‘Clearing the Air’
The Air Quality Strategy for Lancaster district

LANCASTER
CITY COUNCIL
Promoting City, Coast & Countryside

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Prepared by PJ Cartmell, Air Quality Officer, Environmental Health Services

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‘Clearing the Air’ – Executive Summary

Air pollution arising from vehicle emissions in Lancaster remains a health concern and there are no clear indications that the situation is improving. Levels or nitrogen dioxide are measured above acceptable concentrations and levels of particulate pollution are significantly elevated and of particular concern. Past action plans have had some success however their impact has been insufficient to resolve the situation.

Research continues to be carried out to better understand the health impact of air pollution. Currently the national impact in terms of deaths caused is estimated (See Chapter 1 Part 1) to be similar to that for obesity and significantly greater than that attributed to alcohol and environmental tobacco smoke (passive smoking) prior to smoking restrictions. It is arguably the most significant outstanding environmental issue which has a day to day direct impact on public health. Yet despite this, public awareness of this impact is generally limited. Air quality is rarely a topic of local or national news or commonly raised as a matter of concern in general conversation. It is also a risk that is difficult to avoid because for many, breathing polluted air is not a matter of choice. It is reasonable to conclude that presented with an informed choice most people would choose clean over polluted air. A key objective for the strategy is therefore to make sure both the public and partners are better informed about air pollution.

Various plans and policies arising from both the County Council and the City Council indicate support for air quality improvement, however, it can be difficult to discern what directly arises from policy measures and therefore what priority and ambition is intended. This is critical to any action plan as the City Council alone cannot deliver all the necessary actions. Success or otherwise relies on co-operation and delivery in partnership particularly on road traffic matters with Lancashire County Council and through planning sections of both Councils. It is essential that policy aims for tackling air quality are properly embedded and integrated within these services.

With many different issues competing for attention (some conflicting) and nationally predicted improvements in air quality not taking place it is easy to understand why despite past action air pollution remains an issue. This air quality strategy therefore looks to ‘clear the air’ and make a fresh start by putting forward a process that provides the best environment and structure to achieve an agreed successful outcome. It is important to emphasise that significant input by both the City Council and the County Council in partnership is fundamental to the formation of a properly considered and balanced plan. Without this co-operation a good plan cannot be put forward not to mention ultimately delivered. Taking a strategic approach and seeing development actions through to completion, however, will lead to an agreed plan with understood ambition and content. Investment in such clarity both for the public we serve and the various bodies involved has to be worthwhile.

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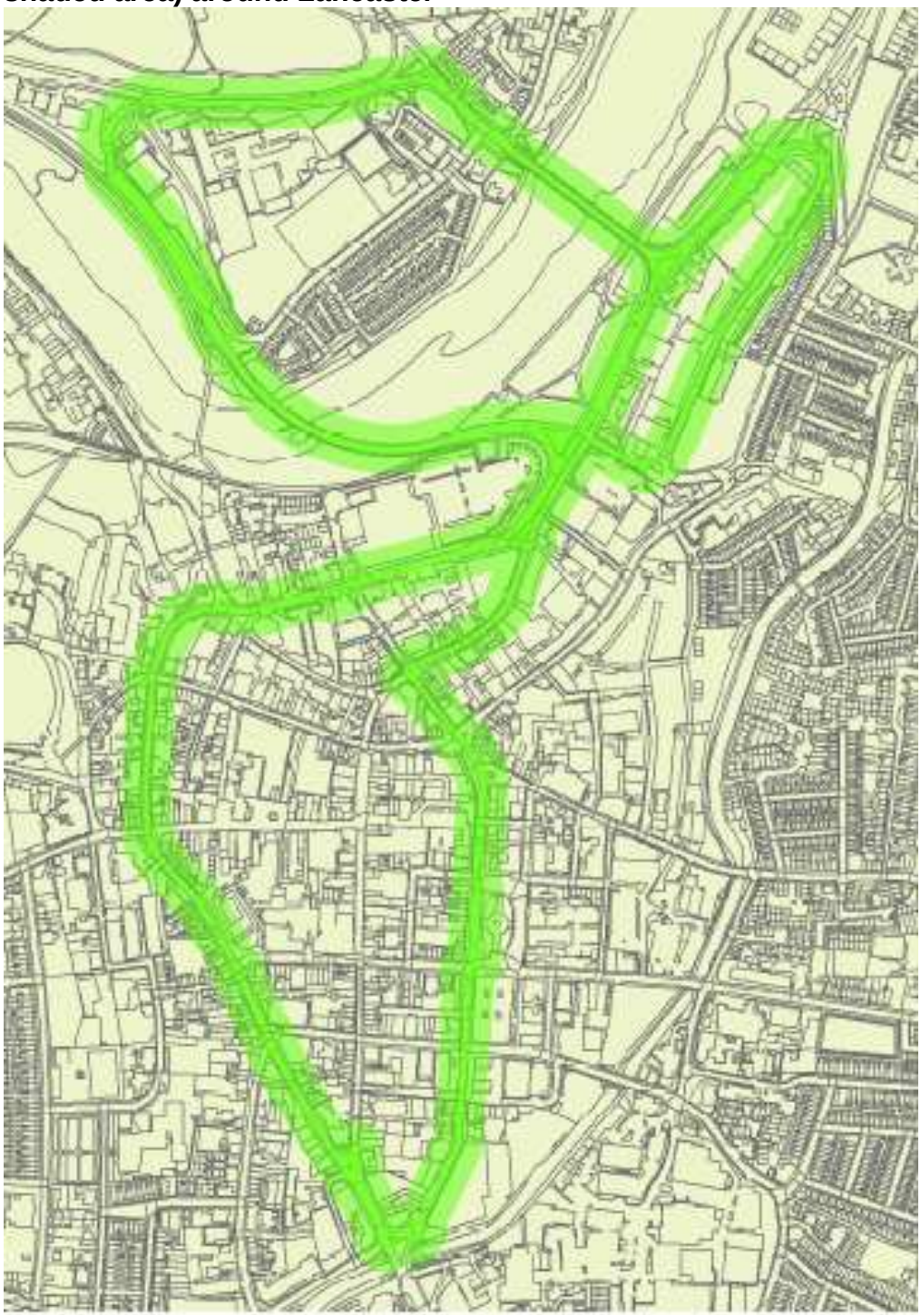
Introduction – Where are we now and why is a strategy needed?

Since the mid 1990’s local authorities have been tasked with the duty of addressing air quality problems in their areas. Initially the task was to establish exactly where pollution was a problem. Given continual change, this task will always be ongoing, however generally speaking most problem areas are now identified and so the appointed task is now far more about how to deal with known issues.

Although an industrial chimney may be the first thing that comes to mind if someone mentions air pollution, investigation has revealed that currently the most dominant issue in air pollution is that from road vehicles. Lancaster City Council has currently designated three areas ‘Air Quality Management Areas’ (AQMA’s) based on the impact on air quality of pollution from road traffic. The three areas are Carnforth, Galgate and Lancaster. Lancaster has the highest and most persistent pollution levels.

A map showing the Air Quality Management Area in Lancaster is shown in Figure 1 below:-

Figure 1 - Map showing designated Air Quality Management Area (green shaded area) around Lancaster



Where Air Quality Management Areas have been designated, Section 84 of the Environment Act 1995 requires local authorities to produce Air Quality Action Plans in pursuit of the air quality standards and objectives in those areas.

Air Quality Action Plans have already been created for some of these areas (including Lancaster), but it is considered that particularly for Lancaster a more prescribed approach is required. This is for three main reasons. Firstly, Lancaster is an historic city with an inherited restricted road network. This arrangement does not easily lend itself to traffic alleviation measures and so has resulted in the entrenched air quality problems. Secondly, air quality improvements anticipated nationally (through Euro emission standard vehicle improvements) have not delivered the pollution reductions expected making the contribution of local intervention more needed than ever (see : http://www.iapsc.org.uk/document/0612_Y_Brown.pdf).
Thirdly, the air quality improvement task is given to Lancaster City Council by Government is without a specific budget to fund actions or strict obligation to meet specific targets. As an outcome of this local action planning and action commissioning has been reliant on unobligated participation and voluntary agreement. This arrangement is not best suited to delivering effective actions, particularly in an environment where there are many competing priorities. Defra are reviewing this position but at present this system remains as it is (see: http://archive.defra.gov.uk/environment/quality/air/airquality/local/documents/laqm-report.pdf).

Therefore with this situation in mind, a strategy which creates the right conditions, defines the process and sets the framework to guide action planning and management is considered to provide the best opportunity for a way forward.

A ‘Questions and Answers’ Section is contained in Appendix 1, which further outlines and explains the purpose of this strategy.

In summary, the purpose of this Air Quality Strategy is to create the right conditions and to set out an ongoing process to facilitate policy and plan review, working with partners, consensus building through action selection, action inclusion or exclusion and finally resulting in the managed delivery and execution of actions (forming an action plan). The level of action and ambition of the resulting action plans will be set through agreement of the Council, its partners and stakeholders.

Chapter 1 – Part 1 - What are the current air quality problems?

In order to understand the need for a strategy or an action plan it is firstly important to understand the impact of air pollution and its importance in relation to health and well being. This chapter therefore provides some information on air pollution issues in Lancaster, gives estimates of the health impact of urban pollution and gives reasons for specific focus/inclusion in this strategy.

1.1 What is the source of air pollution in Lancaster?

Although air pollution generally arises from many sources, some natural and some man made, air pollution problems in Lancaster predominantly arise from road traffic (see: http://www.lancaster.gov.uk/environmental-health/environmental-protection/air-quality/air-quality-downloads-links/#TechnicalReports for further information).

For this reason pollution from road traffic will be the main focus for this strategy and any subsequent action plan.

1.2 What are the main pollutants of concern?

The two pollutants of specific concern are nitrogen dioxide (NO_2) and particulate (two fractions PM_{10} and $PM_{2.5}$). Descriptions of these pollutants, their general health effects and details of set pollution level standards are contained within Appendix 4.

1.2.1 Nitrogen Dioxide

All three of the existing AQMA's have been declared due to the potential for nitrogen dioxide levels to exceed set health based standards (Appendix 4 contains a list of current standards, information on pollutant sources and health effects). These levels have been set and agreed by the European Commission and imposed through European Directives.

Nitrogen dioxide is measured in Lancaster using two automatic monitoring stations (located on Cable Street and at Dalton Square) and also using diffusion tubes. Due to the relative low cost of diffusion tubes and their easy to locate small size, more locations can be monitored to provide a better picture of nitrogen dioxide levels in the Lancaster AQMA. A map showing the location of monitoring sites is shown in Fig 1.1 and a photograph showing a diffusion tube monitoring site is shown in Fig 1.1a below:

