St. Helens Metropolitan Borough Council

Local Air Quality Management

Further Assessment

Project Ref: 22717/001

Doc Ref: R002

September 2011

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Document Control Sheet

Project Name: **Local Air Quality Management**
Project Ref: **22717/001**
Report Title: **Further Assessment**
Doc Ref: **R002**
Date: **September 2011**

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Revision	Date	Description	Prepared	Reviewed	Approved
R001	Aug 2011	Draft	RF	GH	AR
R002	Sept 2011	Final	RF	GH	AR

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Executive Summary

Peter Brett Associates (LLP) has been commissioned by St. Helens Metropolitan Borough Council (SHC) to undertake a Further Assessment of nitrogen dioxide (NO_2) concentrations within the two Air Quality Management Areas (AQMAs) declared in 2009. This assessment is a requirement of the Local Air Quality Management (LAQM) regime.

The aim of the Further Assessment is to confirm the extent and magnitude of likely exceedences of the annual mean NO_2 National Air Quality Objective (NAQO) in 2009, and to identify the main sources of nitrogen oxides (NO_x) that contribute to the exceedence. It also assesses the potential impact of possible traffic management scenarios for each AQMA to inform the Air Quality Action Plan (AQAP) and considers the likelihood of achieving the NAQO by the 2015 compliance date.

NO_2 concentrations are still predicted to exceed the NAQO where there is relevant exposure within the two AQMAs in 2009. Significant reductions in NO_x emissions from traffic would be required in order to meet the NO_2 limit value. Depending on the location this may require as much as a 63% reduction in 2009 emissions from transport.

If it is assumed that road traffic emissions and background concentrations reduce as predicted, the annual mean NO_2 objective is predicted to be achieved in both AQMAs in 2015. There is evidence however to suggest that road traffic emissions and background concentrations are not dropping as rapidly as previously predicted and therefore additional mitigation measures are likely to be required for FA1 to ensure compliance by 2015. As a conservative modelling approach has been adopted for FA2, it may be that additional mitigation measures are not required for this AQMA.

Modelling has been undertaken for potential measures that could be taken to reduce emissions within each of the two AQMAs. Within FA1 (M6 including Park Cottages and Southworth Road), reducing speed on the motorway to 40 mph does not have a significant impact in reducing predicted NO_2 concentrations. The source apportionment work for the worst affected receptors in this area indicates the importance of reducing HDV emissions in achieving compliance for these receptors.

Reducing HDV and/or LDV traffic by 30% gives potentially significant reductions in NO_2 concentrations in FA2 (High Street, Newton-Le-Willows).

The Air Quality Action Plan for the Borough should take into account the results of this modelling in forming the strategy to achieve compliance with the annual average NO_2 limit value.

This executive summary contains an overview of the key findings and conclusions. However, no reliance should be placed on any part of the executive summary until the whole of the report has been read.

1 Introduction

1.1 Scope

1.1.1 St. Helens Metropolitan Borough Council (SHC) has commissioned Peter Brett Associates LLP (PBA) to undertake a Further Assessment of nitrogen dioxide (NO_2) concentrations within the two Air Quality Management Areas (AQMAs) declared in St. Helens in 2009. This assessment is a requirement of the Local Air Quality Management (LAQM) regime.

1.2 Aim of Assessment

1.2.1 Following the Progress Report 2008, monitoring identified the likely exceedences of the annual mean NO_2 national air quality objective (NAQO) at two locations within the Borough.

1.2.2 The aims of this Further Assessment are as follows:

- To confirm that the AQMAs are still required, and the extent of exceedences of the objective,
- To identify the key sources of the NO_2 exceedence in each of the AQMAs, and
- To predict NO_2 concentrations for possible scenarios for each AQMA to inform the Air Quality Action Plan (AQAP).

1.3 Previous Local Air Quality Management Assessments

1.3.1 Local authorities have a statutory duty to periodically review and assess air quality in their area under Part IV of the Environment Act 1995. These reviews and assessments form the cornerstone of Local Air Quality Management (LAQM), and provide a systematic framework for assessing the risk of the air quality objectives being exceeded.

1.3.2 The UK Government has issued technical guidance (LAQM.TG(09)) and additional updates, plus policy guidance (LAQM.PG(09)), to support local authorities in undertaking this work.

1.3.3 The first round of Air Quality Review and Assessment, completed by SHC in 2000, concluded that the National Air Quality Objectives (NAQOs) would be achieved across the Borough.

1.3.4 The second round of Review and Assessment introduced a two staged approach, namely an Updating and Screening Assessment (USA), followed by a Detailed Assessment, where applicable. The second (2003) and third rounds (2006) of Review and Assessment carried out by SHC concluded that the NAQOs would be achieved across the borough. The USA 2006 identified an area of concern close to Southworth Road (adjacent to the M6) due to high concentrations of NO_2. Detailed monitoring was put in place, with assessment against the NAQOs to be made after 12 months of monitoring.

1.3.5 In the 2008 Progress Report it was recognised that two locations within St Helens, Southworth Road/M6 and High Street, Newton-le-Willows, were exceeding the annual mean

NAQO for NO_2. As a result, two Air Quality Management Areas (AQMAs) were declared in April 2009.

1.3.6 This Further Assessment investigates the two AQMAs declared as a result of the third round of Review and Assessment.

1.3.7 The fourth round of Review and Assessment has so far included a USA (2009) for air quality within the borough. The 2009 USA and monitoring across the borough identified five areas where the annual mean objective for NO_2 may be exceeded and detailed assessment of these areas is currently being carried out.

1.4 Report Structure

1.4.1 The structure of the report is set out as follows:

- **Section 2** outlines details of the relevant air quality legislation and policy
- **Section 3** provides NO_2 monitoring data across the AQMAs
- **Section 4** outlines the assessment methodology and model verification
- **Section 5** presents the predicted concentrations and source apportionment for 2009
- **Section 6** presents the predicted concentrations for 2015, the year of compliance
- **Section 7** describes the air quality improvements required to meet the objective
- **Section 8** presents the results of the scenario testing, and
- **Section 9** provides the conclusions and recommendations for the assessment.

1.4.2 The report contains the following appendices:

- **Appendix A –** Glossary of Terms
- **Appendix B** – Reference List
- **Appendix C** – Traffic and Rail Data Used in Modelling
- **Appendix D** – Queue Lengths
- **Appendix E** – Diurnal Profile
- **Appendix F** – Model Verification
- **Appendix G** – Figures

2 Policy & Legislation

2.1 Local Air Quality Management (LAQM)

2.1.1 The Environment Act 1995 introduced a system of LAQM. This requires local authorities to regularly and systematically review and assess air quality within their boundaries against a series of objectives, and appraise development and transport plans against these assessments.

2.1.2 LAQM requires local authorities to assess the likelihood of the air quality objectives for seven key pollutants being achieved within their boundaries. These pollutants are benzene, 1,3 butadiene, carbon monoxide, lead, NO_2, PM_{10}, and Sulphur Dioxide (SO_2).

2.1.3 The first round of the review and assessment process was generally completed between 1998 and 2001. The Government recommended local authorities undertake a four stage approach with increasing detail at each assessment stage.

2.1.4 Subsequent rounds of review and assessment each comprise two phases and possible third and fourth phases. The first stage is to complete an USA to identify any changes since the previous round that may lead to exceedences of the air quality objectives. If the USA highlights a likely exceedence of the air quality objectives the local authority is required to carry out a Detailed Assessment for the pollutants and locations of concern.

2.1.5 The second phase is to complete a Progress Report. Progress reports are intended to maintain continuity in the LAQM process, and fill in the gaps between the three-yearly cycle of Review and Assessment. They are required in all years when a USA is not completed.

2.1.6 The aim of the Detailed Assessment is to determine, with reasonable certainty, the magnitude and extent of any likely exceedences of the air quality objectives. Where an air quality objective is unlikely to be met, the local authority must designate an AQMA and may need to draw up an Action Plan setting out the measures it intends to introduce in pursuit of the objectives within its AQMA.

2.1.7 Once an AQMA is declared, local authorities must complete a Further Assessment within 12 months of designation. It aims to confirm the exceedence of the objectives, define what improvement in air quality and corresponding reduction in emissions is required to attain the objectives.

2.1.8 Over 230 local authorities have declared AQMAs, mainly for exceedences of the annual mean objective for NO_2. Road transport sources are the main cause of AQMAs.

2.1.9 Following the Progress Report 2008 SHC has declared two AQMAs for exceedences of the annual mean NAQO for NO_2. These AQMAs are shown in **Figure 1** and cover:

- The M6 section through the borough, including Park Cottages and Southworth Road, and

- High Street, Newton-Le-Willows.

2.1.10 SHC are in the process of declaring a further AQMA at Borough Road within the borough, following a Detailed Assessment carried out in April 2010.

2.2 Air Quality Strategy

2.2.1 The Air Quality Strategy (2009) establishes the policy for ambient air quality for the UK. Its primary objective is to ensure that everyone can enjoy a level of ambient air quality in public places which poses no significant risk to health or quality of life. The Strategy sets out the national air quality objectives (NAQOs). Those included in LAQM are prescribed in the Air Quality (England) Regulations 2000 and the Air Quality (Amendment) (England) Regulations 2002.

2.2.2 The NAQOs for NO_2 are set out in the Air Quality Regulations (England) 2000, are shown in **Table 2.1**.

Table 2.1 Current Objectives included in the Air Quality (England) Regulations 2000

Pollutant	Objective	Date to be achieved by and maintained thereafter
Nitrogen dioxide (NO_2)	200 µg/m^3 measured a 1 hour mean, not to be exceeded more than 18 times a year	31 December 2005
	40 µg/m^3 measured as an annual mean	31 December 2005

2.3 Exposure

2.3.1 The air quality objectives apply to outdoor locations where people are regularly present, and where they might reasonably be expected to be exposed over the relevant averaging times. The air quality objectives do not apply to occupational, indoor or in-vehicle exposure.

