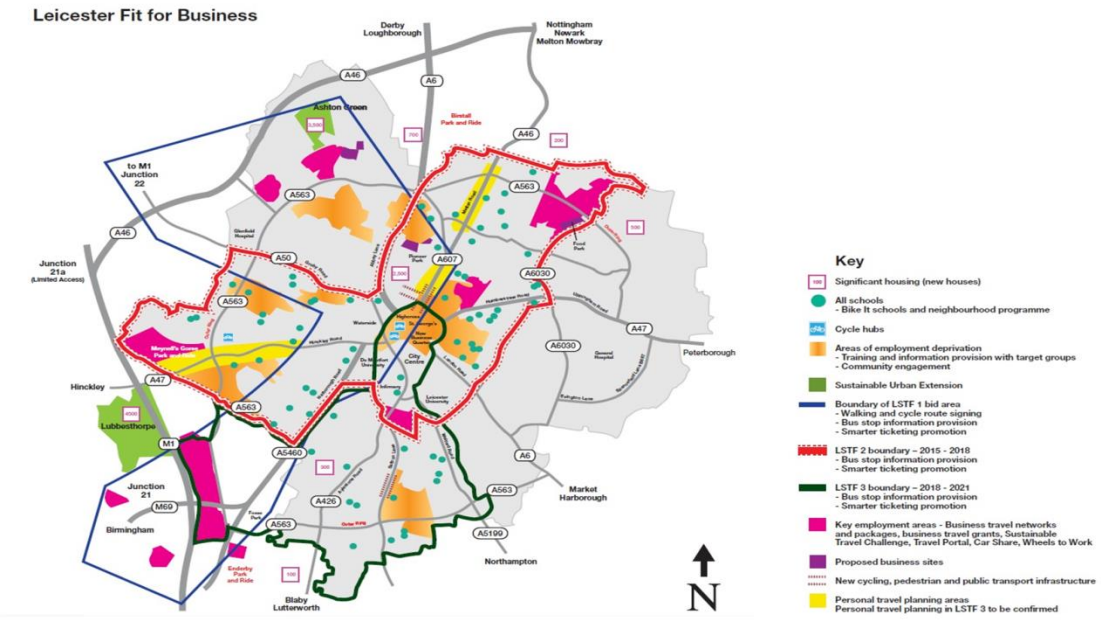
To complement the new bus station the council also introduced a Bus and Taxi Low Emission Zone covering the whole city requiring all the bus and taxi engine standards to be raised to EURO IV or above by the end of 2017. Between the launch of the Air Quality Action Plan in 2015 and the end of 2017 the bus companies have invested over £25million in new vehicles increasing the average EURO engine standard from 3.9 to 4.9. The bus companies have also signed a commitment for a Bus Clean Air Zone requiring all buses to be EURO VI before the end of 2020. As a taxi licensing requirement, all vehicles have to be EURO IV or above, this came into force in 2017.

A major travel behaviour change programme (Choose How You Move) that started in 2011 has continued and developed since 2015 and is still ongoing (see Figure 2-2). It includes a number of interventions that have targeted achieving modal shift away from the private car for commuting, business travel and travel to school. This includes working with businesses, schools and local people living along key transport corridors. Initial evaluation results have suggested that people engaged by some elements of the programme have made changes away from car use, although the effect on the specific target links identified by JAQU's PCM modelling is not known.

In parallel with the behaviour change programme, infrastructure improvements are taking place in Leicester through the Connecting Leicester programme. In particular, Leicester has become a 'Cycle City' and has invested in improving cycling infrastructure to facilitate increased levels of

cycling. This started before 2015 but has continued with ongoing roll-out of cycle lanes, cycle tracks and off-road paths, including in the city centre and on key radial routes. Since the start of 2015 over 2000 metres of cycle way and 2300 metres of public realm have been added.

Figure 2-2: Overview of Leicester's travel behaviour change programme 2011-21



Potential additional measures

A long list of additional measures was developed that could potentially be considered to address the exceedances identified in Part 1. These are things that local authorities can potentially implement (sometimes in collaboration with other organisations) and can be divided into three main categories:

- **Demand management measures** that seek to reduce road use, particularly by the most polluting vehicles.
- **Low emission vehicle measures** that encourage adoption of low emission vehicle technologies.
- **Traffic efficiency measures** that aim to improve the efficiency of traffic movement and thus cut down congestion-related emissions.

Individual measures within those categories are shown below.

Demand management measures

- Interventions to 'nudge' people into behaviour change that involves reducing use of private cars in favour of walking, cycling and public transport use. These include:
    - Employer-based workplace travel plans that encourage walking, cycling, home-working
    - School travel plans
    - Personal travel plans (PTP) working with communities and neighbourhoods
    - Marketing campaigns
    - Operation of lift sharing schemes
    - Operation of car clubs

- Improvement of infrastructure for low-polluting modes:
    - Improved public transport stops, stations and information systems
    - Improved cycling infrastructure
    - Improved pedestrian facilities
    - Park and ride facilities
- Access control and/or charging:
    - Bus lanes and priority measures
    - High occupancy vehicle (HOV) lanes
    - Low emission vehicle lanes
    - Access control regulation linked to vehicle emission standards (low emission zones)
    - Road user charging linked to vehicle emission standards (for passenger and freight vehicles)
    - Workplace parking levy with payments linked to vehicle emission standards
    - On and off-street parking charges linked to vehicle emission standards
- Reducing road traffic demand through sustainable development planning.
- Freight hubs / consolidation centres.
- Freight delivery and service plans (DSPs).

Low emission vehicle measures

- Using taxi and private hire vehicle licensing to introduce lower emission vehicles to the taxi and minicab fleet.
- Working with bus operators to introduce ultra-low emission vehicles into the bus fleet. This may require some form of grant support.
- Working with freight operators to introduce lower emission vehicles into the LGV and HGV fleet, including though the freight fleet eco-recognition scheme EcoSTARS. This may require some form of grant support.
- Alternative fuel infrastructure development (e.g. electric vehicle charging points).
- Procuring low emission vehicles for council-owned fleets

Traffic efficiency measures

- Using traffic signal control to minimise stops and delays on polluted road links to reduce congestion-related emissions.
- Localised road improvements to address ‘pinchpoints’ and junction bottlenecks.
- Using average speed cameras (and potentially variable message signs) on polluted road links to smooth traffic flow and reduce emissions.
- Eco-driving courses to train fleet drivers to drive in a way that minimises emissions.

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

Assessment approach

Moving from a long list of potential measures to a short list involved a two-part assessment. This included considering both (i) ongoing measures that have been implemented since 2015 (the baseline year for the PCM modelling) or are in the process of being implemented; and (ii) new measures or enhancements to ongoing measures.

- The first step in identifying a short list of measures involved sifting the long list developed in Part 2 to assess the potential applicability of each of those measures to the specific targeted links identified in Part 1.
- The second step involved considering the practicality of delivering each measure within the timeframe required to accelerate bringing the targeted road links into compliance with the statutory annual mean limit value.

The assessment included a qualitative assessment of applicability and deliverability. This was then used to carry out a quantitative scoring exercise on a four point scale against the applicability and deliverability criteria, for each of the three targeted links. In this scoring scheme, 1 was least applicable or deliverable, and 4 was most applicable or deliverable.

Measures that scored a 3 or 4 against both applicability and deliverability criteria were then taken forward to form a short list. This included both existing and ongoing measures, and additional measures (or enhancements to ongoing measures).

In undertaking the assessment, the nature and context of the targeted road links was considered. The Vaughan Way and St Matthews Way road links are both part of the heavily-trafficked inner ring road in Leicester. This plays a key role in keeping traffic out of the core of the city centre, by carrying cross-city trips around that area and by enabling radial movements to the city centre to enter the area at the nearest point to its final destination.

Many measures that could be targeted on isolated road links would not be applicable to either Vaughan Way or St Matthews Way because they are part of a complex network of busy city roads. Their use would lead to traffic simply moving on to neighbouring roads, thus potentially moving the air quality problem rather than reducing it, and even potentially exacerbating it by creating extra congestion on roads that are less well suited to carrying high traffic volumes. Both of these links are therefore much better suited to area-based measures rather than measures targeted on the individual links.

The Soar Valley Way link (and its neighbouring link, Glenhills Way) forms part of Leicester's outer ring road. As there are few realistic alternative roads nearby for east-west movements, localised measures could potentially be more appropriate.

In considering measures that rely on changing travel behaviour away from private cars, it is important to recognise that the air quality benefit would be maximised if the resulting reduction in motorised traffic was somehow 'locked in' (e.g. by reallocating road space away from cars) to prevent suppressed demand for car travel from filling the freed road space, particularly at peak periods.

Assessment outputs

The outputs from the assessment exercise are presented in tabular form in Table 4-1. For ease of comprehension, scores of 3 or 4 against the two main assessment criteria are shaded green while scores of 1 or 2 are shaded blue.

Table 4-1: Assessment outputs

Measure		Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
		Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
Interventions to 'nudge' people into behaviour change that involves reducing use of private cars in favour of walking, cycling and public transport use.	Existing/ongoing	4	4	4	4	3	4	Leicester City Council is already working in partnership with Leicestershire County Council to deliver a programme of behavioural change measures (called 'Choose How You Move' (CHYM)). This focusses on journeys being made both within the city and from outside the city to destinations within. This includes employer-based travel plans, school travel plans, personal travel plans, and a car-sharing scheme. While the effort could be intensified, it would need to be focussed on locations and businesses that are key origins or destinations of traffic on the specific targeted links – which could be hard to determine.	Smarter travel measures can be delivered in a relatively short timescale, although the benefits take time to develop. The fact that the CHYM programme already exists would aid deliverability.
	Enhanced	4	4	4	4	3	3		
Improved public transport stops, stations and information	Existing/ongoi	4	4	4	4	1	1	Few buses, if any, operate on Soar Valley Way at present, so potential applicability to the air quality problem on this link is lower than on the other two links. Leicester City Council has already opened the new Haymarket bus station	LCC has a programme of public transport infrastructure improvement within its bid to the Government's Transforming Cities Fund. However, it is unlikely that delivery could be accelerated sufficiently for this to deliver air quality benefits

Measure		Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
		Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
systems	Enhanced	4	2	4	2	1	1	and has a programme in place for rolling out real-time information in much of the city. The council and bus operators have been working together to improve bus stops and associated information, but this could be accelerated on services into the centre. LCC has made a bid to the Transforming Cities fund that includes funding to strengthen bus infrastructure in the city.	before 2020.
Improved cycling infrastructure	Existing/ongoing	4	4	4	4	2	2	Improved cycling infrastructure could potentially attract some trips away from private car use, which is a significant contributor to air quality problems on all three targeted links. Leicester City Council is already implementing a programme of improving cycling infrastructure, particularly in and around the city centre.	While the current programme to deliver better cycle infrastructure could be expanded (with funding availability) to more directly address trips that use the targeted links, it is unlikely that the planning, design and construction phases of implementing significant new cycle infrastructure could be implemented before the targeted links are predicted by JAQU to come into compliance in 2019 or 2020.
	Enhanced	4	2	4	2	3	2		

Measure		Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
		Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
Improved pedestrian facilities	Existing/ongoing	3	4	3	4	1	1	Leicester city centre already has a large pedestrianised area, which encourages walking in and around the city centre. Many journeys that use the inner ring road would not necessarily be readily transferable to walking trips because of their cross-city nature. Improved pedestrian facilities in and around Vaughan Way and St Matthews Way would encourage more walking but would be unlikely to make a significant difference on their own to air quality on those links. Soar Valley Way is likely to be carrying predominantly longer distance passenger trips, many of which would not be readily transferable to walking trips.	While better pedestrian infrastructure could be implemented (with funding availability) to more directly address trips that use the targeted links, it is unlikely that the planning, design and construction phases of implementing significant new pedestrian infrastructure could be implemented before the targeted links are predicted by JAQU to come into compliance in 2019 or 2020.
	Enhanced	2	2	2	2	1	2		
New park and ride facilities		3	1	3	1	1	1	Leicester has three established park and ride (P&R) sites located on main routes into Leicester, at Enderby, Birstall and Meynell's Gorse. The Enderby P&R site already directly reduces private car traffic demand on Soar Valley Way, while the other two may have some effect on traffic demand on Vaughan Way and St Matthews Way. Theoretically, building further P&R sites could transfer travel demand into the city away from private	Implementing new park and ride facilities on routes into Leicester would be a major undertaking, including feasibility studies, planning, land acquisition, design and construction. This would not be deliverable before the targeted links are predicted by JAQU to come into compliance in 2019 or 2020.