Fig 1.1 Map showing air quality monitoring locations in Lancaster

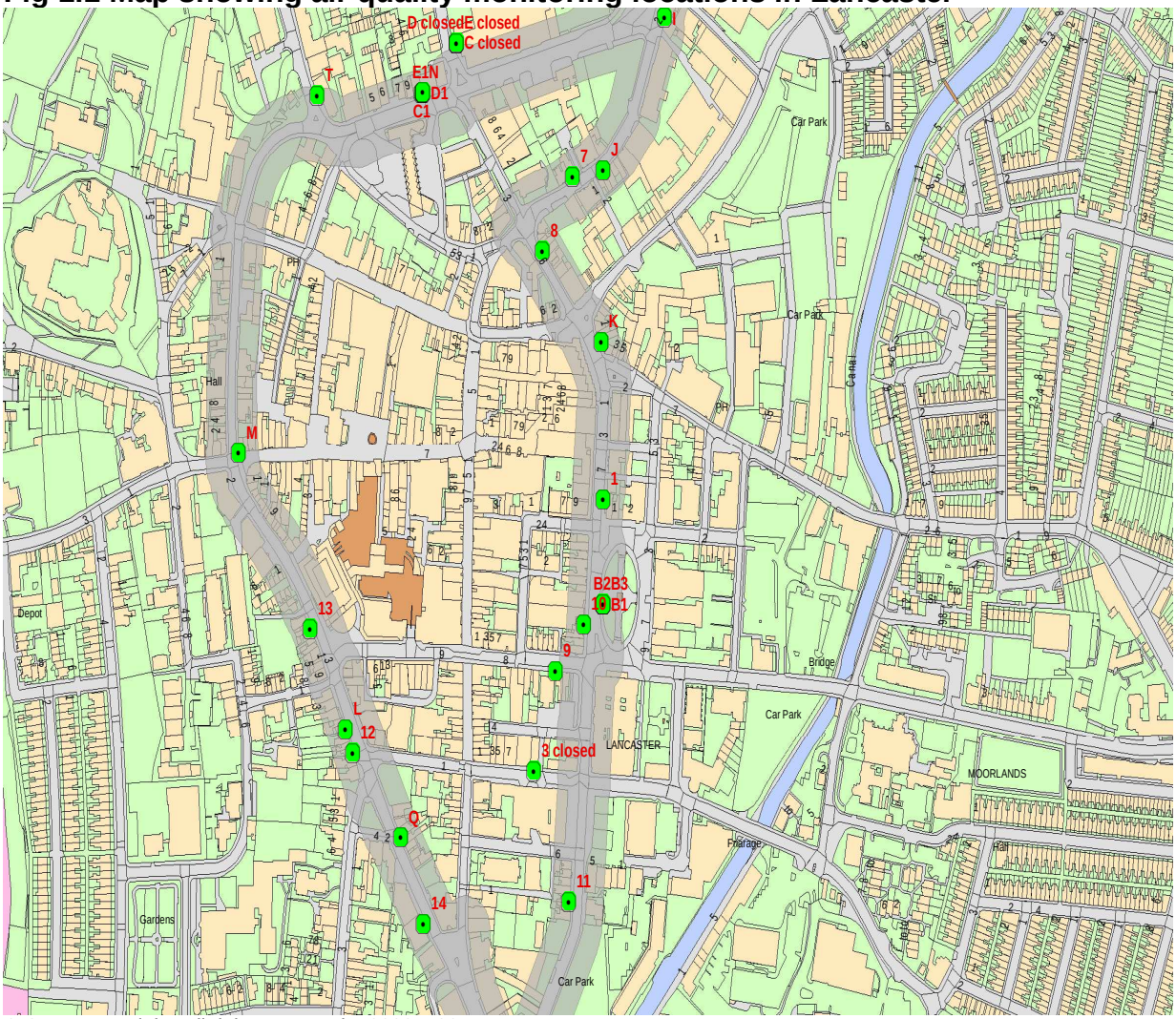
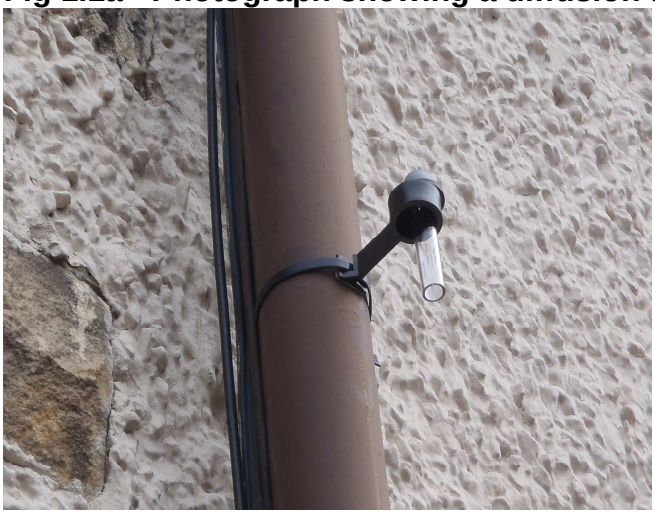
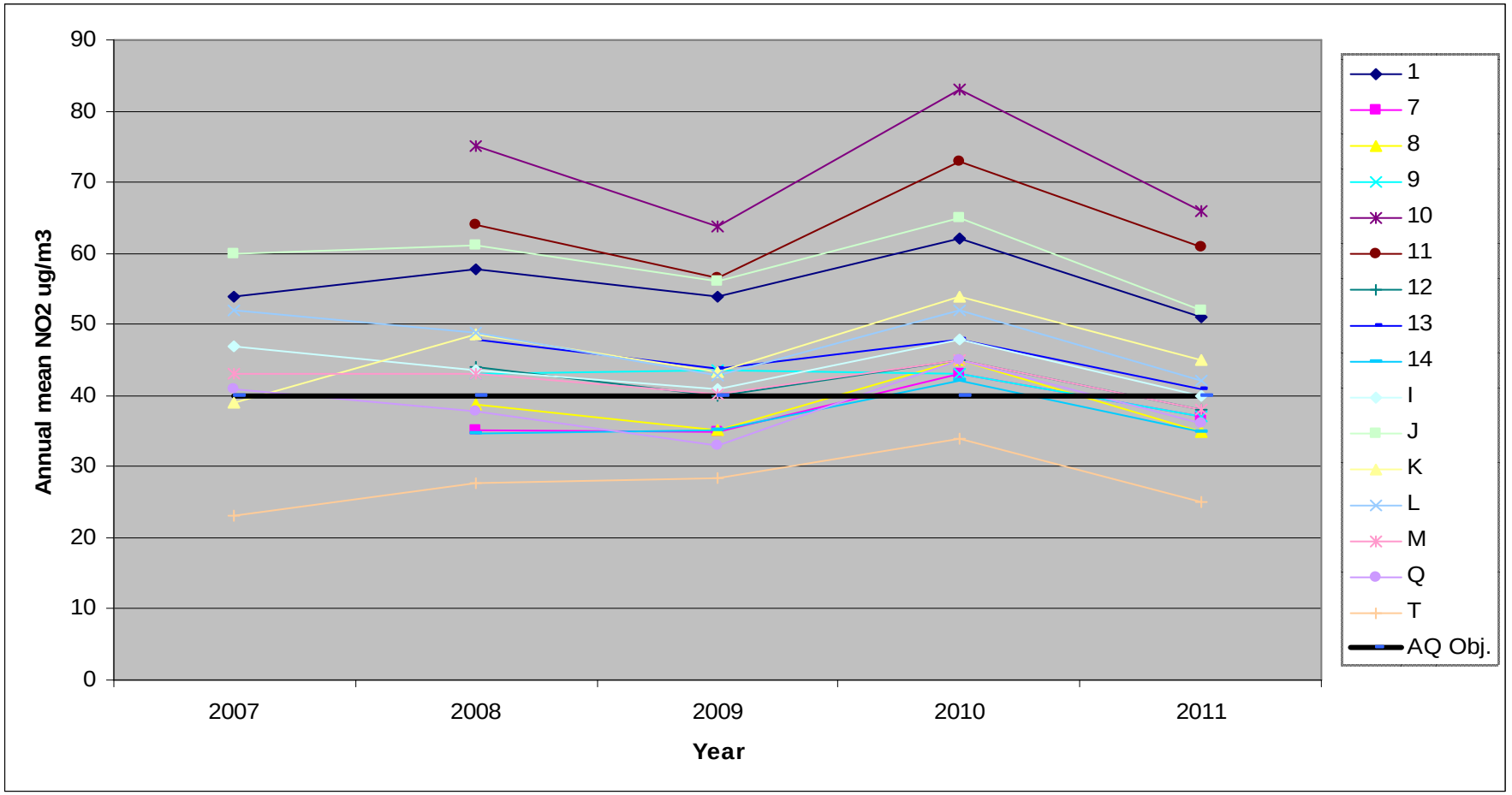


Fig 1.1a - Photograph showing a diffusion tube monitoring site



Nitrogen dioxide levels monitored at these various locations (shown in Figure 1.1 above) within the Lancaster AQMA are shown in Figure 1.2 below:-

Figure 1.2 – Measured levels of nitrogen dioxide (NO_2) at various roadside monitoring locations within the Lancaster AQMA



Graph taken from Lancaster City Council Local Air Quality Management Updating and Screening Assessment 2012 available at: http://www.lancaster.gov.uk/environmental-health/environmental-protection/air-quality/air-quality-downloads-links/.

As can be seen in Figure1.2 above, levels monitored in Lancaster are generally around or above the set annual mean objective level of 40ug/m^3 and have been for a number of years. In some locations within the AQMA levels are particularly high (levels have monitored above 60ug/m^3 in the vicinity of Great John Street/Dalton Square/Thurnham Street/North Road) and so are likely to be exceeding the short term Objective for nitrogen dioxide also (see: http://uk-air.defra.gov.uk/reports/cat18/0806261511_TG_NO2relationship_report_draft1.pdf for more information). Appendix 4 provides more details on the short term objective for nitrogen dioxide.

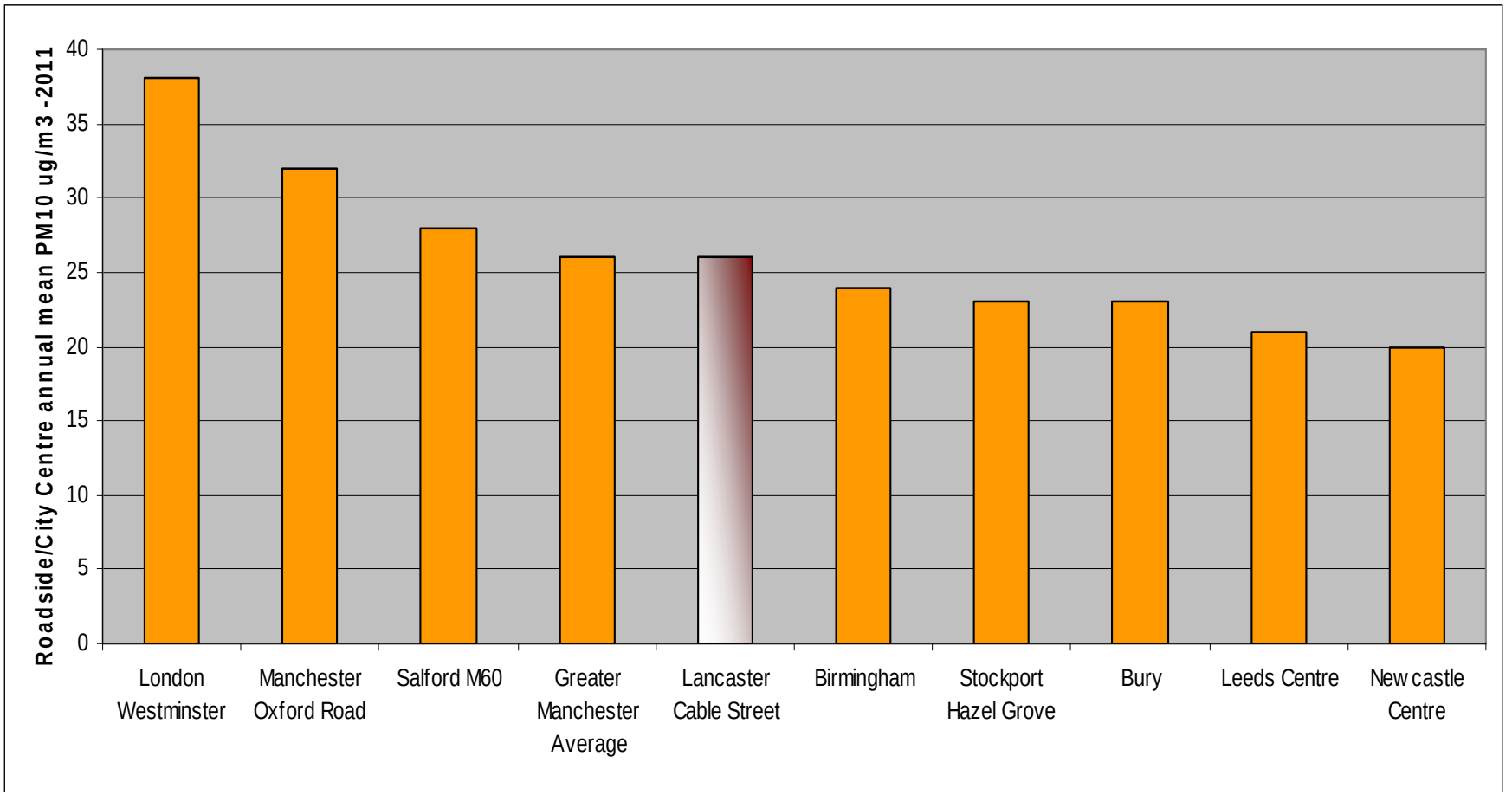
Conclusion for nitrogen dioxide

Monitored results indicate that compliance with objective standards in Lancaster in the near future is unlikely without significant intervention. The reduction in levels of nitrogen dioxide will therefore be a focus for the strategy.

