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Ms Denise Lavender
Environmental Protection
Suffolk Coastal District Council
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13 September 2005
Our Reference: Netcen/ED49359/Issue 1

Dear Denise

AIR QUALITY MONITORING DETAILED ASSESSMENT ADVICE

Suffolk Coastal District Council has commissioned netcen to provide a report stating the likelihood of an exceedence of the national air quality annual mean nitrogen dioxide (NO_2) objective and the need, or otherwise, to declare an Air Quality Management Area for the following location in Suffolk Coastal:

- Junction of Lime Kiln Quay Road, Thoroughfare and St. John's Street in Woodbridge (Woodbridge Junction)

In 2003, a detailed assessment was undertaken for this junction and netcen undertook modelling of NO_2 concentrations on behalf of the Council. The modelling results showed that it is unlikely that an exceedence of the annual objective would occur at the above location in 2005. However, diffusion tube (WBG 1) exposed on the Thoroughfare / Melton Hill arm of the junction showed an exceedence of the annual mean NO_2 objective in 2002 and a predicted exceedence for 2005, which was not in agreement with the modelling results. Consequently, it was recommended at that time there was no need to declare an Air Quality Management Area but further monitoring should be carried out around the junction and the findings reported.

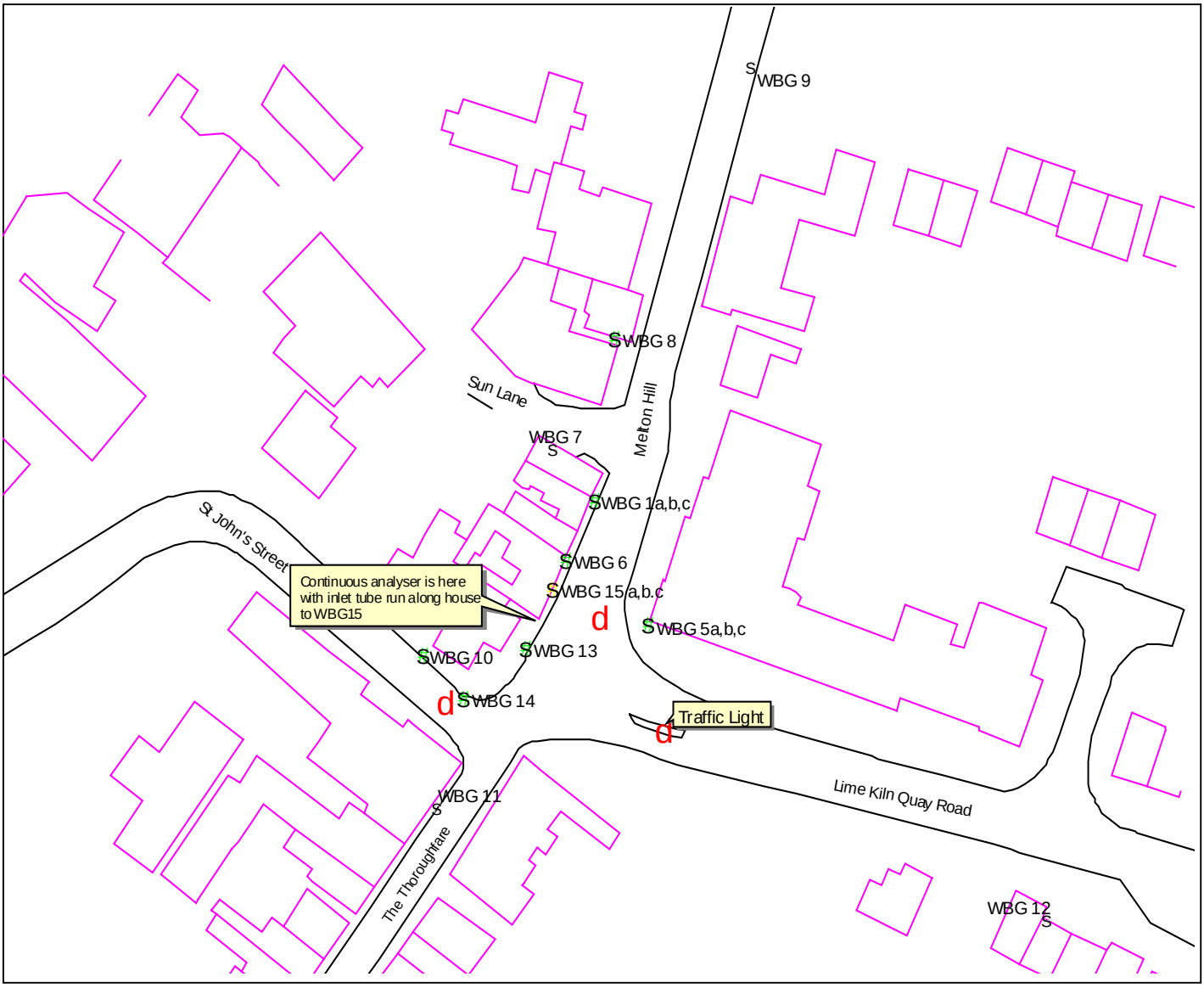
Following the outcome of the detailed assessment, a further 12-month diffusion tube survey was undertaken from July 2003 to June 2004, with seven extra sites set up at the Woodbridge junction. During the first six months of this survey, the results indicated that three arms of the junction (Lime Kiln Quay Road, St. John's Street and the southern arm of the Thoroughfare) were predicted to be within the annual mean objective in 2005. Results for the fourth arm of the junction (northern arm of the Thoroughfare / Melton Hill), diffusion tube sites WBG 1, 6 and 8, however were predicted to be above the annual mean objective in 2005. Subsequently, it was concluded that an automatic NO_x analyser would be sited on the northern arm of the Thoroughfare / Melton Hill to obtain more accurate data and information. Two additional diffusion tube sites (WBG 13 and 14) were also added near the centre of the junction in January 2004 to provide further information.

