



London Low Emission Zone Health Impact Assessment Final report - Non-technical summary

Report to Transport for London

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Non technical summary

Background

To improve air quality in London - which is currently among the worst in Europe - the Mayor and Transport for London (TfL) are proposing to designate Greater London as a Low Emission Zone (LEZ). The objectives of the proposed LEZ (commonly referred to as 'the scheme' in this report) are to further the aim of the Mayor's Transport and Air Quality Strategies by:

- Moving London closer to achieving national and EU air quality objectives for 2010
- Improving the health and quality of life of people who live and work in London, through improving air quality

Reducing the negative health impacts through improving air quality in London is the key driver for the introduction of the Low Emission Zone. In order to assess the potential health impacts arising from the possible implementation of the LEZ scheme, TfL has contracted AEA Technology and the Institute of Occupational Medicine (IOM) to undertake a full health impact assessment (HIA) of the proposal. The HIA will be made available during public and stakeholder consultation held between November 2006 and February 2007. This HIA will provide additional information supporting this consultation process.

It is well understood that the introduction of a LEZ could have direct and indirect impacts on health. In particular, the reduction in emissions due to tighter emission standards from vehicles included in the scheme is predicted to lead to improved air quality, and a reduction in associated health impacts.

This report describes the assessment of potential health impacts resulting from the proposed LEZ, summarises the key findings, and makes recommendations to TfL on how benefits can be maximised, how any negative impacts could be reduced, and how the health impacts of the scheme could be monitored.

The health impact assessment process

There is a range of health impacts that might arise from the implementation of the proposed LEZ scheme. A recognised means of assessing health impacts is through the use of an HIA, *a process that uses a range of methods and approaches to help identify and consider the potential – or actual – health and equity impacts of a proposal on a given population.*¹

Health Impacts may include positive health benefits (e.g. a reduction in respiratory illness due to improvements in air quality) or negative impacts (e.g. an increase in stress and anxiety due to loss of employment resulting from increased costs relating

¹ NHS Health Development Agency (2002), *Introducing health impact assessment (HIA): Informing the decision-making process*, Published by NHS HDA, London

to compliance with a LEZ). TfL needs to be able to identify such impacts, and prioritise them in terms of significance. The potential positive health benefits and negative impacts provide one of the key criteria for evaluating whether the scheme should be implemented. In addition, the HIA should enable the scheme to be considered in order to maximise the benefits and minimise any undesirable impacts.

This report provides a set of evidence-based recommendations to TfL, highlighting the practical ways to enhance the positive benefits of the LEZ and to remove or minimise any negative impacts on health (including well-being) and to remove or minimise health inequalities that might arise or exist.

The Proposed London Low Emission Zone

Newer vehicles have much lower air pollutant emissions because of European legislation implemented over the past decade (known as Euro standards). It is possible to accelerate the introduction of these cleaner vehicles, and reduce the numbers of older, more polluting vehicles, through a **low emission zone (LEZ)**. A LEZ is a defined area that can only be entered or driven within by specified vehicles meeting certain emissions criteria or standards, e.g. certain Euro standards. A LEZ prohibits older vehicles from operating in an area, and so accelerates the turnover of the vehicle fleet (or encourages the fitting of pollution abatement equipment which also leads to cleaner vehicles).

The proposed London LEZ scheme is being designed to discourage the use of the most individually polluting diesel-engined vehicles in Greater London by imposing a daily charge on vehicles which do not meet certain standards. These are generally older diesel-engine heavy-goods vehicles (HGVs), buses, coaches, heavier light-goods vehicles (LGVs) and minibuses.

What vehicles would be affected?

The LEZ would apply to both UK and non-UK registered vehicles. The vehicles to be included are based on European vehicle definitions to ensure a legal basis for the LEZ that applies equally to UK and European-based vehicles. A small number of vehicles would be exempt from the LEZ.

What are the proposed vehicle emission standards?