1.2.2 Particulate

Although PM_{10} and $PM_{2.5}$ levels are not currently exceeding set standards, they are significantly elevated (see Figure 1.3 below which shows roadside PM_{10} levels monitored in Lancaster compared with roadside measurements in other city/urban areas).

Figure 1.3 – Measured levels of particulate (PM_{10}) at various urban roadside locations within England - 2011



Data obtained from http://uk-air.defra.gov.uk/data/ and GM authorities.

The graph in Figure 1.3 above indicates that roadside levels in the Lancaster AQMA ranks alongside levels measures in other major urban conurbations such as Manchester and Birmingham.

Particulate pollution is particularly relevant to human health as currently the estimated relative health impact/damage cost of particulate pollution from road vehicles is around ten times that of nitrogen dioxide (see: http://archive.defra.gov.uk/environment/quality/air/airquality/panels/igcb/documents/damage-cost-calculator-guidancepaper.pdf and http://uk-air.defra.gov.uk/reports/cat19/1102150857_110211_igcb-damage-cost-calculator.xls and Appendix 6). There is also no established level of particulate matter below which health effects do not occur.

Although the overriding focus of the strategy is traffic pollution, due to the importance of particulate pollution there may also be some justification for also considering the potential growing impact from domestic solid fuel combustion.

Conclusion for particulate

Due to the recognised significant health impact of particulate it is very important that this strategy and any subsequent action plan includes and provides and approach for the reduction of particulate pollution as well as nitrogen dioxide.

1.3 What about carbon dioxide (CO_2)?

Although not classed as an air pollutant (and not covered by Local Air Quality Management requirements), carbon dioxide is also a significant emission from road vehicles, and is of concern due to its recognised impact on climate. In Lancashire it is estimated that about 24% of CO_2 emissions arise from transport (see: http://www.lancashire.gov.uk/corporate/web/view.asp?siteid=3945&pageid=25809&e=e).

Conclusion for carbon dioxide

Given the obvious logical approach of dealing with emission collectively, assessment and consideration of carbon dioxide emissions will also be included within this strategy.

1.4 What are the health impacts from air pollution from road vehicles?

It is considered important that stakeholders and decision makers are provided with the best information about the health impact of air pollution to enable proportionate judgements to be made. It is also initially important in considering and understanding the need for an air quality strategy.

There are a number of ways of considering the health impact of air pollution. The following information is provided to give an indication of the importance of the impact of air quality, particularly on human health.

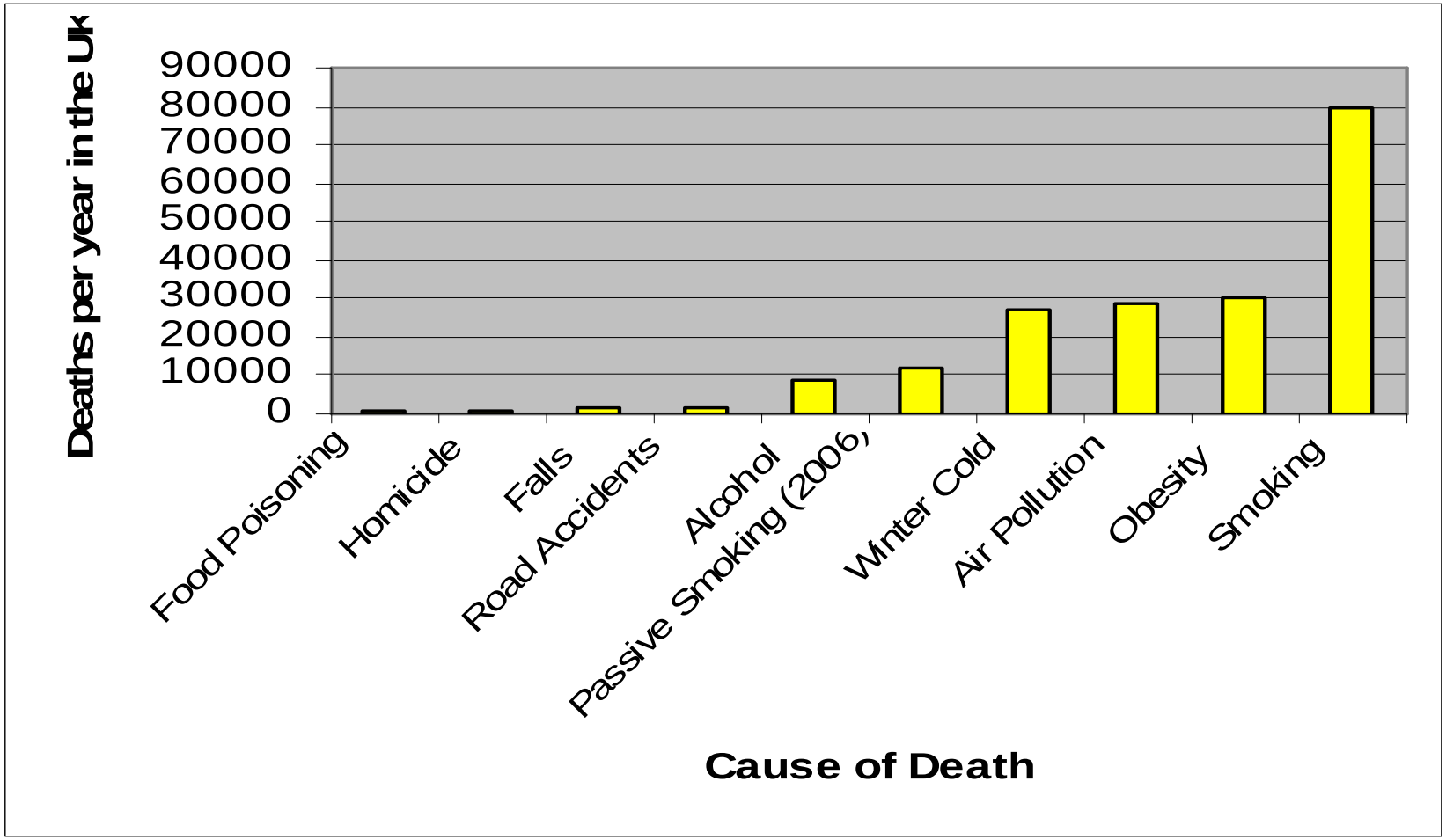
1.4.1 National impact of air pollution

National studies looking at the human health impact of air pollution have focussed on the impact of man made particulate ($PM_{2.5}$) pollution. A report produced by the Health Protection Agency for COMEAP in 2010 (see http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1317137012567) indicated that air pollution was associated with about 29,000 deaths each year in the UK and was estimated to be a contributor in about 200,000 early deaths involving an average loss of life of 2 years. If all man made particulate pollution was removed it is estimated that UK life expectancy would increase by six months. Further work is expected by the Health Protection Agency to break this down to estimate the impact on local areas. However at the time this report was written this information was unfortunately not available.

Damage costs to health were calculated in the 2007 national 'Air Quality Strategy for England Scotland Wales and Northern Ireland' and were estimated to be in the range of £8 – 20 billion a year (see: http://archive.defra.gov.uk/environment/quality/air/airquality/strategy/documents/air-qualitystrategy-vol1.pdf).
This is however considered to be a significant underestimate as it ignores the impact of ongoing ill health due to air pollution (cost relates to reduced life expectancy/deaths) and the impact on the eco-system. Even without taking these costs into account, the estimated health impact costs or air pollution in the UK are estimated to be twice that due to physical inactivity (estimated at £10 billion) and similar to the costs attributed to alcohol misuse (estimated between £ 12-18 billion (see: http://www.lowemissionstrategies.org/downloads/Discussion%20Papers/LES_Case_for_Action_Final%20Report.pdf).

Another way to consider the health impact of air pollution is to compare the risk of death from air pollution with other risks we are exposed to or may choose to take. Figure 1.4 below shows the approximate number of deaths in the UK each year from various causes. As can be seen the number of deaths in the UK from air pollution is estimated to be similar to that due to obesity with only deaths from smoking being a greater. Notably alcohol, which is currently topical due to the debate on minimum pricing, is thought to be responsible for only a fraction (approximately 1/3rd) of the deaths due to air pollution.

Figure 1.4 Approximate numbers of deaths in the UK from various causes*.



*See Table 6 in Appendix 3 for sources of data

1.4.2 Local Impact of air pollution

As for the national impact of air pollution, it is possible to cost the impact of air pollution at a local level. However to do this you need to know what the total emissions (tonnes of each pollutant) that are generated within the district. This information is usually gathered through the creation of a local emissions inventory.

Unfortunately Lancaster does not have an inventory, however an estimation can be made of local damage costs using the IGCB damage cost approach and scaling results relative to the local population (see: http://archive.defra.gov.uk/environment/quality/air/airquality/panels/igcb/documents/damage-cost-calculator-guidancepaper.pdf). The damage covered relates to damage to human health and damage caused to buildings/materials[1].

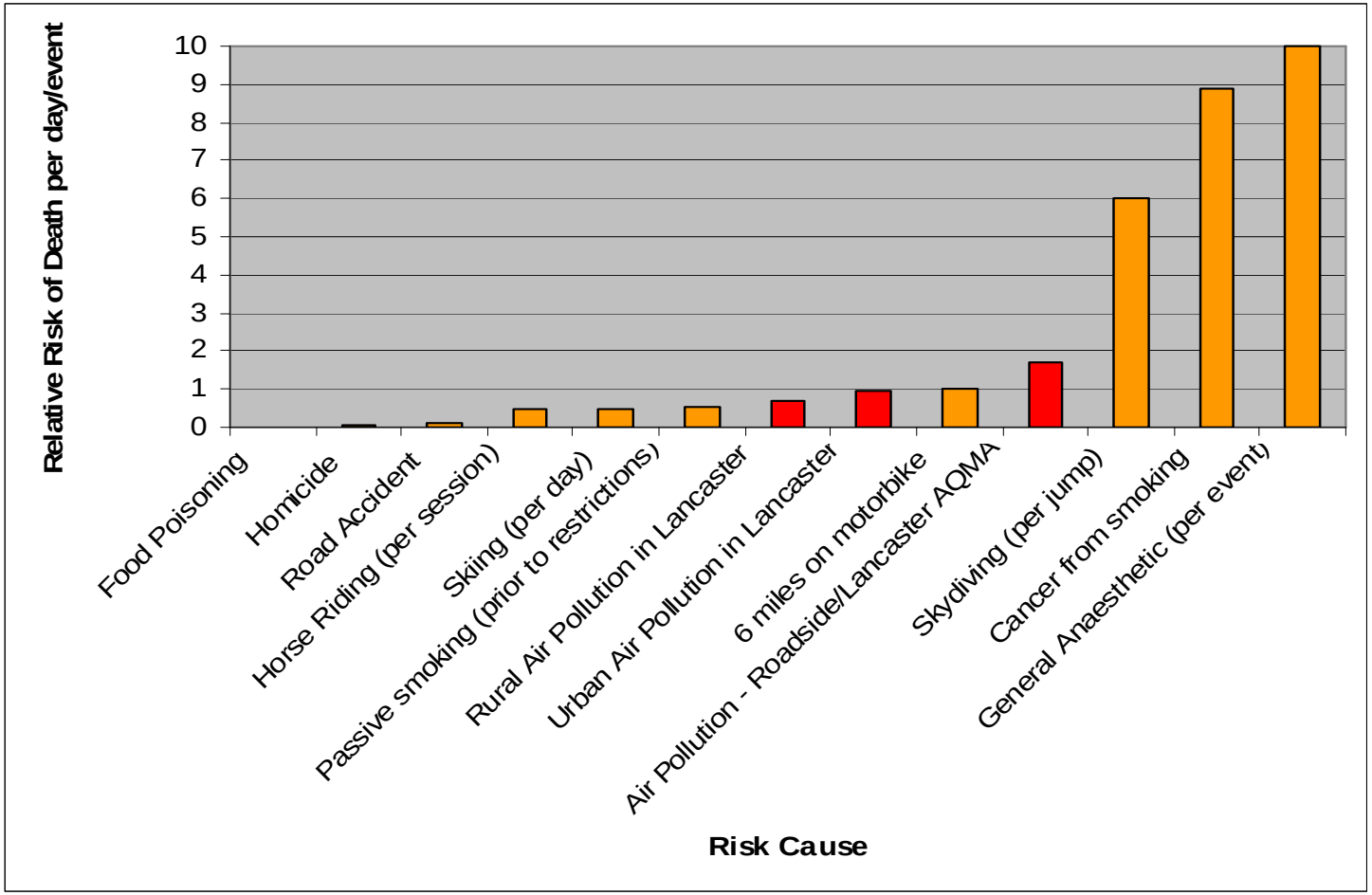
Based on relative human population it is estimated that the annual damage costs from transport emissions in the Lancaster district (from NO_2, PM_{10} and CO_2) are estimated to be around £8 million per year[2]**.** It is estimated that around 75% of this is due to particulate pollution (see Appendix 5) which again indicates the health significance of this pollutant and importance for this strategy.