2.3.2 The technical guidance (LAQM.TG(09)) provides advice as to where the NAQOs apply. Annual mean objectives apply at all locations where members of the public might be regularly exposed, for example, facades of residential properties, schools, hospitals and libraries.

2.3.3 The one-hour objective (NO_2) also applies at kerbside sites (e.g. the pavements of busy shopping centres), those parts of car parks and bus and railway stations which are not fully enclosed, and any other places where the public might reasonably be expected to spend one hour or longer.

2.4 Compliance Dates

2.4.1 The UK intends to submit a time extension notification, for the NO_2 limit values, to the European Commission by September 2011. A package of draft air quality plans for this notification is currently (July 2011) out for consultation. If accepted, it would extend the deadline to 2015 and is likely to apply to a large number of areas.

2.4.2 In assessing future compliance therefore, this report assumes a future compliance date of 2015.

3 Nitrogen Dioxide Monitoring Data

3.1 Chemiluminescent Monitors

3.1.1 **Figures 2** and **3** show the location of chemiluminescent analysers and passive diffusion tubes within the two Further Assessment areas. Further monitoring is undertaken across the borough, however they are located some distance from the assessment areas and results have not been included.

3.1.2 Within the vicinity of the Further Assessment areas SHC operate two chemiluminescent analysers, located at Southworth Road (in FA1) and on High Street in Newton-le-Willows (in FA2). The latter was commissioned in 2010 and data for four months (April 2011 to July 2011) are presented. A continuous monitor was also historically located at West End Road which was decommissioned in 2010.

3.1.3 Monitored annual mean NO_2 concentrations using chemiluminescent analysers between the years 2007 and 2011 are shown in **Table 3.1**.

Table 3.1 Annual mean monitored NO_2 concentrations ($\mu g/m^3$) at chemiluminescent analysers, 2007 – 2011

Location	Site Type	Within AQMA?	Annual mean NO_2 concentration ($\mu g/m^3$)				
			2007	2008	2009	2010	2011**
Southworth Road	R	Y	48.0	48.7	65.5	59.8	58.3
West End Road	R	N	32.0	33.1	23.8*	-	-
High Street, Newton	R	Y	-	-	-	-	33.6***

Site Type: R = Roadside, * Data capture less than 75%, ** January to July 2011, *** April to July 2011

3.1.4 **Table 3.1** shows that there have been exceedences of the annual mean objective at the Southworth Road monitor since monitoring began in 2007.

3.1.5 Four months of monitoring at High Street, Newton-le-Willows shows that the annual mean objective is achieved. However, reliance should not be placed on the results due to the short term nature of the data.

3.1.6 The number of one hour mean concentrations greater than $200 \mu g/m^3$ measured at the continuous monitors, between the year 2007 and 2010 are shown in **Table 3.2**.

Table 3.2 Number of one hour mean concentrations greater than 200 $\mu g/m^3$ at chemiluminescent analysers, 2007 – 2010

Location	Site Type	Within AQMA?	Annual mean NO_2 concentration ($\mu g/m^3$)			
			2007	2008	2009	2010
Southworth Road	R	Y	-	0	0	0
West End Road	R	N	-	0	0	-
High Street, Newton	R	Y	-	-	-	0

3.1.7 **Table 3.2** shows that there have been no exceedences of the 1-hour objective at any of the continuous monitors in St Helens, since 2007.

3.2 Passive Diffusion Tubes

3.2.1 SHC also operate a number passive NO_2 diffusion tube within the Further Assessment areas, the results for which are presented in **Table 3.3.**

Table 3.3 Annual mean monitored NO_2 concentrations (µg/m³) at diffusion tubes, 2002 - 2010

Site ID	Location	Site Type	Relevant Exposure	Annual mean NO_2 concentration (µg/m³)								
				'02	'03	'04	'05	'06	'07	'08	'09	'10
T1	Southworth Road LP 27	R	N	-	-	-	-	-	46	46	62[a]	-
T6	Parkside Monitor	S	N	38	36	36	38	-	38	22	24	23
T7	Southworth Road LP 26	R	N	-	-	-	-	-	46	49	48	-
T8	Kerbside High Street	R	N	-	-	-	-	36	41	39[c]	40[d]	-
T9	Southworth Road Fence	R	N	-	-	-	-	-	49	51	-	-
T10	Southworth Road LP26	R	N	-	-	-	-	51	54	48	55*	-
T14	High Street/Rob Lane	R	Y	-	-	-	-	-	-	41[e]	40*	-
T15	Park Cottages	M	Y	-	-	-	-	-	-	50[b]	48*	-
T30	170 Southworth Road	R	Y	-	-	-	-	-	-	-	-	37
T31	160 Southworth Road	R	Y	-	-	-	-	-	-	-	-	49
T32	160 Southworth Road	R	Y	-	-	-	-	-	-	-	-	50
T34	2 Park Cottages	M	Y	-	-	-	-	-	-	-	-	39
T35	157 High Street	R	Y	-	-	-	-	-	-	-	-	35
T36	19 High Street	R	Y	-	-	-	-	-	-	-	-	53

[a] = 66% data capture for year, [b] = 58.3% data capture for year, [c] = 83.4% data capture for year, [d] = 75% data capture for year [e] = 50% data capture for year, * = estimation of annual mean from 9 months data

3.2.2 The results show that annual mean NO_2 concentrations are above the annual mean objective at roadside locations in the AQMAs. At suburban and urban background concentrations the objective is achieved.

3.2.3 For the monitoring locations in High Street, Newton-Le-Willows (T8, T14 and T35), the data indicates that the annual mean NO_2 concentrations are around the objective. At one receptor location (T36) the monitored data in 2010 was considerably higher than the objective.

3.2.4 Annual mean concentrations predicted for NO_2 can be used to screen whether the short-term objective would be breached[1]. As concentrations are below 60 µg/m³, the short-term objective is likely to be achieved at the monitored locations.

3.2.5 The diffusion tube concentrations have been bias-adjusted using the national factors shown in **Table 3.4**.

Table 3.4 National bias-adjustment factors

Year	Bias-adjustment factor
2002	0.90
2003	1.01
2004	0.83
2005	0.80
2006	-
2007	0.90

[1] Long term monitoring at sites where road transport is the predominant emission source shows that it is unlikely that the short-term objective will be exceeded if the annual mean concentration is below 60 µg/m³ (Defra, 2009. Local Air Quality Management Technical Guidance (LAQM.TG(09)).

Year	Bias-adjustment factor
2008	0.82
2009*	0.83
2010	0.84

3.2.6 Environmental Services Group (ESG), a UKAS accredited laboratory, provides and analyses the diffusion tubes. The diffusion tubes used were 10% triethanolamine (TEA) in water. Analysis is carried out in accordance with documented in-house Laboratory Method GLM6.

4 Methodology

4.1 Model

4.1.1 Air quality modelling was carried out to predict concentrations of nitrogen oxides (NO_x)[2] using the ADMS-Roads dispersion model.

4.1.2 The ADMS-Roads model (version 3.0) was developed by Cambridge Environmental Research Consultants Ltd (CERC). This model has been widely used by local authorities throughout the UK for Review and Assessment purposes.

4.1.3 It applies up-to-date physics of the boundary layer structure based on the Monin-Obukhov length and the boundary layer height. This approach is more advanced than that used in many other models, such as Caline4, Breeze-Roads and AAQUIRE, which represent the structure of the atmosphere using the seven discrete Pasquill-Gifford classes.

4.1.4 The use of the Monin-Obukhov length in ADMS-Roads allows the differing states of the boundary layer to be represented on a continuous scale rather than being segregated into the discrete Pasquill-Gifford classes.

4.1.5 ADMS-Roads more accurately represents vertical variation in boundary layer parameters, such as wind speed. Other models often use a less sophisticated approach and assume that these parameters are constant throughout the whole boundary layer depth.

4.1.6 ADMS-Roads has been comprehensively validated in a large number of studies including comparisons with data from the UK AURN and specific validation studies using field, laboratory and numerical datasets.

4.1.7 The intelligent gridding option was selected. This option substantially reduces the spacing between output points such that close to the modelled roads up to five times as many grid points are added as to the regular grid option. This ensures that the results well represent the concentrations gradients close to the main roads, and hotspots are not missed.

4.1.8 The gridded output for each of the areas has a resolution of between 3 to 10m. Contour plots of a finer resolution were produced from these gridded outputs using a process called interpolation. Each point on the contour is interpolated from the true gridded output to create a continuous grid.

4.2 Model input parameters

4.2.1 The modelled areas are predominantly suburban housing with a relatively small town centre. A surface roughness of 0.5 m was therefore used in the modelling.

[2] NO_x is assumed to be NO_2 and nitric oxide (NO). Within this report all NO_x values are expressed assuming that NO_x has the molecular weight of NO_2 i.e. NO_x as NO_2

4.2.2 A significant amount of heat is generated by traffic and buildings within a town and prevents the atmosphere becoming very stable. In ADMS-Roads, the stability of the atmosphere is represented by the Monin-Obukhov length. The effects of the urban heating is that the Monin-Obukhov length will never fall below a certain value. A minimum Monin-Obukhov length of 30m was used in the modelling to represent a town with a population over 50,000.

4.2.3 The local topography was included within each of the modelled areas. The terrain files used for modelling were based on 25km PANORAMA topographical mapping[3] and ranges from a resolution of 150 to 500m.