Measure		Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
		Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
								cars and on to buses, which could help address the air quality issues on Vaughan Way and St Matthews Way. However, this would be subject to land availability at suitable sites, as well as funding.	
Bus lanes and priority measures	Existing/ongoing	4	4	4	4	2	4	Leicester already has a number of bus lanes and bus priority measures in operation, which help attract people to bus travel in and around the city. The council has firm plans for additional bus lanes along Narborough Road to the south of the city and Groby Road to the west. The Groby Road bus lane in particular may help reduce private car demand to some extent on the Vaughan Way and St Matthews Way links.	There is funding commitment to deliver the two new bus lanes, and the target date for completion is the end of 2019. Potentially, this could help bring forward compliance on Vaughan Way and St Matthews Way in particular, if only by a few months. It is unlikely that any additional such measures could be delivered within the city and bring air quality benefits before 2020.
	Enhanced	3	2	3	2	2	2		
High occupancy vehicle (HOV) lanes or gates		1	2	1	2	3	2	HOV lanes or gates (a road section on which only HOVs are allowed) have not been widely used in the UK, although there are isolated examples. Their aim is to decrease traffic volumes (and hence improve air quality) by increasing car occupancy, particularly during peak periods. Enforcement does, however,	An HOV gate on Soar Valley Way is unlikely to be deliverable before 2020 because of the need for design, appraisal, consultation, approval, agreement of policing arrangements, and implementation, for what could be a locally controversial measure.

Measure	Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
							rely on police presence to intercept violating vehicles. Potentially, an HOV gate could play a role in addressing the Soar Valley Way air quality problem. This could be implemented at peak times only, which could reduce vehicle flows or spread demand so that congestion and queueing are reduced. For maximum effectiveness, the HOV restriction could cover vans as well as cars. HOV facilities would be less applicable to Vaughan Way or St Matthews Way because of the risk of car drivers diverting on to alternative roads (thus moving rather addressing the air quality issue).	
Low emission vehicle lanes	2	2	2	2	2	2	Low emission vehicle lanes could encourage faster take-up of ultra low emission vehicles by giving such vehicles a travel time advantage. Low emission lanes might typically be implemented by allowing electric vehicles to use bus lanes, as has been done on Daleside Road in Nottingham. Potentially, bus lanes in Leicester could be opened to electric vehicles across the city to encourage electric vehicle uptake. However, the real benefits would be	Allowing electric vehicles to use bus lanes in the city would be achievable relatively quickly (by the end of 2019). However, the air quality benefits from accelerated uptake of electric vehicles would be medium-term – beyond the timeframe within which NO_2 emissions are forecast to be non-compliant.

Measure	Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
							seen in the medium term rather than the short term timeframe required to address immediate air quality issues on the targeted links.	
Access control regulation linked to vehicle emission standards (low emission zones)	4	2	4	2	2	2	A non-charging Clean Air Zone (CAZ) is under consideration in Leicester as an area wide measure in the city centre to address air quality issues. Initial examination of options has concluded that this would be a possible measure for freight vehicles (HGVs and LGVs) in the city centre (including the inner ring road). It is anticipated that this would apply a minimum Euro VI emission standard for all freight vehicles entering the zone from 2021 onwards. While this would have a potentially large impact on freight vehicle emissions on Vaughan Way and St Matthews Way, it would also have some (diluted) effect on Soar Valley Way which would lie outside the zone. The impact on air quality would be dependent on effective enforcement, which would need to be undertaken by the police under current legislation.	Because of the need for full consultation and to allow time for freight operators to adapt their fleet, initial feasibility investigations suggest that the full Euro VI restriction could not be implemented until 2021.
Road user charging linked to vehicle emission	4	2	4	2	2	2	An initial feasibility investigation of a charging-based CAZ has been undertaken. This concluded that such a	Because of the need for detailed system design and procurement and full consultation to allow time for freight

Measure	Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
standards (for passenger and freight vehicles)							measure had particular potential to target high emission freight vehicles, as an alternative to the non-charging CAZ described above. This could potentially be similar to the current London scheme with a zero charge for vehicles that met the specified Euro VI emission standards, with a charge for vehicles that did not meet the standard and a significant penalty charge for vehicle owners that did not pay the applicable charge. This would be more complex and expensive to implement than the non-charging CAZ option, but would be enforceable by the council, which may make it more effective.	operators to adapt their fleet, initial feasibility investigations suggest that a charging CAZ of the nature described could not be implemented until 2021.
Workplace parking levy with payments linked to vehicle emission standards	3	2	3	2	3	2	A workplace parking levy (WPL) is that an annual charge is levied on employers within a defined area for each private non-residential (PNR) parking space associated with a place of employment. This includes parking spaces at the employment location and off-site workplace parking spaces (e.g. contract parking) provided at the employer's expense. Parking spaces that may be subject to WPL include those used by employees and those used by business-	Implementing a WPL scheme would be a significant undertaking, requiring a full programme of scheme design and appraisal, business case development, public consultation and potentially an examination-in-public. The Nottingham WPL scheme was several years in preparation as the first such scheme, but learning from that experience should enable Leicester to develop and implement a scheme within a three year period. This is, however, beyond the

Measure	Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
							to-business visitors. Employers need to apply for a licence to provide a specified number of workplace parking spaces and pay the associated levy (charge). The charge may or may not then be passed on by the employer to employees who use the parking spaces. Initial investigations suggest that a workplace parking levy (WPL) scheme could be implemented across the city by Leicester City Council using powers under the Transport Act 2000, to both improve air quality and reduce congestion. A scheme could be set up to (i) act as a general congestion reduction measure and (ii) encourage people to change vehicles to a lower emission type. In the latter case, a premium WPL charge could be levied on businesses that allowed cars to use their parking facilities that didn't meet a minimum emission standard (e.g. Euro 6 for diesel cars).	timeframe required to bring air quality compliance forward from JAQU's forecast compliance dates of 2019 and 2020.
On and off-street parking charges linked to vehicle emission	3	3	3	3	2	3	Parking charges within the city centre area that are controlled by Leicester City Council could be set to (i) act as a demand management measure for high	The process of implementing parking tariffs with emission standard related premiums would be relatively straightforward for council-owned parking

Measure	Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
standards							emission vehicles and (ii) encourage people to change vehicles to a lower-emission type. Differential parking charge tariffs in car parks and for paid on-street parking could be set so that vehicles that didn't meet a minimum emission standard (e.g. Euro 6 for diesel cars) would pay a higher charge for parking (for example, double the normal charge), with a potential discount for those that did. This measure would have greater applicability for Vaughan Way and St Matthews Way than Soar Valley Way because of its central area focus. Its effectiveness would depend on the proportion of off-street public parking within the control of LCC, unless private sector parking operators could also be persuaded by the council to operate emission-related premium charging. The council would also need to ensure that free parking options within the central area and around the boundary were either closed off or limited.	facilities, but would require some potentially difficult negotiations with private parking operators. As with all measures, there would need to be a publicity campaign before the measure was implemented and information would need to be made available that would tell drivers how to find out what emission standard their vehicle met.
Reducing road traffic demand	3	1	3	1	3	1	Reducing road traffic demand through close consideration of sustainable	This is a long term measure rather than a short-term fix. While it should help avoid

Measure	Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
through sustainable development planning.							transport links at planning stage is a key long term measure for maintaining and improving air quality across Leicester in the future. Going forward, the council aims to ensure that air quality issues related to road traffic is taken into account when considering development planning applications.	future air quality problems, sustainable planning decisions made in the short term future are unlikely to significantly improve air quality on the targeted links. They should, however, be used to help ensure that air quality problems are not worsened in those areas.
Freight hubs / consolidation centres.	3	1	3	1	1	1	Freight hubs or consolidation centres aim to reduce freight traffic in city centres by consolidating vehicle loads at a peripheral location for onward delivery by smaller, greener vehicles. It would therefore only be potentially applicable to Vaughan Way and St Matthews Way, but not Soar Valley Way. Wego couriers has already established a parcel hub in Leicester, using bicycles and electric vehicles to distribute parcels in the city centre brought to their hub by major national couriers. There is potential for a larger freight hub in Leicester, although experience elsewhere has identified significant economic and practical barriers to larger scale hubs.	Although initial work has been done on trying to get a larger freight hub off the ground in Leicester (in line with the city's Air Quality Action Plan), the economic case has not yet been found strong enough to get such a facility off the ground. It therefore appears unlikely that such a facility could be operational in time to make a material difference to air quality on the two inner city links before 2020.
Freight delivery and service plans (DSPs).	2	2	2	2	2	2	Freight delivery and servicing plans (DSPs) are the freight industry equivalent of personal travel plans, encouraging	In terms of deliverability, it appears unlikely that more could be done on DSPs than is already being achieved by

Measure	Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
							businesses to look at minimising vehicle movements into particular areas (for example, through load consolidation). They could potentially help address air quality problems on the two inner city targeted links (Vaughan Way and St Matthews Way). However, LCC already works with local freight operators, who are making relatively efficient delivery patterns due to delivery restrictions in the city centre.	local freight operators working in collaboration with LCC.
Using taxi and private hire vehicle (PHV) licensing to introduce lower emission vehicles to the taxi and minicab fleet (taxi Clean Air Zone).	3	3	3	3	3	3	Improving the emission characteristics of taxis and minicabs throughout the city through licensing is an area that is currently being progressed by Leicester City Council. This would particularly benefit the targeted Vaughan Way and St Matthews Way links, as taxi movements tend to be more prevalent in the inner city.	Taxi and minicab operators need to be allowed time to change to lower emission vehicles. At present, the council is considering requiring Euro 6 emission standards on first registration of a vehicle in 2020, with all taxis and PHVs being required to meet Euro 6 standards during 2021. The council could consider bringing the first registration requirement forward to 2019, which may have an additional effect on air quality on the inner city targeted links in particular. A vehicle replacement grant scheme would help encourage early replacement.
Working with bus operators to introduce ultra-	4	3	4	3	2	3	Improving the emission characteristics of buses will have an effect on both Vaughan Way and St Matthews Way.	As part of the agreement a number of operators will be introducing Euro VI compliant buses and/or retrofitting

Measure	Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
low emission vehicles into the bus fleet.							Leicester City Council and the local bus operators have reached a voluntary agreement that all buses operating into and out of the city centre will meet the Euro VI emission standard or better by the end of 2020. The council has accessed funding from Government that can be used to provide grants to retrofit any buses that won't otherwise be compliant within that timescale.	existing vehicles in 2018 and 2019, which will assist with achieving compliance on the inner city links in the shortest possible time.
Working with freight operators to introduce lower emission vehicles into the LGV and HGV fleet through the freight fleet eco-recognition scheme EcoSTARS.	4	3	4	3	4	3	This measure would require liaison with businesses, which could be undertaken as part of an enhanced behavioural change programme (see above). As a cross-city measure it could potentially have a positive air quality impact on all three of the targeted road links. A grant fund for smaller Leicester businesses to encourage take-up of low emission freight vehicles would make the initiative likely to be more effective.	Accelerated engagement with businesses could help freight vehicle emissions reduce earlier than they would do otherwise. Effectiveness would be contingent on availability of a grant fund for smaller businesses, who are likely to have slower natural fleet turnover and operate older vehicles.
Alternative fuel infrastructure development (e.g. electric vehicle charging points).	3	3	3	3	3	3	Leicester City Council has already implemented a number of public electric vehicle charging points in the city since 2015, and is engaged in rolling out further points as funding becomes available. This will accelerate take-up of electric vehicles in and around the city,	The existing implementation programme for public charging points will deliver some benefit to improve air quality on the targeted links before 2020.

