2015

Detailed assessment of air quality in Teynham undertaken by Bureau Veritas for Swale Borough Council

Swale BOROUGH COUNCIL

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Bureau Veritas

1/1/2015

Swale Borough Council

A2 London Road, Teynham

Detailed Assessment

October 2015

Move Forward with Confidence

Foreword to Teynham Detailed Assessment 2015

Swale Borough Council is committed to ensuring a healthy environment for our residents. We work constantly monitoring and targeting areas of concern to ensure improvement and reduction of air pollutants in the Borough.

An annual Air Quality Progress 2014 report was produced and submitted to Defra.

This Detailed Assessment Report for Teynham is one of several mandatory reports produced by our consultants on the status of air quality monitoring in Swale. The Report provides information for 2014 and presents the results of modelling undertaken to investigate the potential impact of traffic pollution on local residents. In 2016 we will need to undertake Further Assessment Report for Teynham. This will aim to identify the likely causes and distribution of traffic pollutants in Teynham. A Steering group will be set up to create an AQMA Action Plan for the Teynham Air Quality Management Area. This year a detailed assessment has been produced for Teynham and an air quality Management Order prepared to declare this area as an Air quality Management Area.

The Council has a statutory duty to monitor, review and assess the air quality in the Borough. This involves comparing the measured and predicted pollutant levels to the National Air Quality Objectives. There are currently four local Air Quality Management Areas declared in Swale where the air pollution has resulted in the levels exceeding the objectives for the pollutant nitrogen dioxide. We take air quality very seriously. Elected members and officers have been working with the KCC and Kent Highways to find ways to reduce the impact of traffic congestion for several years. There have been many mitigation measures implemented in Swale to reduce pollutants in the AQMAs. These include working with Partners and establishing a group in 2012 to work on a Freight Management plan for Swale (to be published next year), a pilot Eco stars scheme to reduce pollutants from HGV traffic throughout the Borough as well as participating in the Kent smarter travel challenge.

Where air quality is poor the community, businesses and all agencies must be informed and provided with support to form Community Steering groups to create Air Quality Management Action Plans which aim to reduce air pollution to acceptable levels below the objective set by the legislation. We will continue to work with local communities to improve air quality and to help Teynham to reduce pollutants along the A2 in Swale.

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Table of Contents

List of Figures

List of Tables

Executive Summary

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area. For local authorities that have identified areas where there is a potential risk of exceedence of Air Quality Strategy (AQS) objectives, a Detailed Assessment is required.

Following the assessment of monitoring results for the monitoring period 2012 to 2014 that indicate three sites have been close to or exceeding the annual mean AQS objective for nitrogen dioxide (NO_2), Bureau Veritas UK Ltd has been commissioned by Swale Borough Council to undertake a Detailed Assessment of the area surrounding the A2 London Road in Teynham.

In order to provide consistency with the Council's own work on air quality, the guiding principles for air quality assessments, as set out in the latest guidance and tools provided by Defra for air quality assessment (LAQM.TG(09)[1]), have been used.

The area was modelled using the advanced atmospheric dispersion model ADMS-Roads (Version 3.4.2).

The model suggests the 40µg/m^3 annual mean AQS objective for NO_2 may be exceeded at three receptor locations, with a further two locations within 10% of the objective.

The maximum annual mean NO_2 concentration at an existing receptor was predicted at '91A London Road', with a concentration of 42.7µg/m^3.

On the basis of the model predicted annual mean NO_2 concentrations and the published empirical relationship with exceedences of the short-term AQS objective limit, it is considered unlikely that the short-term hourly mean NO_2 AQS objective would be exceeded given the concentrations modelled.

Following the results of the report, the below recommendations are made:

- That an Air Quality Management Area (AQMA) be declared in the area, the extent of which is proposed in Figure 6.
- Further monitoring in the area is recommended. Since 2013 the Council has undertaken diffusion tube monitoring at sites SW91 and SW92 near the junction with Lynsted Lane. Both sites should prove useful in the future assessment of air quality in the proposed AQMA. It is recommended that an additional site is installed at the junction with Station Road to confirm existing concentrations at that section of the modelled exceedence area.
- An Air Quality Action Plan is drawn up to determine the best policies and intervention measures to put in place in order to reduce local NO_2 concentrations.
- Further Assessment of the area is conducted post implementation of the AQMA as part of the next round of LAQM reporting.

[1] Local Air Quality Management Technical Guidance LAQM.TG(09). February 2009. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.

1 Introduction

1.1 Scope of Assessment

Swale Borough Council (The Council) has declared four Air Quality Management Areas (AQMAs) under the existing Local Air Quality Management (LAQM) regime in relation to exceedences of the nitrogen dioxide (NO_2) annual mean Air Quality Strategy (AQS) objective of 40µg/m^3. The first AQMA was declared in March 2009 along the A2 in Newington where exceedences of the annual mean objective for NO_2 were predicted. Similarly an AQMA was declared in May 2011 for another part of the A2 in Ospringe near Faversham. A further two AQMAs were declared in January 2013 for areas within Sittingbourne.

Following several years of NO_2 diffusion tube monitoring on the A2 (London Road) through Teynham, the Council have identified several locations which have been observed to be exceeding, or close to exceeding, the 40µg/m^3 AQS objective. As the monitoring concentrations on the A2 (London Road) near the junction with Lynsted Lane have been shown to exceed the objective or be very close to exceedence, the Council has proceeded to a Detailed Assessment for this area of London Road (A2).

Bureau Veritas UK Ltd has been commissioned by Swale Borough Council to undertake the Detailed Assessment of the area through Teynham, from Cellar Hill in the easterly direction to Claxfield Road in the westerly direction. The area considered as part of this study is illustrated in Figure 1.

It is the general purpose and intent of this assessment to determine, with reasonable certainty, the magnitude and geographical extent of any exceedence so that the Council can have confidence in the potential declaration of an AQMA.

The following are the main objectives of the assessment:

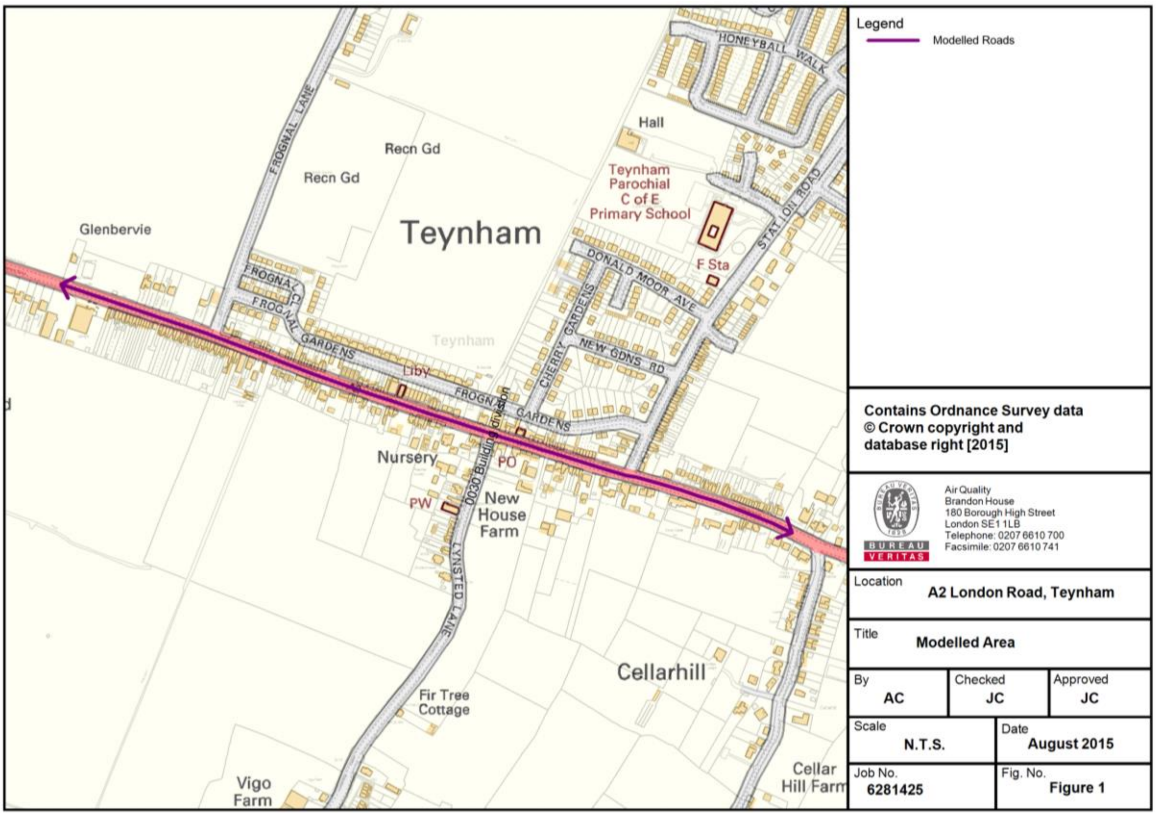
- To assess the air quality at selected locations ("receptors") at the façades of the existing residential units, representative of worst-case exposure, based on modelling of emissions from road traffic on the local road network for 2014;
- To determine the geographical extent of the potential exceedence;
- To attempt to quantify the number of residents exposed to exceedences of the NO_2 annual mean AQS objective; and
- To put forward conclusions and recommendations as to the extent of any proposed AQMA and necessary future monitoring.

