2012
Detailed Assessment Report of St Helen's Street, Ipswich for **Ipswich Borough Council**

In fulfillment of Part IV of the Environment Act 1995
Local Air Quality Management

Local Authority Officer	B Hunter

Department	Environmental Health
Address	Ipswich Borough Council, Grafton House, 15-17 Russell Road, Ipswich, Suffolk, IP1 2DE
Telephone	01473 432000
e-mail	ben.hunter@ipswich.gov.uk

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Executive Summary

This report follows on from the Updating and Screening Assessment (USA) carried out for Ipswich in 2009. The USA found that "exceedences in nitrogen dioxide were obtained at the monitored locations on St-Matthew's Street and St-Helen's Street. These locations are both outside of the existing AQMAs. These locations have been monitored since November 2007 and monitoring is to continue owing to the close proximity of the residential properties. In both cases, a Detailed Assessment is required with a view to determining whether or not to declare an AQMA. In addition, St-Helen's Street is located in between the 2 AQMA sections which form the St-Margaret's and Star Lane AQMA. The findings of the Detailed Assessment should determine whether the separate sections of the AQMA boundaries should be merged".

This report presents the results of this additional monitoring for St-Helen's Street and provides an accurate assessment of the likelihood of the air quality objectives being exceeded at 'relevant' locations in the area. The report has been prepared in accordance with the Local Air Quality Management Technical Guidance Note LAQM.TG(09)

Diffusion tube monitoring work undertaken in 2010 and 2011 has indicated that concentrations of nitrogen dioxide are above air quality objective values along parts of St Helen's Street and Woodbridge Road. Based on this detailed assessment and review of the monitoring data within the areas under assessment it is concluded that further areas along St Helen's Street and Woodbridge Road be declared as Air Quality Management Areas. The declaration will be on the basis of nitrogen dioxide (No_2) where exceedences of the annual mean are predicted at relevant receptor locations. The exact boundaries of the new AQMA would be subject to consultation with members and local residents.

It would also be necessary to continue to undertake monitoring within these areas to ensure that any future changes in the air quality are detected, notably locations representative of relevant exposure.

Any comments or queries regarding this document should be addressed to:

Ben Hunter
Environmental Health Officer

Environmental Health
Ipswich Borough Council
Grafton House
15-17 Russell Road
Ipswich, Suffolk,
IP1 2DE

Email: ben.hunter@ipswich.gov.uk
Tel: 01472 433116

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1.0 Introduction

1.1 Description of Local Authority Area

Ipswich is the county town of Suffolk and the fastest growing regional centre in the East of England.
It is a multi-cultural centre for business, culture, entertainment and sport, with a population of more than 130,000 and is home to University Campus Suffolk and Suffolk New College.
The main routes into and out of Ipswich are congested during typical rush hour times. Travel across Ipswich is restricted to certain routes by the River Orwell.
Transport and traffic management are key strategic priorities for the town as the Waterfront and other areas of the town are undergoing significant redevelopment.
Continuing this economic prosperity is dependent on people being able to move around the town for work, shopping and leisure. At present a significant number of these journeys are made by car.

There is a proposal under development 'Ipswich - Transport Fit for the 21st Century' to improve travel around Ipswich in the future, with the aim of offering an alternative to the car.

The stated vision of the proposal is -

"As the County Town of Suffolk, and a major growth point within the Haven Gateway sub region, Ipswich needs and deserves a sustainable transport system 'Ipswich - Transport Fit for the 21st Century' is an integrated scheme designed to achieve a step change in travel behaviour, challenging and changing existing patterns of travel, and providing the foundation for Ipswich to thrive in the decades ahead.

Our preferred approach is to influence patterns of travel in the Ipswich area, to reduce reliance on the car, particularly for peak hour travel. We can then begin to tackle congestion and associated air quality problems and our transport networks will be better placed to support development growth.

Ipswich must maintain a vibrant economy to match its housing growth and investment in a sustainable transport system will prevent growing congestion. This investment is essential if we are to attract employers into the town and enhance Ipswich's position in delivering services to the wider county and sub-region.

Achieving this outcome, which will require much better accessibility of employment and housing sites for people without cars, is the principal focus of our transport strategy for Ipswich, of which this Major Scheme is a key element".

1.2 Scope of the Detailed Assessment for Nitrogen Dioxide on the St Helens Street Area

This study area is sited to the east of the Crown Street Air Quality Management area and to the West of the St Helens/Argyle/Grimwade Street junction Air quality Management Area. Traffic flows through this area from both the air quality management areas. This area was highlighted in the Updating Screening Assessment completed in 2009 as a potential area for poor air quality due to traffic flows. The plan in figure 1 shows all the Air Quality Management Areas and the plan in figure 2 shows the area of interest highlighted in blue between two of the existing management areas.

The two main roads in this study are Woodbridge Road and St Helens Street both of which contain queuing traffic during busy periods. There are no industrial sources of pollution in the area or other activities considered likely to have an adverse impact on local air quality.

This detailed assessment report will focus on stretches of Woodbridge Road and St Helens Street from the Crown Street AQMA through to the St Helens Street/Argyle Street/Grimwade Street Junction AQMA joining them up. It also concentrates on a section of Woodbridge Road running East from the AQMA. Much of the traffic flowing from the Crown Street AQMA also flows through the St Helens Street/Argyle Street/Grimwade Street Junction AQMA passing through the area of study in this report.

The Crown Street AQMA contains a real time monitoring station which consistently gives NO2 readings greater than the National objective of 40µg/m3.

In undertaking the Detailed assessment it is important to give consideration to the points of maximum relevant exposure (i.e. those points where highest concentrations are expected)

Photo 1 – St Helens Street looking East into Woodbridge Road (left fork) and St Helens St (right fork)

Photo 2 – St Helens Street looking East

Photo 3 Woodbridge Road looking East

2.0 Background

2.1 Requirement for a Detailed Assessment Report

This report fulfills the requirements of the Local Air Quality Management process as set out in Part IV of the Environment Act (1995), the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance documents. The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where exceedences are likely to be considered likely, the local authority must then prepare an Air quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives**.**

This report follows on from the Updating and Screening Assessment (USA) carried out for Ipswich in 2009. The USA found that "exceedences in nitrogen dioxide were obtained at the monitored locations on St-Matthew's Street and St-Helen's Street. These locations are both outside of the existing AQMAs. These locations have been monitored since November 2007 and monitoring is to continue owing to the close proximity of the residential properties. In both cases, a Detailed Assessment is required with a view to determining whether or not to declare an AQMA. In addition, St-Helen's Street is located in

between the 2 AQMA sections which form the St-Margaret's and Star Lane AQMA. The findings of the Detailed Assessment should determine whether the separate sections of the AQMA boundaries should be merged".