The proposed minimum emission standards for a vehicle to be able to drive within the LEZ without charge are as follows:

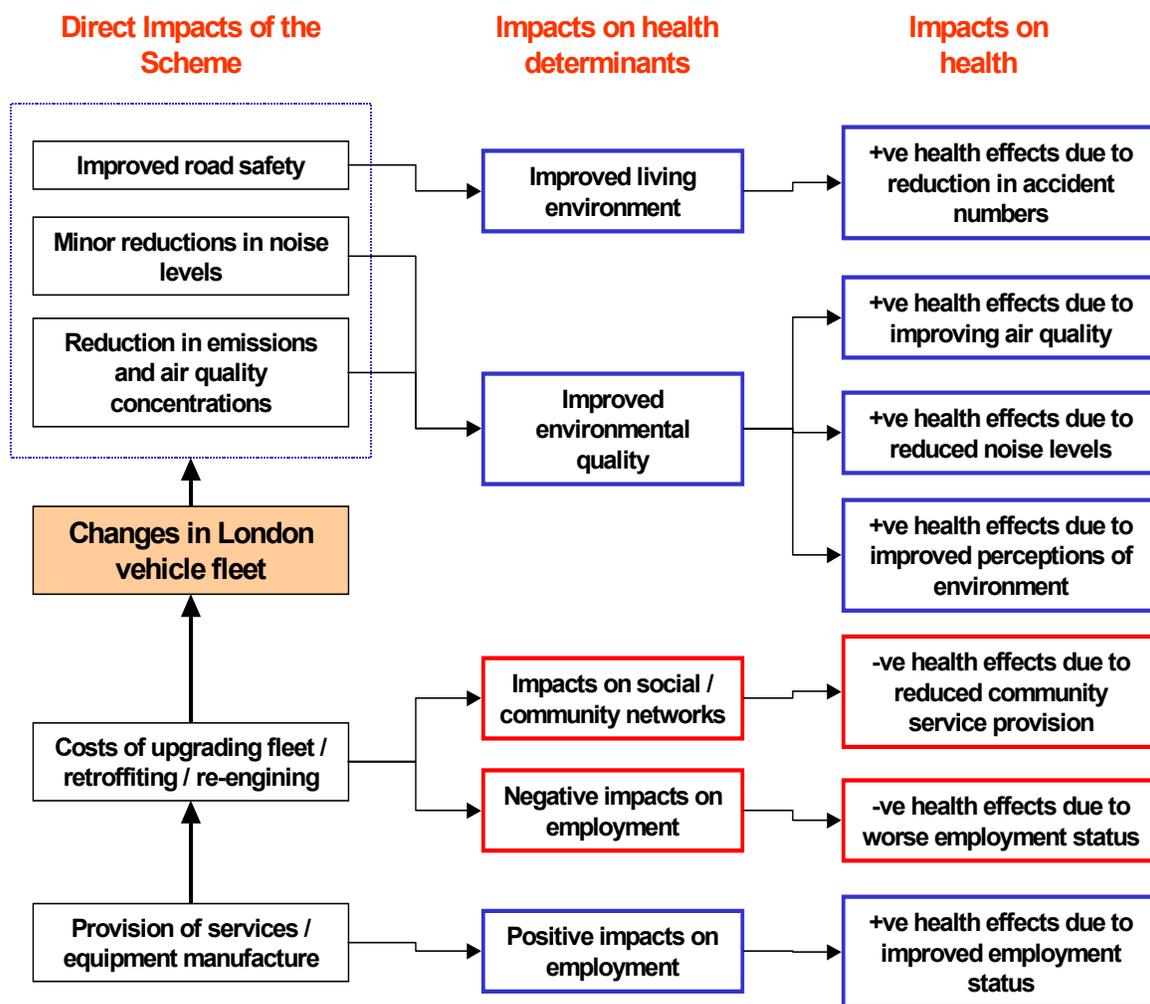
- From February 2008, a standard of Euro III for particulate matter (PM) for HGVs over 12 tonnes
- From July 2008, a standard of Euro III for PM for HGVs over 3.5 to 12 tonnes, buses and coaches
- From October 2010, a standard of Euro 3 for heavier LGVs and minibuses
- From January 2012, a standard of Euro IV for PM for HGVs over 3.5 tonnes, buses and coaches.

Appraisal of the evidence

Following the screening and scoping phases, the appraisal stage of the HIA considered the range of evidence for the potential health impacts of a proposal on the population’s health. It involved investigating, appraising and reporting on how the proposal’s implementation would be likely to affect health.

The scoping phase identified the main health effects and health inter-linkages of the proposed LEZ, illustrated below, and provided a focus for the full appraisal.