The approach adopted in this assessment to assess the impact of road traffic emissions on air quality utilised the atmospheric dispersion model ADMS Roads version 3.4.2, focusing on emissions of NO_2.

In order to provide consistency with the Council's own work on air quality, the guiding principles for air quality assessments as set out in the latest guidance and tools provided by Defra for air quality assessment (LAQM.TG(09)[2]) have been used.

[2] Local Air Quality Management Technical Guidance LAQM.TG(09). February 2009. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.

Figure 1 – Modelled Area



2 Air Quality – Legislative Context

2.1 Air Quality Strategy

The importance of existing and future pollutant concentrations can be assessed in relation to the national air quality standards and objectives established by Government. The Air Quality Strategy[3] (AQS) provides the over-arching strategic framework for air quality management in the UK and contains national air quality standards and objectives established by the UK Government and Devolved Administrations to protect human health. The air quality objectives incorporated in the AQS and the UK Legislation are derived from Limit Values prescribed in the EU Directives transposed into national legislation by Member States.

The CAFE (Clean Air for Europe) programme was initiated in the late 1990s to draw together previous directives into a single EU Directive on air quality. The CAFE Directive[4] has been adopted and replaces all previous air quality Directives, except the 4th Daughter Directive[5]. The Directive introduces new obligatory standards for $PM_{2.5}$ for Government but places no statutory duty on local government to work towards achievement of these standards.

The Air Quality Standards (England) Regulations[6] 2010 came into force on 11 June 2010 in order to align and bring together in one statutory instrument the Government's obligations to fulfil the requirements of the new CAFE Directive.

The objectives for ten pollutants – benzene (C_6H_6), 1,3-butadiene (C_4H_6), carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulate matter - PM_{10} and $PM_{2.5}$, ozone (O_3) and Polycyclic Aromatic Hydrocarbons (PAHs), have been prescribed within the AQS[3].

The EU Limit Values are considered to apply everywhere with the exception of the carriageway and central reservation of roads and any location where the public do not have access (e.g. industrial sites). The AQS objectives apply at locations outside buildings or other natural or man-made structures above or below ground, where members of the public are regularly present and might reasonably be expected to be exposed to pollutant concentrations over the relevant averaging period. Typically these include residential properties and schools/care homes for long-term (i.e. annual mean) pollutant objectives and high streets for short-term (i.e. 1-hour) pollutant objectives.

This assessment focuses on NO_2 as this is the pollutant of most concern within the Council's administrative area. The monitoring concentrations on the A2 (London Road) near the junction with Lynsted Lane have been shown to exceed the annual mean objective for NO_2 or be very close to exceedence in recent years. Moreover, as a result of traffic pollution the UK has failed to meet the EU Limit Values for this pollutant by the 2010 target date. As a result, the Government has had to submit time extension applications for compliance with the EU Limit Values. Continued failure to achieve these limits may lead to EU fines. The AQS objectives for these pollutants are presented in Table 1.

[3] Defra (2007) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland.

[4] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.

[5] Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic hydrocarbons in ambient air.

[6] The Air Quality Standards Regulations (England) 2010, Statutory Instrument No 1001, The Stationary Office Limited.

Table 1 – Relevant AQS Objectives for the Assessed Pollutants in England

Pollutant	AQS Objective	Concentration Measured as:	Date for Achievement
Nitrogen dioxide (NO_2)	200 µg/m³ not to be exceeded more than 18 times per year	1-hour mean	31 December 2005
	40 µg/m³	Annual mean	31 December 2005

2.2 Local Air Quality Management (LAQM)

Part IV of the Environment Act 1995 places a statutory duty on local authorities to periodically Review and Assess the current and future air quality within their area, and determine whether they are likely to meet the AQS objectives set down by Government for a number of pollutants – a process known a Local Air Quality Management (LAQM). The AQS objectives that apply to LAQM are defined for seven pollutants: benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide and particulate matter.

Where the results of the Review and Assessment process highlight that problems in the attainment of health-based objectives for air quality will arise, the authority is required to declare an Air Quality Management Area (AQMA) – a geographic area defined by high concentrations of pollution and exceedences of health-based standards.

Where an authority has declared an AQMA, and development is proposed to take place either within or near the declared area, further deterioration to air quality resulting from a proposed development can be a potential barrier to gaining consent for the development proposal. Similarly, where a development would lead to an increase of the population within an AQMA, the protection of residents against the adverse long-term impacts of exposure to existing poor air quality can provide the barrier to consent. As such, following an increased number of declarations across the UK, it has become standard practice for planning authorities to require an air quality assessment to be carried out for a proposed development (even where the size and nature of the development indicates that a formal Environmental Impact Assessment (EIA) is not required).

One of the objectives of the LAQM regime is for local authorities to enhance integration of air quality into the planning process. Current LAQM Policy Guidance[7] clearly recognises land-use planning as having a significant role in terms of reducing population exposure to elevated pollutant concentrations. Generally, the decisions made on land-use allocation can play a major role in improving the health of the population, particularly at sensitive locations – such as schools, hospitals and dense residential areas.

[7] LAQM Policy Guidance LAQM.PG(09) - February 2009. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.

3 Review and Assessment of Air Quality Undertaken by the Council

3.1 Local Air Quality Management

Part IV of the Environment Act 1995 places a statutory duty on local authorities to periodically Review and Assess the current and the future air quality within their area and determine whether they are likely to meet the AQOs set down by Government for a number of pollutants – a process known a Local Air Quality Management (LAQM). The AQOs that apply to LAQM are defined for seven pollutants: benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide and particulate matter.

Where the results of the Review and Assessment process highlight that problems in the attainment of health-based objectives for air quality will arise, the authority is required to declare an Air Quality Management Area (AQMA) – a geographic area defined by high concentrations of pollution and exceedences of health-based standards.

Between 1998 and 2001, Swale Borough Council undertook its first round of review and assessment of air quality, which concluded that it was not necessary to declare an AQMA for any pollutant.

During the second round of review and assessment (2003 – 2005), measured exceedences of the NO_2 annual mean objective along the A2 at Ospringe resulted in a Detailed Assessment in 2005. Although dispersion modelling confirmed the risk of exceedence in the area, the report concluded that there were too many uncertainties due to lack of monitoring data. Therefore, an extensive monitoring programme was devised, including the installation of a new continuous monitoring station closer to the street canyon section, before deciding whether an AQMA was required for Ospringe.

During the third round of review and assessment, commencing in 2006 with a new Updating and Screening Assessment (USA), new exceedences of the NO_2 annual mean objective at several locations along the A2 in Newington were measured, and therefore a Detailed Assessment was carried out for this area. The Detailed Assessment, completed in 2007, recommended that an AQMA be declared in Newington based on the potential exceedences in the High Street; this AQMA was declared in March 2009 for parts of London Road and High Street in Newington. A Further Assessment, completed in 2010, confirmed the need for the AQMA and provided additional information, which was used to prepare an AQAP for the Newington AQMA (completed in 2010).

The fourth round of review and assessment commenced with the USA in 2009. This identified measured exceedences of the annual mean NO_2 objective at seven locations in Swale outside the Newington AQMA, in Sittingbourne, and in Ospringe. Two of these sites were assessed in a new Detailed Assessment in 2009 focused on Canterbury Road/ East Street and St Paul's Street in Sittingbourne. The recommendation of the Detailed Assessment 2009 was to consider further AQMA designations at these locations, in addition to undertaking additional monitoring. The need for an AQMA in Ospringe was also reassessed in a new Detailed Assessment completed in 2010. The report confirmed the need for an AQMA in Ospringe, which was declared in May 2011. Also in 2011 the Council has installed an NO_2 analyser site in the Newington High Street AQMA and a new continuous monitor at Canterbury Road/East Street. Further monitoring at the original Newington site was carried out for 6 months during 2010 prior to the new site becoming operational.

The 2012 Updating and Screening Assessment detailed the 2011 monitoring results which confirmed the need to declare AQMAs at the Canterbury Road/East Street and St Paul's Street areas. The report also identified a further area, diffusion tube SW80 in Teynham, which may require a detailed assessment, depending on the monitoring results in 2012.