Another method to indicate the impact of air pollution is to compare the relative risk posed by other events, activities or causes. Figure 1.5 below shows the estimated relative daily risk of death from various causes (further information on data sources and how relative risk is calculated, is contained in Appendix 3). This is done to again aid understanding of the risk posed by air pollution and particularly for those living within the Lancaster AQMA. Some caution is obviously needed with these comparisons however again the risk from prolonged exposure air pollution for people living near busy roads (within the Lancaster AQMA in this instance) is indicated to be over twice that for people living in rural locations in Lancaster. It is also pertinent to note that the estimated number of deaths due to air pollution are over three times that previously estimated from passive smoking in 2006 (environmental tobacco smoke exposure). Significant action was taken to address this risk in 2007 through legislated smoking restrictions but notably comparable effective actions for air pollution are hard to find. Another unusual but perhaps thought provoking comparison is that the risk from air pollution within the Lancaster AQMA is indicated to be equivalent to choosing to skydive once or twice a week or having a general anaesthetic every other week!

[1] Does not include affect of Ozone, damage to ecosystems, agriculture, historic buildings, transboundary impacts, etc… CAFE (Clean Air For Europe) Damage Guidance which does include these things indicates figures that can be a factor of 10 different! (http://www.cafe-cba.org/assets/marginal_damage_03-05.pdf). It also should be noted that there is potential for considerable direct cost if any EU fines/part fines if these are passed to LA's (if imposed a national fine figure of around £250-300 million has been indicated to be a possibility). This cost has also not been included.

[2] Data is based on damage costs calculated for the Wigan Council District which has a population of around 306,000, a district area of 200sqkm of which around 70% of the area is rural with two main centres (Wigan and Leigh) and a section of the M6 motorway running through it. This shows some similarity to the Lancaster area which also has two main centres (Lancaster and Morecambe) and 90% of its area is rural and also has a section of the M6 motorway running through it. However Lancaster area is much larger (576 sqkm) and population much smaller (around 145,000). This therefore indicates the potential for greater vehicle movement per head of population than that estimated. Damage costs from road vehicle emissions for Wigan are estimated at an annual cost of £17.5million based on EMIGMA inventory data for 2010). For further information on EMIGMA see: http://www.greatairmanchester.org.uk/whatarewedoing/emigma.aspx .

Figure 1.5 Graph showing the relative risk of death per day or event from various activities



NB Risk from urban air pollution is generally associated with longer term daily exposure rather than single events. Further detail on calculations/data sources used to determine risk is contained in Appendix 3

1.5 How much do we need to reduce pollution by in Lancaster?

Following the designation of an AQMA in Lancaster in 2006 a ‘Further Assessment’ report was produced by the Air Quality Management Resource Centre at the University of the West of England (available at : http://www.lancaster.gov.uk/environmental-health/environmental-protection/air-quality/lancaster-air-quality-management-area-aqma/ .

Although the report is now seven years old, as nitrogen dioxide pollutant levels have not decreased significantly over the past ten years the report still provides an indication of the level of emission reduction required to meet air quality objectives for nitrogen dioxide.

The report indicates the within the Lancaster AQMA reductions of between 21% and 60% are required to meet the Objective for nitrogen dioxide i.e. substantial reductions are required. The report also indicates that just over 50% of the emissions arise from Heavy Duty Vehicles (HDV’s).

Particulate pollution was not covered by this report, however as detailed previously there is no safe level for particulate and given its significant health impact, reductions in particulate of any scale are desirable.

1.6 How many households are affected?

Although most air quality actions have a wider beneficial impact than on a specific population/area, in producing an action plan for Lancaster actions will be intended to improve air quality issues within the designated Lancaster AQMA. As a consequence it is relevant to establish the number of households affected within the AQMA.

A desk study identified around 270 residences within the Lancaster AQMA. Obviously in many cases taking action in this location may also have benefit to households in other locations near to and outside the AQMA in addition to benefits for people working, going to school and visiting the area. As indicated from Figure 2.1 below other wider and important associated benefits often follow from actions.

1.7 Conclusion

Air pollution particularly at roadside within the AQMA is a significant issue both in terms of nitrogen and particulate pollution. The estimated annual damage cost of transport emissions in the Lancaster district is around £8 million per year with a health impact for people living within the Lancaster AQMA (last estimated at around 270 households) over double that of people living in rural locations. The particular significance of particulate in terms of health impact makes this a priority for the strategy although reductions in nitrogen dioxide are also required to meet objective standards.

Chapter 1 - Part 2 – How will the strategy fit in and what are its aims?

The primary and first aim of this strategy is to reduce air pollution in Lancaster.

However if we tackle air pollution it is likely that there will also be other wider ranging benefits, which are sometimes difficult to quantify but are very important to acknowledge. Understanding and distilling the resulting complexities of adopting a particular course of action is essential to choosing what course is appropriate to take. Without this understanding decisions will inevitably be unbalanced. A second aim of this strategy is therefore to obtain sufficient information to allow balanced decision making and where information gaps are identified, to address these.

The following chart (Figure 2.1 below) provides an example of some of the wider ranging problems that arise from increased car ownership and use and therefore also indicates some of the related benefits that can arise if this should change :-

Figure 2.1 Chart showing the various related impacts of increased car ownership.

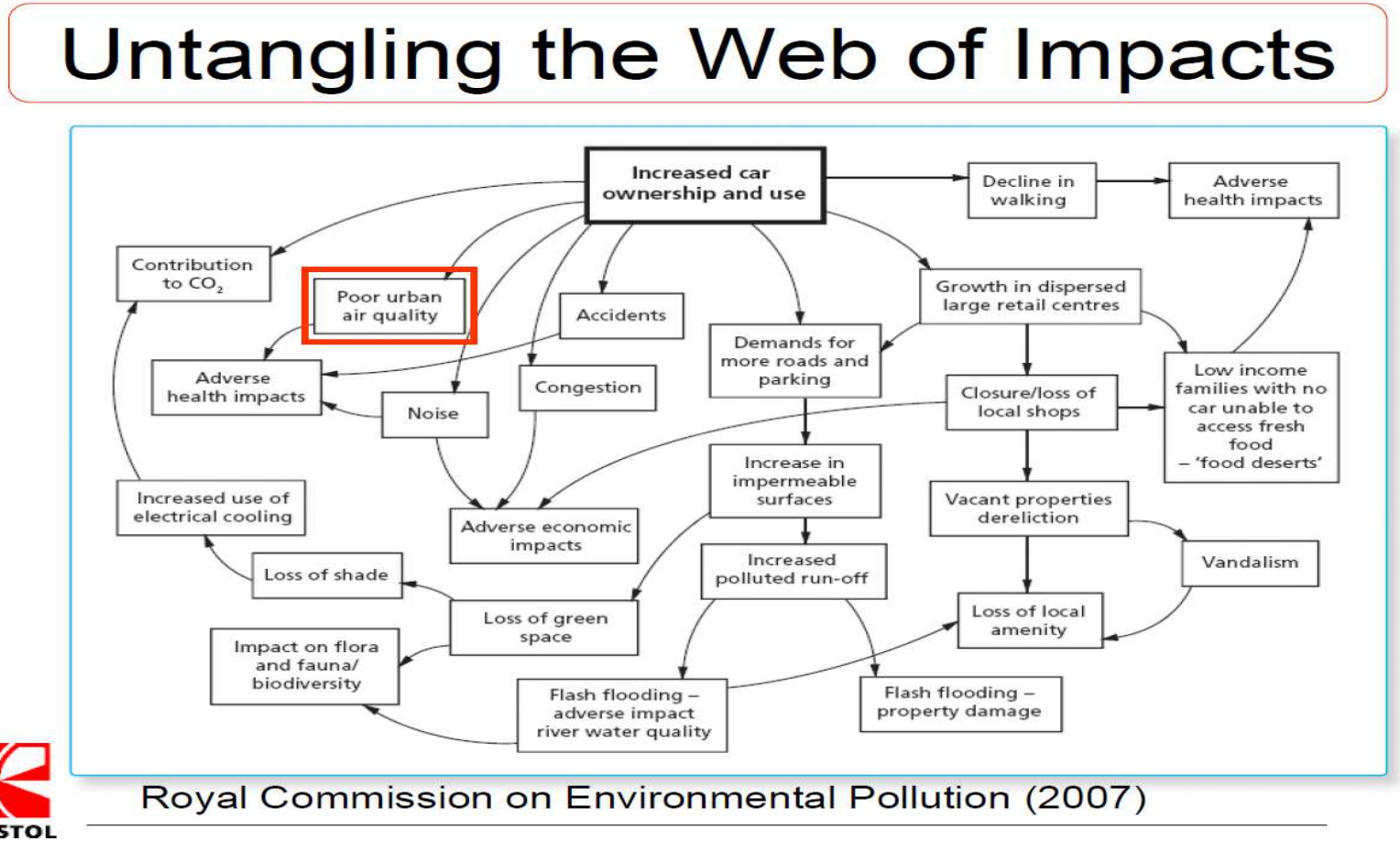


Chart taken from Presentation by Dr Tim Chatterton to IASPC conference in December 2009 entitled ‘Urban Design, Air Quality and Health’. – available at: http://www.iapsc.org.uk/chapter.php?f_cha_id=22

Information gathered from research then needs to be presented in a way that also enables balanced decision making. To this end the strategy’s third aim is to present information in an ordered way and to establish forums and groups for the purposes of maintaining awareness, for consultation, for decision making and to support and oversee actions.

Other existing plans and strategies will also affect decisions arising from this strategy. A table showing the key related plans and strategies and some extracted detail are contained in Appendix 2.

The Local Development Framework Core Strategy for Lancaster and the Lancaster and Morecambe Vision Board identifies three areas important for the local economy, employment and future development. These are (in no particular order):

- Energy – Heysham power stations and off-shore power (including the port).
- Knowledge based industries – in particular higher and further education.
- Tourism – particularly for Lancaster and Morecambe.

All of these areas could if promoted and encouraged without due consideration to traffic impacts could potentially attract increased road traffic to the area and therefore be in conflict with steps to reduce traffic congestion and air pollution/emissions.

However this strategy recognises a common theme between all these plans in their stated aims of reducing local traffic congestion, seeking an efficient and environmentally sustainable transport system and the need to improve and protect health and quality of life. These themes can be seen in all of the plans and strategies and are considered therefore to be both supportive and integral to the delivery of air quality actions. For example if traffic congestion in Lancaster was resolved this may resolve the air quality issues in that location or at least significantly improve the situation.