Anticipated health impacts associated with the possible implementation of the London Low Emission Zone



The left hand side of the figure shows the possible direct impacts of the proposed LEZ, covering both socio-economic and environmental impacts. The potential impact on factors affecting health (determinants), and subsequent impacts on health result

from these direct impacts of the scheme. The analysis suggests that there may be an overall positive effect on health arising from the proposed scheme (as suggested by the previous HIA prepared for the Transport and Air Quality Strategy Revisions public and stakeholder consultation (ERM 2006). The appraisal phase of the HIA investigates the significance of the effects on health, and helps prioritise these impacts for TfL.

For this HIA of the proposed London LEZ, four key elements formed the basis of the appraisal stage.

Literature review. The literature was reviewed to consider the evidence of the impact of transport or air quality schemes on health, and the importance of health impacts associated with the LEZ proposal. The focus of the literature review was directed by the scoping phase and previous HIA analysis of the proposed LEZ. It included reviewing the literature of the following:

Air pollution and health:

- Evidence linking traffic emissions to adverse health effects, the nature of any health effects specifically associated with traffic pollution and by inference the health improvements that would be expected following a reduction in pollution exposure;
- The effectiveness of measures (LEZ or other) to reduce air pollution and other environmental improvements giving rise to measurable improvements in health;
- Information about which groups are potentially most vulnerable to the adverse effects of air pollution (and therefore who would be the most likely to benefit if the LEZ was implemented).

Perception of environmental quality:

- The importance of perception in determining the influence of environment on health and the extent to which a perceived improvement in environmental quality might lead to health benefits.

Socio-economic and other effects:

- The relationship between changes in socio-economic and/or employment status and health in order to understand the potential impacts on health that might arise if the LEZ were to adversely affect some businesses;
- Effects of noise and, therefore, the likely effects of a reduction in noise exposure on health;
- The potential impacts of improved road safety in reducing traffic accidents and the groups most likely to benefit.

In summary, the evidence in the literature indicates that different health effects could arise from the implementation of a LEZ, particularly due to the improvements in air quality.

Stakeholder engagement. The objective of this phase of the HIA was to help identify and prioritise potential health impacts, to understand how negative impacts can be minimised / positive benefits maximised, and to better understand stakeholder concerns on health issues. The engagement was facilitated by two workshops, which were attended by a broad range of health, transport and community stakeholders.

Overall, stakeholders were of the opinion that air quality would be beneficially changed by the LEZ and the perceived improvement in environmental quality would also be beneficial. These benefits could be maximised by integrating the introduction of the LEZ with other measures to encourage participation in walking and cycling, and to create a perception of improved environmental quality. The potential negative impacts of greatest concern was the impact on community transport and the potential for increased social isolation of vulnerable individuals including the elderly and disabled.

Community profile. The distribution of impacts is important to understand who would benefit most from positive health effects resulting from the scheme, and who may incur the greatest health disbenefits. The community profile focused on describing the distribution of air pollution and different types of communities affected.

Assessment of the proposal. Finally, based on the scoping phase, and the three appraisal methods shown above, a detailed assessment of the health impacts of the scheme can be developed. This assessment included consideration of the distribution of impacts. A summary of the overall findings is shown in the following section.

Summary of findings

Air quality

The health benefits modelling estimates that there would be important but relatively modest reductions in the health impacts associated with air pollution, and that the proposed LEZ would be an important part of London's overall strategy for improving air quality and limiting the associated health impacts. This is in evidence from the analysis of the reduction in the number of people in areas where concentration of NO₂ and PM₁₀ exceed air quality objectives after the introduction of the LEZ, and from the quantification of estimated health benefits. It is important to stress that the health benefits would not be confined to London's population but to the wider UK population, due to the impact of cleaner vehicles used outside of the LEZ, as well as inside.

Using the health impact assessment methodology from the Defra Air Quality Strategy Review it is estimated that from 2005 to 2015, the emissions benefit in London from the LEZ will lead to 5,200 years of life lost gained, 43 respiratory hospital admissions avoided, and 43 cardiovascular hospital admissions avoided. Using the EC approach, a much greater additional health benefit is estimated on top of the benefits from extra years of life lost and avoided respiratory hospital admissions. It is estimated that around 310,000 cases of lower respiratory symptoms, 30,000 cases of

respiratory medication use, and around 231,000 restricted activity days will be avoided from the introduction of the LEZ.

The total discounted benefits of the London LEZ schemes are estimated at approximately 200 million pounds using the Defra AQ Evaluation analysis and 420 million pounds using the EC CAFE CBA analysis. A significant proportion of these benefits result from air quality improvements outside of London.