A Quantitative Appraisal of proposed AQAP measures for the Newington AQMA was undertaken in 2012. The aim of the report was to provide a quantitative estimate as to what the impacts on NO_2 concentrations would be as a result of the implementation of measures detailed in the AQAP. The assessment found that no single measure on its own would be sufficient to achieve compliance with the AQS objective, however implementation of a suite of measures would result in compliance at most of the receptor locations that are currently showing exceedences.

In January 2013 a Further Assessment was undertaken for the Ospringe Road AQMA. The report confirmed that the Ospringe AQMA is still required as the annual mean objective is still likely to be exceeded at a number of relevant receptor locations. The updated model results of this assessment also identified the requirement to extend the AQMA to the east to include The Mount along London Road. This is an area Swale Borough Council is currently considering.

In 2013 Swale Borough Council declared two new AQMAs; these were for East Street, Sittingbourne and St Paul's Street, Sittingbourne. A continuous monitor was installed on St Paul's Street in 2013 with a co-located diffusion tube monitoring site. A Further Assessment for the new AQMAs was undertaken in 2014. The updated model results showed that the East Street AQMA should remain unchanged. Updated model results for St Pauls Street AQMA showed that exceedences were centred between the Staplehurst Road roundabout and the junction with Millen Road. If monitored concentrations at the site SW39 are similar in 2014, a contraction of the existing AQMA may be considered.

The review of monitoring results for the monitoring period 2012 to 2014 in the area of London Road (the A2) in Teynham confirmed that three diffusion tube sites have been close to or exceeding the annual mean AQS objective for nitrogen dioxide (NO_2). Therefore the recommendation of the 2013 Progress Report was for the Council to undertake a Detailed Assessment of the area surrounding the A2 London Road in Teynham.

3.2 Review of Air Quality Monitoring

The Council operated four continuous monitoring stations in the local authority area in 2014. Nitrogen dioxide was monitored at the Newington (3) site (High Street, Newington), the Ospringe Roadside (2) site (Water Lane, Faversham), the Canterbury Road (Canterbury Road, Sittingbourne) and the St Paul's Street (St Paul's Street, Sittingbourne). Continuous monitoring of PM10 was undertaken at one location, Swale Ospringe Roadside (2). Recent results from these monitoring stations are shown in Table 2.

Continuous results for 2014 indicate that the annual mean objective and the 1-hour objective for NO_2 were met at all four automatic monitoring locations: The annual mean and the 24-hour mean for PM_{10} continue to be met at the A2 Ospringe Street monitoring location in Faversham. This also demonstrates annual mean PM_{10} concentrations are well below the AQS objective, hence why this pollutant was not considered in this Detailed Assessment.

Table 2 – LAQM Automatic Monitoring Undertaken in the Council area

Site ID	Site Details	Site Type	OS Grid Ref	Pollutants Monitored	Monitoring Technique	Annual Mean Concentration ($\mu g/m^3$)		
						2012	2013	2014
Newington (3)	A2 High Street, Newington	Roadside	585861, 164817	NO_2	Chemiluminescence	30.4	34.8	32.9
Ospringe Roadside (2)	Water Lane (near A2 Ospringe Street), Faversham	Roadside	600360, 160869	NO_2	Chemiluminescence	34.8	36.9	34.4[a]
				PM_{10}	TEOM	26.4	26.9	25.6[a]

Canterbury Road	A2 Canterbury Road, Sittingbourne	Roadside	591483, 163472	NO_2	Chemiluminescence	37.4	**42.5**	34.3
St Paul's Street	St Paul's Street, Sittingbourne	Roadside	590264, 164396	NO_2	Chemiluminescence	-	33.6	35.1

[a] Data has been annualised based on data capture <75%
In **bold**, exceedence of the NO_2 annual mean AQS objective of 40 µg/m^3

The Council carried out passive monitoring for NO_2 at 57 sites in 2014. Recent monitoring results for the sites in Teynham are shown in Table 3 and their locations illustrated in Figure 3.

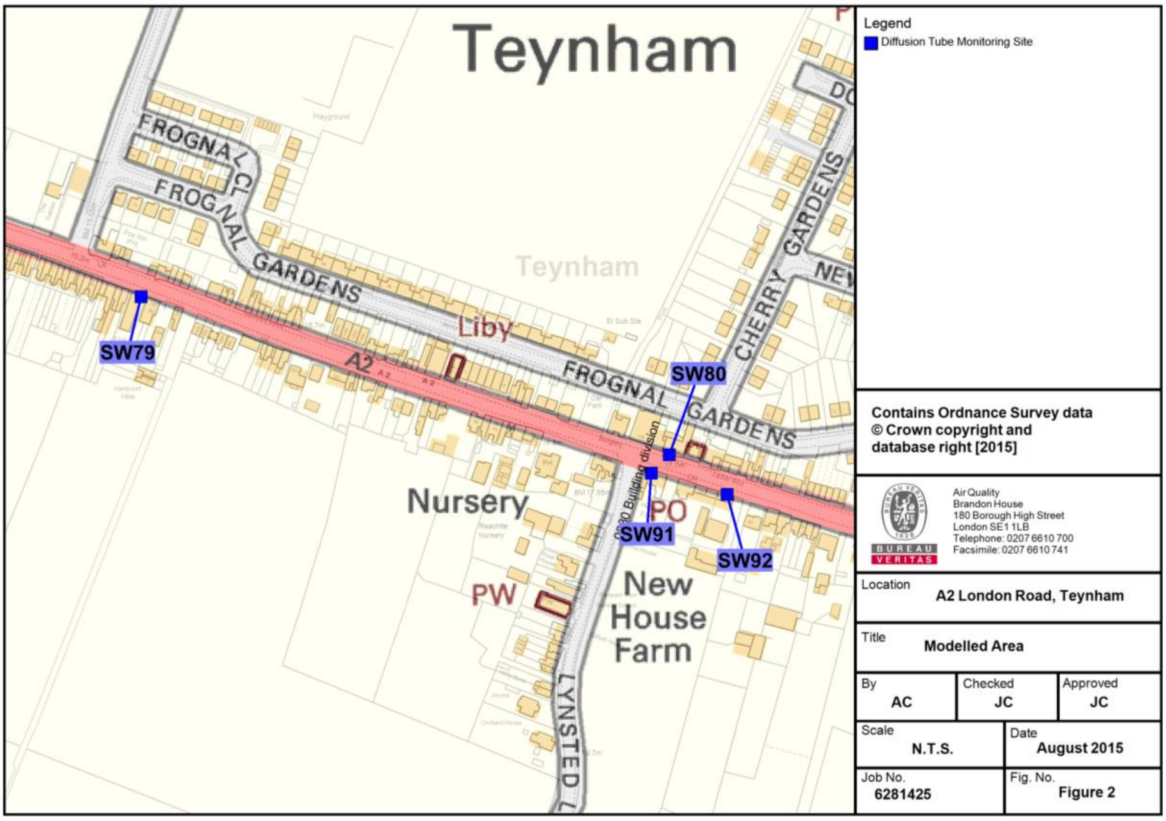
Table 3 – LAQM Diffusion Tube Monitoring undertaken for NO_2 in modelled area and vicinity

Site ID	Site Location	Site Type	OS Grid Ref	Distance to Road (m)	Annual Mean NO_2 Concentration (µg/m^3)		
					2012 (Bias Adjustment Factor = 0.80)	2013 (Bias Adjustment Factor = 0.82)	2014 (Bias Adjustment Factor = 0.81)
SW79	Belle Friday Centre, A2 Teynham	Roadside	594840, 162566	4.0	20.2	32.8	17.1
SW80	Michaels Hairdressers A2 Teynham	Roadside	595160, 162470	1.5	**45.2**	39.1[a]	**41.6**
SW91	72 London Road, Teynham	Roadside	595149, 162459	2.0	-	**41.3[a]**	38.5[a]
SW92	64 London Road, Teynham	Roadside	595195, 162446	3.1	-	39.9[a]	-

[a] Data has been annualised based on data capture <75%
In **bold**, exceedence of the NO_2 annual mean AQS objective of 40 µg/m^3

The results shown in Table 3, show exceedences of the annual mean NO_2 objective on the A2 London Road in Teynham next to the junction with Lynsted Lane. Monitoring location SW80 is observed to have been exceeding the 40µg/m^3 AQS objective for NO_2 in 2012 and 2014 and close to exceeding in 2013. Monitoring location SW91 is observed to have been exceeding the 40µg/m^3 AQS objective for NO_2 in 2013 and close to exceeding in 2014. Monitoring location SW92 is observed to have been close to exceeding in 2013. The 2012-2014 monitoring data therefore supports the Council's decision to progress with a Detailed Assessment.