Measure	Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
							which should have some effect on air quality on all three targeted links.	
Procuring low emission vehicles for council-owned fleets.	3	4	3	4	3	4	Leicester City Council is already in the process of switching its vehicle fleet to low emission vehicles, including electric vehicles. This forms a key action from the city's Air Quality Action Plan, with the aim of reducing emissions from its fleet by 50% from 2015 to 2025. This will potentially help address air quality on all three targeted links to some extent. At present, only cars have been switched to electric operation due to the lack of suitable electric models for vans and larger vehicles. However, converting such vehicles from diesel to LPG (liquid petroleum gas) shows significant potential for reducing NO_x emissions.	The adoption of electric cars within the council fleet is already being implemented and should help improve air quality on the targeted links. Implementing diesel-to-LPG conversions on light duty vehicles (vans) within the fleet and accelerating adoption of electric cars would further improve air quality and be deliverable within a short timescale if additional funding was made available by Government.
Using traffic signal control to minimise stops and delays on polluted road links to reduce congestion-related emissions.	3	2	3	2	3	2	The main traffic junctions surrounding the three targeted links currently operate under traffic signal control. Signal timings for the junctions in the vicinity of Vaughan Way and St Matthews Way are under control of a SCOOT adaptive traffic control system. This seeks to optimise traffic signal timings in real time to minimise stops and delays across the whole signalised network. The junction in	Initial internal consideration of changing signal control approaches suggests that a significant project involving modelling, plan development and testing would be needed before new approaches could be used. It is uncertain whether any revised approaches coming out of that project could be adopted before 2020.

Measure	Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
							the vicinity of the Soar Valley Way junction is operated under MOVA signal control, which is an advanced form of isolated junction control. However, because of the air quality problems on the particular links, there may be some potential for alternative approaches to signal setting to be explored. These may include, for example, looking at setting up 'green waves' on the outer ring road in the vicinity of Soar Valley Way to reduce congestion and stop-start traffic on that particular road. Alternative approaches such as the UTRAQ program that takes explicit account of air quality in signal setting (which Leicester City Council was instrumental in developing) could also be explored. A research and testing project would be needed before firm conclusions could be reached on whether such approaches would materially improve air quality on the targeted links.	
Localised road improvements to address 'pinchpoints' and	2	2	2	2	2	1	Potentially, additional lanes could be constructed on Glenhills Way adjacent to Soar Valley Way. This would remove the bottleneck where a dual two lane road	Adding road lanes to Glenhills Way would be a significant engineering project. It is unlikely that the planning, design and construction phases could be

Measure	Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
junction bottlenecks.							merges into a single lane in each direction near to the Soar Valley Way junction with Glenhills Way. However, careful consideration would need to be given to the danger of moving the air quality problem from Soar Valley Way and the western end of Glenhills Way to the eastern end of Glenhills Way at the Pork Pie Roundabout, where two lanes would again feed into a single lane. There would also be a danger of inducing more traffic on the outer ring road in the medium term by increasing capacity from release of suppressed demand. On Vaughan Way, the potential for traffic smoothing and hence air quality improvement was considered in the context of measures to reduce or remove queuing back from the entry into the Highcross Car Park at times of high demand. However, there were seen to be no straightforward solutions to that particular issue.	completed before the Soar Valley way is forecast by JAQU to become compliant.
Using average speed cameras (and potentially	2	3	2	3	3	2	Using average speed cameras on significant urban roads has the potential to smooth flow and reduce emissions	An average speed camera system is unlikely to be deliverable before 2020 because of the need for design,

Measure	Vaughan Way		St Matthews Way		Soar Valley Way		Qualitative assessment of potential applicability to the targeted links	Qualitative assessment of deliverability to accelerate compliance
	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability	Potential applicability	Potential deliverability		
variable message signs) on polluted road links to smooth traffic flow and reduce emissions.							due to stop-start traffic and consequent acceleration and deceleration cycles. This would be potentially applicable to Soar Valley and Glenhills Way, but less so to Vaughan Way and St Matthews Way, which are part of a more complex city centre road system.	appraisal, consultation, approval, agreement of policing arrangements, and implementation,
Eco-driving courses to train fleet drivers to drive in a way that minimises emissions.	N/A	N/A	N/A	N/A	N/A	N/A	As part of its Air Quality Action Plan, Leicester City Council offers its Greener Safer Driving course to help people minimise fuel consumption and emissions. This has been operated since 2011, so is an existing measure that was introduced before 2015. The EcoSTARS programme referenced above also includes an element of eco-driving training.	Greener Safer Driving was an existing measure before 2015 and is therefore taken into account in JAQU's baseline forecasts. The potential of the overall EcoSTARS programme to deliver earlier air quality compliance is dealt with earlier in this table.

Short list

The resulting short list from the assessment process is shown below in Tables 4-2 and 4-3. In addition to those measures shown, using urban traffic control to improve air quality on the targeted links was felt to be promising and something that could be delivered relatively quickly, but that there was a lack of hard evidence on what approach might give greatest benefits. While this could therefore not be short-listed at this stage, it was concluded that this would be worth exploring further through a more in-depth study with some testing and assessment of options, provided funding could be found.

Table 4-2: Existing and ongoing measures that will contribute to bringing air quality compliance forward on the targeted road links

Existing / ongoing measures since 2015	Vaughan Way	St Matthews Way	Soar Valley Way
Behavioural change programme (Choose How You Move)	✓	✓	✓
Improved public transport stops, stations and information (Haymarket Bus Station & ongoing RTI roll-out and bus stop improvement)	✓	✓	
Improved cycling infrastructure	✓	✓	✓
Improved pedestrian facilities	✓	✓	✓
Bus lanes and priority (Groby Road and Narborough Road)	✓	✓	
Bus Clean Air Zone agreement	✓	✓	
Electric vehicle charging points	✓	✓	✓
Electric vehicles in council fleet	✓	✓	✓

Table 4-3: New measures or enhancements to existing measures that could potentially contribute further to bringing compliance forward on the targeted road links.

New or enhanced measures	Vaughan Way	St Matthews Way	Soar Valley Way
Enhanced behavioural change programme, including freight operator intervention with EcoSTARS	✓	✓	✓
Taxi Clean Air Zone (CAZ)	✓	✓	✓
Smarter parking charging including differential charge tariffs linked to emission standards	✓	✓	
Diesel to LPG conversions in council fleet	✓	✓	✓

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

Introduction

Part 4 of the Leicester Targeted Feasibility Study involved making an evidence-based assessment of (sequentially):

- Impact of measure on traffic variables, such as traffic volumes, composition or speed
- Change in emissions of NOx at the roadside
- Change in concentration of NO_2 at the roadside

This needed to be done for the short-term timeframe of interest, from 2018-2020. The approach adopted and assessment results are described in the following report sections.

Traffic impacts

Approach

The predicted traffic impacts were assessed (i) of existing and committed ongoing measures and (ii) of the shortlisted potential new measures that could contribute to improving air quality on the three non-compliant road links. This was done using a spreadsheet model constructed for this purpose. The spreadsheet model workbook comprised seven scenario sheets, covering:

- A baseline scenario, projecting traffic flows and speeds that would have occurred up to 2020 had there been no initiatives that affected the three targeted links post-2015.
- A scenario in which only existing and planned / committed initiatives (as described earlier in the report) took place.
- Four scenarios in which each of the four main shortlisted measures were individually implemented (an enhanced behavioural change programme targeting users of the three road links; a taxi Clean Air Zone; smarter parking using parking charges to deter traffic (particularly by polluting vehicles); and diesel to LPG conversions in the council vehicle fleet) in addition to the existing and planned / committed initiatives.
- A scenario in which all four shortlisted measures were implemented in addition to the existing and planned / committed initiatives.

<u>Baseline</u>

A starting point for the spreadsheet model was annual average daily traffic (AADT) for 2015, as used by JAQU in its baseline NO_2 concentration modelling. AADT represents the volume of vehicles using each road link on an average day throughout the year. Two-way AADT figures were extracted from data collected by the Department for Transport through its national programme of classified traffic counts, which includes counting sites on all three targeted links. This gave AADT data for the following motorised vehicle classes:

- Motorbike
- Car
- Light goods vehicle (LGV)
- Heavy goods vehicle (HGV) - rigid
- HGV - articulated
- Bus / coach

Car AADT figures were then further subdivided, using other information sources:

- Taxis (including both hackney carriages (HC) and private hire vehicles (PHV)) were estimated to make up 5% of car traffic on Vaughan Way and St Matthews Way - the two

inner city links. This figure was derived from using approximately half of the figure for percentage of taxis within the morning peak period that was used within a detailed low emission taxi study undertaken in 2015-16[3]. The halving was introduced because taxis typically make up a higher proportion of traffic during peak periods than during the rest of the day.

- AADT figures for the remaining car fleet were then split by fuel type according to national fleet projections prepared for the national atmospheric emissions inventory (NAEI) published by Government in December 2017[4].

For subsequent years (2017 to 2020), the AADT forecasts for the different vehicle classes used by JAQU in their initial modelling of baseline NO_2 concentrations (see Table 1-1) were used for consistency. Car AADT figures were again further subdivided, as for 2015 (see above).

Alongside the AADT data, average speed data was obtained by Leicester City Council by using Highways Analyst[5] on speed data for the three targeted links derived from Trafficmaster GPS data. A single all-day average speed (12 hours from 07.00 to 19.00) across both directions of travel was derived for the baseline scenario.

Existing and planned / committed (ongoing) measures

In considering the traffic impacts of existing and committed measures that have been implemented since 2015 (or will be implemented before 2020), these measures were formed into four groups for impact assessment purposes. Commentary on these four groups and their estimated traffic impacts compared with the baseline scenario are presented in Table 4-1.

Table 4-1: Traffic impacts of existing and planned/committed (ongoing) measures

Group of measures	Commentary on traffic impacts	Forecast impacts
Smarter travel measures: – This includes the continuation of the Choose How You Move (CHYM) behavioural change programme since 2015 and infrastructure measures including public transport stop improvements, the new Haymarket bus station, cycling infrastructure and walking infrastructure.	Taken together, these will have an area-wide traffic reduction effect as people move some of their trips away from the car. There is a significant body of evidence that behavioural change programmes coupled with sustainable transport infrastructure investment can achieve change of travel mode away from the car[6]. The quantum of change can vary significantly and some of the traffic reduction benefits from mode shift are usually	In forecasting impacts on traffic volumes (AADT), it was conservatively assumed that these existing and ongoing measures would achieve a 2.4% reduction in car traffic on the three targeted links. This figure is in line with the in-depth examination of traffic reduction in Darlington where a behavioural change programme was coupled with sustainable travel infrastructure improvements, as part of the Sustainable Travel Towns programme.