2.2 Air quality Objectives

The air quality objectives applicable to LAQM in England are set out in the Air Quality (England) Regulations 2000 (SI 928), the Air Quality (England) (Amendment) regulations 2002 (SI 3043), and are shown in table 1.1. This table shows the objectives in units of micrograms per cubic metre μg/m^3 (milligrammes per cubic metre. mg/m^3 for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25μg/m3	Running annual mean	31.12.2003
	5μg/m3	Annual mean	31.12.2010
1,3-Butadiene	2.25μg/m3	Running annual mean	31.12.2003
Carbon Monoxide	10μg/m3	Running 8-Hour mean	31.12.2003
Lead	0.5μg/m3	Annual mean	31.12.2004
	0.25μg/m3	Annual mean	31.12.2008
Nitrogen dioxide (NO2)	200μg/m3 not to be exceeded more than 18 times a year	1 hour mean	31.12.2005
	40μg/m3	Annual mean	31.12.2005
Particles (PM10)	50μg/m3 not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40μg/m3	Annual mean	31.12.2004
Sulphur dioxide	350μg/m3 not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125μg/m3 not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266μg/m3 not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

Table 1 - Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in England.

Annual mean air quality objectives apply to all locations where members of the public might be regularly exposed, for example building facades of residential properties, schools, hospitals care homes etc. Objectives should not apply to building facades or other places of work where members of the public do not have regular access; Hotels, unless people live there as their permanent residence; gardens of residential properties; kerbside sites as opposed to locations at the building façade; or any other location where public exposure is expected to be short term.

2.3 Summary of Previous Review and Assessments in Ipswich

2.3.1 Round 1

The first round of air quality review and assessment was completed in March 2001 and consisted of three stages, each reported separately and progressively looking into more detailed analysis when required;

Stage 1 comprised of an initial study to identify which pollutants required further investigation;

Stage 2 required estimating, modelling or measuring pollutants where there was an indication that national objectives will not be achieved; and

Stage 3 involved using advanced modelling techniques and emissions inventories.

The final assessment (third stage report) concluded that the Air Quality Objectives would be met. There were, however, some areas of concern where levels of nitrogen dioxide from road traffic pollution were expected to be close to reaching the objective level and the need to keep these under review was recognised.

2.3.2 Round 2

In 2003, all local authorities were required to complete a second round of air quality reviews and assessments. The Government issued guidance to assist with this and to direct authorities on the methodology for completing the review. The first stage of the review was an Updating and Screening Assessment (USA). This was based on a checklist to identify those matters that had changed since the first review completed in 2001 and which required further assessment. The USA covered new monitoring data, new sources of pollution and other changes that affected air quality.

The Council's USA, completed in December 2003, concluded that further detailed assessments of nitrogen dioxide from road traffic sources and particulate matter from an industrial source were required to determine whether air quality objectives would be exceeded in 2005. In July 2005, further detailed assessments were completed in respect of the impact of road traffic on concentrations of nitrogen dioxide in St Margaret's Street, Norwich Road/Chevallier Street junction and the Star Lane gyratory system/St Helen's

Street. The assessment was completed using a dispersion model, traffic and meteorological data and an ambient real time continuous monitor to produce concentration plots for 2005 and 2010.

The results of the detailed assessments for nitrogen dioxide indicated that the annual mean objective pollution level would be exceeded along most of the roads under study. In places, the exceedance of the 40µg/m^3 annual mean standard extended 50 metres from the kerb into residential areas.

Under Section 83(1) of the Environment Act 1995, local authorities have to designate areas with a predicted exceedance of the Air Quality Objectives as Air Quality Management Areas (AQMAs). Ipswich Borough Council declared three AQMAs on the 11th of April 2006:

- *Ipswich Air Quality Management Order No 1, 2006: Norwich Road, Chevallier Street and Valley Road*

  This junction is located on one of the main routes into Ipswich town centre with four roads leading into a double mini roundabout (a map of the AQMA is shown in Figure 1.1).

  Generally, the area around this junction is open with some green space and buildings set back from the road. However, there is a public house (with flat above) and some residential flats that are both located adjacent to the junction. In addition, one road, Chevallier Street, leading from the roundabout has terraced properties facing directly onto a pavement.

- *Ipswich Air Quality Management Order No 2, 2006: Junction of Crown Street with Fonnereau Road and St Margaret's Street and St Margaret's Plain*

  This AQMA includes four roads all leading off each other (a map of the AQMA is shown in Figure 1.1). There are main traffic lights at the junction of St Margaret's Street and St Margaret's Plain and pedestrian crossing lights just beyond the junction of Crown Street and Fonnereau Road. The area along St Margaret's Street is partially canyoned.

  St Margaret's Street is flanked by flats on one side, and a vacant building on the other. Permission has been given for this to be turned into residential dwellings. There are residential buildings on all roads within the AQMA.

- *Ipswich Air Quality Management Order No 3, 2006: Star Lane gyratory system and St Helen's Street/Grimwade Street*

  The gyratory system is a circular network of one-way roads located next to the docks (a map of the AQMA is shown in Figure 1.1). There are many residential dwellings (mainly high-rise flats) within these

areas and some commercial and office buildings. Further development of the Gyratory system and Dockside is ongoing.

Traffic flow through many of the areas of this AQMA can be congested.

The Department for Environment, Food and Rural Affairs (DEFRA) also requires that local authorities should submit annual air quality (Progress Reports) in between three yearly USAs. This is to provide a means of ensuring that air quality review is a continuous process and act as a timely indication of the need for measures to improve air quality, rather than delaying for three years until a full review is carried out. Ipswich Borough Council completed a Progress Report in September 2005.

2.3.3 Round 3

The third round of review and assessment commenced in 2006 to enable local authorities to determine whether Air Quality Objectives in their areas would be met by specific target dates by means of a USA review. Ipswich Borough Council completed its USA in January 2008. The USA concluded that four of the seven prescribed pollutants were likely to meet their Air Quality Objectives and as such a Detailed Assessment was not required. However, it was found that further screening works for Benzene, Nitrogen Dioxide (NO_2) and particulates (PM_{10}) were required, as well as a Detailed Assessment of both NO_2 and PM_{10} at the Yarmouth Road/ Bramford Road and Chevalier Street Junction.

The Detailed Assessment, recommended in the USA, was completed in draft in December 2009 and finalised August 2010, and concluded that there are likely to be exceedances of the annual mean NO_2 objective at this location. It is unlikely that the hourly objective will be exceeded. The predicted exceedances of the annual mean objective can be attributed to slow moving vehicles, congestion and queuing traffic. The boundaries for a new AQMA are being determined at the time of writing this report. For the pollutant PM_{10}, modelling indicated a very unlikely risk of exceeding the annual mean PM_{10} objective in the base year and the future year of 2010.

The screening works resulting from the round 3 USA have been completed as part of round 4 USA. At the advice of DEFRA, the information usually included in a progress report has also been incorporated into the round 4 document.