Figure 2 – Local Monitoring Locations



3.3 Background Concentrations used in the Assessment

Defra maintains a nationwide model of existing and future background air quality concentrations at a 1km grid square resolution. The data sets include annual average concentration estimates for NO_x, NO_2, PM_{10} and $PM_{2.5}$, using a base year of 2011. The model used is semi-empirical in nature; it uses the national atmospheric emissions inventory (NAEI) emissions to model-predict the concentrations of pollutants at the centroid of each 1km grid square, but then calibrates these concentrations in relation to actual monitoring data.

Annual mean background concentrations have been obtained from the Defra published background maps[8], based on the 1km grid squares which cover the modelled area and the affected road network. The Defra mapped background concentrations for 2014 are presented in Table 4.

Table 4 – Background Pollutant Concentrations (Defra Background Maps)

Grid Square (E,N)	2014 Annual Mean Concentration (µg/m^3)	
	NO_x	NO_2
595500, 162500	17.2	12.8
594500, 162500	17.0	12.7
AQS objective	-	*40*

These mapped background levels are below the respective annual mean AQS objectives.

[8] Defra Background Maps (2014). http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

The predicted annual mean road contributions are added to the relevant annual mean background concentration in order to predict the total pollutant concentration at each receptor location. The total pollutant concentration can then be compared against the relevant AQS objectives to determine the event of an exceedence.

4 Assessment Methodology

The approach used in this assessment has been based on the following:

- Prediction of ambient NO_2 concentrations, to which existing receptors may be exposed and comparison with the relevant AQS objectives.
- Determination of the geographical extent of any potential exceedence.

4.1 Traffic Assessment

Emissions from road traffic have been predicted using version 6.0.2 of the Emissions Factor Toolkit[9]. Road-NO_x contributions at receptor locations were modelled using the ADMS-Roads (Version 3.4.2) atmospheric dispersion model developed by Cambridge Environmental Research Consultants (CERC).

4.1.1 Model Inputs

The ADMS-Roads assessment incorporates numbers of road traffic vehicles, vehicle speeds on the local roads and the composition of the traffic fleet. The traffic data for this assessment has been collated from the Department for Transports (DfT), Traffic Counts web resource[10] and is outlined in Table 5.Traffic speed data was taken from the speed limits on London Road (A2) in the modelling area. Where appropriate, the speeds have been reduced to simulate queues at junctions and traffic lights.

London Road (A2) from the junction with Lynsted Lane through to the junction with Station Road is lined densely with buildings, which due to reduced dispersion can cause 'street canyons' effects. To account for this effect, the street canyon tool has been used within the ADMS-Road model for these links. The width and height of the canyons was estimated from information gathered from online mapping resources.

Table 5 – Traffic Data used in the Detailed Assessment

Link Name	2014 24hr AADT	% Car	%LGV	% Rigid HGV	% Artic HGV	% Bus /Coach	% Motorcycle	Speed (kph)	Road Width (m)	Canyon Height (m)
A2_1	15963	77.7	15.8	3.1	1.4	0.8	1.2	48	8.4	-
A2_2	15963	77.7	15.8	3.1	1.4	0.8	1.2	40	8.0	-
A2_3	15963	77.7	15.8	3.1	1.4	0.8	1.2	30	7.8	-
A2_4	15963	77.7	15.8	3.1	1.4	0.8	1.2	30	18.0*	10
A2_5	15963	77.7	15.8	3.1	1.4	0.8	1.2	30	15.0*	10
A2_6	15963	77.7	15.8	3.1	1.4	0.8	1.2	30	15.0*	10
A2_7	15963	77.7	15.8	3.1	1.4	0.8	1.2	30	13.6*	10
A2_8	15963	77.7	15.8	3.1	1.4	0.8	1.2	30	17.8*	10
A2_9	15963	77.7	15.8	3.1	1.4	0.8	1.2	30	6.8	-
A2_10	15963	77.7	15.8	3.1	1.4	0.8	1.2	40	7.0	-
A2_11	15963	77.7	15.8	3.1	1.4	0.8	1.2	48	7.3	-

* The road width for street canyons was measured as distance between the buildings on both sides of the road.

[9] EFT_v6.0.2 available at - http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

[10] Department for Transport – Traffic Counts (2014) http://www.dft.gov.uk/traffic-counts/

The following scenario has been assessed:

- 2014 Base Case

Background pollutant concentrations have been taken from the estimated background concentrations compiled by Defra[8], as discussed previously in Section 3. Background concentrations used in the assessment of road traffic emissions are shown in Table 6.

Table 6 – Background Concentrations used in the Assessment of Road Traffic Emissions

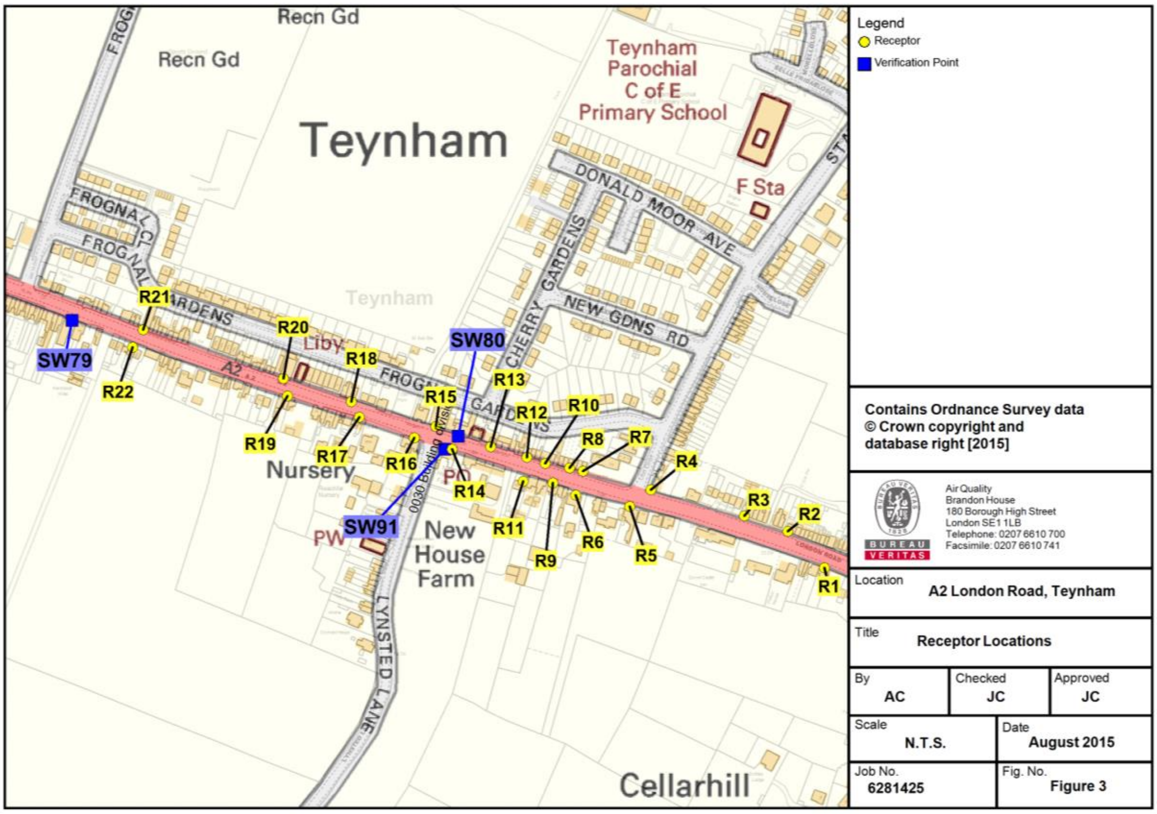
Year	Grid Square (E,N)	Annual Mean Concentration (µg/m^3)	
		NO_2	NO_x
2014	595500, 162500	12.8	17.2
	594500, 162500	12.7	17.0

The receptors considered in the assessment of emissions from road traffic are shown in Table 7, and their location illustrated in Figure 3. Concentrations were also modelled across a regular gridded area of 900x400m. Furthermore, additional receptor points were added to the model close to the modelled part of London Road, using the intelligent gridding tool in ADMS Roads.