However despite these common policy themes, it can be difficult to discern what actions are explicitly intended for Lancaster and specifically how and when the policy aims will be delivered and what benefit will arise. It is also unclear exactly what the accepted roles and responsibilities for tackling air quality issues are and what the ambition is for Lancaster over forthcoming years with anticipated development. It will therefore be a fourth aim of this strategy to clarify theses issues.

In summary there are a number of key aims for the strategy. These are as follows :-

- To reduce air pollution/emissions in Lancaster and specifically to :
  - To meet air pollution objectives/limit values for nitrogen dioxide in Lancaster.
  - To minimise levels of particulate air pollution in Lancaster.
  - To reduce carbon dioxide emissions.

- To better understand the benefits and conflicts arising from policies, plans and actions and to present them in a format to assist decision makers.

- To provide a lasting structure for ongoing participation, consensus building, awareness and overseeing of air quality matters.

- To ensure clarity is provided to what is intended from plans and policies (new or existing) and for roles and responsibilities to be understood and accepted.

Lancaster currently is potentially presented with an unprecedented opportunity to consider and relieve traffic and air pollution problems in Lancaster. This opportunity is due to a combination of both strategic approach through this and other strategies and also potential opportunities offered by new development should they proceed (particularly the M6-Heysham link Road and Canal Corridor/Lancaster Castle developments in Lancaster City). The latter two of these developments will of course also potentially attract traffic to Lancaster City, emphasising the current importance of producing a properly considered and integrated action plan. Poor air quality, an unpleasant environment and traffic congestion are things that will not assist success for any new or existing city centre occupiers.

Finally it is also worth mentioning that given current exceedances of air quality standards across the country the government may be exposed to infraction fines from the European Union. Local authorities should be aware that under Part 2 of the Localism Act, it is possible that these fines or a proportion of the fines may be passed on to the local authority (see: http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenvaud/1820/182004.htm).

2.1 Conclusion

The common themes between various existing plans and strategies are to reduce traffic congestion, to seek environmentally sustainable transport options and to protect and improve the health and quality of life of the residents of Lancaster. These themes are also inherent in this strategy, however this strategy will more specifically direct the approach to look more closely at policies and plans to see if they can be strengthened, to determine whether there is conflict and also through better communication to be clear what is intended and required. Finally it is also very important that air quality is not seen or dealt with in isolation as a burden to be overcome, but rather integrated as part of development and transport planning services recognising

the numerous non air quality benefits that can arise (as indicated in Fig 2.1 above).

Chapter 2 - The Strategy - Where are we going and how do we get there?

3.1 Why is a strategy required rather than going directly to an action plan?

Historically across the country Air Quality Action Plans (AQAP) have been produced to help address air quality problems. However in the majority of cases action plans have been largely composed of adopted actions (air quality improvement not being their main purpose) and the measured success of these actions has often been very difficult to determine. The whole process has therefore been brought into question. This strategy is therefore put forward to address these issues and within the current legislative framework, to create the most favourable conditions for effective measured air quality actions to be delivered.

The main specific objectives of the strategy mirror its aims. These are as follows :-

- Review the existing policy framework which may contain underlying conflicts or limited ambitions (particularly local development and transport plans) and maintain engagement where policies are amended or introduced.

- Define and agree the accepted roles and responsibilities of the Council and its partners, particularly the County Council, the planning sections of the County and City Councils and with developers.

- Provide a platform for better knowledge on local air quality impacts and for ongoing research to enhance knowledge (including working with, Defra, the County Council, public health bodies, consultant specialists, the Low Emissions Strategies Partnership and Lancaster University).

- Establish and maintain a forum to obtain a consensus about public support for air quality action.

- Deliver, implement and monitor an effective air quality action plan.

Further detail on how the strategy will deliver its aims and objectives is contained in Table 1 below:-

Table 1 Detail on the delivery of the strategy aims and objectives

Theme	Reason	Strategy Response
Roles and Responsibilities	Given the existing separation of roles; in order to deliver effective actions it is important that the roles and responsibilities are defined and accepted by the Council and its partners.	Roles and responsibilities to facilitate air quality action planning and for the subsequent delivery and monitoring will be clearly defined and agreed. Well established and defined partnership working will be essential to the delivery of a plan.
Policy and Plans	Plans and policies need to define clearly what is proposed and planned specifically for Lancaster	Specific questions will be raised in relation to existing plans and policies (see Stage 1 of Table 2 below). Where new policies or plans are proposed a similar approach will be adopted.
Information	It is important that the local air quality impact is adequately understood and also put in context with other health impacts to enable proper consideration and proportionate action. Decision makers and stakeholders need to be adequately informed so that a consensus on action can be obtained.	Chapter 1 of this document goes some way to explain the estimated impact of air pollution. However key to the first few stages of the strategy will be to communicate this information (in addition to any other information available through further review/research/investigation) to all parties involved (See Strategy process -Table 2 below). This may also include identifying and directing the need for further research/study where gaps are identified.
Process	The process needs to set the right conditions to allow the review, consideration, selection, agreement and delivery of actions. Action review and assessment needs to be suitably structured to set the right conditions and provide the required level of detail and assistance to enable decisions to	The process will follow the general staging in Table 2 below, however forums and groups will be maintained beyond the delivery of the action plan to oversee and support agreed action delivery. Ultimately it is considered that a wide range of actions will be considered for assessment. The assessment process will provide estimated key information in the suggested outline format detailed in Table 3 below to produce a structured and informed decision

	be made. It is also important that the process specifically includes the selection and exclusion of possible actions or measures. It is also important that ultimately actions and the ambition through action are selected and carried forward by the public and their representative councillors. The role of officers in the process is to present the information in a way the facilitate selection.	making process. For clarity and to direct action to a restricted number of key significant effective actions, the selection process will look to include or exclude actions.
Collaboration, participation and agreement (forming a consensus).	The implementation of actions are reliant on participation and agreement of key partners, particularly at the County Council (through traffic/highway management and infrastructure), through new development (planning sections of City and County Council and key developers) and the public (through group/forum based public consultation and local councillors).	Outline agreement has been obtained with the County Council to work together to produce a list of assessed actions based on format contained in Table 3 below. Further detailed agreement(s) will be obtained to enable the production of the final list of actions for assessment. Engagement will also take place directly with planning departments of the City and County Councils and with developers (through the planning system) regarding the delivery of actions. Again agreements will be sought. Smarter engagement will take place with the public to understand what support there is for action and this will be maintained during the formation of the action plan and subsequently to support and oversee agreed action delivery. The outcome will be consensus agreement and support dictating the ambition and level of action.

Timing	Given the current opportunities it important that a planned time frame is given to implement the strategy culminating in the production and managed execution of an action plan. It is also important that sufficient time and resource is allocated to the proper review and assessment of actions.	A time frame will be set for implementation of the Strategy :- Initial review consultation - Spring 2014 Assessment of Actions – Complete Autumn 2015 Production of final Action Plan - 2016 NB The above timescale does not prohibit actions being taken forward in advance of the production of the final plan. This will be necessary in some cases to meet current opportunities.
Tangible Outcomes	Actions should be both selected and rejected. Actions selected must measurable and in their detail include measurement parameters. Actions contained in the plan should provide a significant impact.	The final plan will include only significant actions with targets and monitoring requirements (a quantified action plan). Actions with minimal air quality impact will not be discouraged and will be supported by the plan. They will however not be specifically assessed and listed/monitored within the final plan.

Note:
1. A ‘Questions and Answers’ Section is contained in Appendix 1, which further outlines and summaries the purpose of this strategy

Further detail of the strategy process framework and outline assessment requirements are contained in Tables 2, 3 and 4 below.

Table 2 – The Strategy Process (Process Framework)

Stage Ref	Stage	Description	Outcome
1	Review of existing plans and policies	Existing plans and strategies will be reviewed and the following questions raised :- What are the specific outcomes from the plans/policy for Lancaster? How are outcomes measured? Could the plans and policies be improved? If the plan/policy could be improved is this feasible? Are any new plans/policies required and are they feasible? Are there any conflicts created by existing plans/policies? Can working arrangements be improved to aid delivery?	A review of existing plans and policies to determine what is currently being delivered and assessing whether any changes are required and are feasible. Outcome will be a list of recommendations relating for each existing plan and strategy (List 1). This process can also be applied to proposed new plans and policies.
2	Informative	Local air quality information will be prepared and presented to newly formed forums/group(s) composed of members of the public councillors, officers, interested agencies/bodies.	Forums and group(s) established to develop a future Air Quality Action Plan for Lancaster. Inform these forums and group(s) of air quality issues for Lancaster in context of anticipated/planned future development for Lancaster. List produced of possible actions to be included for consideration (List 2). Forums and groups will be maintained through the

		Further research/study may also be directed where a need is identified.	delivery of the action plan and subsequently to oversee and support agreed action. Execution or commissioning of additional research as identified/required.
3	Establish roles and responsibilities	Key partners identified. Meeting, consultation and agreement with key partners.	Agreement on recommendations arising through policy and plan review (List 1) and proposing changes for implementation (List 3). Written agreement with partners regarding their role in air quality action planning and subsequently action delivery.
4	Consultation	Circulate and consult on draft list of possible actions produced from stage 2 (List 2) and policy changes from stage 3 (List 3). Consultation to include particularly households within the Lancaster AQMA.	Finalised proposed list of policy/plan changes produced (List 4) Finalised proposed list of possible action measures produced (List 5).
5	Report to Councils	Report to City Council/County Council detailing list of measures/policy changes to be taken forward for further assessment and measures/policy changes that have been excluded/rejected.	Confirmation of action/policy measures proposed or amendment of measures to proceed to assessment stage (List 6). This includes a list of rejected action/policy changes.
6	Assessment	Information outlined in Table 3 below will be obtained for each action. Where combined actions are considered to contribute significant	Full list of assessed measures produced (List 6 with assessment as per Table 3 below)

		synergistic additional benefit these actions will be also be assessed in combination.	
7	Re-assembly of group(s) established in Stage 2	Consider assessment results and establish a consensus.	Prioritised list of measures produced (List 7)
8	Report to Councils	Priority list of measures reported to Councils including any proposed method of delivery e.g. grant funding, existing budgets, new development based funding, other. Report to also detail method for action delivery measurement.	Output for Air Quality Action Plan (List 8 – see format shown in Table 4 below - with measurement and delivery proposal)
9	Report to forum/group	Maintain forum/group to oversee and support agreed air quality actions	Delivery of actions overseen by forum/group. Comments/action instigated by the forum to be reported to both Councils annually as part of the annual action progress report.
10	Report to Councils	Action delivery progress report produced by Lancaster City Council Environmental Protection Service submitted to Councils (both City and County Councils) on an annual basis.	Progress report accepted by the Councils with or without recommendations.

Note:

1. Assessment of actions will require significant time input from City Council (emission/health impact based part of the assessment) and the County Council (outlining schemes, determining traffic changes and providing estimate costings for transport based actions).

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Table 3 Air Quality Action Assessment Detail

Key components of assessment								
Unit of measurement	**Concentration (ug/m^3) or mass emission (kg or tonnes) based assessment dependant on action**		**Mass emission (kg or tonnes)**	**£000**	**£000**	**Integer**	**A micromort is a measurement indicating the risk of death**	**Text/Numeric**
Action	**Emission Change NO_2**	**Emission Change PM_{10} (and $PM_{2.5}$ if feasible)**	**Emission Change CO_2**	**Estimated Capital/Revenue Cost of Action**	**Annual Damage Cost Avoided**	**Number of Households Targeted**	**Micromort benefit (only where change is significant)**	**Other Benefits/disadvantages of action (Quantitative or Qualitative description)**
Cumulative Total								

NB In some cases it may be difficult to estimate/predict the impact of actions as detailed above, however a key principal of the strategy approach is that quantification is a requirement and that the best available data (specified) is used to provide an estimate. Assumptions, where made, will be stated.