There are significant differences in the distribution of these benefits. Central London boroughs appear to experience the highest level of benefit because that this is where the air quality problems are most severe. These boroughs are also those that have the highest proportion of deprived communities; therefore, it is the most deprived communities that on average experience the most significant improvements in air quality. Although the relative improvements in air pollution are modest, they are important given that such communities are thought to be more vulnerable to air quality impacts on health.

The most important health benefits from the proposed LEZ are those associated with improvements in air quality. The benefits estimated illustrate the important impact that the scheme would have on reducing the illness associated with air pollution in London.

Socio-economic Impacts

The economic and business impact assessment, prepared by Steer Davies Gleeve to support this public and stakeholder consultation of the proposed LEZ has estimated a small net cost to the London and south east economy, and a small loss in employment across certain sectors once the benefits to ancillary sectors have been taken into account. Based on this analysis, it is assumed that there would be a resulting small negative impact on health particularly due to impacts on employment. The distribution of the effects is probably more important given that there would be differences in the impact both between sector and within sectors. In particular, it appears to be the smaller businesses and those that are less able to pass costs through to the consumer that would be most affected. Sectors identified include construction and transport / storage / communications.

The compliance costs associated with replacing vehicles or retrofitting abatement technologies could have an impact on the ability of voluntary and public sectors to maintain a community services, whether this is transportation or a service that requires the use of vehicles affected by the scheme. At this time we cannot be sure to what extent these services would be affected by the scheme, if at all. It is recommended that TfL gather further insight through the consultation process.

Access to services is a particular issue for vulnerable groups, such as the elderly, disabled or most deprived communities, who have the greatest reliance. Any reduction in services could have implications for health, in terms of physical health (e.g. provision of healthcare or healthy food), and mental health and well being (e.g. participating in the community and use of local amenities).

Perceptions of the Environment

There is evidence that perception of environment can affect the health of the population, particularly in terms of well being, associated with how people view their quality of environment, and its impact on quality of life. Measuring this is difficult, particularly as perceptions within and between communities will differ significantly. On balance, it is likely that the health benefits from a changed perception of the environment would be relatively small.

The environmental improvement resulting from the LEZ might not be obvious. In which case the perception of improvements would only be likely through knowledge that a scheme was being introduced, and effective communication as to the likely benefits to health.

Noise

The evidence suggests that exposure to noise can have important effects on health. A LEZ has potential benefits on noise, as it removes older noisier vehicles from the fleet. However, it is estimated that the proposed LEZ would lead to only small reductions in noise levels; therefore, health benefits are likely to be marginal.

Road safety

Newer vehicles tend to be safer, and are part of the reason why road safety in the UK has improved. An increase in newer vehicles resulting from the proposed LEZ could lead to some small improvements in road safety, and a resulting small benefit to health.

We believe that the health impacts identified in this study can be prioritised on a relative basis, to provide guidance on which impacts are the most important in terms of evaluating the proposed LEZ on health. Prioritisation is based on our understanding of the magnitude of the impact, our confidence in the estimates, and the likelihood of the impact. In addition, the distribution of health impacts, particularly on the most vulnerable groups in London, can also be a factor in helping determine prioritisation.

Summary of health impacts associated with the proposed London LEZ

Impact on health determinant	Benefit or negative impact to health*	Relative prioritisation of impacts: - high, medium or low	Measurability / likelihood
Improvements in air quality	Quantified reduction in years of life lost (mortality impacts) attributable to PM ₁₀ air pollution (including both primary particles from vehicle exhausts, and secondary particles generated from NO _x emissions)	H	Calculated / Definite
	Quantified reduction in morbidity (e.g. respiratory hospital admissions, restricted activity days) attributable to PM ₁₀ air pollution (both primary and secondary particles).	H	Calculated / Definite
	<i>Outside of London</i> health benefits resulting from the use of LEZ compliant vehicles outside of the zone	H	Calculated / Definite
	Non-quantified health benefits associated with reduction in pollutants other than PM ₁₀ (E.g. direct impacts of NO ₂ and ozone - quantification more difficult but possible with available pollution data)	M	Calculated / Definite
Access to services	Cost implications of the LEZ potentially leading to a reduction in community services, with implications for health, particularly those in most vulnerable groups	M	Qualitative / Possible
Employment status	The direct and indirect economic impacts of the proposed LEZ result in a small net financial cost; therefore, a small negative impact on health is assumed. The distribution of these impacts is potentially more important.	M	Qualitative / Probable
Perceptions of environmental improvement	Small health benefits could arise from people perceiving that the environment (in terms of air quality) is improving	L	Qualitative / Probable
Reduction in noise	Small positive health benefit associated with lower background noise levels due to increase in newer vehicles	L	Qualitative / Probable
Improved road safety	Small positive health benefit associated with fewer road casualties due to increase in newer, and therefore, safer vehicles	L	Qualitative / Speculative

* Benefits shaded green; negative impacts shaded orange

Recommendations

The following recommendations concerned with minimising any negative impacts and maximising health benefits have been proposed to Transport for London for their consideration, based on this HIA analysis.