4.3 Modelling domain

4.3.1 A model domain was set up for each AQMA; that is Area 1 covering Southworth Road and Park Cottages and Area 2 covering the High Street in Newton-Le-Willows.

4.3.2 Each modelled area extends at least 200m from the AQMAs to ensure that all roads likely to affect the AQMA are included within the modelling.

4.3.3 Concentrations were predicted at the following receptors (as shown in **Figures 2** and **3**):

- Further Assessment Area 1 (FA1): Park Cottages and Southworth Road, and
- Further Assessment Area 2 (FA2): High Street, Newton-Le-Willows

4.3.4 In addition, concentrations were predicted using ADMS-Roads' intelligent grid option for the production of pollution contours. This option substantially reduces the spacing between output points such that close to the modelled roads the output points are less than 3m apart, while further from the source it may be up to 40m apart. This ensures that the results better represent the concentrations gradients close to the main roads, and hotspots are not missed.

4.4 Modelled Roads

4.4.1 In FA1 (in the vicinity of Southworth Road) the roads and railway lines vary with height from ground level, that is:

- The Liverpool to Manchester railway line sits in a cutting to the west of Southworth Road and the motorway, and
- The M6 is raised as it crosses Southworth Road.

4.4.2 ADMS-Roads does not allow for road heights to be reduced below zero (negative height). Guidance provided in LAQM.TG(09) and from CERC advises care should be taken when considering how to account for varying source heights, especially where there are sensitive receptors. Increasing the whole road network at an elevated base to account for a cutting (railway or road) may result in the model under predicting at a receptor. Conversely, not accounting for elevated road sections appropriately may result in the model over predicting at a receptor.

[3] https://www.ordnancesurvey.co.uk/opendatadownload/products.html

4.4.3 In the case of the railway, it is set as zero height (the height of the other modelled road sources) to avoid under-predicting concentrations. The results and relevant exposure in each case are discussed in the results sections for each of the affected areas.

4.4.4 In the case of the M6, it is set at a modelled height of 5m as it crosses over Southworth Road.

4.5 Meteorological data

4.5.1 Hourly sequential meteorological data from Liverpool Airport for 2009 was used. Liverpool Airport is located approximately 15km south west of St. Helens.

4.5.2 The wind rose for Liverpool Airport (shown in **Figure 4**) is not typical for wind conditions across the UK. The prevailing wind for the UK is from the south west, whereas for Liverpool it is the south east through to the south and west through to the north west. It is likely that weather conditions at Liverpool are strongly influenced by its proximity to the coast and the River Mersey. For comparison, wind conditions at Manchester Airport (32km east of St. Helens) show a predominance of north westerly and southerly winds, likely to be influenced by the Pennines.

4.5.3 It is considered therefore that wind conditions in the north west are not typical of conditions across the UK and that wind conditions at Liverpool Airport provide an appropriate representation of meteorological conditions across the modelling areas.

4.5.4 Hours with calm winds (less than 0.75m/s) or missing data are not used in the model calculations. Of the 8760 hours of meteorological data between 1st January to 31st December 2010, 97.3 % were used in the modelling.

4.5.5 ADMS-Roads allows a different surface roughness to be specified at the meteorological site to account for variation in meteorological conditions between the monitored and modelled sites. A value of 0.2m was input for the Liverpool Airport meteorological site, to represent the flatter terrain found near airports.

4.6 Traffic data

4.6.1 Traffic data used in the modelling were supplied by SHC. Traffic data for the modelled roads are included in **Appendix C**.

4.6.2 **Figures 2 and 3** show the modelled road network for each of the Further Assessment areas.

4.6.3 Traffic data were scaled to the assessment years 2009 and 2015 (from 2008 and 2009) using Tempro growth factors for St. Helens. The Tempro growth factors used are shown in **Table 4.1**.

Table 4.1 Tempro growth factors

Years	Growth factor
2008 to 2009	1.0064
2009 to 2015	1.0333

4.6.4 Traffic emissions were calculated using the February 2010 Emission Factors Toolkit (EFT) v4.2.2 issued by AEA on behalf of DEFRA.

4.6.5 Diurnal traffic patterns (obtained from automatic traffic counts) were applied to the daily traffic data to obtain hourly flows. These are shown in **Appendix D**, for each of the Further Assessment areas. Where a diurnal traffic pattern was not available for a particular link, an average of the traffic links was used. The diurnal profile does not vary greatly across links therefore this approach was considered most appropriate.

4.6.6 Congestion (for peak hours) as queuing traffic (assuming a speed of 5kph) were included within the model and are based on the site visit carried out on 23rd April 2010 and through discussion with SHC. The queue lengths are provided in **Appendix E**.

4.6.7 Peak hour (8am to 10am, 4pm to 6pm) congestion has been modelled at the following junctions in FA2:

- Crow Lane East, and
- Ashton Road.

4.7 Rail data

4.7.1 SHC provided data for passenger and freight train movements along the Liverpool to Manchester and London to Birmingham train lines, which are close to the modelled existing receptors in FA1; the modelled rail link is shown in **Figure 2**.

4.7.2 The train movements were for a typical day during 2010. This was assumed to be applicable to 2009. The total daily train movements and their diurnal profile are shown in **Appendix C**.

4.7.3 Train movement data were provided for the following train classes: Voyager (Class 120), Pacer (Class 142), Coradia (Class 175), Super Sprinter (Class 156), British Rail Class 66 and British Rail Class 67. Emission factors were provided by AEA Technology and the emission rates are provided in **Appendix C**.

4.7.4 All rail sources were modelled with a width of 10m, as estimated from digital Ordnance Survey maps.

4.8 Background maps

4.8.1 The estimated background concentrations predicted by AEA Technology (on behalf of DEFRA) were used in the modelling[4]. This data allows for spatial variation in background concentrations across the modelled areas to be taken into account.

4.8.2 There are no background continuous monitors located close to either of the AQMAs. As such, it is not possible to validate the background mapping data for the borough.

[4] http://www.airquality.co.uk/archive/laqm/tools.php

4.8.3 Guidance is provided to avoid 'double counting' of background concentrations. For example, where there is a very busy road passing through a grid that is explicitly modelled in ADMS-Roads, it is possible to remove its contribution to the background. Roads modelled for this assessment were predominantly A roads and the motorway. A summary of the emissions removed from the background are provided in **Table 4.3** below.

4.8.4 The background concentrations of nitrogen oxides (NO_x) and NO_2 used in the modelling are shown in **Table 4.2**.

Table 4.2 Background concentrations used in modelling

Grid	Summary of concentration removed	Background concentrations (µg/m^3)					
		NO_x			NO_2		
		Total	Contribution Removed	Adjusted	Total	Contribution Removed	Adjusted
2009							
358000, 397000	100 % Trunk Road 25 % A Road	37.1	0.9	36.2	24.3	0.5	23.8
359000, 395000	100 % A Road	34.7	1.0	33.7	23.0	0.6	22.4
360000, 395000	100 % Trunk Road 100 % A Road	35.9	0.5	35.4	23.7	0.3	23.4
358000, 395000	100 % A Road	29.5	0.9	28.7	20.0	0.5	19.5
2015							
358000, 397000	100 % Trunk Road 25 % A Road	24.6	0.5	24.2	17.4	0.3	17.1
359000, 395000	100 % A Road	24.0	0.6	23.4	16.9	0.4	16.6
360000, 395000	100 % Trunk Road 100 % A Road	23.8	0.3	23.5	16.9	0.2	16.7
358000, 395000	100 % A Road	21.5	0.5	21.0	15.3	0.3	15.0

4.9 NO_x to NO_2 conversions

4.9.1 Predicted NO_x concentrations from road emissions were converted to NO_2 using the methodology outlined in the LAQM.TG(09) guidance and the conversion for St. Helens.

4.10 Model verification

4.10.1 For Park Cottages (FA1), verification has been undertaken using 2009 and 2010 monitoring results at the Park Cottages diffusion tube. For Southworth Road (FA1), verification has been undertaken using 2009 and 2010 monitoring results at the Southworth Road continuous monitor and several diffusion tubes. Verification factors of 1.5 and 2.3 were used respectively.

4.10.2 For 3 of the monitored locations in FA2 the model over predicts concentrations whilst for 1 of the monitoring locations it under predicts (T36). There is no determinable explanation for this and it could be that this diffusion tube may have over measured concentrations by comparison with monitoring along the rest of the High Street. As such, and in order to be conservative, no verification adjustment factor has been applied to the modelled data for FA2. If a verification factor had been calculated from the modelling data it would have been equal to 0.9. Essentially therefore, the model is slightly over predicting the monitoring data on average.

4.10.3 Details of the model verification calculations and traffic data used for verification are shown in **Appendix F.**

4.11 Source Apportionment

4.11.1 Road transport is the main cause of the AQMAs in St Helens. Source apportionment of NO_x has also been undertaken, according to the methodology outlined in LAQM.TG(09) to determine the relative contribution of vehicle types and background concentrations to the total NO_2 concentration. The following sources have been considered:

- Local background (LB)
- Regional background (RB)
- Light duty vehicles (LDV – comprising cars, vans, motorcycles)
- Heavy duty vehicles (HDV – comprising buses, articulated and rigid HGVs), and
- Trains (FA1 only).

4.12 Scenarios

4.12.1 The initial modelling and source apportionment was undertaken for 2009.

4.12.2 The practicalities for achieving reductions in emissions will vary greatly between the two AQMAs, therefore different scenarios are suggested for each of the AQMAs.