[3] Leicester and Leicestershire Ultra Low Emission Taxi Feasibility Study – Final Report. Prepared for Leicester City Council by Low Emission Strategies Ltd and Mint Green Sustainability, February 2016.
[4] Rtp_fleet_projection_NAEI_2015_Base 2016 v4.0_Final. NAEI Ref: ED62553001. Prepared for NAEI by Ricardo Energy & Environment, December 2017.
[5] http://www.basemap.co.uk/highwaysanalyst/
[6] The Effects of Smarter Choice Programmes in the Sustainable Travel Towns: Research Report to the Department for Transport. Sloman L, Cairns S, Newson C, Anable J, Pridmore A & Goodwin P, 2010.

	eroded by suppressed demand taking up some of the road space freed up by other people changing their behaviour. Nevertheless, evaluation of the three DfT 'Sustainable Travel Towns' suggested that mode shift could result in traffic reductions ranging from 0.2% to 5.3%. Inner city locations tend to show larger impacts than outer locations.	This showed traffic reduction of between 2.4% and 3.2%.[7] In line with this conservative approach, it was predicted that average daily traffic speeds would stay the same as in the baseline scenario.
Bus lanes and priority: - This covers the planned Groby Road and Narborough Road bus priority corridors.	It was assumed that these schemes would have a traffic reduction impact (due to modal switch away from the car towards bus use) from 2019 onwards. Any direct traffic reduction on the two corridors themselves would lead to a diluted effect on Vaughan Way and St Matthews Way, but would be unlikely to have a significant effect on Soar Valley Way.	In forecasting impacts on traffic volumes (AADT), it was estimated that the bus lanes and priority measures would reduce traffic flows on the inner city links (Vaughan Way and St Matthews Way) by 1.5% from 2019 onwards. This estimate aligns with the 2014 'Lestair' study[8] that underpins Leicester's Air Quality Action Plan. It was predicted that average daily traffic speeds would remain the same as in the baseline scenario.
Bus Clean Air Zone: - This concerns the agreement with bus operators to achieve at least Euro VI emission standards on the Leicester fleet by the end of 2019.	There is some evidence that newer buses would help encourage more bus use if introduced as part of a package of quality measures. However, newer buses on their own would be unlikely to have a significant traffic reduction impact.	It was assumed that this measure would have no direct impact on traffic volumes or average speeds on the targeted links, with the air quality benefit coming from improved emission characteristics of buses rather than traffic reduction.
Electric vehicles: - This included the adoption of electric vehicles in place of diesel vehicles within the Council fleet and provision of electric vehicle charging points around the city.	Switching to electric vehicles within the LCC fleet or promoting electric vehicles through charger point provision would be unlikely to affect traffic volumes or speeds. However, electric car	The additional electric cars resulting from their adoption within the LCC fleet were assumed to all get used daily, with one quarter assumed to use the inner city links once each day and 10% assumed to

[7] The Effects of Smarter Choice Programmes in the Sustainable Travel Towns: Research Report to the Department for Transport, Chapter 17. Sloman L, Cairns S, Newson C, Anable J, Pridmore A & Goodwin P, 2010.

[8] LestAir Technical Paper 3 - Emissions screening assessment of the long list of measures. Report to Leicester City Council. Ricardo AEA, February 2014.

	traffic levels would be likely to rise, with a corresponding fall in diesel car use in particular.	use the outer ring road link once each day. The proportion of car travel undertaken by electric cars on Vaughan Way and St Matthews Way was adjusted upwards in line with these numbers, and the proportion undertaken by diesel cars adjusted correspondingly downwards.

Shortlisted new measures

Enhanced behavioural change programme targeting users of the three road links

In assessing the traffic impacts of an enhanced behavioural change programme, it was estimated that an enhanced programme would achieve an additional 50% on top of the estimated car traffic reduction impact from the existing behavioural change programme and sustainable transport infrastructure investment[9]. This would represent a 1.2% reduction in car traffic on top of the impact of the ongoing measures. For LGV traffic which has not really been targeted to date, it was estimated that the enhanced programme would achieve the full 2.4% reduction, while a smaller (0.5%) reduction was assumed for heavy goods vehicle traffic.

As with other measures, it was conservatively estimated that the traffic reduction would not produce a noticeable change in average vehicle speeds.

A more detailed description of this measure is in Annex A.

Taxi Clean Air Zone

With the Taxi Clean Air Zone (CAZ) measure, this was forecast to have no impact on traffic flows or speeds. The air quality benefit of this measure would come from reducing emission rates, which was captured in the emission impact modelling described later in this part of the report.

Smarter parking charging including raised parking charges and, potentially, links to emission standards

Using parking charges to deter polluting traffic could potentially take many forms, including differential parking charges with premiums for high emission cars and discounts for low emission cars. For the traffic impact assessment, it was assumed that a differential tariff (with discounts and premiums) would be applied in all central Leicester City Council controlled parking facilities both on-street and off-street. It was assumed that this would result in an overall average rise of 20% initially (although this would gradually reduce as people responded by changing to lower-emission vehicles). Estimates that were input to the spreadsheet model in order to assess the likely impact on traffic volumes were as follows:

- Output from a Leicester and Leicestershire Integrated Transport Model (LLITM) 'do minimum' model run was used to determine the proportion of trips made on each targeted road link that had a destination in the central Leicester area where differential parking charges would apply. This showed that 24.3%, 24.8% and 1.7% of traffic on Vaughan Way, St Matthews Way and Soar Valley Way respectively resulted from trips being made into that area.

[9] The rationale for estimating half the previous impact is that car users have already been targeted to some extent by the current behavioural change programme, so achieving further behavioural change would be more difficult.

- For those trips with destinations in central Leicester, Leicester City Council data gave estimates that 25% of parking would be in private parking, with the remaining 75% split between Leicester City Council controlled parking (21.8%) and commercial (e.g. NCP and other private sector operators) parking (53.2%).
- Evidence on elasticity of demand from various studies around the world was reviewed. A good summary of relevant evidence is shown in Table 4-2, taken from a recent Masters thesis[10]. This suggests that -0.4 is a widely used figure in parking planning. This was applied to the 20% overall initial price rise figure for the affected proportion of private car traffic to calculate an overall impact on private car traffic levels on Vaughan Way, St Matthews Way and Soar Valley Way.

Table 4-2: Overview of parking price elasticity studies (taken from E Bijl Masters Thesis)

Study	Price Elasticity
Gillen (1978)	-0,78
Kanafani and Lan (1988)	-0,3 to -3
Henshes and King (2001)	-0,47 to -1,02
Hess (2001)	-0,02 to -0,44
Vaca and Kuzmyak (2005)	-0,1 to -0,6
Albert and Mahalel (2006)	-1,20
Kelly and Clinch (2009)	-0,29
Simicevic et al (2012)	-0,34 to -0,50
Kobus et al (2013)	-2,2 to -5,5
Pierce and Shoup (2013)	-0,53 to -0,21
Zhang (2014)	-0,17 to -0,29
Hoss (2014)	-0,31 to -0,37

Diesel to LPG conversions in council fleet

For impact assessment purposes, it was assumed that 100 light goods vehicles (LGVs) would undergo diesel to LPG conversion within the council fleet. 50 would be operational by the end of 2018, with the full 100 operational by the end of 2019. While this was forecast to have no impact on overall traffic flows or speeds on the targeted links, diesel-powered LGV traffic flow would reduce and cleaner LPG-powered LGV traffic flow would correspondingly increase. As with assessment of the introduction of electric vehicles within the LCC fleet (see Table 4-1), all converted vehicles were assumed to get used daily, with one quarter assumed to use the inner city links once each day and 10% assumed to use the outer ring road link once each day.

Results

The traffic impact assessment results are presented in Tables 4-3, 4-4 and 4-5 for 2018, 2019, and 2020 respectively. These show, relative to a baseline forecast, the estimated traffic impacts of:

- Existing and planned / committed (ongoing) measures
- The four additional potential measures, individually, on top of the ongoing measures
- The four additional potential measures, implemented together, on top of the ongoing measures

These outputs were utilised as inputs to emissions and air quality impact modelling, as described in the following sections.

[10] The price elasticity of demand for parking: a case study of Hoorn, The Netherlands. Edgar Bijl, Masters Thesis, Erasmus University, Rotterdam, 2015.

Table 4-3: Traffic impact assessment results for 2018

	2018			Potential new measures									
	Baseline forecast		Baseline + ongoing measures	Ongoing + enhanced behavioural change programme		Ongoing + taxi CAZ		Ongoing + smarter parking charges		Ongoing + LPG conversions in council fleet		Ongoing + all new measures	
Vaughan Way	AADT	Ave speed (km/hr)	AADT	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline
Total (AADT)	68292	31	66783	65935	-2357	66783	-1509	66550	-1742	66783	-1509	65705	-2587
Motorbike	413	31	413	413	0	413	0	411	-2	413	0	411	-2
Car diesel	25199	31	24590	24295	-904	24590	-609	24486	-713	24590	-609	24193	-1007
Taxi (HC & PHV)	2960	31	2960	2925	-36	2960	0	2960	0	2960	0	2925	-36
Car petrol	30946	31	30203	29841	-1105	30203	-743	30075	-870	30203	-743	29714	-1231
Car electric	100	31	100	99	-1	100	0	100	0	100	0	99	-1
LGV/van	6561	31	6404	6250	-311	6404	-157	6404	-157	6404	-157	6250	-311
HGV rigid	910	31	910	910	0	910	0	910	0	910	0	910	0
HGV artic	195	31	195	195	0	195	0	195	0	195	0	195	0
Bus / coach	1008	31	1008	1008	0	1008	0	1008	0	1008	0	1008	0
LGV/van LPG	0	31	0	0	0	0	0	0	0	0	0	0	0

	2018			Potential new measures									
	Baseline forecast		Baseline + ongoing measures	Ongoing + enhanced behavioural change programme		Ongoing + taxi CAZ		Ongoing + smarter parking charges		Ongoing + LPG conversions in council fleet		Ongoing + all new measures	
St Matthews Way	AADT	Ave speed (km/hr)	AADT	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline
Total (AADT)	41601	31	40676	40142	-1459	40676	-925	40536	-1065	40676	-925	40004	-1597
Motorbike	233	31	233	233	0	233	0	232	-1	233	0	232	-1
Car diesel	14871	31	14512	14338	-533	14512	-359	14449	-422	14512	-359	14276	-595
Taxi (HC & PHV)	1747	31	1747	1726	-21	1747	0	1747	0	1747	0	1726	-21
Car petrol	18263	31	17824	17610	-652	17824	-438	17747	-515	17824	-438	17534	-728
Car electric	59	31	59	59	-1	59	0	59	0	59	0	59	-1
LGV/van	5300	31	5173	5049	-251	5173	-127	5173	-127	5173	-127	5049	-251
HGV rigid	776	31	776	776	0	776	0	776	0	776	0	776	0
HGV artic	216	31	216	216	0	216	0	216	0	216	0	216	0
Bus / coach	136	31	136	136	0	136	0	136	0	136	0	136	0
LGV/van LPG	0	31	0	0	0	0	0	0	0	0	0	0	0

	2018			Potential new measures									
	Baseline forecast		Baseline + ongoing measures	Ongoing + enhanced behavioural change programme		Ongoing + taxi CAZ		Ongoing + smarter parking charges		Ongoing + LPG conversions in council fleet		Ongoing + all new measures	
Soar Valley Way	AADT	Ave speed (km/hr)	AADT	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline
Total (AADT)	51917	31	50772	50110	-1807	50772	-1145	50760	-1157	50772	-1145	50098	-1819
Motorbike	302	31	302	302	0	302	0	302	0	302	0	302	0
Car diesel	18401	31	17958	17742	-659	17958	-444	17952	-449	17958	-444	17737	-664
Taxi (HC & PHV)	2162	31	2162	2136	-26	2162	0	2162	0	2162	0	2136	-26
Car petrol	22597	31	22055	21790	-807	22055	-542	22048	-549	22055	-542	21784	-813
Car electric	73	31	73	72	-1	73	0	73	0	73	0	72	-1
LGV/van	6626	31	6467	6312	-314	6467	-159	6467	-159	6467	-159	6312	-314
HGV rigid	1039	31	1039	1039	0	1039	0	1039	0	1039	0	1039	0
HGV artic	528	31	528	528	0	528	0	528	0	528	0	528	0
Bus / coach	188	31	188	188	0	188	0	188	0	188	0	188	0
LGV/van LPG	0	31	0	0	0	0	0	0	0	0	0	0	0