1. The air quality health benefits are recognised as the key health effects associated with the proposed LEZ. It is therefore recommended that TfL further develop the methodology for assessing these benefits prior to the scheme's possible implementation. This recommendation is developed further in the section on monitoring.
2. The scheme currently proposed allows older vehicles to be fitted with PM abatement technology; there is no requirement to fit NOx abatement technology. However, the recent start of Euro IV heavy-duty vehicle emissions standards means that NOx abatement technology is developing rapidly. It is therefore recommended that TfL monitors these developments and at a future date reassesses the practicalities, costs and benefits of including NOx abatement within the LEZ scheme.
3. The health benefits that have been identified through the HIA and health benefits modelling work should be effectively communicated to the wider public, so that there is a wide understanding of health benefits associated with the possible introduction of a LEZ. This is also important for people's perceptions of the proposed LEZ, and could result in further health benefits.
4. The distribution of health benefits associated with air quality improvements could also be communicated – that the most deprived communities who are most susceptible to impacts from air pollution experience the largest reductions in pollutant concentrations.
5. The detail of the LEZ scheme should be widely publicised, particularly to the businesses and community organisations that might be affected. This should be done as soon as possible, to ensure that the cost implications of the LEZ can be managed before the introduction of the proposed LEZ. This could help minimise any negative health impacts that could result from job losses or reduction in community service provision. One way of achieving this for heavy goods vehicles (HGVs) would be for TfL to prepare, and VOSA to distribute, explanatory leaflets at the few HGV testing stations within and adjacent to London when vehicles are presented for their annual roadworthiness (MOT) test.
6. Community service providers, particularly those who provide services to vulnerable groups, should be encouraged to respond to the consultation to establish the potential impacts, and ways that impacts might be mitigated. This could minimise any disruption to services, and the potential associated health impacts.

7. Wider concerns on health raised through the HIA engagement process, and the other impact assessments, should be communicated widely to ensure awareness of the LEZ in different communities.
8. A monitoring strategy should be further developed to assess the actual health impacts of the LEZ post-implementation. This is discussed in greater detail in the following section.

Approach to monitoring

The impact of most measures targeting environmental improvement cannot be easily identified through health statistics because of the influence of many other factors on the population's health. This is likely to be the case with the proposed London Low Emission Zone, and therefore the collation of health statistics as part of a strategy to monitor the health impacts of the scheme has not been recommended here.

We propose that TfL collect a range of different baseline data prior to the date of implementation that enables them to 'estimate' the health impacts of the scheme. Depending on resources to undertake monitoring and the greater relative importance of some impacts, prioritisation for the collection of some data should be agreed. We propose four parts to the monitoring strategy for health impacts, with a focus on the health benefits resulting from air quality improvements.

Monitoring of health effects associated with air quality improvements

It has been recognised in this study that the main health benefits result from the improvements in air quality, resulting from lower emissions due to changes in the road vehicle stock in London. Analysis, as described in this report, can be further developed over the next few years to establish a more robust baseline prior to scheme introduction. The same analysis techniques can then be used to assess the impacts on health after implementation. Refinements to the current health benefits modelling could include the following:

- Improved emission inventories. It is understood that traffic monitoring is already underway to provide a significantly improved understanding of the vehicle profile across different parts of the London road network. This data will feed into the emission inventories, which are an important part of the input into air quality modelling, on which the health impact assessment is largely based.

In addition, it will be important for new knowledge of emission factors, particularly across different euro standard vehicles, to feed into the emission inventory development. This may be achieved through continuing co-operation between London Atmospheric Emission Inventory (LAEI) and National Atmospheric Emission Inventory (NAEI) activities. However, uncertainty over appropriate emission factors for HGVs, particularly for Euro IV specification vehicles which only became mandatory from 1st October 2006, may mean that some further research is required.