Table 7 – Receptor Locations considered in the Assessment of Emissions from Road Traffic

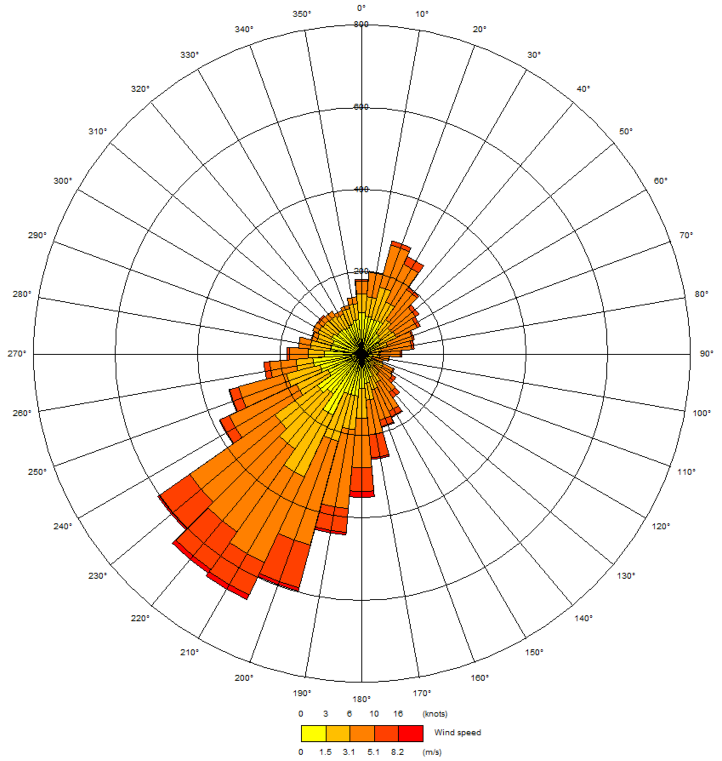
ID	Receptors	Coordinates		Height (m)
		X	Y	
Existing Receptors – all addresses approximate				
R_1	12 London Road	595463.7	162360.7	1.5
R_2	35 London Road	595433.5	162390.9	1.5
R_3	47 London Road	595397.4	162403.9	1.5
R_4	67 London Road	595319.9	162425.3	1.5
R_5	32 London Road	595302.2	162411.6	1.5
R_6	42 London Road	595257.6	162421.2	1.5
R_7	75 London Road	595263.5	162440.9	1.5
R_8	81 London Road	595252.3	162443.5	1.5
R_9	50 London Road	595238.7	162431.0	1.5
R_10	87 London Road	595232.4	162447.3	1.5
R_11	56 London Road	595214.2	162432.5	1.5
R_12	91A London Road	595217.0	162452.3	1.5
R_13	101 London Road	595186.9	162461.1	1.5
R_14	72 London Road	595154.9	162459.2	1.5
R_15	109 London Road	595141.6	162478.0	1.5
R_16	The George, London Road	595123.6	162468.4	1.5
R_17	80, London Road	595078.2	162485.8	1.5
R_18	121 London Road	595071.5	162498.6	1.5
R_19	98 London Road	595018.5	162503.4	1.5
R_20	133 London Road	595015.1	162517.6	1.5
R_21	167A London Road	594899.0	162558.2	1.5
R_22	140B London Road	594890.1	162543.6	1.5

Figure 3 – Receptor Locations considered in the Assessment of Emissions from Road Traffic



Meteorological data from a representative station is required by the dispersion model. 2014 meteorological data from Charlwood weather station, has been used in this assessment. A wind rose for this site for the year 2014 is shown in Figure 4. Most dispersion models do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75m/s. It is recommended in LAQM.TG(09) that the meteorological data file be tested within a dispersion model and the relevant output log file checked, to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedences. LAQM.TG(09) recommends that meteorological data should only be used if the percentage of usable hours is greater than 75%, and preferably 90%. 2014 meteorological data from Charlwood include 8,737 lines of usable hourly data out of the total 8,760 for the year, i.e. 99.7% usable data. This is therefore suitable for the dispersion modelling exercise.

Figure 4 – Wind rose for Charlwood Meteorological Data 2014



4.1.2 Model Outputs

The background pollutant values available from Defra[8] have been used in the ADMS-Roads model to calculate predicted total annual mean concentrations of NO_x and NO_2. These background pollutant concentrations are based upon all of the sources of air pollutants in the 1km grid square and any air pollutants from adjacent grid squares which may be of relevance.

For the prediction of annual mean NO_2 concentrations for the modelled scenario, the output of the ADMS-Roads model for NO_x has been converted to NO_2 following the methodology in LAQM.TG(09)[2] and using the NO_x to NO_2 conversion tool developed on behalf of Defra. This tool also utilises the total background NO_x and NO_2 concentrations. This assessment has utilised version 4.1 (June 2014) of the NO_x to NO_2 conversion tool. The road contribution is then added to the appropriate NO_2 background concentration value to obtain an overall total NO_2 concentration.

For the prediction of short term NO_2 impacts, LAQM.TG(09)[2] advises that it is valid to assume that exceedences of the 1-hour mean AQS objective for NO_2 are only likely to occur where the annual mean NO_2 concentration is 60µg/m^3 or greater. This approach has thus been adopted for the purposes of this assessment.

Verification of the ADMS assessment has been undertaken using the local authority monitoring locations which are located adjacent to the affected road network. All NO_2 results presented in the assessment are those calculated following the process of model verification, using a factor of 1.289, as detailed in Appendix 2.

5 Results

This assessment has considered emissions of NO_2 from road traffic at existing receptor locations. The results of the dispersion modelling are provided below, for those receptor locations detailed and illustrated in Table 7 and Figure 3 respectively.

Table 8 presents the annual mean NO_2 concentrations predicted at existing residential receptor locations for 2014.

The model suggests that the 40µg/m^3 annual mean AQS objective is observed to be exceeded at a total of three receptor locations, with a further two locations within 10% of the objective.

The maximum annual mean NO_2 concentration was predicted at '91A London Road', with a predicted result of 42.7µg/m^3.

The empirical relationship given in LAQM.TG(09)[2] states that exceedences of the 1-hour mean objective for NO_2 are only likely to occur where annual mean concentrations are 60µg/m^3 or above. Annual mean NO_2 concentrations at all receptor locations are below this limit, and therefore short-term NO_2 exposure from road traffic emissions at the assessed receptor locations is not considered to be significant.

Table 8 – Predicted Annual Mean NO_2 Concentrations for 2014

ID	Receptors	Height (m)	Annual Mean NO_2 (µg/m³)		% of AQS Objective
			AQS objective	2014	
Existing Receptors					
R_1	12 London Road	1.5	40	20.7	51.8%
R_2	35 London Road	1.5	40	24.6	61.4%
R_3	47 London Road	1.5	40	24.1	60.1%
R_4	67 London Road	1.5	40	27.0	67.4%
R_5	32 London Road	1.5	40	21.4	53.5%
R_6	42 London Road	1.5	40	20.5	51.2%
R_7	75 London Road	1.5	40	28.4	71.0%
R_8	81 London Road	1.5	40	<u>37.7</u>	94.4%
R_9	50 London Road	1.5	40	35.9	89.7%
R_10	87 London Road	1.5	40	<u>39.9</u>	99.8%
R_11	56 London Road	1.5	40	20.0	50.0%
R_12	91A London Road	1.5	40	**42.7**	106.8%
R_13	101 London Road	1.5	40	**42.0**	105.1%
R_14	72 London Road	1.5	40	**42.6**	106.4%
R_15	109 London Road	1.5	40	29.6	73.9%
R_16	The George, London Road	1.5	40	23.9	59.6%
R_17	80, London Road	1.5	40	25.6	63.9%
R_18	121 London Road	1.5	40	30.5	76.3%
R_19	98 London Road	1.5	40	22.8	57.1%
R_20	133 London Road	1.5	40	29.8	74.6%
R_21	167A London Road	1.5	40	29.9	74.8%
R_22	140B London Road	1.5	40	19.3	48.3%
In **bold**, exceedence of the NO_2 annual mean AQS objective of 40 µg/m³ <u>Underlined</u>, result within 10% of annual mean NO_2 objective of 40 µg/m³					

Annual mean NO_2 concentrations were also predicted at generic receptor locations within a grid with a minimum spatial resolution of 9m, covering the modelled area for the purposes of generating concentration isopleths.

Figure 5 illustrates the annual mean NO_2 concentration isopleths. To mitigate against the uncertainty of modelled exceedences, 44µg/m³, 40µg/m³ and 36µg/m³ concentration isopleths (i.e. ±10% of the AQS objective) are presented.

These predicted areas were used to determine the population exposure to potential exceedence of the annual mean NO_2 AQS objective. The Office for National Statistics[11] provides an average number of 2.4 people per UK household in 2014. Based on the number of properties located within the 36µg/m³ and above area , the number of people exposed to potential exceedences of the annual mean NO_2 is approximately 74.

Given the exceedences modelled and the relevant receptors exposed, an AQMA is required in the area, the extent of which is proposed in Figure 6.