Table 4-4: Traffic impact assessment results for 2019

	2019			Potential new measures									
Vaughan Way	Baseline forecast		Baseline + ongoing measures	Ongoing + enhanced behavioural change programme		Ongoing + taxi CAZ		Ongoing + smarter parking charges		Ongoing + LPG conversions in council fleet		Ongoing + all new measures	
	AADT	Ave speed (km/hr)	AADT	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline
Total (AADT)	69589	31	67491	66629	-2960	67491	-2098	67255	-2334	67491	-2098	66396	-3193
Motorbike	416	31	416	416	0	416	0	414	-2	416	0	414	-2
Car diesel	25710	31	24838	24540	-1170	24838	-872	24733	-977	24838	-872	24436	-1274
Taxi (HC & PHV)	3020	31	3020	2984	-36	3020	0	3020	0	3020	0	2984	-36
Car petrol	31573	31	30507	30141	-1432	30507	-1066	30378	-1195	30507	-1066	30013	-1559
Car electric	102	31	101	100	-2	101	-1	101	-1	101	-1	100	-2
LGV/van	6626	31	6467	6312	-314	6467	-159	6467	-159	6454	-172	6299	-327
HGV rigid	917	31	917	912	-5	917	0	917	0	917	0	912	-5
HGV artic	197	31	197	196	-1	197	0	197	0	197	0	196	-1
Bus / coach	1028	31	1028	1028	0	1028	0	1028	0	1028	0	1028	0
LGV/van LPG	0	31	0	0	0	0	0	0	0	13	13	13	13

	2019			Potential new measures									
St Matthews Way	Baseline forecast		Baseline + ongoing measures	Ongoing + enhanced behavioural change programme		Ongoing + taxi CAZ		Ongoing + smarter parking charges		Ongoing + LPG conversions in council fleet		Ongoing + all new measures	
	AADT	Ave speed (km/hr)	AADT	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline
Total (AADT)	42374	31	41101	40557	-1817	41101	-1273	40959	-1415	41102	-1272	40417	-1957
Motorbike	235	31	235	235	0	235	0	234	-1	235	0	234	-1
Car diesel	15173	31	14658	14482	-691	14658	-515	14595	-578	14658	-515	14420	-753
Taxi (HC & PHV)	1782	31	1782	1761	-21	1782	0	1782	0	1782	0	1761	-21
Car petrol	18633	31	18004	17788	-845	18004	-629	17926	-707	18004	-629	17711	-922
Car electric	60	31	60	59	-1	60	-1	60	-1	60	-1	59	-1
LGV/van	5352	31	5224	5099	-254	5224	-128	5224	-128	5211	-141	5086	-266
HGV rigid	782	31	782	778	-4	782	0	782	0	782	0	778	-4
HGV artic	218	31	218	217	-1	218	0	218	0	218	0	217	-1
Bus / coach	139	31	139	139	0	139	0	139	0	139	0	139	0
LGV/van LPG	0	31	0	0	0	0	0	0	0	13	13	13	13

	2019			Potential new measures									
Soar Valley Way	Baseline forecast		Baseline + ongoing measures	Ongoing + enhanced behavioural change programme		Ongoing + taxi CAZ		Ongoing + smarter parking charges		Ongoing + LPG conversions in council fleet		Ongoing + all new measures	
	AADT	Ave speed (km/hr)	AADT	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline
Total (AADT)	52877	31	51710	51028	-1849	51710	-1167	51698	-1179	51710	-1167	51017	-1860
Motorbike	305	31	305	305	0	305	0	304	0	305	0	304	0
Car diesel	18774	31	18321	18102	-672	18321	-452	18316	-458	18321	-452	18096	-678
Taxi (HC & PHV)	2205	31	2205	2179	-26	2205	0	2205	0	2205	0	2179	-26
Car petrol	23055	31	22502	22232	-823	22502	-553	22495	-560	22502	-553	22225	-830
Car electric	75	31	74	73	-1	74	0	74	0	74	0	73	-1
LGV/van	6691	31	6530	6374	-317	6530	-161	6530	-161	6526	-165	6369	-322
HGV rigid	1047	31	1047	1042	-5	1047	0	1047	0	1047	0	1042	-5
HGV artic	533	31	533	531	-3	533	0	533	0	533	0	531	-3
Bus / coach	192	31	192	192	0	192	0	192	0	192	0	192	0
LGV/van LPG	0	31	0	0	0	0	0	0	0	5	5	5	5

Table 4-5: Traffic impact assessment results for 2020

	2020			Potential new measures									
	Baseline forecast		Baseline + ongoing measures	Ongoing + enhanced behavioural change programme		Ongoing + taxi CAZ		Ongoing + smarter parking charges		Ongoing + LPG conversions in council fleet		Ongoing + all new measures	
Vaughan Way	AADT	Ave speed (km/hr)	AADT	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline
Total (AADT)	70886	31	68748	67870	-3016	68748	-2138	68507	-2379	68748	-2138	67633	-3253
Motorbike	419	31	419	419	7	419	7	418	-2	419	0	418	5
Car diesel	26220	31	25331	25027	-172	25331	132	25224	-996	25331	-889	24921	-278
Taxi (HC & PHV)	3080	31	3080	3043	83	3080	120	3080	0	3080	0	3043	83
Car petrol	32200	31	31113	30739	-206	31113	167	30981	-1219	31113	-1087	30609	-336
Car electric	104	31	103	102	1	103	3	103	-1	103	-1	102	1
LGV/van	6691	31	6530	6373	-188	6530	-31	6530	-161	6506	-185	6349	-212
HGV rigid	924	31	924	919	9	924	14	924	0	924	0	919	9
HGV artic	198	31	198	197	3	198	4	198	0	198	0	197	3
Bus / coach	1049	31	1049	1049	41	1049	41	1049	0	1049	0	1049	41
LGV/van LPG	0	31	0	0	0	0	0	0	0	25	25	25	25

	2020			Potential new measures									
	Baseline forecast		Baseline + ongoing measures	Ongoing + enhanced behavioural change programme		Ongoing + taxi CAZ		Ongoing + smarter parking charges		Ongoing + LPG conversions in council fleet		Ongoing + all new measures	
St Matthews Way	AADT	Ave speed (km/hr)	AADT	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline
Total (AADT)	43147	31	41850	41296	-1851	41850	-1297	41705	-1442	41851	-1296	41154	-1993
Motorbike	237	31	237	237	4	237	4	236	-1	237	0	236	3
Car diesel	15474	31	14949	14770	-101	14949	78	14885	-589	14949	-525	14706	-165
Taxi (HC & PHV)	1818	31	1818	1796	49	1818	71	1818	0	1818	0	1796	49
Car petrol	19003	31	18361	18141	-122	18361	99	18282	-721	18361	-642	18063	-200
Car electric	62	31	61	60	1	61	2	61	-1	61	-1	60	1
LGV/van	5405	31	5275	5148	-152	5275	-25	5275	-130	5251	-154	5125	-176
HGV rigid	787	31	787	784	8	787	12	787	0	787	0	784	8
HGV artic	220	31	220	219	3	220	4	220	0	220	0	219	3
Bus / coach	142	31	142	142	6	142	6	142	0	142	0	142	6
LGV/van LPG	0	31	0	0	0	0	0	0	0	25	25	25	25

	2020			Potential new measures									
	Baseline forecast		Baseline + ongoing measures	Ongoing + enhanced behavioural change programme		Ongoing + taxi CAZ		Ongoing + smarter parking charges		Ongoing + LPG conversions in council fleet		Ongoing + all new measures	
Soar Valley Way	AADT	Ave speed (km/hr)	AADT	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline	AADT	Change v baseline
Total (AADT)	53838	31	52649	51956	-1882	52649	-1189	52637	-1201	52649	-1189	51944	-1894
Motorbike	307	31	307	307	5	307	5	307	0	307	0	307	5
Car diesel	19147	31	18685	18461	60	18685	284	18680	-467	18685	-461	18456	55
Taxi (HC & PHV)	2249	31	2249	2222	61	2249	88	2249	0	2249	0	2222	61
Car petrol	23513	31	22949	22673	76	22949	351	22942	-571	22949	-564	22667	69
Car electric	76	31	75	74	1	75	2	75	-1	75	-1	74	1
LGV/van	6756	31	6594	6436	-190	6594	-32	6594	-162	6584	-172	6426	-199
HGV rigid	1055	31	1055	1050	11	1055	16	1055	0	1055	0	1050	11
HGV artic	538	31	538	536	7	538	10	538	0	538	0	536	7
Bus / coach	195	31	195	195	8	195	8	195	0	195	0	195	8
LGV/van LPG	0	31	0	0	0	0	0	0	0	10	10	10	10

Emissions and air quality impacts

Approach

The predicted emissions and air quality impacts of existing and committed ongoing measures and of the shortlisted potential new measures on the three non-compliant road links were assessed. This was completed using the above predicted traffic data in conjunction with the Emission Factors

Toolkit (EFT) to produce estimates of the total annual NOx emissions for each link for the seven previously outlined scenarios (including baseline). As outlined in JAQU's guidance, these emission estimates were then submitted to JAQU who used the Stream Lined PCM (SLPCM) model to determine NO_2 concentrations.

Results

Baseline

Emissions were calculated for the baseline scenario (without any measures) to enable a direct comparison with the following six scenarios to determine the potential for emission reductions.

- Ongoing measures;
- Enhanced behavioural change programme;
- Taxi Clean Air Zone;
- Differential parking charges;
- Diesel to LPG conversions in council fleet; and
- All measures.

No information on Euro standards was available, so the default composition in the EFT was used for the baseline scenario.

The predicted emissions for each link for the baseline scenario is outlined below in Table 4-6. These were converted into annual mean NO_2 concentrations by JAQU using the SLPCM model as outlined in Table 4-7. These predicted baseline annual mean NO_2 concentrations are in accordance with those shown in Table 1-1 at the start of this report.

Table 4-6: Baseline Annual Emissions

Link	PCM Link ID	NOx Annual Emissions (kg/yr)		
		2018	2019	2020
A594 Vaughan Way	48489	5361	5040	4668
A594 St Matthews Way	36524	5763	5429	5059
A563 Soar Valley Way	73725	2489	2339	2180

Table 4-7: Estimated Baseline NO_2 Concentrations

Link	PCM Link ID	Annual Mean NO_2 Concentrations ($\mu g/m^3$)		
		2018	2019	2020
A594 Vaughan Way	48489	43.62	42.02	40.04
A594 St Matthews Way	36524	42.60	41.12	39.37
A563 Soar Valley Way	73725	41.60	39.92	37.94

Ongoing measures

The EFT was used to determine the impacts on emissions based on the predicted traffic data for the four existing and proposed measures as outlined in Table 4-1. No information on Euro standards was available, so the default composition in the EFT was used, with the exception of buses. Leicester City Council propose to achieve a bus fleet composition of 70% Euro VI and 30% Euro V in 2020. As such, the Euro classes for buses were adjusted in the 2020 scenario accordingly.

The predicted emissions for each link with the implementation of the committed measures are outlined below in Table 4-8. The differences relative to the baseline situation are shown in brackets in this table.

Table 4-8: Ongoing Measures Annual Emissions

Link	PCM Link ID	NOx Annual Emissions (kg/yr)		
		2018	2019	2020
A594 Vaughan Way	48489	5262 (-99)	4920 (-120)	4502 (-166)
A594 St Matthews Way	36524	5645 (-117)	5290 (-140)	4914 (-145)
A563 Soar Valley Way	73725	2440 (-48)	2293 (-46)	2129 (-51)

The predicted emissions for the committed measures for each link were converted into annual mean NO2 concentrations by JAQU using the SLPCM model as outlined in Table 4-9. Again, the difference relative to the baseline situation is provided in brackets.