2.3.4 Round 4

The fourth and current round of review and assessment began in 2009. The USA was completed in January 2010. The USA concluded that five of the seven prescribed pollutants were likely to meet the Air Quality Objectives. However, it was found that a Detailed Assessment for NO_2 was required for the Civic Drive/St Matthews Street junction and St Helens Street, along with a Detailed Assessment of both NO_2 and PM_{10} at a Biomass Boiler on Nacton

Road. Further screening for NO_2 and PM_{10} at the Reg Driver Centre, Christchurch Park was also required and the results have been included in this progress report.
The detailed assessment of the NO_2 and PM_{10} at the Biomass Boiler on Nacton road was completed in September 2011. The assessment concluded that there were no exceedences of the air quality objectives for particulates and NO_2.

2.3.5 Summary

The various stages of the previous review and assessments are summarised in Table 2

Round	Date	Type of Assessment	Conclusion/Outcome
1	March 2001	Final Assessment	Predicted that the Air Quality Objectives would be met Areas of concern where levels of nitrogen dioxide from road traffic pollution were expected to be close to reaching the objective level were kept under review.
2	December 2003	Updating and Screening Assessment	Concluded that further detailed assessments of nitrogen dioxide from road traffic sources and particulate matter from an industrial source was required to determine whether Air Quality Objectives would be exceeded in 2005.
	July 2005	Detailed Assessment	Concluded that the annual mean objective pollution level would be exceeded along most of the roads under study.
	11th of April 2006		Declaration of 3 AQMAs.

3	January 2008	Updating and Screening Assessment	Concluded that four of the seven prescribed pollutants were likely to meet their Air Quality Objectives and as such a Detailed Assessment was not required. Recommended further screening works for Benzene, Nitrogen Dioxide (NO_2) and particulates (PM_{10}) and a Detailed Assessment of both NO_2 and PM_{10} at the Yarmouth Road/ Bramford Road and Chevalier Street Junction.
	January 2007	Progress Report	Data included in the 2009 Updating and Screening Report as requested by Defra
	December 2009	Detailed Assessment	Completed draft December 2009. Submitted December 2009. Finalised August 2010. Concluded that there are likely exceedances of the NO_2 annual mean objective at the Bramford Road/Yarmouth Road/Chevalier Street junction
4	January 2010	Updating and Screening Assessment	Concluded that a Detailed Assessment for nitrogen dioxide is required at St-Matthew's Street and St-Helen's Street. A Detailed Assessment is also required for a 2.90MW biomass combustion plant on Nacton Road for particulate matter with consideration given to nitrogen dioxide. Particulate matter and nitrogen dioxide emissions from the Reg Driver Centre, Christchurch Park, Ipswich also required further screening work.

Table 2 Summary of previous review and assessments carried out by Ipswich Borough Council