Table 4 – Measurement of Actions (Annual)

Action/policy	Measurement method	Indicator	Reporting method	Inclusion/amendment to other strategy/plan	Party responsible for delivery and monitoring of action

3.2 Conclusion

Following the steps outlined by this strategy will create the right conditions for the production of an agreed and accepted quantified Air Quality Action Plan and for ongoing air quality awareness and support. Although this strategy relates specifically to the Lancaster Air Quality Management Area, the approach adopted can equally be applied to other Air Quality Management Areas.

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Appendix 1

Questions & Answers – The Air Quality Strategy

Q:- What is it, in a nutshell?
A: Short version:- The strategy sets the right conditions, defines the process and framework to facilitate policy review, action selection, action inclusion or exclusion and ultimately the delivery, monitoring and overseeing of actions. The level of action and ambition of the resulting action plans will be set through agreement of the Council, its partners and stakeholders.
A: Longer version:- Lancaster City Council has a statutory Local Air Quality Management duty to address local air quality issues, however the task is given without a specific budget to fund actions or strict obligation to meet specific targets. Action therefore relies on partnership working, and often the unobligated and unfunded will and ambition to support or execute actions. This position has historically led to a piecemeal approach with collected actions rarely being taken for identified air quality reasons. Success has therefore been limited. The strategy therefore sets out to change this by defining and agreeing the accepted roles and responsibilities of the Council, its partners (e.g. the County Council), political leaders and stakeholders and specifically the process and framework to facilitate policy review, action selection, action inclusion or exclusion and ultimately the delivery, monitoring and overseeing of actions. This process will ultimately result in the delivery of a commonly agreed air quality/emission reduction action plan with agreed targets and monitoring systems. The level of action and ambition of the plan will be set through agreement of the Council, its partners and stakeholders.

Q: What is in it? (…and what won't be)
A: -This strategy defines the mechanism to end up with an agreed and accepted plan that will be implemented and properly overseen. It will not however include the actions/action plan itself. This will be an outcome from the Strategy. A considerable amount of work will be undertaken calculating, collecting and interpreting information, ensuring the issues are properly presented and understood, considering other strategies and plans and reviewing policies, consulting stakeholders and understanding common and conflicting aims. This will however support the strategic approach but does not directly form part of this strategy document itself.

Q: What are its aims and objectives?
A:

Aims	Objective(s)
To reduce air pollution/emissions in Lancaster and specifically to : • To meet air pollution objectives/limit values for nitrogen dioxide in Lancaster. • To minimise levels of particulate air pollution in Lancaster. • To reduce carbon dioxide emissions.	Deliver, implement and monitor an effective air quality action plan
To better understand the benefits and conflicts arising from policies, plans and actions and to present them in a format to assist decision makers.	Provide a platform for better knowledge on local air quality impacts and for ongoing research to enhance knowledge (including working with, Defra, the County Council, public health bodies, consultant specialists, the Low Emissions Strategies Partnership and Lancaster University).
To provide a lasting structure for ongoing participation, consensus building, awareness and overseeing of air quality matters.	Establish and maintain a forum to obtain a consensus about public support for air quality action.
To ensure clarity is provided to what is intended from plans and policies (new or existing) and for roles and responsibilities to be understood and accepted	Review the existing policy framework which may contain underlying conflicts or limited ambitions (particularly local development and transport plans) and maintain engagement where policies are amended or introduced Define and agree the accepted roles and responsibilities of the Council and its partners, particularly the County Council, the planning sections of the County and City Councils and with developers.

Q: Why are we doing things this way?
A: Past process has not delivered resolution to the air quality issues in the centre of Lancaster. Due to the absence of strict obligation to resolve air quality issues (through existing legislation) and undelivered nationally predicted pollution reductions, the past managed process has not delivered a accepted solution to the problem or reached an end point of where all possible actions have been properly considered, challenged, assessed and then either planned/implemented or rejected. The strategy will clearly define and set the management structure for this process so that a commonly agreed, accepted and properly managed plan can emerge.

Q: What will it deliver?
A: The strategy will ultimately deliver an agreed action plan and process to manage and take it forward. The extent to which this delivers air quality/emissions improvements will be decided by the partners and stakeholders and not by the City Council’s Health and Housing Service. The Health and Housing Service will act through the strategy to manage and help inform the process. What agreed actions the plan includes, what these should deliver (in terms of improvement,) where responsibility for execution of actions lies, what targets are set and how these will be monitored and importantly what actions have been rejected will be explicit within the delivered action plan.

Q: How long is it going to take?
A: Delivery of this Air Quality Strategy (essentially comprising of a process management plan) will be delivered by April 2013. The final delivery of the action plan will be dependant level of the sophistication and robustness of the approach adopted (and past experience of action planning indicates the approach should be robust). For example, if an in-house assessment system adopting sophisticated traffic/pollutant modelling is developed this could take more than a year to produce useful outputs. It is considered bearing this in mind that delivery of the final plan should take approximnately 2 years following the delivery of the strategy.

Q: What do you need to make it happen?
A:
1. Ongoing support of councillors and senior officers through process.
2. Scrutiny of outcomes by councillors and senior officers (and others as set out by the strategy) to ensure actions are appropriately included or excluded.
3. Public support for action.
4. Sufficient resources to make process robust (time/money)
5. An established working framework/relationship with partners, particularly with the County Council, Planning (City and County) and local developers (through planning regimes) which are considered at the outset (subject to review) to be the key partners for the delivery of any actions.
6. An established management and reporting system to support and oversee the delivery of actions.
7. Sourced funding for the delivery of actions through existing or new funding streams.

Q What does success look like?
A:
1. Delivery of an agreed, properly defined, managed and monitored action plan designed to fulfil the aims and objectives of the strategy.
2. Delivery of support mechanisms to deliver and maintain air quality actions.
3. Increased awareness of the impact/related impacts of poor air quality.

Q: What are the main risks to success?
A:
1. Non-compliance/lack of engagement with the strategy process.
2. Inadequate understanding of issues and their relative importance.
3. Lack of robustness in assessment process.
4. Absence of funding for some actions.
5. Change in national requirements.

Appendix 2

Exerts from Selected proposals, plans and Strategies for Lancaster

Table 5 Showing selected detail from existing proposals, plans and strategies for Lancaster

Measure	Detail from Plan/Strategy/proposal
M6/Heysham Link Road	o The scheme if delivered offers potential traffic/air quality relief benefits to Lancaster. o There is emphasis in the scheme to look at additional measures to address traffic issues in Lancaster
Canal Corridor Development	The impact of the canal corridor development (should it gain approval and proceed) is yet to be determined however the development potentially offers the opportunity to particularly look at traffic management and parking provision/management in central Lancaster
Lancaster Castle	As for Canal Corridor development above.
Local Development Framework for Lancaster Core Strategy	Key policies affecting air quality :- Policy E1 ENVIRONMENTAL CAPITAL - To improve the quality of the District's environment. Policy E2 TRANSPORTATION MEASURES - To support the District's Regeneration, improve Residents' Quality of Life and minimise the environmental impact of traffic. Policy MR1 Planning Obligations – To ensure that development meets the needs of communities and the delivery of sustainable development. The following extracts details particular relevant objectives :- **3.13** The Strategy seeks to improve public transport with more 'Quality Bus' services and, after completion of the Heysham/M6 link, provide more road space for buses or introduce other innovative transport solutions. The City's cycling and walking network will be completed and there will be integrated management of parking and park and ride. **3.17** The Strategy seeks better public transport links to Lancaster, a completed cycle and walking network and investment in the local rail network. The Heysham/M6 Link Road will deliver better access to White Lund and south Heysham. **6.21** The high volume of vehicles using the constrained and sensitive network of the city centre results in excessive queuing and high levels of congestion, leading to poor air quality. In 2004, the City Council declared an Air Quality Management Area in the city centre. The City and County Councils are working closely together to ensure that suitable measures are provided on this sensitive network to alleviate the problem of air quality. **6.23** The key means of improving transport in the District is the Lancashire Local Transport Plan. The key schemes for Lancaster District in the period up to 2011 are; ▪ the Heysham to M6 Link Road; ▪ Lancaster City Centre Air Quality Zone;

<table>
<tr><td></td><td>

Cycling Demonstration Project;
Personalised Travel Planning;
Morecambe West End Neighbourhood Schemes.

Other schemes under development include Park & Ride and Intelligent Transport Systems including Variable Message Signs to improve network management.

6.25 The City Council supports the M6 Heysham link road subject to the following issues being addressed:

The scheme should be delivered in connection with a full range of sustainable traffic initiatives to avoid the released road space being filled by private vehicular traffic;
The scheme should also include provision for park and ride facilities to the north of the City;
Consideration be given to measures to reduce construction noise; and
All HGV’s should be routed along the link once it is constructed.

From Appendix 8 (Core Target List)
<table>
<tr><th colspan="2">Core Targets</th><th>Monitoring</th></tr>
<tr><td>3.4</td><td>Transport</td><td></td></tr>
<tr><td>3.4 a)</td><td>Completion of Lancaster and Morecambe Integrated Transport Study by December 2008;</td><td>Through Lancaster Vision Board Monitoring;</td></tr>
<tr><td>3.4 b)</td><td>Completion of Heysham-M6 Link Road by 2011</td><td>Through Local Transport Plan monitoring</td></tr>
<tr><td>3.4 c)</td><td>Completion of Cycling and Walking Network by 2021</td><td>Through Local Transport Plan monitoring</td></tr>
<tr><td>3.4 d)</td><td>7.6% of working population travelling to work by cycle (baseline 3.8% (2001))</td><td>Through Cycle Demonstration Town Monitoring</td></tr>
<tr><td>3.4 e)</td><td>15% of working population travelling to work on foot (baseline 14.3% (2001))</td><td>Through Local Transport Plan monitoring</td></tr>
<tr><td>3.4 f)</td><td>Reduce traffic flows to and from central Lancaster by 5% for 2021 compared to 2001</td><td>Through Local Transport Plan monitoring</td></tr>
</table>
</td></tr>
<tr><td>Corporate Plan 2012-2015 – Lancaster City Council</td><td>Health and wellbeing improved and mortality rates reduced for vulnerable people in the district.

– Air quality strategy in place and agreed by March 2013</td></tr>
<tr><td>The Lancashire Climate Change Strategy – 2009 - 2020</td><td>o Develop and maintain an integrated, efficient and sustainable transport system.
o Increase the use of public transport, walking and cycling.
o Promote the use of more efficient vehicles and alternative transport fuels, including sustainable bio-fuels.
o Personalised Travel Planning - 25,000 households in Lancaster and Morecambe were approached. Results indicate that participating households reduced their car journeys by 12%.The exercise complemented the Cycling Demonstration Town project in Lancaster
(taken from the Local Transport Plan 2006/07 to 2010)

Lancaster City Council is also committed to reducing its carbon emissions by 34% by 2020. Our target annual carbon reduction is 3.4% until 2020. Since 2008/09 we have saved a total of 19.69% tCO_2, over half the 2020 target saving in only three years.</td></tr>
</table>

Local Transport Plan 2011 – 2021, A Strategy for Lancashire (items selected specifically relevant to Lancaster)	Stated priorities include:- o **Reduce congestion and delay and increase road capacity on our most congested transport corridors, improve highway links and junctions** to support the growth of our key economic centres (including Lancaster), the development of strategic employment sites, regeneration of town centres and other places which will be key drivers of economic growth (e.g. our universities). o Major new road building including proposals to support growth in Central Lancashire including the Morecambe/Heysham peninsula with the **Heysham - M6 link**. o Introduce **Park and Ride sites** serving major employment areas or supporting city centre development principally in Preston and Lancaster o Promote sustainable **travel options to important visitor destinations** o **Deliver adequate parking** whilst ensuring that public transport is a viable alternative for many journeys o Travel planning, IT solutions and suitably located development o **Expand our network of footways and cycleways** where it will contribute to the wider objective of creating quality neighbourhoods o Many of our local transport priorities also support a reduction in carbon emissions and help fight against climate change. Congestion, for example, is identified as a constraining factor to our economic growth and **solutions to this will, in turn, reduce vehicle emissions and improve air quality.** o Looking to ways of actively managing peak traffic flows to **reduce queueing and congestion**, and improving journey time reliability. o Complement regional initiatives for **new electric vehicles charging points**, through the infrastructure provided in new developments.