Whilst the predicted annual mean NO_2 concentrations for the committed measures all show an improvement in air quality concentrations in comparison to the baseline, on their own these would not result in compliance being brought forward by a year for any of the targeted links.

Table 4-9: Estimated Ongoing Measures NO_2 Concentrations

Link	PCM Link ID	Annual Mean NO_2 Concentrations ($\mu g/m^3$)		
		2018	2019	2020
A594 Vaughan Way	48489	43.11 (-0.51)	41.40 (-0.62)	39.17 (-0.87)
A594 St Matthews Way	36524	42.14 (-0.47)	40.56 (-0.56)	38.78 (-0.59)
A563 Soar Valley Way	73725	41.06 (-0.54)	39.40 (-0.52)	37.35 (-0.58)

Enhanced behavioural change programme

The EFT was used to determine the impacts on emissions resulting from the enhanced behavioural change programme on top of the ongoing measures. As with previous options, no information on Euro standards was available, so the default composition in the EFT was used, with

the exception of buses in 2020 as outlined above.

The predicted emissions for each link with the implementation of the enhanced behaviour change programme, together with the ongoing measures, are outlined below in Table 4-10.

Table 4-10: Enhanced Behavioural Change Programme Annual Emissions

Link	PCM Link ID	NOx Annual Emissions (kg/yr)		
		2018	2019	2020
A594 Vaughan Way	48489	5201 (-160)	4858 (-182)	4444 (-224)
A594 St Matthews Way	36524	5571 (-191)	5212 (-217)	4842 (-217)
A563 Soar Valley Way	73725	2407 (-81)	2260 (-79)	2098 (-82)

Difference relative to the baseline provided in brackets

The predicted emissions for the enhanced behaviour change programme for each link were converted into annual mean NO_2 concentrations by JAQU using the SLPCM model. The results are shown in Table 4-11, with the difference relative to the baseline provided in brackets.

The predicted annual mean NO_2 concentrations for the enhanced behavioural change programme all show an improvement in air quality concentrations in comparison to the baseline along all three links. Importantly, the date of compliance on St Matthews Way is predicted to be brought forward by one year from 2020 to 2019 with the implementation of the enhanced behavioural change programme measure on top of the ongoing measures.

Table 4-11: Estimated Enhanced Behavioural Change Programme NO_2 Concentrations

Link	PCM Link ID	Annual Mean NO_2 Concentrations ($\mu g/m^3$)		
		2018	2019	2020
A594 Vaughan Way	48489	42.80 (-0.82)	41.08 (-0.77)	38.86 (-0.91)
A594 St Matthews Way	36524	41.84 (-0.94)	40.25 (-0.88)	38.49 (-0.89)
A563 Soar Valley Way	73725	40.69 (-1.17)	39.03 (-0.88)	37.00 (-0.94)

Taxi Clean Air Zone

The EFT was used to determine the impacts on emissions resulting from the introduction of a Taxi Clean Air Zone in Leicester. As the traffic data indicated that this measure would have no impact on traffic levels or speeds, the Euro standards within the EFT were reviewed to account for improvements in the taxi fleet. Under this option, Leicester City Council would envisage implementing a measure to ensure that from 2019 all taxis will be Euro 5 or higher. As such, it was considered that from 2019 all taxis would be Euro standard 5 or higher. The EFT default Euro classes for 2018 were used and the default EFT Euro classes above Euro 5 were used for 2019 and 2020, to ensure the proposals are not less ambitions than the default. The Euro classes used for each year are outlined below in Table 4-12.

Table 4-12: Taxi Euro Classes

Euro 3	Euro 4	Euro 5	Euro 6	Euro 6c	Euro 6d
2018					
0.04	0.16	0.35	0.20	0.25	0.00
2019					
0.00	0.00	0.45	0.20	0.35	0.00
2020					
0.00	0.00	0.38	0.18	0.33	0.11

No information on Euro standards for the rest of the traffic fleet was available, so the default composition in the EFT was used, with the exception of buses in 2020 as previously outlined.

The predicted emissions for each link with the implementation of the Taxi Clean Air Zone, together with the ongoing measures, are shown in Table 4-13. The differences in emissions relative to the baseline are shown in brackets.

Table 4-13: Taxi Clean Air Zone Annual Emissions

Link	PCM Link ID	NOx Annual Emissions (kg/yr)		
		2018	2019	2020
A594 Vaughan Way	48489	5262 (-99)	4919 (-122)	4500 (-169)
A594 St Matthews Way	36524	5645 (-117)	5289 (-141)	4913 (-147)
A563 Soar Valley Way	73725	2440 (-48)	2294 (-45)	2129 (-51)

The predicted emissions from the introduction of a Taxi Clean Air Zone for each link were converted into annual mean NO_2 concentrations by JAQU using the SLPCM model. These are shown in Table 4-14, with differences from the baseline situation shown in brackets.

Whilst overall the predicted annual mean NO_2 concentrations for the Taxi Clean Air Zone show an improvement in comparison to the baseline, these would not result in bringing compliance forward by a year for any of the links.

Table 4-14: Estimated Taxi Clean Air Zone NO_2 Concentrations

Link	PCM Link ID	Annual Mean NO_2 Concentrations (µg/m^3)		
		2018	2019	2020
A594 Vaughan Way	48489	43.11 (-0.51)	41.39 (-0.63)	39.15 (-0.88)
A594 St Matthews Way	36524	42.14 (-0.47)	40.55 (-0.57)	38.77 (-0.59)
A563 Soar Valley Way	73725	41.06 (-0.54)	39.41 (-0.51)	37.36 (-0.58)

Differential parking charges

The EFT was used to determine the impacts on emissions resulting from the implementation of increased parking charges based on the traffic composition changes detailed within the Traffic Impacts section, together with the committed measures. The default traffic composition in the EFT was used, with the exception of buses in 2020 as outlined earlier.

The predicted emissions for each link with the implementation of differential parking charges, together with the ongoing measures, is outlined below in Table 4-15. Differences relative to the baseline situation are shown in brackets.

Table 4-15: Differential Parking Charges Annual Emissions

Link	PCM Link ID	NOx Annual Emissions (kg/yr)		
		2018	2019	2020
A594 Vaughan Way	48489	5252 (-108)	4907 (-133)	4490 (-179)
A594 St Matthews Way	36524	5635 (-127)	5276 (-153)	4903 (-156)
A563 Soar Valley Way	73725	2440 (-49)	2292 (-47)	2129 (-51)

The predicted emissions from the implementation of differential parking charges for each link were converted into annual mean NO_2 concentrations by JAQU using the SLPCM model. The results are outlined in Table 4-16. Whilst overall the predicted annual mean NO_2 concentrations for the differential parking charges show an improvement in in comparison to the baseline, these would not result in bringing compliance forward by a year for any of the links.

Table 4-16: Estimated Differential Parking Charges NO_2 Concentrations

Link	PCM Link ID	Annual Mean NO_2 Concentrations (µg/m^3)		
		2018	2019	2020
A594 Vaughan Way	48489	43.07 (-0.55)	41.33 (-0.51)	39.10 (-0.55)
A594 St Matthews Way	36524	42.09 (-0.69)	40.51 (-0.62)	38.73 (-0.53)
A563 Soar Valley Way	73725	41.05 (-0.94)	39.39 (-0.63)	37.35 (-0.58)

Diesel to LPG Conversions in Council Fleet

The EFT was used to determine the impacts on emissions resulting from the retrofit of part of the Council fleet LGVs to LPG in 2019 and 2020. No information on Euro standards was available, so the default composition in the EFT was used, with the exception of buses in 2020 as outlined earlier.

The predicted emissions for each link with the retrofit of the part of the Council LDV fleet, together with the ongoing measures, is outlined below in Table 4-17. As with previous tables, differences relative to the baseline situation are shown in brackets.

Table 4-17: LPG Conversions Annual Emissions

Link	PCM Link ID	NOx Annual Emissions (kg/yr)		
		2018	2019	2020
A594 Vaughan Way	48489	5262 (-99)	4918 (-122)	4499 (-169)
A594 St Matthews Way	36524	5645 (-117)	5286 (-143)	4910 (-149)
A563 Soar Valley Way	73725	2440 (-48)	2293 (-47)	2129 (-52)

The predicted emissions from the implementation of the retrofit of part of the Council LGV fleet to LPG for each link were converted into annual mean NO_2 concentrations by JAQU using the SLPCM model. The results are outlined in Table 4-18, with differences from the baseline situation shown in brackets.

Whilst overall the predicted annual mean NO_2 concentrations for the LPG conversions scenario show an improvement in air quality concentrations in comparison to the baseline, these would not result in bringing compliance forward by a year for any of the links.

Table 4-18: Estimated LPG Conversions NO_2 Concentrations

Link	PCM Link ID	Annual Mean NO_2 Concentrations (µg/m^3)		
		2018	2019	2020
A594 Vaughan Way	48489	43.11 (-0.51)	41.39 (-0.63)	39.15 (-0.88)
A594 St Matthews Way	36524	42.14 (-0.47)	40.54 (-0.58)	38.76 (-0.60)
A563 Soar Valley Way	73725	41.06 (-0.54)	39.39 (-0.53)	37.35 (-0.59)

All Measures

The predicted emissions for each link with the implementation of all the implemented, committed and proposed measures are outlined below in Table 4-19. Differences relative to the baseline situation are provided in brackets.

Table 4-19: All Measures Annual Emissions

Link	PCM Link ID	NOx Annual Emissions (kg/yr)		
		2018	2019	2020
A594 Vaughan Way	48489	5192 (-169)	4841 (-199)	4430 (-239)
A594 St Matthews Way	36524	5555 (-207)	5199 (-231)	4826 (-233)
A563 Soar Valley Way	73725	2407 (-82)	2259 (-80)	2097 (-84)

The predicted emissions from the implementation of all outlined measures for each link were converted into annual mean NO_2 concentrations by JAQU using the SLPCM model, as shown in Table 4-20. Differences relative to the baseline situation are shown in brackets.

Table 4-20: Estimated All Measures NO_2 Concentrations

Link	PCM Link ID	Annual Mean NO_2 Concentrations (µg/m^3)		
		2018	2019	2020
A594 Vaughan Way	48489	42.76 (-0.87)	40.99 (-1.03)	38.79 (-1.25)
A594 St Matthews Way	36524	41.77 (-0.83)	40.19 (-0.93)	38.42 (-0.95)
A563 Soar Valley Way	73725	40.68 (-0.91)	39.01 (-0.91)	36.98 (-0.95)

The predicted annual mean NO_2 concentrations for the All Measures scenario show an

improvement in air quality concentrations in comparison to the baseline for all three links. In addition St Matthews Way is predicted to achieve an earlier year of compliance, from 2020 to 2019, with the implementation of all proposed measures.

Part 5: Setting out a preferred option

Conclusions on air quality compliance (Primary Success Factor)

The results of air quality impact assessment of all the shortlisted potential options (as reported in Part 4) are summarised in Table 5-1 below. These should be viewed in the context that 40 µg/m^3 is the annual mean limit value. In line with advice from JAQU, in determining compliance it is understood that values may be rounded to the nearest integer.