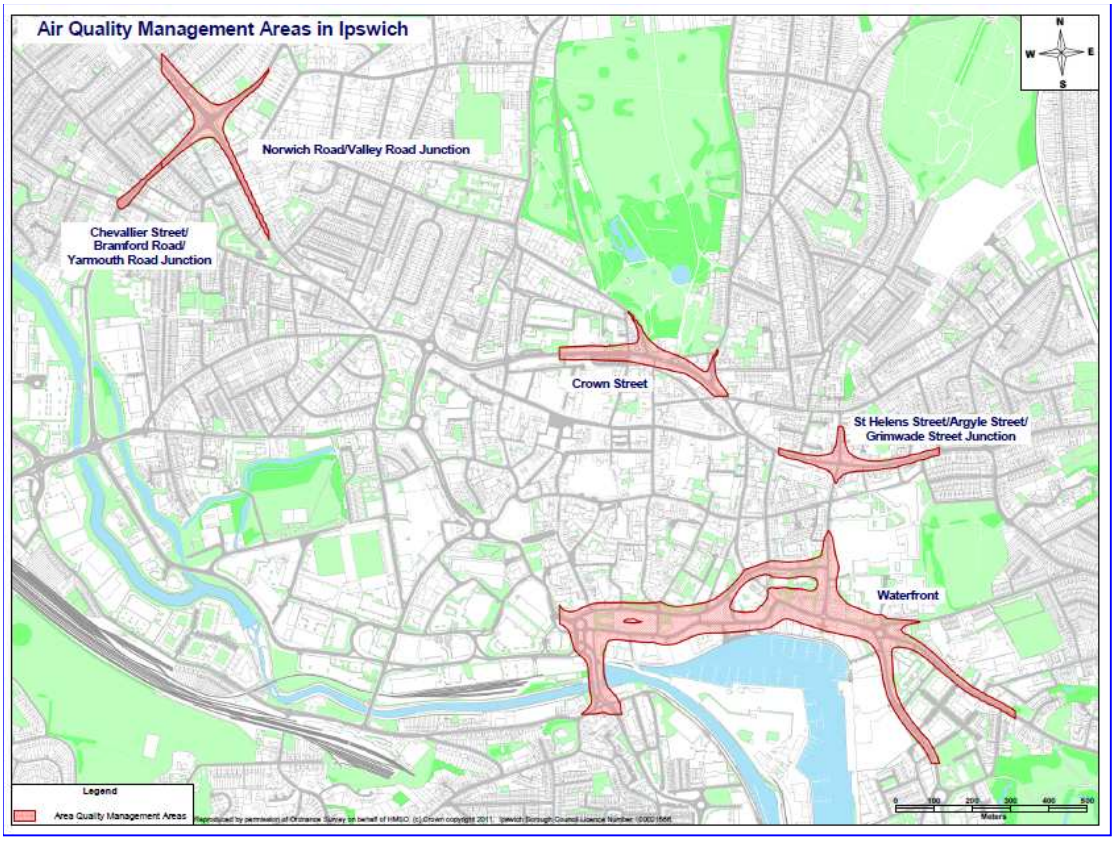

Fig 1 – Existing Air Quality Management Areas In Ipswich

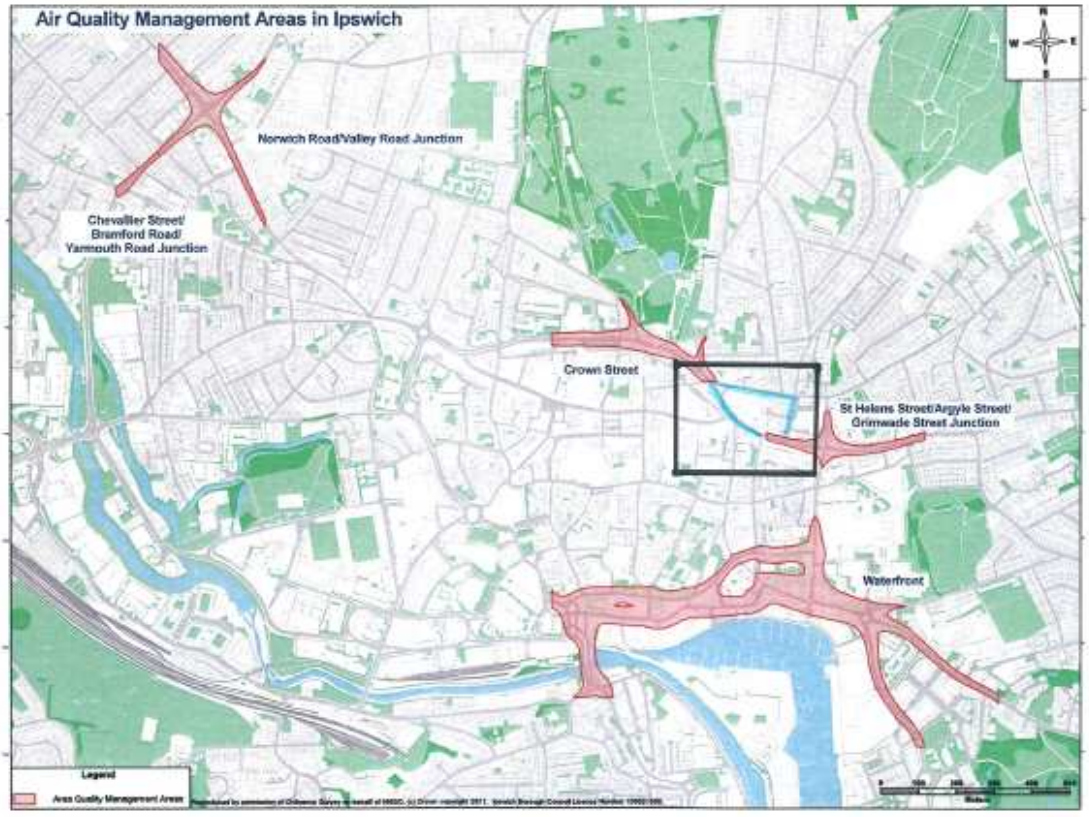

Fig 2 – Location of Area of Study between Existing AQMAs

3.0 Detailed Assessment for Nitrogen Dioxide

3.1 The National perspective

Nitrogen dioxide (NO2) and nitric oxide (NO) are both oxides of nitrogen. Together they are collectively referred to as NOx. All combustion processes produce NOx emissions, largely in the form of NO which is then converted in the atmosphere to NO2.
The principal source of NOx emissions is road transport. Motorways which carry large volumes of high speed traffic are a predominant source, as are roads in congested city or town centres where there are large volumes of slow moving traffic combined with poor natural dispersion.

The contribution of road transport to NOx emissions has declined significantly in recent years due to the introduction of tighter vehicle emission standards. However despite a continued reduction in NOx emissions there has been growing concern in recent years about levels of primary NO_2 emissions from vehicles. Recent research indicates that these are greater than previously recognised and may have increased in some areas as a result of retrofitting particulate emission control equipment to some vehicles.

Other significant sources of NOx emissions include the electricity supply industry and the commercial sector. Emissions from both these sectors have also been dramatically reduced in recent years due to the introduction of low NOx burners and the widespread replacement of solid fuel boiler plant with natural gas.

The majority of the AQMAs which have already been declared in the UK are based on exceedances of the annual average nitrogen dioxide objective due to traffic emissions.

3.2 Monitoring for Nitrogen Dioxide In Ipswich

There are presently 3 real time NO_2 monitors in Ipswich linked to the AQMAs. In addition to this there are 85 NO_2 passive diffusion monitoring tubes placed at specified locations across the Borough. In 2010 and 2011 the St Helens Street area had 12 tubes located at various points giving a good indication of the air quality in the study area.

DEFRA’a Review and Assessment Helpdesk has previously confirmed with other local authorities undertaking a Detailed Assessment that continuous monitoring and/or dispersion modeling are not absolutely essential for the purposes of a Detailed Assessment. This assessment is based on Diffusion tubes placed out in the Norwich Road area over a period of 19 months.

At the end of 2007 two diffusion tubes were placed in In St Helens Street as it was suspected that this area would have higher levels of NO_2 due to the slow congested traffic flow.

Tube Ref	Bias corrected annual average NO_2 µgm^3	
	2008	2009
24	41.7	44.7
25	44.52	47.3

Table 3 - Results of the St Helens Street Tubes 2008 - 2009

These two years show exceedences above the annual mean national objective therefore a decision was made to study the area in more detail. In January 2010 a further tube was placed in Cobden Place just off Woodbridge Road.

In June 2010 a further 10 passive diffusion tubes were place at suitable points to monitor the levels to see which roads are the most affected. Figure 3 shows the positions of the 12 passive diffusion tubes in the St Helens Street area in 2010 and 2011.

The NO_2 passive diffusion tube nitrogen dioxide diffusion tubes used in Ipswich are supplied and analysed by Harwell Scientifics. The preparation method was 50% TEA in Acetone.

According to the Local Air Quality Management Guidance LAQM.TG(09) the data from the tubes in the period from June to December 2010 would be sufficient to assess whether an extension of the Air Quality Management areas are needed, As long as the data is adjusted to estimate an annual mean concentration using a set method. However it was decided for the sake of accuracy that it would be better to take into account a full year's worth of data in addition to the 7 months collected in 2010.

The estimation of the annual mean for the 7 months of data collected for June to December 2010 has been made by factoring the data according to the methodology presented in box 3.2 in LAQM.TG(09). For this assessment results from 4 long term sampling sites local to, or within, the study area were used. 4 sites are used to allow for the greater uncertainty of diffusion tubes. The tubes used are all from the same supplier using the same method of preparation as all the tubes used in the survey area.

Using Tubes from within or just outside the area under study would is the most accurate method of estimation of the annual mean as they would have been under the same conditions as all the tubes in the survey.

Calculations and results are shown in table 4

Long Term Site	Tube ref	Annual Mean 2010 µg/m^3 (Am)	Period mean June – Dec 2010 µg/m^3	Ratio (Am/Pm)
St Margaret's Street	24	54.3	54.0	1.01
St Helen's St/Grimwade Street	26	49.6	46.2	1.07
St Helen's St/Argyle Street	27	56.0	54.0	1.04
St Helen's St/Dove Street	28	36.1	35.1	1.03
			Average (R_a)	1.04