Lancaster District Transport Vision and Strategy	**1 Introduction** **1.1 Introduction and Context** ……The vision is to be ambitious, yet realistic and maximise the benefits for Lancaster and Morecambe, by addressing the following issues: _ Improve access and movement between the two key centres; _ Alleviate congestion in the city centre and at other key hotspots; _ Improve the quality of life for local residents, addressing the environment and air quality; _ Address the negative impact of traffic and parking on the major architectural and historic assets and public spaces; _ Restore public confidence in public transport as a viable alternative to the car; _ Connecting the rural hinterland; and _ To assist economic development and support regeneration in the district, with particular reference to Morecambe. **1.3 Key Identified Themes** The Key Themes identified for the Lancaster District Transport Vision and Strategy are as follows: _ To reduce the influence of traffic that simply passes through Lancaster City Centre – the Heysham to M6 Link Road is a major building block towards this aim; _ To build upon the core existing transport assets of the city rather than create new, such as the west coast mainline and the M6; _ To intercept long stay and long distance visitors to Lancaster and Morecambe at the edges and offer them attractive alternatives to driving into the centre; _ To encourage greater use of more sustainable, high occupancy modes for longer trips (e.g. rail, bus, car clubs); _ To create a walkable and cycleable urban area, making greater use of natural resources such as the River Lune Corridor and Lancaster Canal corridors in particular; and _ To develop a climate that ‘raises the bar’ in terms of public transport. 6 Final Vision and Strategy **Table 6.1: Key Interventions** 15 Improving poor air quality and environment. _ Lancaster City Centre Gyratory Review _ Travel Planning _ Car Sharing/Car clubs _ Integrated Ticketing _ Park & Ride schemes _ Bus Priority Measures _ Enhanced cycling and pedestrian facilities

Appendix 3

Relative Risk Data

In order make some judgement of the importance of air pollution it is important to try and compare the risks it poses with other risks we recognise. In order to do this there are inevitably estimations and simplifications that are required. The approaches adopted below however are considered reasonable for the purpose of basic comparison to aid a more general understanding of the risk posed by air pollution.

One method of considering the risk posed by air pollution is to simply compare the number of death from various causes based on national statistics and estimates. This data and its source is shown in Table 6 below and presented in Figure 1.4 above.

Another method is to compare the risk of death from various causes or activities, using the concept of micromorts. The concept of micromorts is explained below:-

The average risk of dying per day can be calculated from the average lifetime. Taking this to be 80 years, this means that there is one death for every 29,200 days lived (80 × 365 = 29,200).
The number of micromorts per day (risk of death from all causes across the population) is one million divided by that number of days (29,200) = approximately 34 micromorts per day. Therefore on average each person has approximately 34 micromorts (34 chances in a million of dying each day from some cause). To help try to put this into context with events we commonly associate with chance, the chance of winning the UK national lottery each time is 0.07 in a million (or approximately 1 in 14 million), the chance of being struck by lightening each day is 0.33 in a million (0.08 of being killed) (or approximately 1 in 3 million/ 1 in 13 million respectively) and the chance of being killed in a plane crash is around 0.09 in a million (or 1 in 11 million).

This can also be calculated another way by taking the number of people dying each day in the UK and dividing this number by the total population - 2000/63,200,000*1,000,000= 32 micromorts or 32 chances in a million of dying of some cause.

The daily risk of death on average in the UK is therefore approximately 32 to 34 micromorts. This is of course spreading the risk equally across the whole population of the UK. Obviously for individuals this will change. For example risks will change with age and how we choose to live our lives. However this method of assessing risk allows us to compare some of these risks (some which we choose to take and some of which we have little choice) and try to understand their relative importance. This is considered to be particularly important for decision makers deciding on whether action to reduce the risk is warranted or not.

The following (Table 6 below) therefore presents various data which has been used to derive relative risk.

Table 6 Data showing number of deaths from various causes and data used to derive relative risk of death.

Data	Description	Source
500	Deaths per year from food poisoning in the UK (2010)	http://www.food.gov.uk/multimedia/pdfs/publication/fsaenews0610.pdf
550 (E&W) 620 (UK)	Deaths from homicide in England and Wales (extrapolated at 620 for the UK)	http://www.bbc.co.uk/news/uk-18900384
1694 (E&W) 1909 (UK)	Deaths from falls in England and Wales (extrapolated at 1909 for the UK) - 2011	http://www.ons.gov.uk/ons/rel/vsob1/injury-and-poisoning-mortality-in-england-and-wales/2011/stb-injury-and-poisoning-2011.html
1901 (GB) 1957 (UK)	Deaths from Road accidents in Great Britain (extrapolated at 1957 for the UK) - 2011	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/9274/rrcgb2011-01.pdf
8,748 (UK)	Alcohol Related deaths in the UK (2011)	http://www.ons.gov.uk/ons/rel/subnational-health4/alcohol-related-deaths-in-the-united-kingdom/2011/alcohol-related-deaths-in-the-uk--2011.html
12,000 (UK)	Estimated deaths each year in the UK due to environmental tobacco smoke prior to restrictions (2006)	http://www.cancerresearchuk.org/cancer-info/cancerstats/types/lung/smoking/lung-cancer-and-smoking-statistics#cancer Scottish Executive, Smoking in Public Places - A Consultation on Reducing Exposure to Second Hand Smoke. 2004
26,700 (UK)	Estimated excess deaths due to winter cold	http://www.ageuk.org.uk/Documents/EN-GB/Campaigns/STW/The_cost_of_cold_2012.pdf?dtrk=true

29,000 (UK)	Estimated deaths annually in the UK due to air pollution ($PM_{2.5}$ considered to be main cause)	http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1317137012567
30,000 (UK)	Estimated deaths per year due to obesity	http://www.noo.org.uk/NOO_about_obesity/mortality
43,000 (UK)	Estimated annual deaths from cancer related to tobacco smoking (2009)	http://www.cancerresearchuk.org/cancer-info/cancerstats/types/lung/smoking/lung-cancer-and-smoking-statistics#source6 http://www.cancerresearchuk.org/cancer-info/cancerstats/types/lung/smoking/lung-cancer-and-smoking-statistics#cancer
80,000 (UK)	Estimated total annual smoking related deaths in the UK (2009)	http://www.dh.gov.uk/health/category/policy-areas/public-health/tobacco/ http://www.cancerresearchuk.org/cancer-info/cancerstats/types/lung/smoking/lung-cancer-and-smoking-statistics#cancer
730,000 (UK)	Approximate total number of deaths (all causes) each year in the UK (2010)	http://www.ons.gov.uk/ons/rel/mortality-ageing/mortality-in-the-united-kingdom/mortality-in-the-united-kingdom--2010/mortality-in-the-uk-2010.html
79.4 (UK)	Estimated average number of deaths each day in the UK due to air pollution ($PM_{2.5}$ considered to be main cause)	29,000/365
63.2 million (UK)	UK Population (2011)	http://www.ons.gov.uk/ons/rel/mro/news-release/uk-population-estimate-revealed/uk-population-estimate-revealed-.html
80 years (UK)	Life expectancy in the UK (2011) – 78 years for men, 82 years for women	http://www.nhs.uk/news/2011/03March/Pages/uk-life-expectancy-still-rising.aspx

13ug/m^3	Annual average $PM_{2.5}$ across the UK at urban background locations	http://uk-air.defra.gov.uk/library/annualreport/air_pollution_uk_2011_Compliance_Assessment_Summary_issue_2.pdf
7.6ug/m^3	Annual average background $PM_{2.5}$ within the Lancaster District (2012)	http://laqm.defra.gov.uk/maps/maps2010.html#2010BackgroundMaps
7.0ug/m^3	Lowest annual average background $PM_{2.5}$ concentration (rural parts of Lancaster) -2012	http://laqm.defra.gov.uk/maps/maps2010.html#2010BackgroundMaps
9.8ug/m^3	Annual average background $PM_{2.5}$ concentration (Lancaster City centre) - 2012	http://laqm.defra.gov.uk/maps/maps2010.html#2010BackgroundMaps
25.7ug/m^3	Roadside annual mean PM_{10} (2012) measured at Cable Street Lancaster (from 2012 USA for Lancaster)	http://www.lancaster.gov.uk/environmental-health/environmental-protection/air-quality/air-quality-downloads-links/
17.6ug/m^3	Estimated roadside $PM_{2,5}$ level at Cable Street Lancaster based on monitored PM_{10} levels and adjusted using $PM_{2,5}/PM_{10}$ ratio (0.7) obtained from the Chesterfield AURN roadside monitoring site for 2012	http://uk-air.defra.gov.uk/data/data_selector?
6%	Increase in death rate per 10ug/m^3 increase in $PM_{2.5}$	http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1317137012567 http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1317137020357

The number of deaths annually due to air pollution in the UK is estimated at around 29,000 and this in the main is considered to be due largely to particulate pollution ($PM_{2.5}$).
Therefore the number of micromorts attributed to air pollution (daily risk of death from air pollution) can therefore be calculated in the same way as for death from all causes:-

29,000 (estimated number of deaths annually due to air pollution) divided by 365 (days in the year) = 79.4 deaths per day on average.

This therefore can therefore converted to micromorts by dividing by the population of the UK (63.2 million) and then multiplying by 1 million:-

79.4 /63,200,000*1,000,000 = 1.26 micromorts. (This methodology can be used to calculate the relative risk from other causes of death. The data used and the results obtained are shown in Table 7 below.)

1.26 micromorts is therefore considered to be the average of risk of death from air pollution (average air $PM_{2.5}$ air pollution in the UK being 13ug/m^3 - see http://uk-air.defra.gov.uk/library/annualreport/air_pollution_uk_2011_Compliance_Assessment_Summary_issue_2.pdf). This method of using averages (average risk of death and average air pollution level) does very much simplify the relationship between death and air pollution, but for the purposes of comparison to aid the understanding of relative impact it is considered reasonable.

Pollution at roadside locations e.g. the Lancaster AQMA, is however elevated above this average level and therefore death rates would logically be expected to be higher. The estimated $PM_{2.5}$ roadside level at Cable Street Lancaster (derived from PM_{10} monitoring data – see Table 6 above) is 17.6ug/m^3

Therefore based on a accepted linear 6% increase in death rate for every 10ug/m^3 increase in the level of $PM_{2.5}$ (see p.11 http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1317137012567) a comparable increase/decrease in death rate/risk of death (micromorts) related to $PM_{2.5}$ levels (see data in Table 6 above) can be calculated as follows:-

0.006*17.6 = 10.56% (increase in death rate at roadside)
0.006*7.6 = 4.56% (average increase in death rate at background locations in Lancaster (away from principal roads/significant emission sources).
0.006*9.8 = 5.88% (from background air around Lancaster City away from principal roads/significant emission sources)
0.006*13 = National average urban background – 7.8% increase in death rate at national average urban background locations

Using national average $PM_{2.5}$ (13ug/m^3) to represent 1.26 micromorts (national average risk of death from air pollution) the following can be calculated using the percentage changes in death rate shown above:

Roadside (Cable Street Lancaster) (17.6ug/m^3) represents 1.71 micromorts
Average background in Lancaster $PM_{2.5}$ (7.6ug/m^3) = 0.74micromorts
Background around Lancaster Centre (9.8ug/m^3) = 0.95 micromorts
Highest background location in Lancaster (10.5ug/m^3) = 1.02 micromorts
Lowest Background location in Lancaster (7.0ug/m^3) = 0.68 micromorts

Table 7 below summarises the various risks changes calculated and data/source of data used.