Table 5-1: Predicted annual mean roadside NO2 concentrations (all values are in µg/m^3)

	Baseline	Existing & Committed (Ongoing) Measures	Ongoing + enhanced behavioural change programme	Ongoing + taxi CAZ	Ongoing + smarter differential parking charges	Ongoing + LPG conversions in council fleet	Ongoing + all new measures
2018							
St Matthews Way	42.60	42.14	41.84	42.14	42.09	42.14	41.77
Vaughan Way	43.62	43.11	42.80	43.11	43.07	43.11	42.76
Soar Valley Way	41.60	41.06	40.69	41.06	41.05	41.06	40.68
2019							
St Matthews Way	41.12	40.56	40.25	40.55	40.51	40.54	40.19
Vaughan Way	42.02	41.40	41.08	41.39	41.33	41.39	40.99
Soar Valley Way	39.92	39.40	39.03	39.41	39.39	39.39	39.01
2020							
St Matthews Way	39.37	38.78	38.49	38.77	38.73	38.76	38.42
Vaughan Way	40.04	39.17	38.86	39.15	39.10	39.15	38.79
Soar Valley Way	37.94	37.35	37.00	37.36	37.35	37.35	36.98

Our conclusions related to air quality compliance alone are:

- JAQU's modelling predicts that all three links will be compliant by 2020 or earlier under a baseline scenario. Leicester's local air quality monitoring suggests that achieving compliance on Vaughan Way and Soar Valley Way by this date may be challenging given current measurements and trends (as noted in Part 1). There is therefore some uncertainty surrounding predicted compliance dates, which suggests that Leicester City Council should do as much as is affordable as soon as possible to reduce the risk of continued non-compliance.
- Ongoing measures that have been implemented since 2015 in Leicester or that the council is committed to implement should help meet the annual mean NO_2 limit value somewhat quicker than predicted by JAQU under its baseline scenario. However, these will not bring compliance forward by a whole year or more.
- A significant, targeted enhanced behavioural change programme implemented as soon as possible on top of the ongoing measures and continued over the next two years would be likely to bring NO_2 compliance on St Matthews Way (link 36524) forward by a year to 2019 and would improve air quality on the other two links.
- The three other potential measures examined (taxi CAZ, differential parking charging,

and diesel-to-LPG conversions within the council fleet) would each have a positive impact on concentrations along the three targeted road links. While they would each individually not bring compliance forward by a whole year or more, taken together with the enhanced behavioural change programme they would increase the probability of achieving compliance on all three targeted links by the forecast dates. This is important in the context of the uncertainty surrounding modelling forecasts.

- It would also be worth undertaking further work on medium term measures for Vaughan Way and Soar Valley Way. In particular, work undertaken in this study suggested that a project to investigate and test the potential for using urban traffic control in new ways to minimise emissions on the targeted links would be valuable.

Secondary Critical Success Factors

Secondary Critical Success Factors were examined for the measures where it was concluded that, on air quality grounds alone, implementation should be pursued. The results of this process are set out in Table 5-2.

Table 5-2: Secondary Critical Success Factors

Factor	Measure	Assessment
Affordability	Enhanced behavioural change programme	The budgetary estimate for a significant, targeted enhanced behavioural change programme over a two year period is £600,000. Leicester City Council does not have this available at present, so would require additional funding from central Government to implement this measure.
	Taxi Clean Air Zone	The Taxi Clean Air Zone would use licensing conditions to achieve a low emission taxi fleet composition. The City Council has applied for ERDF funding to cover the estimated cost of £2.8m required for a grant fund to assist taxi operators make the transition to low emission vehicles. Should the ERDF bid be unsuccessful, Government funding would be required for the grant fund.
	Differential parking charges	Implementation of differential parking charges could be done at a relatively low marginal cost, but there would need to be additional systems for parking officers to be able to carry out real-time checks on the Euro standards of parked vehicles. The estimated capital cost of this would be £200,000. This is not allowed for in the LCC budget, and would need to be covered by additional Government funding.
	Diesel-to-LPG conversions in the council fleet	Diesel-to-LPG conversions are estimated to cost around £10,000 per vehicle. A 100-vehicle conversion programme would therefore cost £1m. This cost would need to be met from Government funds.
Value for money	Enhanced behavioural change programme	Estimated value for money would be very high. Overall evaluations of behavioural change programmes in the UK and elsewhere have shown overall high or very high benefit/cost ratios in nearly all cases.

	Taxi Clean Air Zone	Estimated value for money would be medium. As well as air quality benefits, there would be carbon savings (particularly from replacing some of the oldest vehicles) to set against the relatively high cost of the grant fund.
	Differential parking charges	Estimated value for money would be high.
	Diesel-to-LPG conversions in the council fleet	Estimated value for money would be medium, given the relatively high cost.
Distributional impacts	Enhanced behavioural change programme	There would be no disproportionate impact on any particular group, since behavioural change programmes influence behaviour through persuasion and incentives rather than through regulation or pricing.
	Taxi Clean Air Zone	Providing the grant fund for taxi operators would help ensure that there were no significant negative distributional impacts, with poorer operators able to upgrade vehicles on the same basis as those with more resources.
	Differential parking charges	Differential parking charges could potentially be seen as more likely to affect poorer people with older vehicles. However, information would be provided to help people trade in vehicles for those of a similar age but with better emission characteristics, which would help minimise any negative impacts. Any negative impacts would also be offset by air quality benefits, which may tend to affect poorer communities who live near busy roads.
	Diesel-to-LPG conversions in the council fleet	There would be no disproportionate impact on any particular group.
Strategic fit	Enhanced behavioural change programme	There would be an excellent fit with the wider policies and strategies of the council, which aim to get more people using active and low emission modes of transport instead of the private car because of the environmental, health and economic benefits of doing so. Local policy aims also include reducing carbon emissions as well as delivering Healthier Air for Leicester through the Air Quality Action Plan.
	Taxi Clean Air Zone	There would be an excellent fit with the wider policies and strategies of the council that include reducing carbon emissions as well as delivering Healthier Air for Leicester through the Air Quality Action Plan.

	Differential parking charges	There would be an excellent fit with the wider policies and strategies of the council, which aim to get more people using active and low emission modes of transport instead of the private car because of the environmental, health and economic benefits of doing so. Local policy aims also include reducing carbon emissions as well as delivering Healthier Air for Leicester through the Air Quality Action Plan.
	Diesel-to-LPG conversions in the council fleet	There would be an excellent fit with the wider policies and strategies of the council - specifically delivering Healthier Air for Leicester through the Air Quality Action Plan.
Supply side capacity and capability	Enhanced behavioural change programme	There are no concerns over the capability and capacity of suppliers to deliver this measure within the required timeframe.
	Taxi Clean Air Zone	There are no concerns over the capability and capacity of suppliers to deliver this measure within the required timeframe.
	Differential parking charges	There are no concerns over the capability and capacity of suppliers to deliver this measure within the required timeframe.
	Diesel-to-LPG conversions in the council fleet	There are no concerns over the capability and capacity of suppliers to deliver this measure within the required timeframe.
Achievability	Enhanced behavioural change programme	This measure is readily achievable given the management structures and staff resources available. Leicester City Council also has access to a number of call-off frameworks that can be used to provide rapid organisation and delivery of services.
	Taxi Clean Air Zone	This measure is readily achievable given the management structures and staff resources available. Leicester City Council also has access to a number of call-off frameworks that can be used to provide rapid organisation and delivery of services.
	Differential parking charges	This measure is readily achievable given the management structures and staff resources available. Leicester City Council also has access to a number of call-off frameworks that can be used to provide rapid organisation and delivery of services.
	Diesel-to-LPG conversions in	This measure is readily achievable given the management structures and staff resources available. Leicester City Council also has access to a number of call-off frameworks

	the council fleet	that can be used to provide rapid organisation and delivery of services.
Displacement	Enhanced behavioural change programme	The behavioural change programme would be aimed at changing people's mode of travel or frequency of travel rather than re-routing. No unwanted displacement of traffic or the associated air quality problem would therefore be envisaged.
	Taxi Clean Air Zone	No displacement of traffic or the associated air quality problem is anticipated.
	Differential parking charges	No displacement of traffic or the associated air quality problem is anticipated.
	Diesel-to-LPG conversions in the council fleet	No displacement of traffic or the associated air quality problem is anticipated.

The overall preferred option

Taking account of all the work described in this report, of the air quality impact assessment, and of the assessment of the secondary critical success factors, Leicester City Council's overall preferred option for bringing about nitrogen dioxide concentration compliance in the shortest possible timescale is as follows:

- As a first priority, a significant enhanced behavioural change programme should be implemented starting as soon as possible and targeted on users of the three non-compliant links. This would need to be creatively designed and implemented using social marketing campaigns and techniques; provision of information and incentives; and collaborative working with business users of the road links to get them to minimise vehicle usage and use low emission vehicles.

  A two year programme starting as soon as possible would bring forward NO_2 compliance on St Matthews Way (link 36524) by a year to 2019 and would improve air quality on the other two links. Implementation could start as early as September 2018. The estimated cost of such a programme would be £600,000 and anticipated value for money is very high. As noted in the consideration of affordability outlined above, Leicester City Council is not in a financial position to cover the costs of new measures on top of ongoing and committed measures, so its implementation would critically depend on additional funding being made available by Government.

- The probability of achieving compliance on all three targeted links as early as possible would be enhanced by implementing a taxi Clean Air Zone, differential parking charging, and diesel-to-LPG conversions within the council fleet. This is important in the context of the uncertainty surrounding modelling forecasts. However, some of these additional measures are relatively high cost (£2.8m, £200,000, and £1m respectively) and so implementation would be subject to affordability by Government.

- In addition, further investigative work should be undertaken on medium term measures for Vaughan Way and Soar Valley Way in the light of uncertainty surrounding predictions of these coming into compliance by 2020. This should include a project to investigate and test the potential for using urban traffic control in new ways to minimise emissions on the targeted links. This further investigative work would need funding from Government

and would include cooperative working with JAQU (e.g. on further runs of the JAQU PCM model using local data inputs).

Further monitoring data

The Council's local data suggest a greater level of exceedance than the national PCM modelling. For this reason, further local data was submitted to Government for assessment. A monitoring checklist was submitted for Census ID 56464 on the A594. The monitoring site is showing an exceedance of 52ug/m3 in 2017. Using Defra roadside projection factors it is predicted that this link will be in compliance in 2022 with a concentration of 40ug/m^3. Further work will be required to consider if any measures could bring forward compliance on this link.

Table 5-3 summarises the preferred option.

Table 5-3: Summary of preferred option

Road link	PCM identified link?	Summary of exceedance	Measures identified that could bring forward compliance	Costs and timeframe
36524 St Matthews Way	Yes – this link was identified as having an exceedance in the national PCM modelling	The national PCM modelling has projected that this link will be compliant in 2020. Summary of NO_2 concentration projections: • 2018: 43 µg/m^3 • 2019: 41 µg/m^3 • 2020: 39 µg/m^3 • 2021: 38 µg/m^3	We have identified a measure that, on top of ongoing measures, could bring forward compliance on this road link from 2020 to 2019. This is a significant, targeted enhanced behavioural change programme.	Estimated cost of a two year programme is £600,000. The programme could start in September 2018.
48489 Vaughan Way	Yes – this link was identified as having an exceedance in the national PCM modelling	The national PCM modelling has projected that this link will be compliant in 2020. Summary of NO_2 concentration projections: • 2018: 44 µg/m^3 • 2019: 42 µg/m^3 • 2020: 40 µg/m^3 • 2021: 38 µg/m^3 Local air quality monitoring suggests that this forecast may be optimistic.	The behavioural change programme described above would improve air quality on this link but would not bring compliance forward by a whole year.	As above

73725 Soar Valley Way	Yes – this link was identified as having an exceedance in the national PCM modelling	The national PCM modelling has projected that this link will be compliant in 2020. Summary of NO_2 concentration projections: • 2018: 42 µg/m^3 • 2019: 40 µg/m^3 • 2020: 38 µg/m^3 • 2021: 36 µg/m^3 Local air quality monitoring suggests that this forecast may be optimistic.	The behavioural change programme described above would improve air quality on this link but would not bring compliance forward by a whole year.	As above
56364 A594	No – this link was added to the study using local monitoring data	The monitoring site is showing an exceedance of 52ug/m^3 in 2017. Using Defra roadside projection factors it is predicted that this link will be in compliance in 2022 with a concentration of 40ug/$m^{3.}$	Further work is required to consider any measures that could bring forward compliance.	NA