Pm – Period Mean
Am – Annual Mean
Ra – Ration of Annual mean to Period Mean

Table 4 Adjustment to estimate annual mean for 2010

Full results for the above tubes are presented in Appendix 2

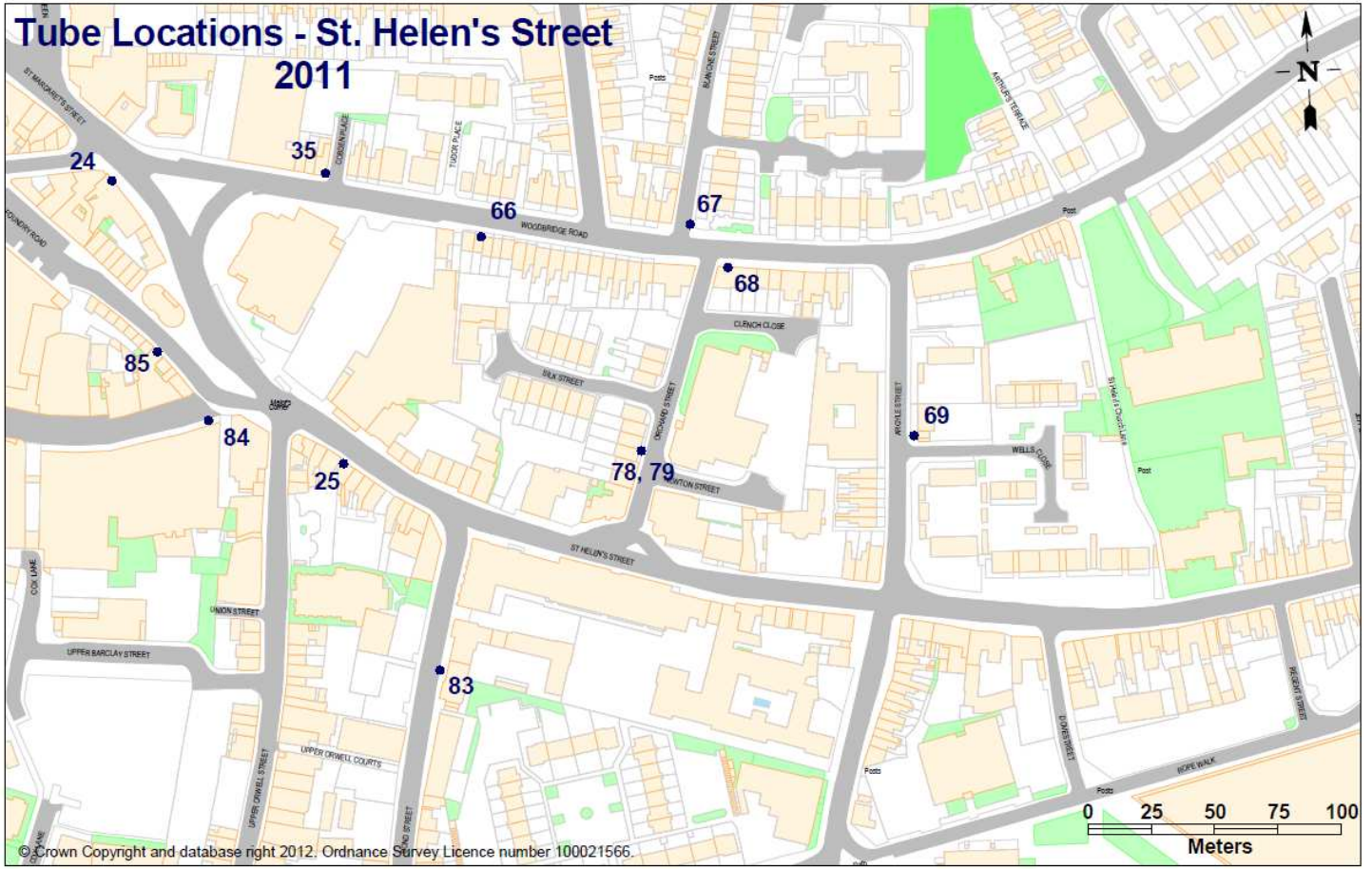

Figure 3 Tube Locations St Helens Street Area in 2010 and 2011

3.3 Calculation of a local bias correction factor

The bias adjustment figure applied to the diffusion tube results is a local factor of 0.87 as a local average of the two nearby continuous monitors St Margaret's Street (0.94) and Chevallier Street (0.8).

3.4 Results

There are 4 diffusion tube locations that indicate exceedences above the annual mean level of 40µ/m^3. These are highlighted in red in Table 5 and can be seen in Figure 4.
The 4 areas of exceedence are all in heavy traffic flows and at points where the buildings are close to the road. The tubes giving the lower readings in this area are generally in more open areas where the pollution is more likely to be more dispersed

The whole study area comprises a one way road system interspersed by a number of traffic lights causing queues and standing traffic to build up during peak flow times.

Tube No	Tube Position	OS Grid Ref	Site Type	Estimated annual mean concentrations (µg/m3) adjusted 2011 annual	mean concentrations (µg/m3) adjusted for bias	Distance Kerb to Receptor	Distance Kerb to Tube	What is receptor	2010 Distance calculator result using background for Kings Road - 19.7(µg/m3)	2011 Distance calculator result using background for Kings Road - 18.3(µg/m3)
24	St Margaret's Street – on lamppost o/s No. 33 (Viking Aquatics)	616659/244689	Urban roadside	51	42.3	3.68	3.35	Shop	50.2	41.7
25	St Helen's Street – on lamppost o/s No. 12	616750/244578	Urban roadside	49.6	45.3	2.4	1.35	Residential above shop	45.9	42
35	Cobden Place – on lamp post next to side entrance to 39 Woodbridge Road	616743/222696	Urban roadside	30	27.8	2.44	5.48	Residential above shop	32.6	30.2
83	Bond Street on road sign no 345 outside no 29	616788/244497	Urban roadside	36.9	32.1	3.2	1.65	Residential	34.3	30.1
85	Old Foundry Road o/s no 5	616677/244622	Urban roadside	37.1	32.5	1.57	1.4	Residential above shop	36.7	32.1
84	Carr Street junc Majors Corner – on street furniture, local directional pole	616697/244595	Urban roadside	34	29.1	2.85	0.5	Commercial	29.6	25.8
66	Woodbridge Road – on down pipe attached to 30A	616804/244667	Urban roadside	43.2	41.6	2.58	3.52	House	45.2	43.6
67	Woodbridge Road junc Blanche Street – on Lamp Post	616886/244672	Urban roadside	34.5	32.7	3.9	1.3	Residential above shop	31	29.3
68	Woodbridge Road – on down pipe of N0. 62 – Ebony & Ivory Hairdressers	616901/244655	Urban roadside	56.6	48.5	3.38	3.25	Residential above shop	56.2	48.2
69	Argyle Street – on down pipe of garage beside No 2 to 4	616974/244589	Urban roadside	32.7	30.0	4.63	4.5	Residential	32.6	29.9
78	Orchard Street – on lamp post A655 outside No 7	616867/244583	Urban roadside	29.1	27.3	2.95	1.42	Residential	30.9	25.9
79	Orchard Street – on lamp post A655 outside No 7	616867/244583	Urban roadside	28.8	25.9	2.95	1.49	Residential	27.4	24.8