- Improved pollution monitoring. It is understood that TfL has already expanded the pollution monitoring network, in particular to increase the measurements of PM_{2.5}. This is important because virtually all vehicle exhaust PM₁₀ is actually PM_{2.5}, whereas the PM from tyre, brake and road wear, resuspension and from other non-road transport sources are predominantly in the PM_{2.5} – PM₁₀ range. Consequently, monitoring PM_{2.5} is a more sensitive measure of PM from road transport exhaust, and will be a more sensitive measure of the effect of the LEZ on air quality. This additional data can then feed into the air quality modelling.
- Improved pollution modelling. It is important that advances in the understanding of techniques to model air quality pollution are incorporated into the methods used for the LEZ analysis.
- Refined health benefits modelling. There are number of ways that the health benefits modelling could be further developed over the next few years:
 - Quantification of health impacts associated with other pollutants
 - Incorporation of developments in quantification methodologies, including better characterisation of the impacts of different particle species
 - Improved knowledge of the patterns of daily population movement to more accurately model exposure

We recommend that the health benefits modelling approach, and the methodologies for compiling the input data, are further developed over the next few years. This is important given that the key health benefits of the scheme are those relating to air quality improvements, and that such benefits are difficult to measure empirically.

For health affects associated with noise, these can be determined from the change in vehicle stock, which will be monitored. However, the impacts are likely to be small.

Impacts on employment and businesses and associated health effects

The HIA analysis suggests that health, particularly mental health and well being, can be affected by employment status. The proposed LEZ is likely to have a small negative impact on the levels of employment in certain sectors, notably construction and transport. This may be offset by new opportunities in manufacturing, fitting and maintaining pollution abatement equipment. Potential changes of employment resulting from the additional costs imposed by the proposed LEZ would be distributed differently across London's communities.

It is important that impacts on employment and businesses are monitored. From such information, it should be possible to assess qualitatively the relative importance of associated health impacts. Monitoring of the economic impacts of the Scheme is planned and the secondary health effects can be assessed based on such data.

TfL will put a monitoring strategy in place to assess the actual economic changes due to the LEZ, so will take into account the baseline situation without a LEZ. As part of this strategy, changes in employment will be identified. This information could be

used to assess health benefits indirectly in sectors such as retrofitting, or selling new vehicles, and the additional revenues generated for the local economy. There may also be additional jobs associated with scheme implementation.

We recommend that the employment and business benefits and possible negative impacts are monitored through surveying or other relevant methods. The secondary health benefits can be qualitatively assessed from such monitoring data.

Impacts on access to community services and associated health effects

From the stakeholder engagement process, it was apparent that there are some concerns amongst providers of community services about the potential cost implications of the LEZ, and the impacts that this might have on the ability to provide services. The evidence suggests that the level of provision of community health-related services and other community based or public services that enable access to services by communities can impact on health.

We recommend that the levels of service provision across a range of public sector and voluntary service providers are monitored prior to the confirmation of the Scheme Order and following the introduction of the LEZ (should the Mayor confirm the Scheme Order). However, it is appreciated that it would not be appropriate to devote a disproportionately high level of resources at this, and consequently the monitoring would be at a semi-quantitative level.

Changing perceptions of the environment and associated health impacts

Perceptions of the environment can have limited impacts on well being and health. To monitor how perceptions of the environment, particularly air quality, change before and after possible LEZ implementation, surveys of different communities would be useful; many such surveys have been undertaken in the academic community. Such surveys could also identify differences in perceptions across London communities.

Changing perceptions are likely to be a factor of people's awareness of the scheme, particularly because physical changes resulting from the scheme are likely to be imperceptible. Research undertaken to assess the effectiveness of dissemination of information concerning the scheme, and the effectiveness of communicating the benefits of the LEZ could provide some indication as to general awareness about the scheme.

We recommend that some form of surveying is undertaken to consider people's perception of air quality before and after the scheme. From survey data, the implications of changing perceptions for health can be qualitatively assessed. For example, TfL may consider including some appropriate questions in the Londoner's Survey which is carried out several times a year.

In summary, we recommend that the focus of the monitoring strategy for health impacts is on refining the data inputs and methodology used in the health benefits modeling. This is because the primary health benefits of the scheme will be through improvements to air quality. A more robust methodology for this assessment is important in view of the lack of empirical data (e.g. changes in the incidence of

illness) for use in monitoring. We also recommend that surveys are undertaken to enable assessment of health effects associated with socio-economic impacts and perception, although these are less of a priority.