11 http://www.ons.gov.uk/ons/rel/family-demography/families-and-households/2014/index.html

Figure 5 – Annual Mean NO_2 Concentration Isopleths (µg/m³)

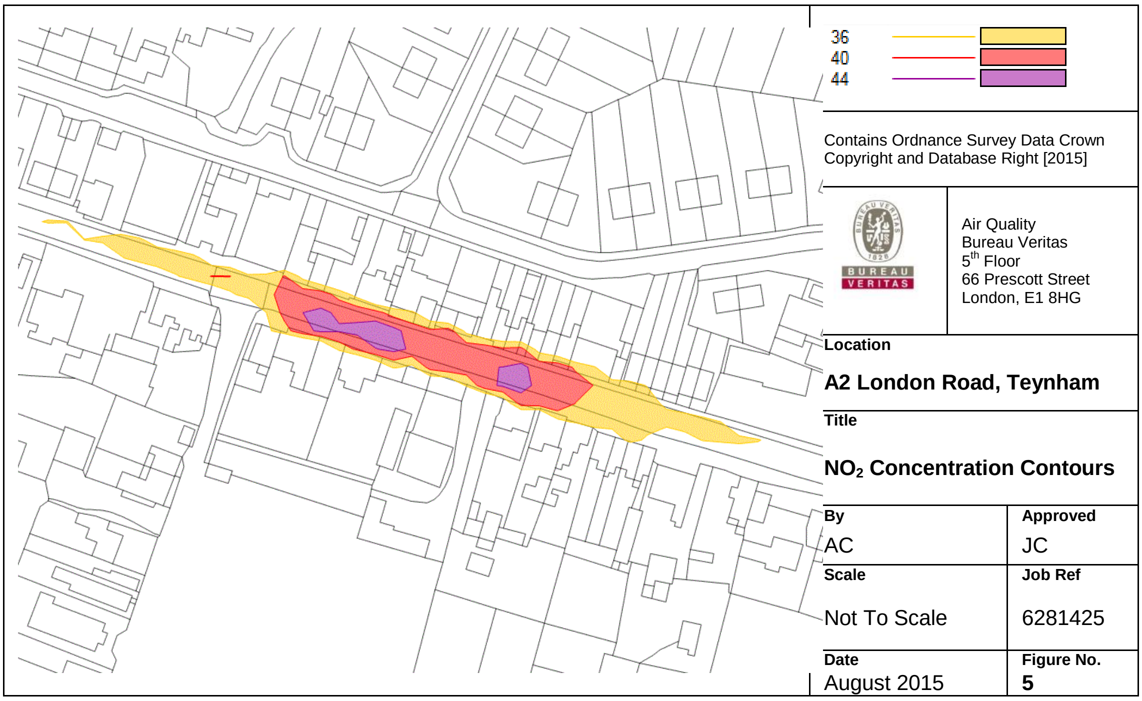
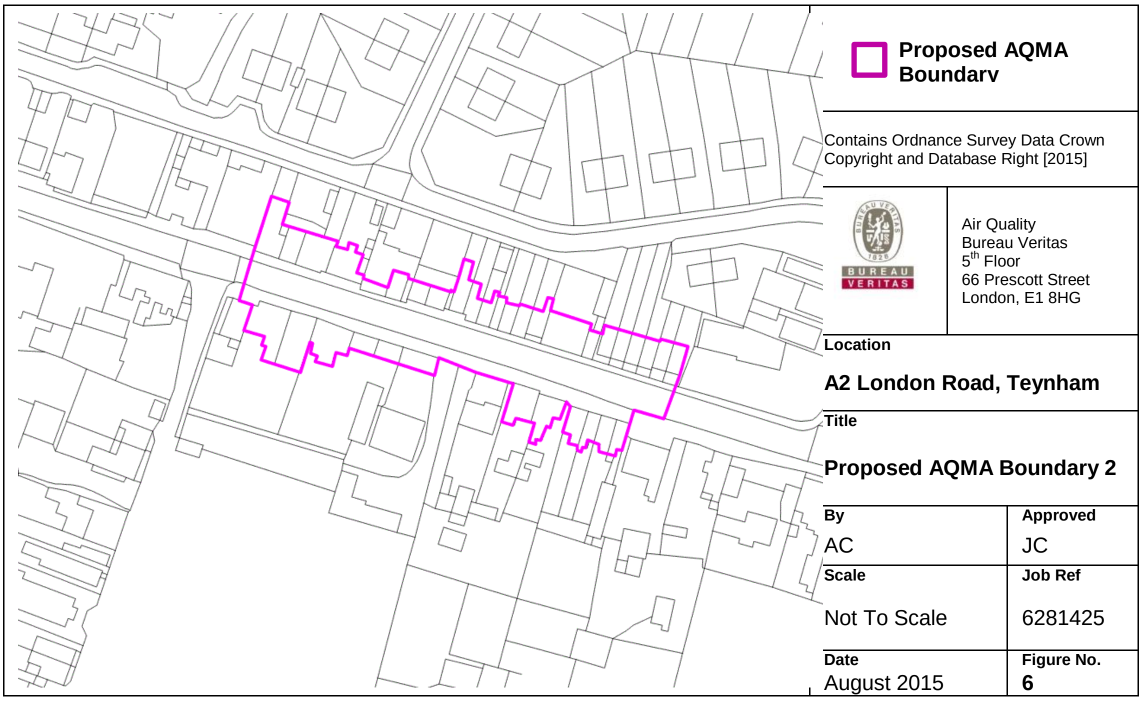


Figure 6 – Proposed AQMA Boundary



6 Conclusions and Recommendations

Bureau Veritas UK Ltd, on behalf of Swale Borough Council, has produced a Detailed Assessment of the area surrounding the A2 London Road in Teynham. The following section provides the conclusions of this assessment.

6.1 Predicted Concentrations

The ADMS-Roads dispersion model (version 3.4.2) has been used to determine the likely NO_2 concentrations at existing receptor locations.

Assessed locations included twenty two residential receptors around the main road link of concern (the A2), representative of worst-case exposure. Annual mean NO_2 concentrations were found to be exceeding the 40µg/m^3 annual mean AQS objective at three locations. The highest modelled concentration was at '91A London Road', at 42.7µg/m^3. With respect to the hourly NO_2 objective, all modelled concentrations were below the 60µg/m^3, above which exceedences of the short-term NO_2 AQS objective are considered possible, and thus exceedences of the 1-hour mean AQS objective are considered unlikely.

The gridded output of the model demonstrates that the geographical extent of the exceedence covers the area along the A2 London Road from the junction with Lynsted Lane to the junction with Station Road.

In conclusion, this assessment has demonstrated that local air quality is in breach of the 40µg/m^3 annual mean AQS objective for NO_2, so the declaration of an AQMA is required. The suggested extent of this is demonstrated in Figure 6.

6.2 Future Recommendations

Following the above conclusions, the following recommendations are made:

- That an Air Quality Management Area (AQMA) be declared in the area, the extent of which is proposed in Figure 6.
- Further monitoring in the area is recommended. Since 2013 the Council has undertaken diffusion tube monitoring at sites SW91 and SW92 near the junction with Lynsted Lane. Both sites should prove useful in the future assessment of air quality in the proposed AQMA. It is recommended that an additional site is installed at the junction with Station Road to confirm existing concentrations at that section of the modelled exceedence area.
- An Air Quality Action Plan is drawn up to determine the best policies and intervention measures to put in place in order to reduce local NO_2 concentrations.
- Further Assessment of the area is conducted post implementation of the AQMA as part of the next round of LAQM reporting.

Appendices

Appendix 1 – Background to Air Quality

Emissions from road traffic contribute significantly to ambient pollutant concentrations in urban areas. The main constituents of vehicle exhaust emissions, produced by fuel combustion are carbon dioxide (CO_2) and water vapour (H_2O). However, combustion engines are not 100% efficient and partial combustion of fuel results in emissions of a number of other pollutants, including carbon monoxide (CO), particulate matter (PM), Volatile Organic Compounds (VOCs) and hydrocarbons (HC). For HC, the pollutants of most concern are 1,3 - butadiene (C_4H_6) and benzene (C_6H_6). In addition, some of the nitrogen (N) in the air is oxidised under the high temperature and pressure during combustion; resulting in emissions of oxides of nitrogen (NO_x). NO_x emissions from vehicles predominately consist of nitrogen oxide (NO), but also contain nitrogen dioxide (NO_2). Once emitted, NO can be oxidised in the atmosphere to produce further NO_2.

The quantities of each pollutant emitted depend upon a number of parameters; including the type and quantity of fuel used, the engine size, the vehicle speed, and the type of emissions abatement equipment fitted. Once emitted, these pollutants disperse in the air. Where there is no additional source of emission, pollutant concentrations generally decrease with distance from roads, until concentrations reach those of the background.

This air quality assessment focuses on NO_2 and PM_{10} (PM of aerodynamic diameter less than 10µm) as these pollutants are least likely to meet their respective Air Quality Strategy (AQS) objectives near roads. This has been confirmed over recent years by the outcome of the Local Air Quality Management (LAQM) regime. The most recent statistics[12] regarding Air Quality Management Areas (AQMAs) show that, 601 AQMAs were declared in the UK, of which 562 include NO_2 and 99 include PM_{10} (a number of AQMAs have been declared for both pollutants). The majority (92%) of existing AQMAs have been declared in relation to road traffic emissions.