Table 5 Results for Tubes in the St Helens Street study Area

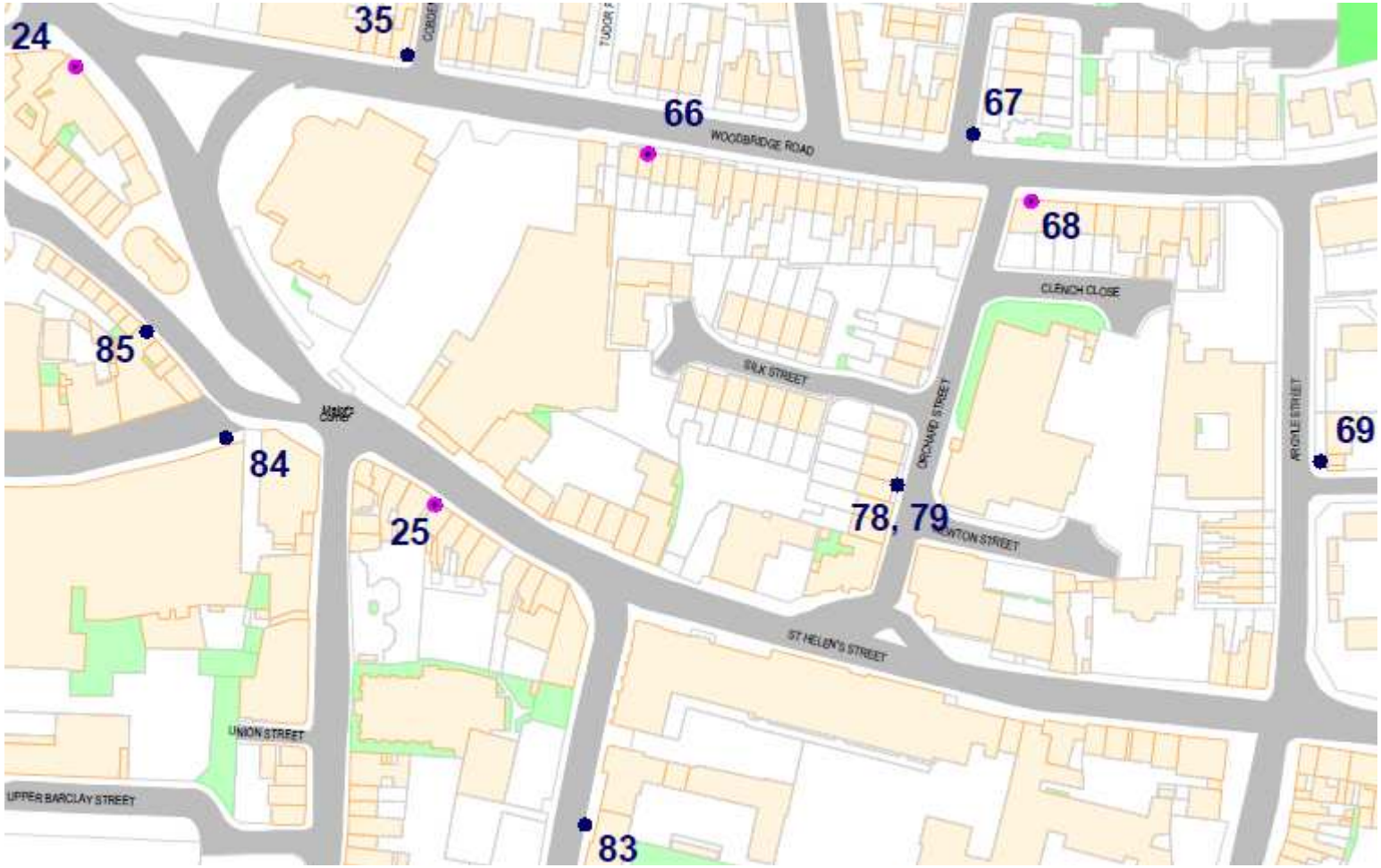

Figure 4 Tube points (Highlighted in Red) showing Exceedences (Tube numbers 24, 25, 66 and 68)

4 Identification of potential breach areas

Likely exceedences of the objectives should be assessed in relation to “the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are likely to regularly present”. It is important that Review and Assessments focus on those locations where members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective.

LAQM.TG09 box 1.4 states that for annual mean averaging periods, the air quality objectives should apply at all locations where members of the public might be regularly exposed. Building facades of residential properties, school, hospitals and care homes would all be relevant in terms of long-term annual mean objectives.

These conditions apply to 3 out of the four points found to exceed the national NO_2 objectives. Tube number 24 is located on a junction with traffic lights. The buildings adjacent to it are commercial, so it cannot be said that members of the public are likely to be regularly present.
The 3 tubes numbers 25, 66 and 68 are all adjacent to residential accommodation.

5 Estimating Population Exposure

Within their Detailed Assessments, local authorities are required to estimate the number of people exposed to pollutant concentrations above the objectives, and the maximum pollutant concentration (measured or modeled) at a relevant receptor location. The information is required to help DEFRA and the devolved administrations quantify the health benefits of improving air quality within the LAQM regime.

DEFRA acknowledge that it is not feasible to take into account subtleties such as transient exposure (e.g. at schools) or exposure at different heights within these assessments, and authorities should assume that the residential population is representative within the exceedence area.

Total relevant exposure has been estimated within the area using the GIS system and by undertaking a number of manual surveys during site visits. The total population for the study area is approximately 140.

Area	Approximate no of Residential Properties (including first floor flats)	Equivalent Population No of properties x 2.5
St Helens Street	9	22.5
Woodbridge Road	47	117.5
Total		140

Table 6 Approximate Population numbers for residential accommodation in areas where NO_2 levels breach the national objective.

6 Conclusions and recommendations

There are areas in St Helen's Street and Woodbridge Road where the national objective for Nitrogen Dioxide is being exceeded. These areas should be highlighted as requiring attention in future traffic planning. In declaring the areas in an Air Quality Management Area their profile will be raised so attention and resources can be further focused to remedy the issue.

The proposals, if accepted by Government, in 'Ipswich - Transport Fit for the 21st Century' will help in the long run with traffic congestion and potentially will be a means of resolving the issues highlighted in this report.

It is recommended that the areas highlighted in figure 5 should be included in an Air Quality Management Area. A decision whether to merge this area into the existing AQMAs at Crown Street and St Helens Street/Argyle Street/Grimwade Street Junction would be subject to consultation with members and members of the public.

It is also recommended that monitoring is continued within these areas to ensure that any changes in air quality are detected notably in locations representative of relevant exposure.