4.12.3 For FA1, the key source of pollution is from vehicles on the M6. It is considered there is little opportunity for changing the vehicle composition using the motorway or reducing traffic numbers. One approach could be to lobby with the Highways Agency (HA) for a reduction in speeds along these sections of motorway. This task would form part of the Action Plan, however, it is worth testing the impact reductions in speed have on total concentrations in the Further Assessment.

4.12.4 The following scenarios have therefore been assessed for FA1:

- Scenario 1A – Reduction in speeds to 60mph,
- Scenario 1B – Reduction in speeds to 50mph, and
- Scenario 1C – Reduction in speeds to 40mph.

4.12.5 For FA2, the key source of pollution at High Street in Newton-le-Willows is from a combination of congestion, vehicle composition and total traffic numbers. It is considered that the greatest benefits to air pollution could be achieved through reducing traffic numbers, reducing the number of the worst polluting vehicles and reducing speeds along the High Street.

4.12.6 The following scenarios have therefore been assessed for FA2:

- Scenario 2A – 30% reduction in HDV traffic,
- Scenario 2B – 30% reduction in LDV traffic,
- Scenario 2C – 30% reduction in HDV and LDV traffic, and
- Scenario 2D – Reduction of speed limit to 20mph.

4.13 Future Compliance

4.13.1 The UK intends to submit a time extension notification, for the NO_2 limit values, which if accepted would extend the deadline to meet the air quality limit values to 2015. Modelling has been undertaken for 2015 for FA1 and FA2 to assess the likelihood of meeting the NO_2 limit value by the compliance date.

4.13.2 There is evidence that NO_2 concentrations are not declining at the rate predicted by Defra's local air quality management tools and emissions will not decline at the rate represented in the EFT.

4.13.3 Defra have not published any guidance on how to consider these uncertainties, therefore the predicted 2015 background concentrations and emission factors have been used in the modelling. As such, the modelling results should be interpreted with care.

5 Predicted NO_2 Concentrations and Source Apportionment

5.1 FA1 Park Cottages and Southworth Road

Predicted NO_2 concentrations (2009)

5.1.1 **Table 5.1** presents the predicted annual mean NO_2 concentrations at modelled sensitive receptors within the FA1 AQMA, in 2009.

Table 5.1 Predicted annual mean NO_2 concentrations for Park Cottages and Southworth Road (FA1), 2009

Receptor Number	Receptor Name	Location Description	Predicted annual mean NO_2 concentration ($\mu g/m^3$)
FA1-1	1 Park Cottages	Near Junction 23 of M6	51
FA1-2	Highfield	North of SW Rd	36
FA1-3	3 Waterworks Cottage	West of M6	36
FA1-4	Southworth Road		37
FA1-5	87 Southworth Road		34
FA1-6	94 Southworth Road		31
FA1-7	160 Southworth Road	East of M6	54
FA1-8	164 Southworth Road		48
FA1-9	168 Southworth Road		44
FA1-10	170 Southworth Road		41

5.1.2 There are predicted exceedences of the annual mean objective at Park Cottages (FA1-1) and at properties to the east of the M6 (FA1-7 to FA1-10).

5.1.3 The motorway is elevated and has been modelled at a height of 5m. The railway line is in a cutting, however this (negative) height has not been modelled. Presented concentrations are likely to be slightly overpredicted, since the railway line is modelled at zero, whereas it is in reality in a cutting. Since the contribution from the railway line is less than 1% (see **Graph 1b** below), this is unlikely to greatly affect the modelled results.

5.1.4 The objective is predicted to be achieved at Highfield (north of Southworth Road) (FA1-2) and to the west of the M6 (FA1-3 to FA1-6).

Source Apportionment of NO_x concentrations

5.1.5 **Table 5.2** presents the relative contribution of vehicle types and background concentrations to the total NO_2 concentration.

Table 5.2 Source apportionment results for Park Cottages and Southworth Road (FA1), 2009

Receptor Number	Receptor Name	Location Description	LB	RB	LDV	HDV	Trains
FA1-1	1 Park Cottages	Near Junction 23 of M6	39%	8%	15%	38%	0%
FA1-2	Highfield	North of SW Rd	51%	12%	11%	26%	0%
FA1-3	3 Waterworks Cottage	West of M6	51%	12%	12%	24%	1%
FA1-4	Southworth Road		50%	12%	14%	23%	1%
FA1-5	87 Southworth Road		53%	12%	14%	20%	1%
FA1-6	94 Southworth Road		59%	14%	10%	16%	2%
FA1-7	160 Southworth Road	East of M6	35%	8%	19%	38%	0%
FA1-8	164 Southworth Road		40%	9%	17%	34%	0%
FA1-9	168 Southworth Road		43%	10%	16%	31%	0%
FA1-10	170 Southworth Road		46%	10%	15%	28%	0%

5.1.6 **Table 5.2** shows that local background concentrations contribute the most to the NO_x concentrations, accounting for between 39% and 59%. Regional background concentrations accout for an average of 11% of the total NO_x concentrations.

5.1.7 HDVs and LDVs contribute on average 28% and 14% respectively to the total NO_x concentrations. Trains contribute the least which is on average 1%. In particular, at FA1-1 and FA1-7, HDVs contribute a relatively high 38% of the total NO_x.

5.2 FA2 High Street, Newton-le-Willows

Predicted NO_2 concentrations (2009)

5.2.1 **Table 5.3** presents the predicted annual mean NO_2 concentrations at modelled sensitive receptors within the FA2 AQMA, in 2009.

Table 5.3 Predicted annual mean NO_2 concentrations for Newton-Le-Willows (FA2), 2009

Receptor Number	Receptor Name	Predicted annual mean NO_2 concentration ($\mu g/m^3$)
FA2-1	21 Crow Lane East	27
FA2-2	10 Crow Lane East	36
FA2-3	2-4 Crow Lane East	38
FA2-4	2 Ashton Road	32
FA2-5	158-160 High Street	44
FA2-6	173 High Street	41
FA2-7	135-139 High Street	43
FA2-8	119 High Street	42
FA2-9	101 High Street	45
FA2-10	83 High Street	46
FA2-11	52 High Street	53
FA2-12	42 High Street	53
FA2-13	24 High Street	53
FA2-14	13 High Street	42
FA2-15	16 High Street	48
FA2-16	5 High Street	39
FA2-17	8 Church Street	28

5.2.2 There are predicted exceedences of the annual mean objective at properties along High Street (FA2-5 to FA2-15). On Crow Lane East, towards the western end of the High Street and leading into Church Street, the objective is achieved.

5.2.3 Even taking into account that the model may be slightly over predicting concentrations, exceedences would still be predicted in FA2.

Source Apportionment of NO_x concentrations

5.2.4 **Table 5.4** presents the relative contribution of vehicle types and background concentrations to the total NO_2 concentration.

Table 5.4 Source apportionment results for Newton-Le-Willows (FA2), 2009

Receptor Number	Receptor Name	LB	RB	LDV	HDV
FA2-1	21 Crow Lane East	56%	16%	11%	17%
FA2-2	10 Crow Lane East	42%	12%	15%	31%
FA2-3	2-4 Crow Lane East	40%	11%	18%	31%
FA2-4	2 Ashton Road	47%	13%	15%	25%
FA2-5	158-160 High Street	35%	10%	22%	33%
FA2-6	173 High Street	37%	11%	21%	31%
FA2-7	135-139 High Street	36%	10%	23%	31%
FA2-8	119 High Street	36%	10%	23%	31%
FA2-9	101 High Street	34%	10%	24%	32%
FA2-10	83 High Street	33%	9%	25%	33%
FA2-11	52 High Street	34%	8%	25%	33%
FA2-12	42 High Street	34%	8%	25%	33%
FA2-13	24 High Street	34%	8%	25%	33%
FA2-14	13 High Street	43%	10%	20%	27%
FA2-15	16 High Street	38%	9%	23%	30%
FA2-16	5 High Street	47%	11%	18%	24%
FA2-17	8 Church Street	65%	15%	8%	12%

5.2.5 **Table 5.4** shows that local background concentrations again contribute the most to the NO_x concentrations, accounting for between 34% and 65%. Regional background concentrations account for an average of 11% of the total NO_x concentrations.

5.2.6 HDVs and LDVs contribute on average 29% and 20% respectively to the total NO_x concentrations.

5.2.7 There does not appear to be a pattern in the source apportionment for those receptors predicted to exceed the air quality limit value (FA2-5 to FA2-15).

Summary

5.2.8 NO_2 concentrations are predicted to exceed the NAQO within the two AQMAs in 2009.

5.2.9 The source apportionment highlights the local background concentration is often the predominant source of NO_x. Of the local transport sources HDVs contribute the most.

6 Expected Date of Achievement of Nitrogen Dioxide Objectives

6.1 FA1 Park Cottages and Southworth Road

Predicted NO_2 concentrations (2015)

6.1.1 **Table 6.1** presents the predicted annual mean NO_2 concentrations at modelled sensitive receptors within the FA1 AQMA, in 2015.

Table 6.1 Predicted annual mean NO_2 concentrations for Park Cottages and Southworth Road (FA1), 2015

Receptor Number	Receptor Name	Location Description	Predicted annual mean NO_2 concentration ($\mu g/m^3$)
FA1-1	1 Park Cottages	Near Junction 23 of M6	35
FA1-2	Highfield	North of SW Rd	24
FA1-3	3 Waterworks Cottage	West of M6	24
FA1-4	Southworth Road		25
FA1-5	87 Southworth Road		23
FA1-6	94 Southworth Road		21
FA1-7	160 Southworth Road	East of M6	38
FA1-8	164 Southworth Road		33
FA1-9	168 Southworth Road		30
FA1-10	170 Southworth Road		28

6.1.2 The annual mean NO_2 objective is predicted to be achieved at all modelled receptors within FA1 in 2015.

6.1.3 Whilst the modelling predicts that the limit value will be met by 2015, this is based on the current predictions of reductions in road transport emissions and background concentrations. Current evidence is that the emissions and background concentrations are not dropping as rapidly as previously predicted. As such, it is likely that without further mitigation there will still be some exceedences of the limit value in 2015. Receptors FA1-1 and FA1-7 are particularly vulnerable in this regard.