In line with these results, the reports produced by the Council under the LAQM regime have confirmed that road traffic within their administrative area is the main issue in relation to air quality.

An overview of these two pollutants, describing briefly the sources and processes influencing the ambient concentrations, is presented below.

Particulate Matter (PM_{10})

Particulate matter is a mixture of solid and liquid particles suspended in the air. There are a number of ways in which airborne PM may be categorised. The most widely used categorisation is based on the size of particles such as $PM_{2.5}$, particles of aerodynamic diameter less than 2.5µm (micrometre = 10^{-6} metre), and PM_{10}, particles of aerodynamic diameter less than 10µm. Generically, particulate residing in low altitude air is referred to as Total Suspended Particulate (TSP) and comprises coarse and fine material including dust.

Particulate matter comprises a wide range of materials arising from a variety of sources. Examples of anthropogenic sources are carbon (C) particles from incomplete combustion, bonfire ash, recondensed metallic vapours and secondary particles (or aerosols) formed by chemical reactions in the atmosphere. As well as being emitted directly from combustion sources, man-made particles can arise from mining, quarrying, demolition and construction operations, from brake and tyre wear in motor vehicles and from road dust resuspension from moving traffic or strong winds. Natural sources of PM include wind-blown sand and dust, forest fires, sea salt and biological particles such as pollen and fungal spores.

[12] Statistics from the UK AQMA website available at http://aqma.defra.gov.uk – Figures as of January 2013

The health impacts from PM depend upon size and chemical composition of the particles. For the purposes of the AQS objectives, PM_{10} or $PM_{2.5}$ is solely defined on size rather than chemical composition. This enables a uniform method of measurement and comparison. The short and long-term exposure to PM has been associated with increased risk of lung and heart diseases.PM may also carry surface-absorbed carcinogenic compounds. Smaller PM have a greater likelihood of penetrating the respiratory tract and reaching the lung to blood interface and causing the above adverse health effects.

In the UK, emissions of PM_{10} have declined significantly since 1980, and were estimated to be 114kt (kilotonne) in 2010[13]. Residential / public electricity and heat production and road transport are the largest sources of PM_{10} emissions. The road transport sector contributed 22% (25kt) of PM_{10} emissions in 2010. The main source within road transport is brake and tyre wear.

It is important to note that these estimates only refer to primary emissions, that is, the emissions directly resulting from sources and processes and do not include secondary particles. These secondary particles, which result from the interaction of various gaseous components in the air such as ammonia (NH_3), sulphur dioxide (SO_2) and NO_x, can come from further a field and impact on the air quality in the UK and vice versa.

Similarly to PM_{10}, emissions of $PM_{2.5}$ have declined since 1970, and were estimated to be 67kt in 2010, which makes over 58% of PM_{10} emissions. In 2010, the road transport sector emitted 28% (18kt) of the total $PM_{2.5}$ emissions in the UK.

Nitrogen Oxides (NO_x)

NO and NO_2, collectively known as NO_x, are produced during the high temperature combustion processes involving the oxidation of N. Initially, NO_x are mainly emitted as NO, which then undergoes further oxidation in the atmosphere, particularly with ozone (O_3), to produce secondary NO_2. Production of secondary NO_2 could also be favoured due to a class of compounds, VOCs, typically present in urban environments, and under certain meteorological conditions, such as hot sunny days and stagnant anti-cyclonic winter conditions.

Of NO_x, it is NO_2 that is associated with health impacts. Exposure to NO_2 can bring about reversible effects on lung function and airway responsiveness. It may also increase reactivity to natural allergens, and exposure to NO_2 puts children at increased risk of respiratory infection and may lead to poorer lung function in later life.

In the UK, emissions of NO_x have decreased by 62% between 1990 and 2010. For 2010, NO_x (as NO_2) emissions were estimated to be 1,106kt. The transport sector remained the largest source of NO_x emissions with road transport contribution 34% to NO_x emissions in 2010.

[13] National Atmospheric Emissions Inventory (NAEI) Summary Emission Estimate Datasets 2010. March 2012

Appendix 2 – ADMS Model Verification

The ADMS-Roads dispersion model has been widely validated for this type of assessment and is specifically listed in the Defra's LAQM.TG(09)[2] guidance as an accepted dispersion model.

Model validation undertaken by the software developer (CERC) will not have included validation in the vicinity of the proposed development site. It is therefore necessary to perform a comparison of modelled results with local monitoring data at relevant locations. This process of verification attempts to minimise modelling uncertainty and systematic error by correcting modelled results by an adjustment factor to gain greater confidence in the final results.

The predicted results from a dispersion model may differ from measured concentrations for a large number of reasons, including uncertainties associated with:

- Background concentration estimates;
- Source activity data such as traffic flows and emissions factors;
- Monitoring data, including locations; and
- Overall model limitations.

Model verification is the process by which these and other uncertainties are investigated and where possible minimised. In reality, the differences between modelled and monitored results are likely to be a combination of all of these aspects.

Model setup parameters and input data were checked prior to running the models in order to reduce these uncertainties. The following were checked to the extent possible to ensure accuracy:

- Traffic data;
- Distance between sources and monitoring as represented in the model;
- Speed estimates on roads;
- Background monitoring and background estimates; and
- Monitoring data.

Traffic data was obtained from the Highways Agency Traffic Counts Website[10] as detailed in Section 4.1.1. Separation distances between road sources and receptors were checked using electronic OS mapping data.

Swale Borough Council undertakes passive monitoring as part of its LAQM commitments at 57 locations, four of which are located in the modelled area. Of these four locations, three (SW79, SW80 and SW91) have been used for the purpose of model verification. As there were only two months of results available in 2014 from the site SW92 the mean result from this site was not considered representative of annual mean and was not reported in 2014 or used in this assessment.

Details of the three LAQM monitoring sites used for the purposes of model verification are presented in Table A1 below.

Table A1 – Local Monitoring Data Suitable for Model Verification

Site ID	Location	OS Grid Reference[a]	2014 Annual Mean NO_2 ($\mu g/m^3$)[b]
SW79	Belle Friday Centre, A2 Teynham	594840, 162566	17.1
SW80	Michaels Hairdressers A2 Teynham	595160, 162470	**41.6**
SW91	72 London Road, Teynham	595149, 162459	38.5[a]

[a] Taken from Swale Borough Council's 2014 Air Quality Progress Report.
[b] Bias Adjustment Factors taken from Swale Borough Council's 2014 Air Quality Progress Report (0.81 for 2014).

Verification calculations

The verification of the modelling output was performed in accordance with the methodology provided in Annex 3 of LAQM.TG(09)[2].

For the verification and adjustment of NO_x/NO_2, the LAQM diffusion tube monitoring data was used as detailed above. Data capture for 2014 at the four sites was 100%. Table A2 below shows an initial comparison of the monitored and unverified modelled NO_2 results for the year 2014, in order to determine if verification and adjustment was required.

Table A2 – Comparison of Unverified Modelled and Monitored NO_2 Concentrations

Site ID	Site Type	Background NO_2	Monitored total NO_2 ($\mu g/m^3$)	Modelled total NO_2 ($\mu g/m^3$)	% Difference (modelled vs. monitored)
SW79	Roadside	12.7	17.1	18.60	8.77
SW80	Roadside	12.8	41.6	36.08	-13.27
SW91	Roadside	12.8	38.5	32.68	-15.12

The model was clearly under-predicting at two locations - SW80 and SW91 - while over-predicting at site SW79 and no further improvement of the modelled results could be obtained on this occasion. At all sites, the difference between modelled and monitored concentrations was less than 25%. The relevant data was then gathered to allow the adjustment factor to be calculated.

Model adjustment needs to be undertaken based on NO_x and not NO_2. For the diffusion tube monitoring results used in the calculation of the model adjustment, NO_x was derived from NO_2; these calculations were undertaken using a spreadsheet tool available from the LAQM website[14].

Table A3 provides the relevant data required to calculate the model adjustment based on regression of the modelled and monitored road source contribution to NO_x.

[14] http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc

Table A3 – Data Required for Adjustment Factor Calculation

Site ID	Monitored total NO_2 (µg/m³)	Monitored total NO_x (µg/m³)	Background NO_2 (µg/m³)	Background NO_x (µg/m³)	Monitored road contribution NO_2 (total - background) (µg/m³)	Monitored road contribution NO_x (total - background) (µg/m³)	Modelled road contribution NO_x (excludes background) (µg/m³)
SW79	17.1	25.5	12.7	17.0	4.4	8.5	11.4
SW80	41.6	80.8	12.8	17.2	28.8	63.7	49.7
SW91	38.5	72.9	12.8	17.2	25.7	55.7	41.5

Figure A1 provides a comparison of the Modelled Road Contribution NO_x versus Monitored Road Contribution NO_x, and the equation of the trend line based on linear regression through zero. The Total Monitored NO_x concentration has been derived by back-calculating NO_x from the NO_x/NO_2 empirical relationship using the spreadsheet tool available from Defra's website. The equation of the trend lines presented in Figure A1 gives an adjustment factor for the modelled results of 1.289.