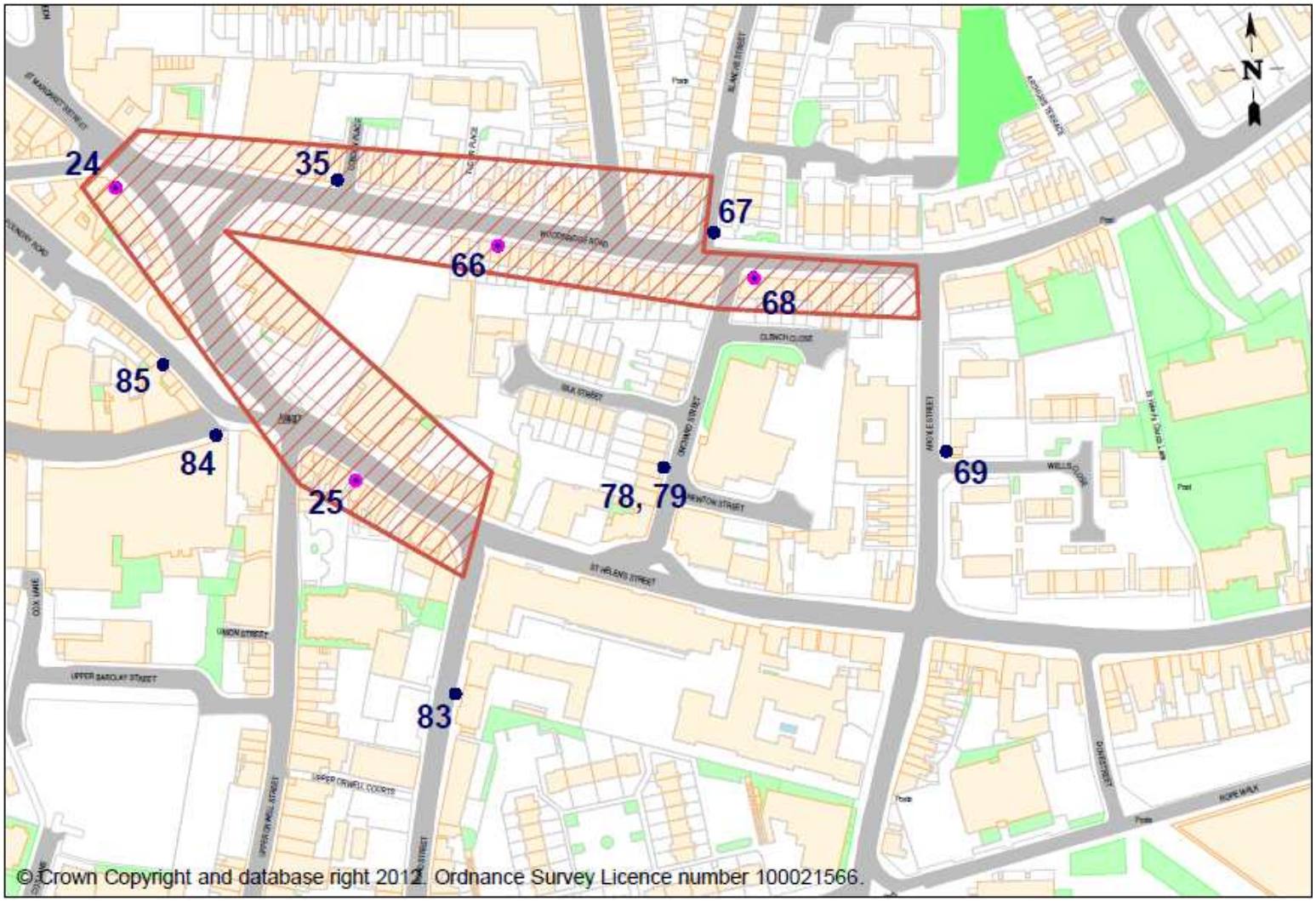

Figure 5 Areas of residential accommodation recommended to be included in a new Air Quality Management Area.

Appendix 1

ESG Environmental Scientifics Group

scientifics

Information Sheet – NO_2 Diffusion Tubes

50% TEA:50% Acetone (Blue Cap)

20% TEA:80% Water (Black Cap)

50% TEA: 50% Acetone – Alternate Holder

Overview;

It has been shown (*Palmes et al 1976*) that the principle of molecular diffusion can be utilised for the indicative measurement of ambient nitrogen dioxide in the atmosphere. Using this research, a cost effective passive sampler was developed for the diffusive monitoring of NO_2.

Diffusion Tube Performance:

Uncertainty:	Under European guidelines, diffusion tubes are considered an indicative method, and as such the uncertainty is defined as <20%. (In field intercomparisons Scientifics' diffusion tubes perform at <10% uncertainty.)
Analytical Repeatability:	± 1.9%
LOD:	0.03µg NO_2 on the tube. Over a 4-week exposure this would equate to 0.6µg/m^3, or 0.3ppb
Shelf-life:	Tubes should be analysed within 4 months of manufacture
Storage:	Ideally, tubes should be stored in a fridge. A cool dark location is an acceptable alternative.
Exposure:	2-6 Weeks
Diffusion Coefficient:	0.1361cm^{2}s^{-1} at STP (*Massman 1998*)
Quality Assurance:	- The manufacture and analysis of NO_2 diffusion tubes is covered by our UKAS accreditation - The method meets the requirements laid out in DEFRA's "Diffusion Tubes For Ambient NO2 Monitoring: Practical Guidance." - The laboratory has taken part in the WASP proficiency scheme since it's inception, and has the highest ranking of 'Good'

Manufacture:

Description:	Two stainless steel grids coated in the absorbent are located within a coloured polyethylene end cap. The cap is placed on a polypropylene tube and the open end sealed with a white polyethylene cap.		
Quality Control:	2% of manufactured tubes are analysed to check the tubes are free from contamination.		
Tubes:	Material: Natural Polypropylene Internal Diameter: 10.8 ± 0.2 mm Outer Diameter: 13.8 ± 0.4 mm Length: 71.0 ± 1.0 mm		
Stainless Steel Grids:	Type: 304 Diameter: 12mm Weave: Plain Mesh Number: 100 Wire Diameter: 0.112mm Aperture: 0.142mm Open Area: 31.3% Weight: 0.62 kg/m^2		
End Caps (Grid End):	Material: LDPE (Low Density Polyethylene) Colour: Blue or Black Internal Diameter: 13.70mm ± 0.25mm Height: 14.99mm ± 0.25mm		
End Cap:	Material: LDPE (Low Density Polyethylene) Colour: White		
Absorbent:	50% Triethanolamine : 50% Acetone 20% Triethanolamine : 80% Ultrapure Water	Dipping Method Pipette Method	(Blue Caps) (Black Caps)

Dispatch:

- Each tube is labelled with a unique ID, and each batch placed in an airtight bag before being dispatched to the customer.
- An exposure sheet, pre-printed with the tube IDs and manufacturing lot number, is included with each batch of tubes.
- Site names can be pre-printed on the exposure sheet on request.
- Each bag of tubes is marked with a use by date.
- Tubes will normally be dispatched 7 days prior to the changeover date.
- Upon receipt the tubes should be checked, and then left in the airtight bag prior to use.