Table 7 - Table showing relative risk of death from various activities/events/causes and source data

Activity (per day unless stated otherwise)	Micromorts (risk of death)	Comment/Data Source
Air pollution in a rural location Lancaster district	0.68	Location away from main roads/other pollution sources Defra background maps - 2012) http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html
Air pollution in busy built up urban area (away from principal roads)	1.02	(based on highest background in concentration in Lancaster estimated from Defra background maps - 2012) http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html
Air pollution in the Lancaster Air Quality Management Area	1.71	Derived from Cable Street PM_{10} measurement (2012) Using ratio $PM_{10}/PM_{2.5}$ adjustment obtained from Chesterfield Roadside monitoring site (2012) http://uk-air.defra.gov.uk/data/data_selector
Nation average urban background	1.26	Obtained from - Air Pollution in the UK – Compliance Assessment Summary 2011 http://uk-air.defra.gov.uk/library/annualreport/air_pollution_uk_2011_Compliance_Assessment_Summary_issue_2.pdf
Dying from cancer related to smoking	16.51 (all deaths) 8.88 (cancer deaths)	Based on estimated 80,000 total smoking related deaths and 43,000 smoking related cancer deaths in the UK (2009) and a smoking population of 13,272,000 (21% of population) http://www.dh.gov.uk/health/category/policy-areas/public-health/tobacco/ http://www.cancerresearchuk.org/cancer-info/cancerstats/types/lung/smoking/lung-cancer-and-smoking-statistics#cancer
Dying or dying of lung cancer from exposure to environmental tobacco smoke (prior to public place restrictions)	0.54 (deaths) 0.03(cancer deaths)	Estimated 12,000 deaths due to environmental tobacco smoke (60.6 million population) Estimated at 600 cancer deaths for the UK prior to 2007 http://www.cancerresearchuk.org/cancer-info/cancerstats/types/lung/smoking/lung-cancer-and-smoking-statistics#cancer Scottish Executive, Smoking in Public Places - A Consultation on Reducing Exposure to Second Hand Smoke. 2004 www.ons.gov.**uk**/.../**population**.../**population**.../**2006**-based-national-…

Alcohol related deaths in UK	0.42 (alcohol drinking population) 2.12 (allocating deaths to ‘at risk’ population only)	Based on estimated 8,748 alcohol related deaths in the UK (2011) and an estimated alcohol drinking population (90% of total population – 56,880,000) or estimated ‘at risk’ alcohol population of 11.3 million who drink above recommended safety limits) 11http://www.ons.gov.uk/ons/dcp171778_296289.pdf http://www.avon.nhs.uk/alcohol/the_facts.htm#howmany
Death from road accident	0.08	Based on road 1901 deaths (2011) and population for Great Britain of 61,400,000 (63,200,000 - Northern Ireland population 1.8 million) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/9274/rrcgb2011-01.pdf http://www.guardian.co.uk/news/datablog/2012/dec/11/2011-census-northern-ireland-religion-identity
Deaths from falls in England and Wales	0.08	1694 (2011) based on rate of 30.2 deaths per million of population (56.1 million population 2011) http://www.ons.gov.uk/ons/rel/vsob1/injury-and-poisoning-mortality-in-england-and-wales/2011/stb-injury-and-poisoning-2011.html http://www.ons.gov.uk/ons/rel/census/2011-census/population-and-household-estimates-for-england-and-wales/index.html
Deaths from Food poisoning	0.02	Based on 500 deaths per year (FSA, 2010) http://www.food.gov.uk/multimedia/pdfs/publication/fsaenews0610.pdf
Deaths caused by Obesity	1.3	Based on estimated 30,000 deaths per year http://www.noo.org.uk/NOO_about_obesity/mortality
Homicide in England and Wales	0.03	Based on 550 homicides in England and Wales in 2011/12 (56.1 million population) http://www.bbc.co.uk/news/uk-18900384 http://www.ons.gov.uk/ons/rel/census/2011-census/population-and-household-estimates-for-england-and-wales/index.html
Deaths from Cold	1.16 (total population) 7.32(allocating deaths to over 65 population only)	Based on estimated 26,700 excess winter deaths against total population and population (63.2 million) over 65 (10 million) http://www.ageuk.org.uk/Documents/EN-GB/Campaigns/STW/The_cost_of_cold_2012.pdf?dtrk=true http://www.parliament.uk/business/publications/research/key-issues-for-the-new-parliament/value-for-money-in-public-services/the-ageing-population/
Driving 250miles (car)	1	http://plus.maths.org/content/os/issue55/features/risk/index
General Anaesthetic (UK) – per event	10	http://plus.maths.org/content/os/issue55/features/risk/index

Giving Birth (UK) – per event	80	http://plus.maths.org/content/os/issue55/features/risk/index
17 miles walking	1	http://plus.maths.org/content/os/issue55/features/risk/index
20 miles cycling	1	http://plus.maths.org/content/os/issue55/features/risk/index
6 miles on a motorbike	1	http://plus.maths.org/content/os/issue55/features/risk/index
Skiing (1 day)	0.5	http://plus.maths.org/content/os/issue55/features/risk/index
Hang Gliding – per session	8	http://plus.maths.org/content/os/issue55/features/risk/index
Horse riding (per session)	0.5	http://plus.maths.org/content/os/issue55/features/risk/index
Skydiving (per jump)	6	http://plus.maths.org/content/os/issue55/features/risk/index

Appendix 4

Air Quality Objectives, sources of pollutants and health effects

Table 8 - Air Quality Objectives included in Regulations for the purpose of LAQM in England - from LAQM TG(09)

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 $\mu g/m^3$	Running annual mean	31.12.2003
	5.00 $\mu g/m^3$	Running annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu g/m^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.5 $\mu g/m^3$	Annual mean	31.12.2004
	0.25 $\mu g/m^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu g/m^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu g/m^3$	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 $\mu g/m^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu g/m^3$	Annual mean	31.12.2004
Sulphur dioxide	350 $\mu g/m^3$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu g/m^3$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu g/m^3$, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

Table 9 - Proposed standards for $PM_{2.5}$ particulate matters (not currently the subject of LAQM regulation) – from LAQM TG(09)

Table 1.2: Proposed new $PM_{2.5}$ objectives (not included in Regulations)			
Region	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
UK (except Scotland)[a]	25 µg/m³	annual mean	2020
Scotland[a]	12 µg/m³	annual mean	2020
UK urban areas	Target of 15% reduction in concentrations at urban background locations	3-year mean	Between 2010 and 2020

[a] The concentration cap is to be seen in conjunction with the 15% exposure reduction target.

Table 10 – Sources of pollutants and health effects - from LAQM TG(09)

Box 1.6: Sources of pollutants and health effects

Pollutant	Sources	Health Effects
Nitrogen Dioxide	Nitric oxide (NO) is mainly derived from road transport emissions and other combustion processes such as the electricity supply industry. Nitric oxide is not considered to be harmful to health. However, once released to the atmosphere, NO is usually very rapidly oxidized, mainly by ozone (O_3), to nitrogen dioxide (NO_2), which can be harmful to health. Nitrogen dioxide and NO are both oxides of nitrogen and together are referred to as nitrogen oxides (NO_x).	Nitrogen dioxide can irritate the lungs and lower resistance to respiratory infections such as influenza. Continued or frequent exposure to concentrations that are typically much higher than those normally found in the ambient air may cause increased incidence of acute respiratory illness in children.
Fine Particles (PM_{10}, $PM_{2.5}$ and PM_1)	Fine particles are composed of a wide range of materials arising from a variety of sources including: *combustion sources* (such as road traffic); *secondary particles*, mainly sulphate and nitrate formed by chemical reactions in the atmosphere, and often transported from far across Europe; *coarse particles*, suspended soils and dusts (eg, from the Sahara), sea salt, biological particles and particles from construction work.	Particles are measured in a number of size fractions according to their mean aerodynamic diameter. Most monitoring is currently focused on PM_{10}, but the finer fractions such as $PM_{2.5}$ and PM_1 are becoming of increasing interest in terms of health effects. Fine particles can be carried deep into the lungs where they can cause inflammation and a worsening of the condition of people with heart and lung diseases. In addition, they may carry surface-absorbed carcinogenic compounds into the lungs.
Sulphur Dioxide	Sulphur dioxide (SO_2) is produced when a material, or fuel, containing sulphur is burned. Globally, much of the SO_2 in the atmosphere comes from natural sources, but in the UK the predominant source is power stations burning fossil fuels, principally coal and heavy oils. Widespread domestic use of coal can also lead to high local concentrations of SO_2.	Even moderate concentrations may result in a fall in lung function in asthmatics. Tightness in the chest and coughing occur at high levels, and lung function of asthmatics may be impaired to the extent that medical help is required. Sulphur dioxide pollution is considered more harmful when particulate and other pollution concentrations are high.
Benzene	Benzene is a volatile organic compound (VOC) which is a minor constituent of petrol. The main sources of benzene in the atmosphere in Europe are the distribution and combustion of petrol. Of these, combustion by petrol vehicles is the single biggest source (70% of total).	Possible chronic health effects include cancer, central nervous system disorders, liver and kidney damage, reproductive disorders, and birth defects.
1,3-Butadiene	1,3-butadiene, like benzene, is a VOC emitted into the atmosphere principally from fuel combustion of petrol and diesel vehicles. 1,3-butadiene is also an important chemical in certain industrial processes, particularly the manufacture of synthetic rubber.	Possible chronic health effects include cancer, central nervous system disorders, liver and kidney damage, reproductive disorders, and birth defects.
Carbon Monoxide	Carbon monoxide (CO) is a colourless, odourless poisonous gas produced by incomplete, or inefficient, combustion of fuel. It is predominantly produced by road transport, in particular petrol-engine vehicles.	This gas prevents the normal transport of oxygen by the blood. This can lead to a significant reduction in the supply of oxygen to the heart, particularly in people suffering from heart disease.
Lead	Since the introduction of unleaded petrol in the UK there has been a significant reduction in urban lead levels. In recent years industry, in particular secondary non-ferrous metal smelters, have become the most significant contributors to emissions of lead. The highest concentrations of lead and heavy metals are now therefore found around these installations in industrial areas.	Even small amounts of lead can be harmful, especially to infants and young children. In addition, lead taken in by the mother can interfere with the health of the unborn child. Exposure has also been linked to impaired mental function, visual-motor performance and neurological damage in children, and memory and attention span.

Tables 8,9 and 10 taken from Defra Local Air Quality Management Technical Guidance LAQM.TG(09) – February 2009

Appendix 5

Damage Cost from Transport emissions - Wigan area (used as basis for estimating transport damage costs in Lancaster by scaling relative to human population)

Estimated annual transport emission damage costs (based on EMIGMA 2010 data/2010 year costs) – using IGCB central estimates from Damage Cost Calculator

	NO_2 £ million	**PM_{10} £ million**	**CO_2 £ million**
Wigan	1.2	13.4	2.9

Appendix 6

Glossary

NO_2 – Nitrogen Dioxide – Pollutant generally arising directly or indirectly from combustion.

NOx – Nitrogen Oxides – The term is used to refer to the collective of various oxides of nitrogen including nitrogen dioxide and nitrogen monoxide (NO).

PM_{10} and $PM_{2.5}$ – PM_{10} and $PM_{2.5}$ are the terms used to describe very small particulate pollution of a size that can be easily breathed into the lungs. Visible dust is often composed of coarser particulate of larger size than PM_{10} and $PM_{2.5}$. Particulate is not a single chemical pollutant, but may be composed of a wide variety of substances that may have an affect on health.

Air Quality Objectives – The government has set a number of air quality objectives through the Air Quality Strategy and Regulations. These are periodically revised in response to European directive requirements and new scientific evidence.

Air Quality Limit and Target values – These are air quality standards set through European Commission directives.

Local Air Quality Management (LAQM) – Through the Environment Act 1995 and the government's Air Quality Strategy there is a requirement placed on local authorities to assess local air quality for certain pollutants and to put in place action plans where exceedances of air quality objectives may take place.

AQMA – is the acronym for Air Quality Management Areas. These are designated areas of potentially poor air quality (where air quality objectives may be exceeded).

Greenhouse gases - emissions of gases such as carbon dioxide (CO_2) and methane (CH_4) which are generally considered to be responsible for climate change/global warming. They are not classed as air quality pollutants for the purposes of Local Air Quality Management.

Emission Inventory – Detail showing the mass (usually in kg or tonnes) of emissions for various pollutants/gases arising from various sources (transport, domestic, industrial/commercial) within a defined area e.g. Lancaster district.