6.2 FA2 High Street, Newton-le-Willows

Predicted NO_2 concentrations (2015)

6.2.1 **Table 6.2** presents the predicted annual mean NO_2 concentrations at modelled sensitive receptors within the FA2 AQMA, in 2015.

Table 6.2 Predicted annual mean NO_2 concentrations for Newton-Le_Willows (FA2), 2015

Receptor Number	Receptor Name	Predicted annual mean NO_2 concentration ($\mu g/m^3$)
FA2-1	21 Crow Lane East	19
FA2-2	10 Crow Lane East	26
FA2-3	2-4 Crow Lane East	27
FA2-4	2 Ashton Road	23
FA2-5	158-160 High Street	32
FA2-6	173 High Street	29
FA2-7	135-139 High Street	31
FA2-8	119 High Street	30
FA2-9	101 High Street	32
FA2-10	83 High Street	32
FA2-11	52 High Street	37
FA2-12	42 High Street	38
FA2-13	24 High Street	36
FA2-14	13 High Street	28
FA2-15	16 High Street	32
FA2-16	5 High Street	27
FA2-17	8 Church Street	20

6.2.2 By 2015 the annual mean NO_2 objective is predicted to be achieved at all modelled receptors within FA2.

6.2.3 Whilst the modelling predicts that the limit value will be met by 2015, this is based on the current predictions of reductions in road transport emissions and background concentrations. Current evidence is that the emissions and background concentrations are not dropping as rapidly as previously predicted, albeit for FA2 this is balanced by the slight conservancy in the modelling. As such, it is possible that further mitigation may not be required although receptors FA2-11 to FA2-13 have predicted concentrations above $36\mu g/m^3$.

7 Air Quality Improvements Required

7.1 Air Quality Management Areas

7.1.1 The modelling shows that exceedences remain within the two AQMAs. This section of the report identifies the improvements required to meet the annual mean NO_2 objective.

7.2 Air Quality Improvements Required

7.2.1 For the annual mean NO_2 NAQO to be achieved the annual average concentration should be below 40µg/m^3. Due to uncertainties in the modelling, it is also appropriate to consider predicted concentrations above 36µg/m^3 as being potentially at risk of exceeding the limit value.

7.2.2 The predicted NO_2 concentrations are calculated using modelled NO_x concentrations from ADMS-Roads plus the Defra background NO_2. To identify the most appropriate measures to improve air quality it is necessary to calculate the required NO_x emission reduction.

7.2.3 **Tables 7.1** to **7.2** show the NO_2 reductions required to meet the objective of 40µg/m^3 and to remove the risk of exceeding 36µg/m^3 at each of the receptors with predicted exceedences in 2009.

Table 7.1: Reduction in NO_2 required to meet objective of 40µg/m^3 within FA1

Receptor Number	Receptor Name	Reduction required to meet objective of 40µg/m^3		Reduction required to remove the risk of exceeding 36µg/m^3	
		NO_2 (µg/m^3)	% NO_x	NO_2 (µg/m^3)	% NO_x
FA1-1	1 Park Cottages	11	46	15	61
FA1-7	160 Southworth Road	14	53	18	65
FA1-8	164 Southworth Road	8	38	12	55
FA1-9	168 Southworth Road	4	24	8	44
FA1-10	170 Southworth Road	1	9	5	33

7.2.4 In FA1, NO_x emission reductions from traffic of up to 53% and 65% are required to achieve 40µg/m^3 and 36µg/m^3 respectively.

Table 7.2: Reduction in NO_2 required to meet objective of 40µg/m³ within FA2

Receptor Number	Receptor Name	Reduction required to meet objective of 40µg/m³		Reduction required to remove the risk of exceeding 36µg/m³	
		NO_2 (µg/m³)	% NO_x	NO_2 (µg/m³)	% NO_x
FA2-5	158-160 High Street	4	19	8	37
FA2-6	173 High Street	1	6	5	27
FA2-7	135-139 High Street	3	14	7	33
FA2-8	119 High Street	2	10	6	30
FA2-9	101 High Street	5	22	9	39
FA2-10	83 High Street	6	28	10	44
FA2-11	52 High Street	13	49	17	62
FA2-12	42 High Street	13	49	17	62
FA2-13	24 High Street	13	49	17	62
FA2-14	13 High Street	2	13	6	35
FA2-15	16 High Street	8	36	12	52

7.2.5 In FA2, NO_x emission reductions from traffic of up to 49% and 62% are required to achieve 40µg/m³ and 36µg/m³ respectively.

7.3 Summary

7.3.1 Significant reductions in NO_x emissions from road traffic are required in order to ensure that the air quality objective is achieved. Depending on the location, this may require as much as 63% reduction in 2009 emissions from transport.

8 Scenario Testing

8.1 Scenarios

8.1.1 The impacts on air quality of a number of scenarios for each AQMA have been modelled for 2009:

- Scenarios 1A to 1C (FA1) investigate the impact of reducing speeds along the M6.
- Scenarios 2A to 2C (FA2) investigate the impact of different traffic reduction assumptions.
- Scenario 2D (FA2) investigate the impact of reducing the speed limit along the High Street.

8.1.2 These scenarios have been devised to reflect the sorts of mitigation options that may be feasible to achieve.

8.2 FA1 Scenario Results

8.2.1 Table 8.1 shows the predicted NO_2 concentrations from the scenarios for all receptors modelled in area FA1. The results from the 2009 baseline have also been included for comparison.

Table 8.1: Scenarios results for FA1

Receptor Number	Receptor Name	Location Description	NO_2 Concentration (µg/m^{3})			
			Baseline	Scenario		
				1A	1B	1C
FA1-1	1 Park Cottages	Near Junction 23 of M6	51	51	50	49
FA1-2	Highfield	North of SW Rd	36	34	34	33
FA1-3	3 Waterworks Cottage	West of M6	36	35	35	34
FA1-4	Southworth Road		37	36	36	35
FA1-5	87 Southworth Road		34	34	33	33
FA1-6	94 Southworth Road		31	30	30	30
FA1-7	160 Southworth Road	East of M6	54	54	53	52
FA1-8	164 Southworth Road		48	48	47	46
FA1-9	168 Southworth Road		44	44	43	43
FA1-10	170 Southworth Road		41	41	41	40

8.2.2 The modelling indicates that reducing speeds on the motorway has a small effect in reducing NO_2 concentrations. Reducing speeds to an annual average of 40mph would only reduce predicted concentrations by 2µg/m^3 at the worst affected receptors.

8.3 FA2 Scenario Results

8.3.1 Table 8.2 shows the predicted NO_2 concentrations from the scenarios for all receptors modelled in area FA2. The results from the 2009 baseline have also been included for comparison.

Table 8.2: Scenarios results for FA2

Receptor Number	Receptor Name	NO_2 Concentration (µg/m^3)				
		Baseline	Scenario			
			2A	2B	2C	2D
FA2-1	21 Crow Lane East	27	26	26	25	27
FA2-2	10 Crow Lane East	36	33	35	32	37
FA2-3	2-4 Crow Lane East	38	35	36	33	38
FA2-4	2 Ashton Road	32	30	31	29	32
FA2-5	158-160 High Street	44	41	42	38	44
FA2-6	173 High Street	41	38	39	36	42
FA2-7	135-139 High Street	43	40	41	37	44
FA2-8	119 High Street	42	39	40	36	43
FA2-9	101 High Street	45	41	42	38	45
FA2-10	83 High Street	46	42	42	38	46
FA2-11	52 High Street	53	48	49	45	53
FA2-12	42 High Street	53	48	49	45	53
FA2-13	24 High Street	53	47	48	44	52
FA2-14	13 High Street	42	38	38	35	41
FA2-15	16 High Street	48	42	43	40	46
FA2-16	5 High Street	39	35	36	34	38
FA2-17	8 Church Street	28	27	27	26	28

8.3.2 The modelling indicates that reducing HDV traffic by 30% could potentially reduce predicted concentrations by 4-6µg/m^3 at the worst affected receptors.

8.3.3 Reducing LDV traffic by 30% could potentially reduce predicted concentrations by 3-5µg/m^3 at the worst affected receptors.

8.3.4 Reducing both types of vehicles by 30% has a significant impact on reducing predicted concentrations, by up to 8µg/m^3 at the worst affected receptors.

8.3.5 Reducing the speed limit to 20mph does not have a significant impact and results in higher annual mean NO_2 concentrations at some receptors.

8.4 Summary

8.4.1 For FA1, reducing motorway speeds has only a small impact on predicted concentrations such that the limit value continues to be exceeded by a relatively large amount at 3 receptors in 2009.

8.4.2 For FA2, reducing HDV and LDV traffic by 30% reduces predicted concentrations by a significant amount, although not enough to eliminate all predicted exceedences.

9 Conclusions and Recommendations

9.1 Conclusions

9.1.1 NO_2 concentrations are predicted to exceed the annual mean NAQO where there is relevant exposure within the two AQMAs in 2009.

9.1.2 Significant reductions in NO_x emissions at some receptor locations will be required in order achieve compliance with the NO_2 limit value. Depending on the location this may require as much as 63% reduction in 2009 emissions from transport.