Exposure:

- A monitoring site should be selected that best meets current guidelines.
- Clips or similar should be used to position the tubes, so that they are approximately 5cm from any flat surface, and ideally 1.5m from the ground. However, it is not uncommon practice to position the tubes higher to prevent vandalism.
- To begin exposure, remove the white end cap, and position the tube perpendicular to the ground with the open-end facing down.
- Note the time and date in the 'On Time' column of the exposure sheet.
- If required, a brief description of the tube location should be entered in the 'Site' column.
- Once the exposure is complete the process should be reversed – Remove the tube, replace the white cap, and note the date and time in the 'OFF time' column. Return the tube to the airtight bag.
- Where applicable, additional observations should be annotated on the exposure sheet e.g. spider in tube, water in tube etc,
- The tubes should then be returned to the laboratory for analysis as soon as possible.

Note 1: Insects should be removed before the white cap is replaced.

Note 2: The tubes should be put out for exposure no later than the use-by date given on the tubes.

Analysis:

Analytical Technique:	Colorimetric
Instrument:	Continuous Flow Auto-analyser
Principle:	Nitrite ions react with Sulphanilamide to form a diazonium compound. In acidic conditions, this couples with N-(1-naphthyl)-ethylenediamine dihydrochloride to form a purple azo dye. Utilising spectrophotometric analysis at 540nm, the NO_2 concentration is calculated by quantification of the colour change in comparison to that produced by known standards.
Extraction:	To ensure complete, homogeneous extraction, a vortex mixer is used.
Quality Control:	A quality control sample of known concentration is run every 10 samples. The data generated is compared to acceptable limits as determined statistically using a Shewhart Chart control system. The laboratory takes part in inter-comparison schemes, to monitor data accuracy.

Reporting & Calculations:

- Data is imported directly from the analytical software, eliminating the possibility of transcription errors
- As per current guidelines, air volumes are calculated assuming an average exposure temperature of 11°C, and a pressure of 101.3kPa
- Final results are converted to an equivalency at 20°C, to allow direct comparison to EU guidelines
- The report lists;
  - The amount of the Nitrite (NO_2) on the tube in µg. This is the analytically derived value.
  - The µg/m^3 of gaseous NO_2 at the sampling location. Knowing the tube dimensions and gas diffusion coefficient, the sampling rate of the tube can be calculated. In turn, knowing the sampling rate, the length of exposure and the total µg of NO_2 on the tube allows the µg/m^3 of NO_2 to be calculated.
  - Parts Per billion (ppb) NO_2. The ppb levels are calculated from the µg/m^3 value, using the known relationship that ppb = 24.04 x Concentration (µg/m^3) / Molecular Weight . For NO_2, 1ppb = 1.91 µg/m^3, or 1 µg/m^3 = 0.52ppb (at 20°C, 101.3kPa)
- A soft copy of the report is emailed to the customer (for ease of data handling), and a signed hardcopy is posted.

NOTE: ***The reported values are NOT bias adjusted. The guidance is for the end user to select and use the bias factor best suited to their monitoring program.***

Contact Details:

Contact:	Andy Parish	Address:	Diffusion Tube Laboratory
Direct Tel:	+44 (0) 1235 750733		Unit 12, Moorbrook
Switchboard:	+44 (0) 1235 750730		Southmead Industrial Estate,
Fax:	+44 (0) 1235 750739		Didcot,
Email:	andy.parish@esg.co.uk		Oxfordshire.
Group Email:	HarDiffusionTubes@esg.co.uk		OX11 7HP

NO2 Diffusion Tube Information – 2011/2

Supplier: Environmental Scientifics Group Ltd

Address: Unit 12
Moorbrook
Southmead Industrial Estate
Didcot
Oxfordshire
OX11 7HP

Diffusion Tube Performance:

Tube Type: 50% Acetone : 50% TEA

Uncertainty: Under European guidelines, diffusion tubes are considered an indicative method, and as such the uncertainty is defined as <20%. (In field intercomparisons ESG's diffusion tubes perform at <10% uncertainty.)

Quality Control: A quality control sample of known concentration is run every 10 samples. The data generated is compared to acceptable limits as determined statistically using a Shewhart Chart control system.

Analytical Repeatability: In 2011 several thousand QC samples were analysed, achieving a relative standard deviation of 1.09%

Confidence Intervals: Assuming a normal distribution, 95.45% of results should fall within 2σ (±2.18%) and 99.73% of results should fall within 3σ (±3.18%) of the expected value.

Limit Of Detection: 0.03µg NO_2 on the tube.

Over a 4-week exposure this would equate to 0.6µg/m^3, or 0.3ppb

Quality Assurance: The manufacture and analysis of NO_2 diffusion tubes is covered by our UKAS accreditation

- The method meets the requirements laid out in DEFRA's "Diffusion Tubes For Ambient NO2 Monitoring: A Practical Guidance."
-
- The laboratory has taken part in the WASP proficiency scheme since it's inception, and has maintained the highest ranking of 'Satisfactory'
-
- Component part control: 20 tubes from each batch of newly manufactured tubes are measured to ensure the diffusion tube factor remains accurate. The internal diameter of both ends of the tube is measured to ensure the tube is square, as well as the tube length.
-

Analytical Information :

Analytical Technique: Colorimetric

Instrument: Continuous Flow Auto-analyser

Principle: Nitrite ions react with Sulphanilamide to form a diazonium compound. In acidic conditions, this couples with N-(1-naphthyl)-ethylenediamine dihydrochloride to form a purple azo dye. Utilising spectrophotometric analysis at 540nm, the NO_2 concentration is calculated by quantification of the colour change in comparison to that produced by known standards.

Calibration: Standards are made from brought in 1000ppm standard – These standards hold ISO Guide 34 and ISO/IEC 17025 certification

The instrument is calibrated every run

The instrument calibration must achieve a coefficient of linearity >0.999 to be considered acceptable.

System Suitability Checks: System suitability checks are used to ensure performance within expected criteria. These include baseline, peak height and gain.

Extraction:	To ensure complete, homogeneous extraction, tubes are mixed on a vibrating tray for not less than 30 minutes.

Appendix 2

2010 Results for the 4 tubes representing St Matthews Street for Calculation of the Estimated Annual Mean.

Street	Tube nos	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Count	Min	Max	Mean	Bias Adjustment
																		Local average 0.87
St Margaret's Street	24	51	63	60	51	48.3	50	57	47	56.8	55	54	58	12	46.5	63	54.3	**51.0**
St Helen's St/Grimwade Street	26	49	66	53	59	45.2	45	39	35	46.7	48	53	57	12	35.3	66	49.6	**43.2**
St Helen's St/Argyle Street	27	57	69	64	55	49.2	43	52	51	51.9	61	54	67	12	43	68.8	56.0	**48.7**
St Helen's St/Dove Street	28	41	46	38	35	27.4	28	30	28	36.4	37	38	48	12	27.4	48.3	36.1	31.4