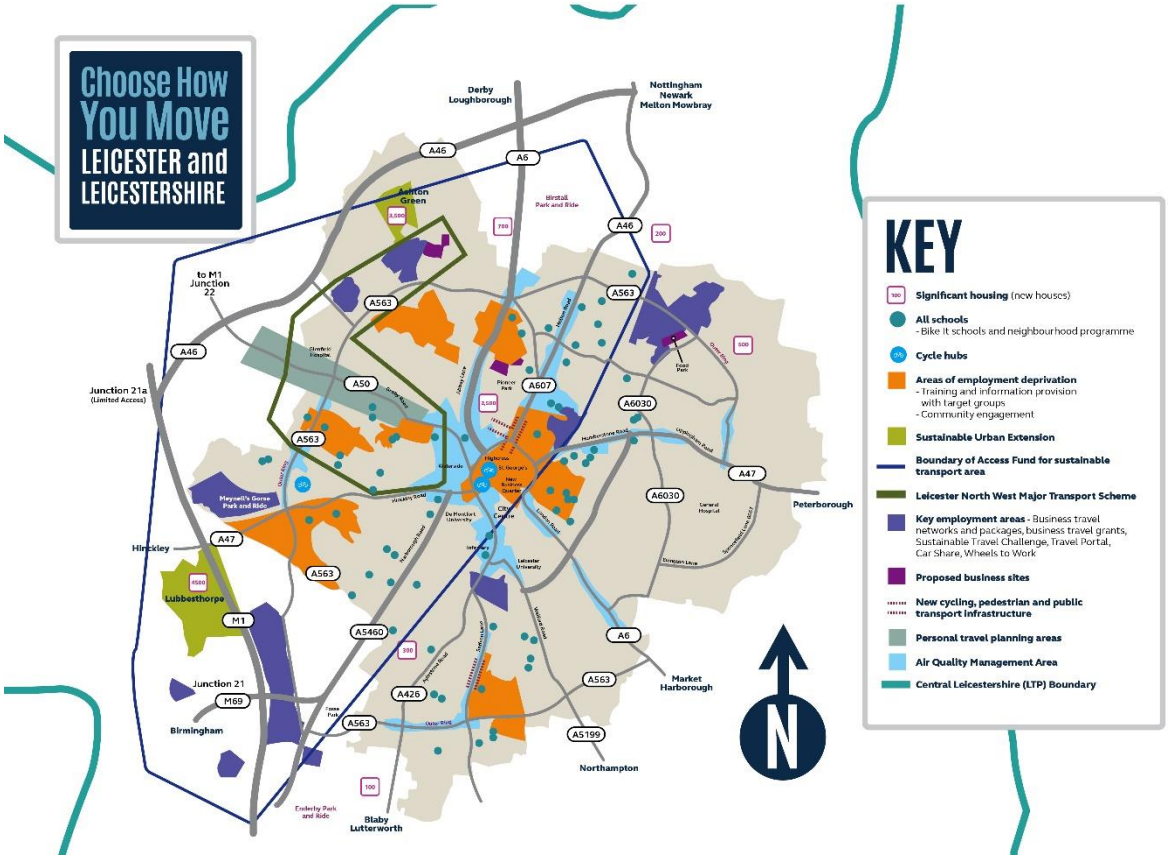
Annex A – Full description of the Enhanced Behavioural Change Programme

Leicester's current behavioural change programme

The Leicester and Leicestershire Choose How You Move (CHYM) travel behaviour change programme started in 2011 and has continued and developed since that time and is still ongoing (see Figure 1). It includes a number of interventions that have targeted achieving modal shift away from the private car for commuting, business travel and travel to school. This includes working with businesses, schools and local people living along key transport corridors. Initial evaluation results have suggested that people engaged by some elements of the programme have made changes away from car use, although the effect on the specific target links identified by JAQU's PCM modelling is not known.

In parallel with the behaviour change programme, infrastructure improvements are taking place in Leicester through the Connecting Leicester programme. In particular, Leicester has become a 'Cycle City' and has invested in improving cycling infrastructure to facilitate increased levels of cycling. This started before 2015 but has continued with ongoing roll-out of cycle lanes, cycle tracks and off-road paths, including in the city centre and on key radial routes. Since the start of 2015 over 2000 metres of cycle way and 2300 metres of public realm have been added.

Figure 1: Choose How You Move



Key objectives of the enhanced behavioural change programme

The enhanced behavioural change programme will build on the work of CHYM, but with very specific new targets. Its specific overall objective will be to reduce NOx emissions from vehicles using the targeted non-compliant road links. To do this, the programme aims to achieve behavioural change by individuals and businesses that use the targeted links. Desirable behavioural changes that will be sought through the programme include:

- Using sustainable means of travel rather than car travel – switching car trips to bus use, walking, cycling or car-sharing
- Making fewer trips – for example, through consolidation of freight loads
- Using 'cleaner' vehicles – avoiding use of older diesel vehicles (where the user has that option)
- Re-routing away from the areas where air quality is worst.
- Avoiding travel at peak periods – since congested conditions generate significantly greater emissions

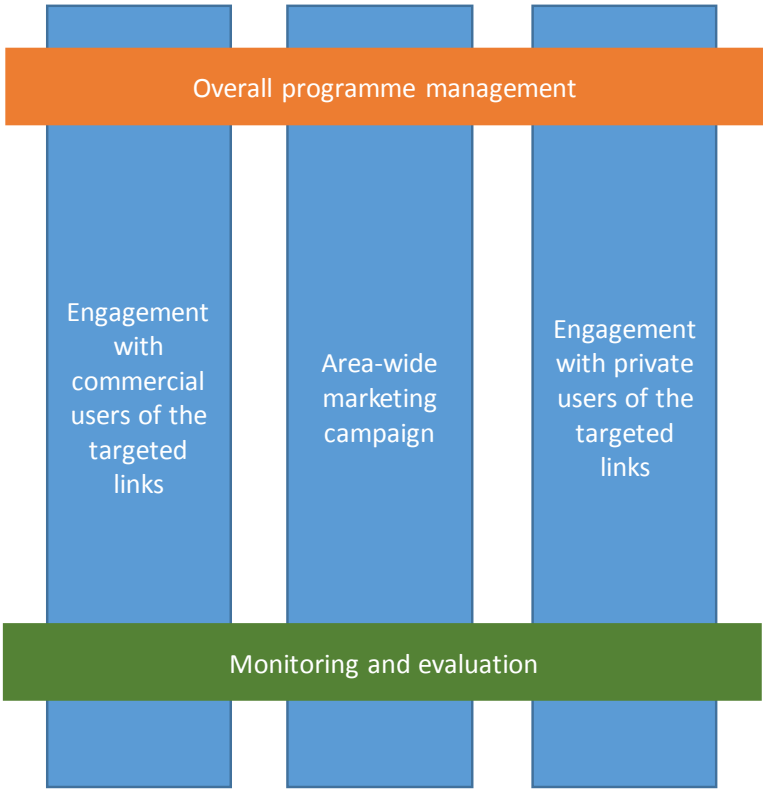
Scope of the enhanced behavioural change programme

The enhanced behavioural change programme will have three main work areas:

- Engagement with commercial users of the targeted links
- An area-wide marketing campaign
- Engagement with private users of the targeted links

These will be complemented by two cross-cutting work strands – programme management; and monitoring and evaluation. The overall structure of the proposed programme is shown in Figure 2. The programme will be implemented over a 2-year timeframe, starting in autumn 2018, and the individual work areas are outlined below.

Figure 2: Proposed programme structure



Engagement with commercial users of the targeted links

The first stage of engagement with commercial users of the targeted road links will involve identifying who those commercial users are. While some may be self-evident (e.g. businesses located in close proximity to the targeted links) others will be harder to immediately identify. We therefore propose to:

- Undertake a series of surveys on the targeted links themselves (either manual or video surveys) to note down business names and contact numbers.
- Work with business groups in Leicester to encourage commercial users to self-identify.

After this initial stage, business engagement will involve:

- One-to-one meetings and discussions with owners or managers of businesses that use the targeted links
- Development of business travel plans
- Provision of grants to help businesses that make regular use of the targeted links to adapt their usage.
- Provision of information packs to help businesses change their behaviour.
- Introduction of the EcoSTARS programme in Leicester to encourage low emission vehicles
- Networking events
- Events for business users that showcase low emission products, tools and behaviours
- 'Clean Air Champion' annual awards ceremonies

Area-wide marketing campaign

The area-wide marketing campaign will be the core of the enhanced behavioural change programme, underpinning the other activities. Using social marketing campaigns is a long-established means of encouraging travel behaviour change[11] and will be particularly important in the context of the Leicester enhanced behavioural change programme. This is because the population of users of the targeted non-compliant links will be widespread across the city and surrounding area. The area-wide marketing campaign will therefore reach out to a broad audience, to complement the more in-depth engagement activities with particular user groups.

The messages to be used within the marketing campaign will focus very much on improving air quality through adjustments in behaviour. These will include messages concerning:

- Improving people's health (including drivers)
- Leicester as an 'environment city'
- Leicester as a cleaner, greener place to live and work

[11] Making Campaigning for Smarter Choices Work – Guidelines for Local Authorities. Department for Transport & TAPESTRY Project, May 2005.

A combination of message channels will be utilised, in order to reach as many users of the targeted links as possible. These may include:

- Use of variable message signs (VMS) on targeted links
- Local radio adverts and editorial coverage
- Local press adverts and editorial coverage
- Local TV adverts and editorial coverage
- Advertising on backs of buses
- Bus stop and street furniture advert displays

Engagement with private users of the targeted links

As with the commercial users, the first stage of engagement with private car users of the targeted links will involve investigating who are the most regular users of those links. A starting point will be to look at the origin and destination zones of traffic using the targeted links from the Leicester and Leicestershire Integrated Transport Model (LLITM). We can then verify that as necessary using automatic number plate recognition (ANPR) surveys.

A series of public engagement activities can then be focussed on geographic areas that form significant origins or destinations for traffic using the links. These may include a combination of:

- Travel clinics (offering sustainable travel advice) at significant destinations (e.g. leisure attractions, shopping centres)
- Personal travel planning advice at a household level in significant trip origin areas
- Engagement events for members of the public in significant trip origin areas
- Enhancing the “Choose How You Move” website to include a new journey planner function showing modal shift alternatives

Programme management

Strong programme management will be required in order to deliver the enhanced behavioural change programme within a short timeframe. Leicester City Council has an excellent record (working with Leicestershire County Council) of behavioural change programme management through Choose How You Move (CHYM), and should be able to ‘hit the ground running’. A specific programme manager for the enhanced behavioural change programme (i.e. separate to the overall CHYM manager) will be identified, and they will call on staff, consultant and other third party support as required to ensure that the demanding delivery schedule is met.

The programme manager will liaise as required with the funding body, and will also coordinate actions with any neighbouring authorities (e.g. Blaby) who may be taking similar actions.

Monitoring and evaluation

Monitoring and evaluation will be a core part of the enhanced behavioural change programme. This will monitor effectiveness of interventions in changing behaviour and in

addressing traffic levels and compositions and (most importantly) air quality. This will therefore include:

- Classified traffic counts and surveys on the targeted links and on alternative routes
- Air quality monitoring adjacent to the targeted links
- Updating the councils existing Airviro air quality modelling with new data and software enhancements
- Monitoring of commercial usage of the links (in conjunction with the operators concerned)
- Monitoring of travel behaviour and attitudes by private car users through surveys linked to the interventions.

Monitoring activities will help the programme manager to steer, refine and fine-tune the delivery programme as it progresses, as well as providing evidence of cost-effectiveness at the end of the programme for future reference.