9.1.3 If it is assumed that road traffic emissions and background concentrations reduce as previously predicted, the annual mean objective is predicted to be achieved in both AQMAs in 2015.

9.1.4 There is evidence to suggest that road traffic emissions and background concentrations are not dropping as rapidly as previously predicted and therefore additional mitigation measures are likely to be required for FA1 to ensure compliance by 2015. Given the conservancy in the modelling for FA2, it may be that additional mitigation measures are not required for this AQMA.

9.1.5 Modelling has been undertaken on potential measures that could be taken to reduce emissions within each of the two AQMAs.

9.1.6 Within FA1 reducing speed on the motorway to 40 mph does not have a significant impact in reducing predicted NO_2 concentrations. The source apportionment work for the worst affected receptors (FA1-1 and FA1-7) indicates the importance of reducing HDV emissions in achieving compliance for these receptors.

9.1.7 Reducing HDV and/or LDV traffic by 30% gives potentially significant reductions in NO_2 concentrations in FA2.

9.2 Recommendations

9.2.1 The extents of the two AQMAs remain appropriate as there are still exceedences of the annual mean objective at receptors within these areas.

9.2.2 The Air Quality Action Plan for the Borough should take into account the results of this modelling in forming the strategy to achieve compliance with the annual average NO_2 limit value. Reducing the speed does not significantly reduce concentrations, and results in an increase in concentration at some receptors.

Appendix A Glossary of Terms

AADT	Annual Average Daily Traffic
Air Quality Strategy	The Strategy required by the Environment Act 1995 to be produced by Government laying down its policies for air quality in the UK
AQMA	Air Quality Management Area
AQR&A	Air Quality Review and Assessment, a requirement of the Local Air Quality Management regime
Defra	Department for Environment, Farming and Rural Affairs
Diffusion Tube	A passive sampler used for collecting nitrogen dioxide in the air
HDV	Heavy Duty Vehicle; a vehicle with a gross vehicle weight greater than 3.5 tonnes. Includes HGV and buses.
LAQM	Local Air Quality Management
LAQM.PG(09)	Local Air Quality Management Policy Guidance published in 2009 by Defra
LAQM.TG(09)	Local Air Quality Management Technical Guidance published in 2009 by Defra
LDV	Light Duty Vehicle
NAQO	National Air Quality Objective as set out in the Air Quality Strategy and the Air Quality Regulations
Nitrogen oxides	See NO_x
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides, generally considered to be nitric oxide and nitrogen dioxide. Its main source is from combustion of fossil fuels, including petrol and diesel used in road vehicles
Objective	See NAQO
Receptor	A location where the effects of pollution may occur
SHC	St. Helens Metropolitan Borough Council
Urban Background	The air quality away from the immediate influences of local sources of pollution. Typically more than 50m from a busy road
Roadside	The air quality typically within one to five metres of the kerb of a busy road.
USA	Updating and Screening Assessment

Appendix B Reference List

Environmental Act 1995, Part IV.

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Statutory Instrument 2007, No. 64, The Air Quality Standards Regulations 2007, HMSO.

Environment Act 1995 Review and Assessment of Local Air Quality Stage 1 (2000) St. Helens Metropolitan Borough Council.

Updating and Screening Assessment 2006 St. Helens Metropolitan Borough Council.

Progress Report 2008 St. Helens Metropolitan Borough Council

Updating and Screening Assessment 2009 St. Helens Metropolitan Borough Council.

Appendix C Traffic and Rail Data Used in Modelling

Traffic data used for modelling

Table C.1 Traffic data used for FA1, 2009

Link Number	Link Name	Speed (kph)	AADT			
			Cars	LGV	HDV	Bus
FA1-1	M6 NB Junction 23 - 24	100.5	46143	0	9451	0
FA1-2	M6 SB Junction 24 – 23	100.7	38665	0	8488	0
FA1-3	M6 NB Junction 22 -23	103.8	49054	0	8657	0
FA1-4	M6 SB Junction 23 – 22	97.6	47852	0	8445	0
FA1-5	M6 Slip on SB Junction 23 -22	58.0	44475	8445	2815	563
FA1-6	M6 Slip off NB Junction 22 – 23	52.0	45038	9570	1126	563
FA1-7	A49 Lodge Lane	52.0	6260	1330	156	78
FA1-8	A572 Southworth Road	52.0	9173	1949	229	115

Table C.2 Traffic data used for FA2, 2009

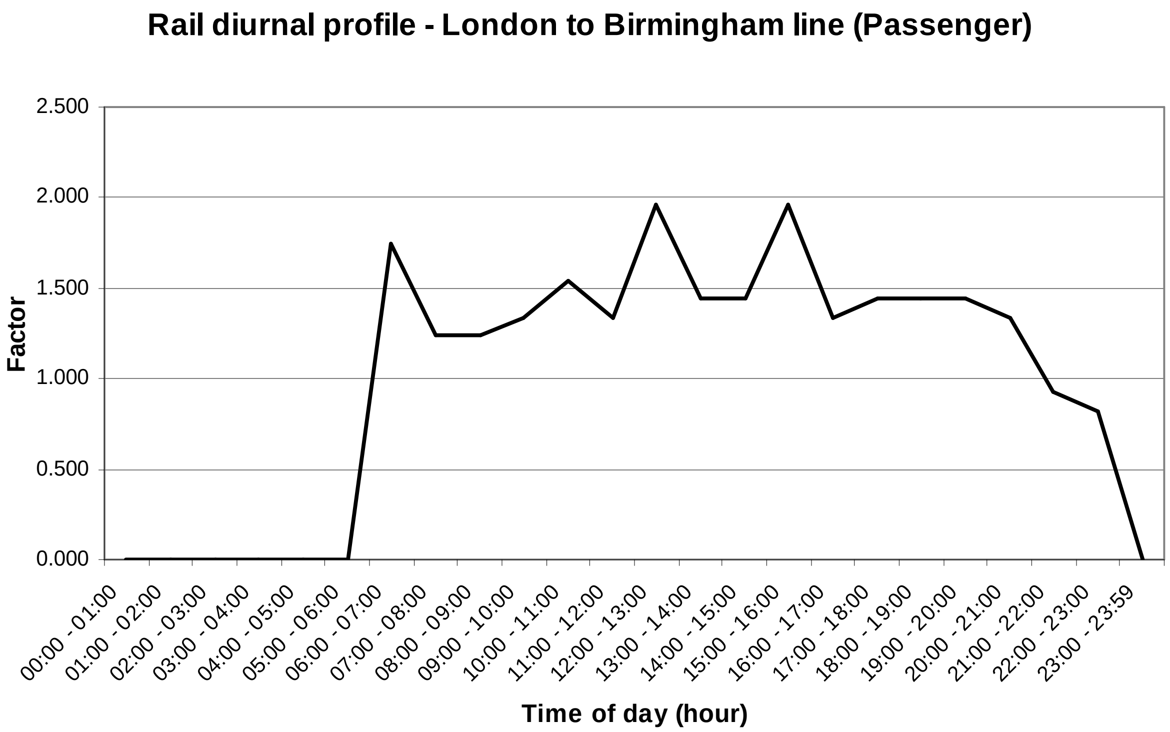
Link Number	Link Name	Speed (kph)	AADT			
			Cars	LGV	HDV	Bus
FA2-01	A49 Ashton Road NB	58.0	8658	0	820	71
FA2-02	A572 Crow Lane East west bound	42.0	10467	0	904	125
FA2-03	A49 High Street	35.0	10342	1658	511	255
FA2-04	A572 Southworth Road	52.0	4777	1014	119	60

Rail data used in modelling

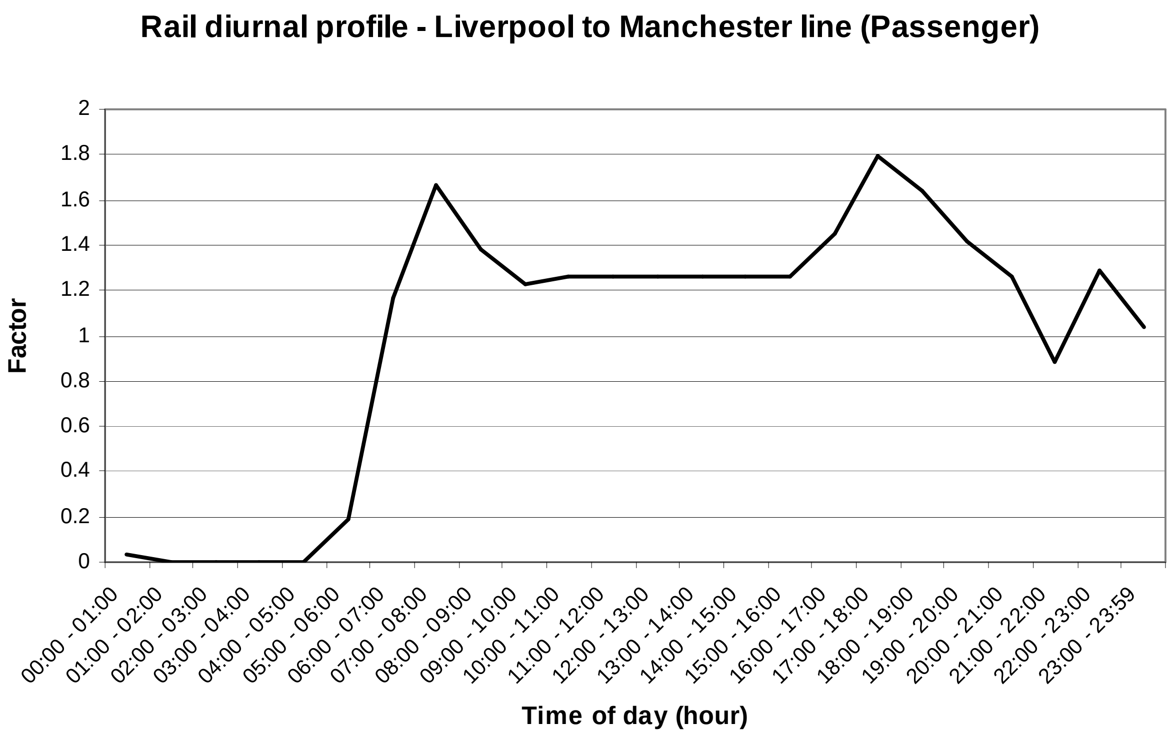
Table C.3 Train daily movement, NO_x emissions factors (provided by AEA Technology) and emission rates used for modelling