Figure A1 – Comparison of the Modelled Road Contribution NO_x versus Monitored Road Contribution NO_x

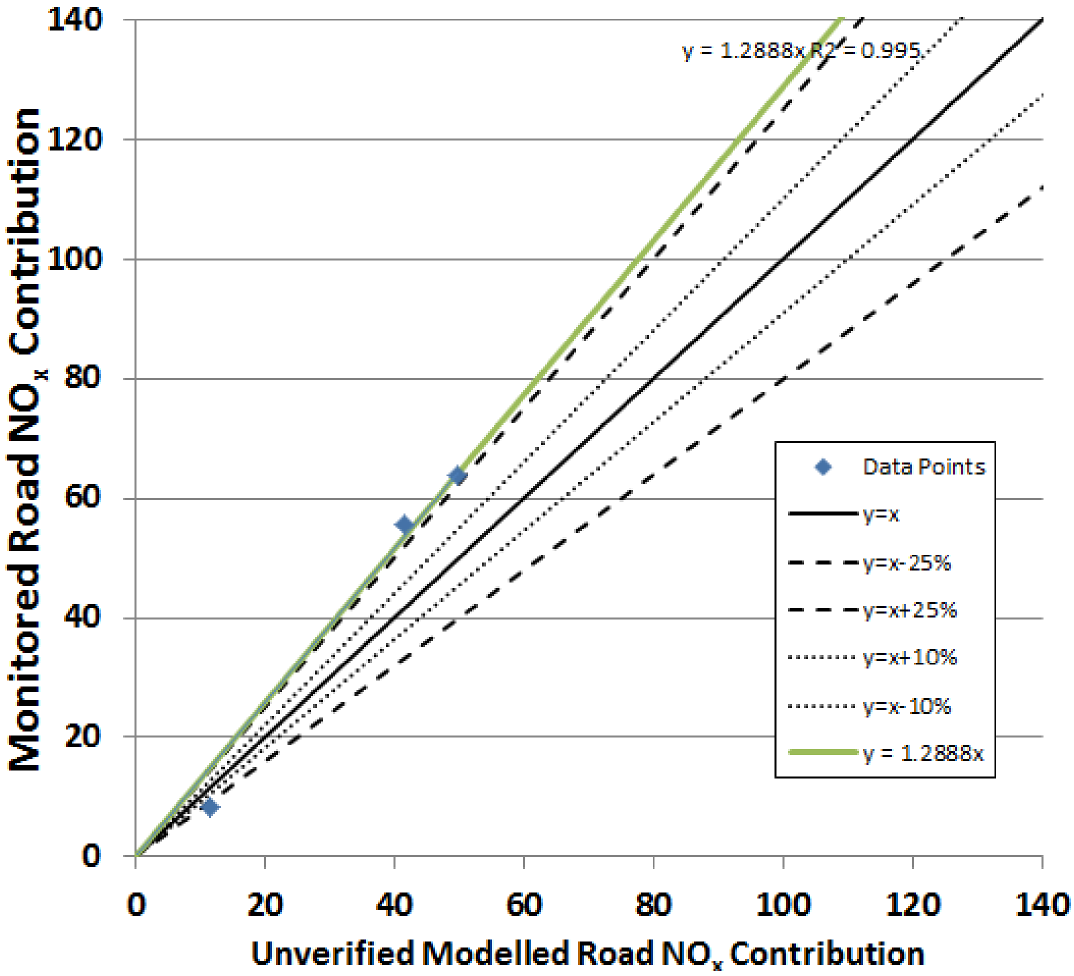
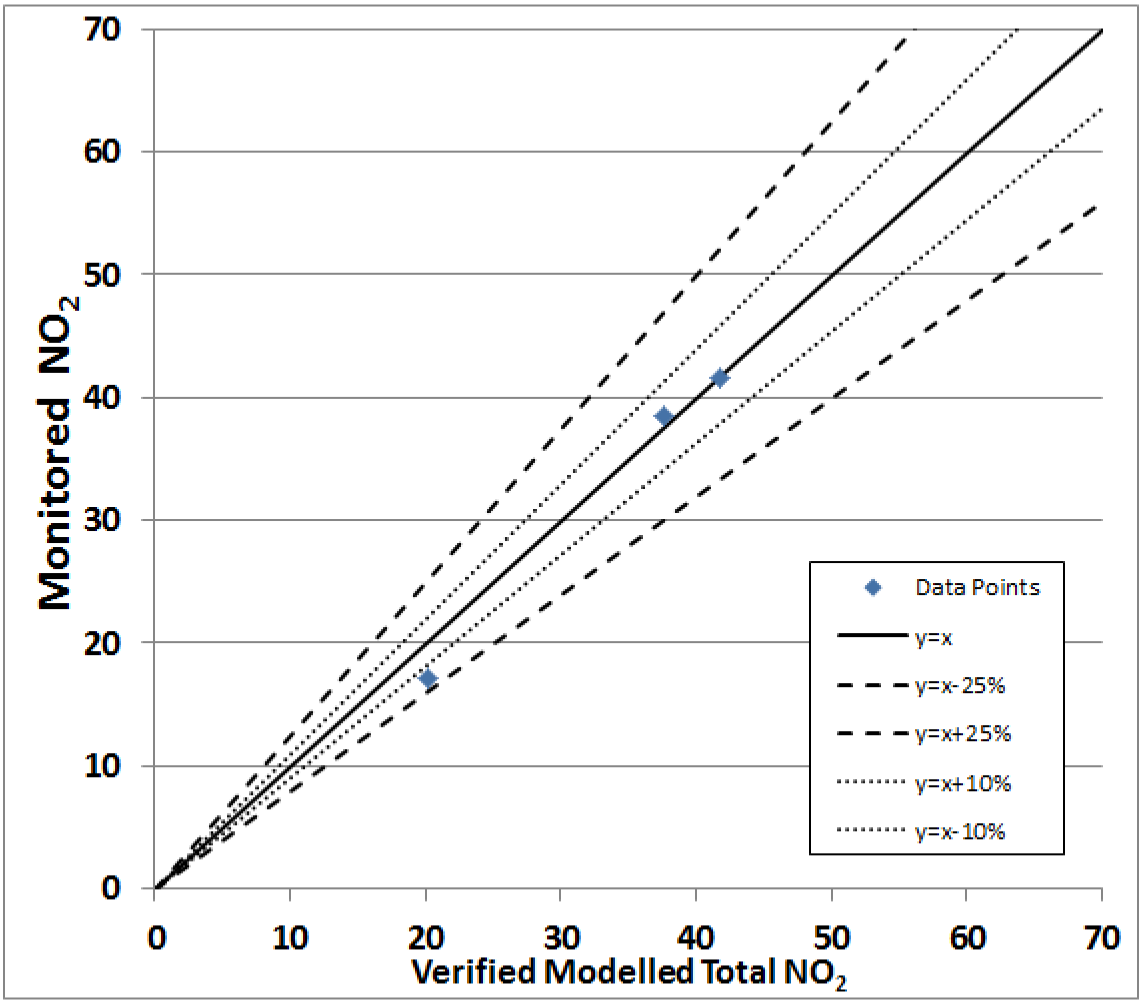


Table A4 and Figure A2 show the ratios between monitored and modelled NO_2 for each monitoring location. The three sites show acceptable agreement between the ratios of monitored and modelled NO_2 all being ±10%. A verification factor of 1.289 was therefore used to adjust the model results. A factor of 1.289 reduces the Root Mean Square Error (RMSE) from a value of 4.7 to 1.9.

Table A4 – Adjustment Factor and Comparison of Verified Results Against Monitoring Results

Site ID	Ratio of monitored road contribution NO_x / modelled road contribution NO_x	Adjustment factor for modelled road contribution NO_x	Adjusted modelled road contribution NO_x (µg/m^3)	Adjusted modelled total NO_x (including background NO_x) (µg/m^3)	Modelled total NO_2 (based upon empirical NO_x / NO_2 relationship) (µg/m^3)	Monitored total NO_2 (µg/m^3)	% Difference (adjusted modelled NO_2 vs. monitored NO_2)
SW79	0.74	1.289	14.73	31.72	20.24	17.10	18.36
SW80	1.28		64.01	81.19	41.74	41.60	0.14
SW91	1.34		53.52	70.70	37.64	38.50	-2.23

Figure A2 – Comparison of the Modelled NO_2 versus Monitored NO_2



The adjustment factor of 1.289 was applied to the road-NO_x concentrations predicted by the model to arrive at the final NO_2 concentrations. All NO_2 results presented and discussed herein are those calculated following the process of model verification using an adjustment factor of 1.289.