Class	Daily movements	Emission factor (g/unit/km)	Emission rate (g/km/s)
Voyager (Class 120)	33	26.8	0.0103
Pacer (Class 142)	39	25.6	0.0114
Coradia (Class 175)	37	26.5	0.0113
Super Sprinter (Class 156)	33	29.5	0.0114
British Rail Class 66	5	120.0	0.0069
British Rail Class 67	1	66.7	0.0006

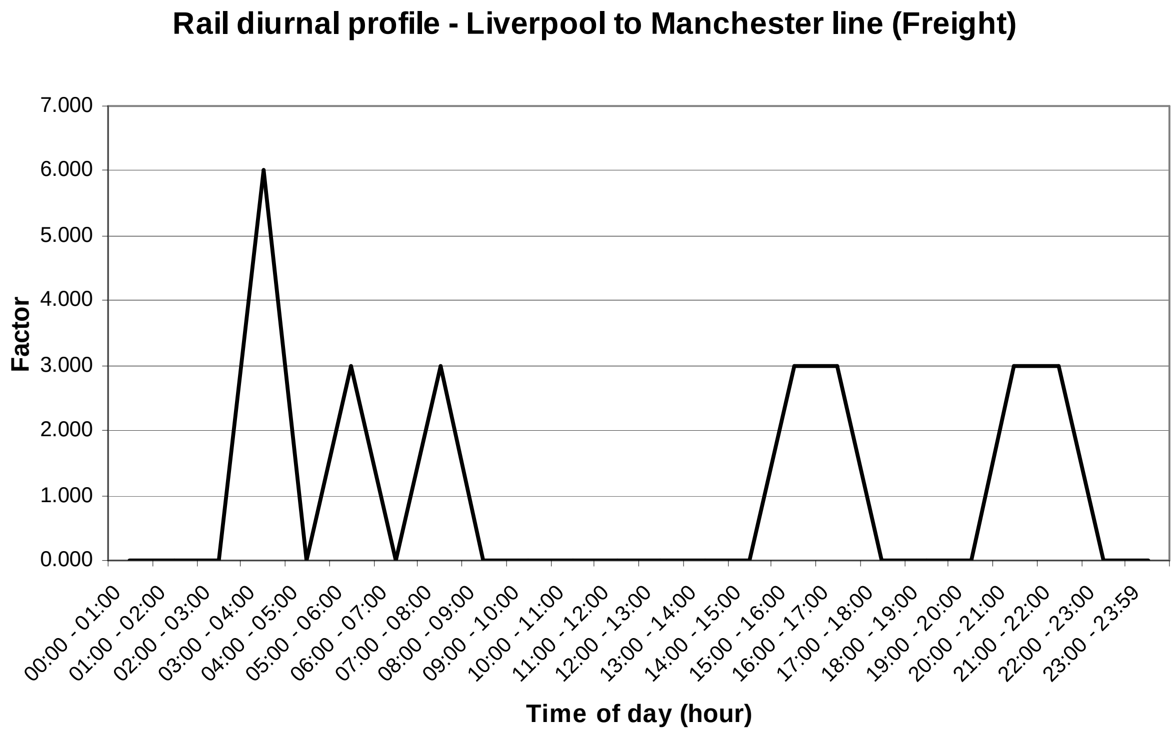
Graph C.1 Diurnal Profile of passenger train movements for London to Birmingham railway line (FA1)



Graph C.2 Diurnal Profile of passenger train movements for Liverpool to Manchester railway line (FA1)



Graph C.3 Diurnal Profile of freight train movements for Liverpool to Manchester railway line (FA1)



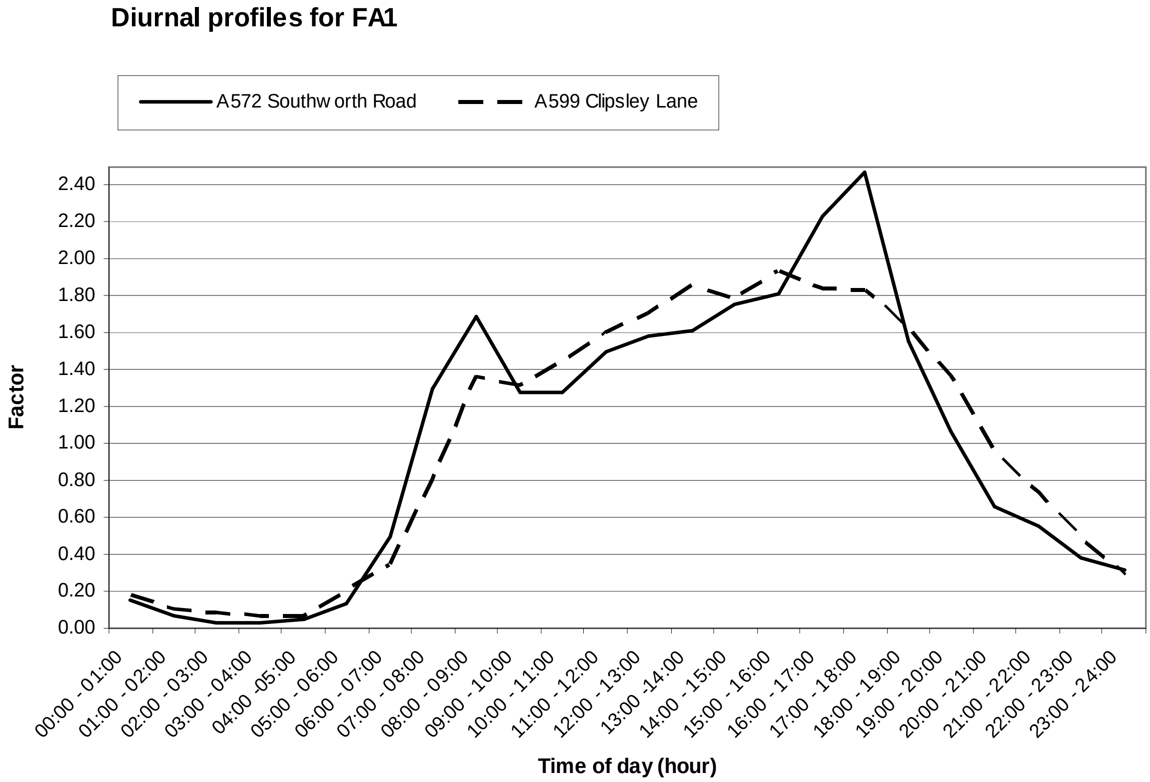
Appendix D Queue Lengths

Table D.1 Queue length used in modelling

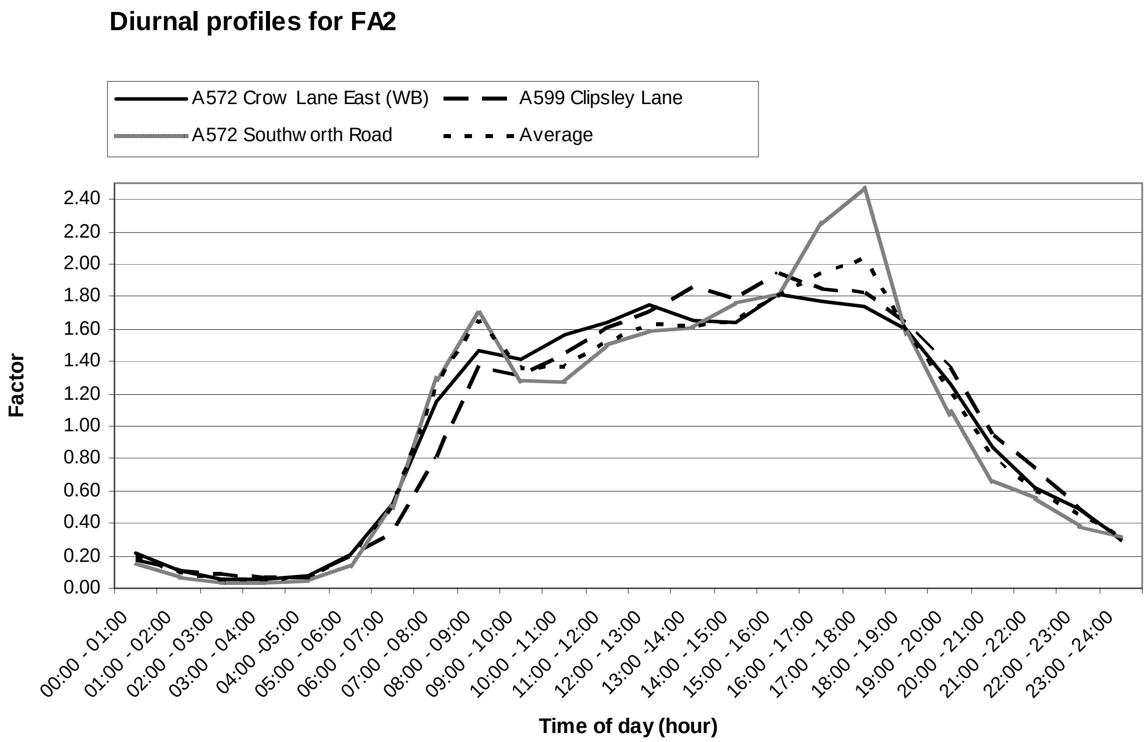
Link Number	Link Name	Queue Length (m)
FA2		
FA2-01	Crow Lane East	28.0
FA2-02	Ashton Road	32.0

Appendix E Diurnal Profile

FA1 – Park Cottages and Southworth Road



FA2 – High Street, Newton-le-Willows



Appendix F Model Verification

FA1 – Park Cottages and Southworth Road

A model verification factor for NO_x was calculated for FA1 using the methodology in LAQM.TG(09) Annex 3. The methodology recommends the use of a combination of continuous monitoring and diffusion tubes. In addition, it points out that where a range of location types are represented by monitoring, a model may perform differently and it may be more suitable to derive verification factors based on the site type (e.g. urban site, main road through rural area). Two verification factors were calculated, one for Park Cottages and the other for Southworth Road.

For Park Cottages modelling was carried out for 2009 and 2010 to predict NO_x concentrations at the Park Cottages diffusion tube. For Southworth Road, modelling was carried out for 2009 and 2010 to predict NO_x concentrations at the Southworth Road continuous monitor and several diffusion tubes. The monitored NO_2 concentrations were converted to NO_x concentrations using the methodology recommended in LAQM.TG(09).

Table E.1 shows the percentage difference between the modelled and monitored NO_2. The percentage differences vary between -15 and -37 % for Southworth Road and -4 and -21 % for Park Cottages, i.e. the model under predicted the measured concentrations.

LAQM.TG(09) requires adjustment of the modelled result.

Table E.1: Comparison of monitored and modelled NO_2 concentrations

Year	Monitoring Site	Monitor Type	Background NO_2	Monitored Total NO_2 (µg/m^3)	Modelled Total NO_2 (µg/m^3)	% Difference
Southworth Road						
2009	Southworth Road	CM	23.4	65.5	41.0	-37
	Southworth Road LP26 (T7)	DT	23.4	48.4	41.3	-15
	Southworth Road LP26 (T10)	DT	23.4	54.7*	41.2	-25
2010	Southworth Road	CM	21.7	59.8	38.5	-36
	170 Southworth Road (T30)	DT	21.7	37.4	28.6	-24
	Southworth Road (T31)	DT	21.7	48.9	35.8	-27
	160 Southworth Road (T32)	DT	21.7	49.7	35.8	-28
Park Cottages						
2009	Park Cottages (T15)	DT	23.8	47.8*	37.6	-21
2010			22.2	39.3	37.6	-4

* = Estimation from 9 months, DT = Diffusion Tube, CM = Continuous Monitor

Not enough data was available (ideally five monitoring sites) to calculate a linear trend line for Park Cottages (as outlined in LAQM.TG(09)) for obtaining a verification factor. As an alternative, the average ratio of difference was determined, a verification factor of 1.5.

Table E.2 shows the monitored and modelled road contributions, and their ratio.

Table E.2: Model verification data

Year	Monitoring Site	Monitor Type	Monitored Road NO_2 ($\mu g/m^3$)	Monitored Road NO_x ($\mu g/m^3$)	Modelled Road NO_x ($\mu g/m^3$)	Ratio
Southworth Road						
2009	Southworth Road	CM	42.1	110.0	42.4	2.6
	Southworth Road LP26 (T7)	DT	25.0	64.6	43.2	1.0
	Southworth Road LP26 (T10)	DT	31.3	85.9	43.2	2.0
2010	Southworth Road	CM	38.1	136.5	38.5	3.5
	170 Southworth Road (T30)	DT	15.7	35.7	14.6	2.4
	Southworth Road (T31)	DT	27.2	67.8	31.7	2.1
	160 Southworth Road (T32)	DT	28.0	70.3	31.7	2.2
Park Cottages						
2009	Park Cottages (T15)	DT	24.0	61.7	32.3	1.9
2010			17.1	39.5	35.2	1.1

For Southworth Road, the monitored and modelled road contributions to NO_x have been plotted on a graph (**Graph E.1**). The gradient of the linear trend line forced through the origin represents the verification factor. A NO_x verification factor of 2.3 was used.

Graph E.1 Determination of verification factor

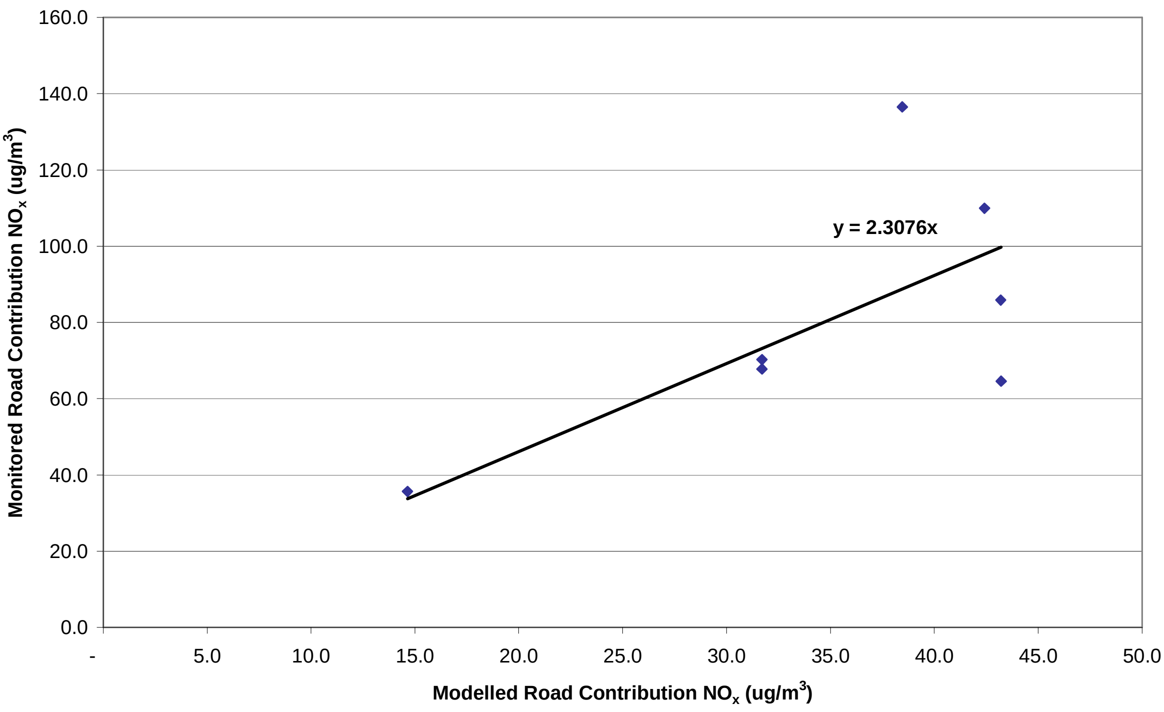


Table E.3 applies the verification factors to the modelled data. The monitored NO_2 is compared to the adjusted modelled NO_2 concentrations.

Table E.3: Comparison of Monitored NO_2 and Adjusted NO_2 Concentrations

Year	Monitoring Site	Monitor Type	Adjusted Modelled Road NO_x (µg/m^3)	Adjusted Modelled Total NO_x (µg/m^3)	Adjusted Modelled Total NO_2 (µg/m^3)	Monitored Total NO_2 (µg/m^3)	% Difference
Southworth Road							
2009	Southworth Road	CM	98.0	133.4	58.0	65.5	-11
	Southworth Road LP26 (T7)	DT	99.8	135.3	58.5	48.4	21
	Southworth Road LP26 (T10)	DT	99.8	135.2	58.5	54.7*	7
2010	Southworth Road	CM	88.8	121.0	55.4	59.8	-7
	170 Southworth Road (T30)	DT	33.8	66.0	36.7	37.4	-2
	Southworth Road (T31)	DT	73.2	105.4	50.7	58.9	4
	160 Southworth Road (T32)	DT	73.2	105.4	50.7	59.7	2
Park Cottages							
2009	Park Cottages (T15)	DT	49.0	85.2	43.6	47.8*	-9
2010			53.4	86.4	44.4	39.3	13

Note:
* = Estimation from 9 months, DT = Diffusion Tube, CM = Continuous Monitor

Table E.3 shows that the percentage difference between the adjusted modelled NO_2 and monitored NO_2 varies from -11 to 21 % and -9 to 13 %, respectively for Southworth Road and Park Cottages.

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Table E.4 shows the percentage difference between the modelled and monitored NO_2. The percentage differences vary between -23 and 19 %, i.e. the model over predicted the measured concentrations at three locations.

LAQM.TG(09) requires adjustment of the modelled result.

Table E.4: Comparison of Monitored NO_2 and Adjusted NO_2 Concentrations

Year	Monitoring Site	Monitor Type	Background NO_2	Monitored Total NO_2 (µg/m^3)	Modelled Total NO_2 (µg/m^3)	% Difference
2009	T8 High Street	DT	22.4	40.1	47.7	19
	T14 High Street, Rob Lane	DT	22.4	40.0	41.0	3
2010	T35 157 High Street	DT	18.3	35.4	36.5	3
	T36 19 High Street	DT	18.3	52.5	40.3	-23

DT = Diffusion Tube,

No verification factor has been applied to the results for FA2 in order to provide a conservative assessment.

Appendix G Figures