At the end of the survey period, a number of new sites had an annual mean NO_2 concentration close to or above the annual objective mean of 40 $\mu g/m^3$ and it was decided that monitoring at these sites would continue. The historic diffusion sites, WBG 1 and 5 were also left in place.

The diffusion tube sites WBG 7, 9, 11 and 12 had an annual mean NO_2 concentration below the annual NO_2 objective mean and were removed. Figure 1 shows the locations of past and existing diffusion tube sites and the location of the automatic analyser.

This report examines the latest air quality monitoring data obtained from the existing monitoring sites. An emissions modelling exercise has also been carried out to investigate current and potential future nitrogen dioxide levels.

Figure 1. Monitoring locations at Woodbridge junction



Air Quality Monitoring

The automatic NO_x analyser began collecting data on 5 April 2004. Due to space restrictions, the analyser inlet was unable to be located at the diffusion tube site where highest NO_2 concentrations have been measured (WBG1). The analyser was located in the front garden of 87 Thoroughfare with the maximum length of tubing taking the inlet point midway along 89/91 Thoroughfare, approximately 13.5m from WBG1 (Figure 1).

Table 1 shows the measured concentrations between 05 April 2004 and 31 March 2005. The concentrations measured at this point are below the annual mean objective for nitrogen dioxide of 40 $\mu g/m^3$. However, it should be noted that the analyser inlet was unable to be located at the point where the highest NO_2 concentrations have been measured, hence the results might not be representative of the worst situation.

Table 1 Summary of ratified NO_2 data recorded by the automatic NO_x analyser between 05 April 2004 and 31 March 2005.

	Concentration ($\mu g/m^3$)
Period Mean NO_2	37
Max Daily Mean NO_2	74
Data Capture (%) NO_2	94.0

There are currently seven diffusion tube sites at roadside locations on the Woodbridge junction that measure monthly average concentrations of nitrogen dioxide (Figure 1).

A triplicate diffusion tube site (WBG15) has been collocated at the analyser inlet since April 2004. The diffusion tubes exposed at this site recorded an average concentration of 44 $\mu g/m^3$ between April 2004 and March 2005 whereas the continuous monitor recorded an average concentration of 37 $\mu g/m^3$ over the same time period. This provides a bias adjustment factor of 0.868 as calculated using the netcen_DifTPAB.xls spreadsheet. The bias adjustment factor enables the annual mean concentration recorded by diffusion tubes to be corrected, increasing the accuracy.

The diffusion tubes are supplied and analysed by Harwell Scientifics using the 50% TEA in acetone method. The typical bias correction factor for these tubes was obtained from the database of collocation studies issued by University of West of England (UWE) on behalf of DEFRA. The published figure for 2004 was 0.89 (UWE (2004)) based on six other local authority and AEA Technology collocation studies, and it is in very good agreement with the Council's own collocation study result. Hence, the bias correction factor obtained from the Council's own collation study is applied to the diffusion tubes results.

The results of the diffusion tube survey for nitrogen dioxide reported for the 2004 annual period are shown in Table 2 below.

Table 2 Results of the nitrogen dioxide diffusion tube survey undertaken in 2004 at the Woodbridge junction, results corrected for co-located bias with predictions for 2005.

Site	Site Type	Site Location	No. of months	Annual mean 2004 unbiased	Annual mean 2004 bias corrected	Predicted 2005 Annual mean
WBG 1a,b,c	K	93 Thoroughfare (Triplicate site)	12	55	**48**	**47**
WBG 5a,b,c	R	Suffolk Place, Lime Kiln Quay Road (Triplicate site)	12	35	30	29
WBG 6	R	87 Thoroughfare	11	51	**44**	**43**
WBG 8	R	95 Thoroughfare	12	46	**40**	39
WBG 10	R	St. John's Street (opposite Surgery)	12	38	33	32
WBG 13	R	Traffic lights at front of 85 Thoroughfare	12	38	33	33
WBG 14	K	Traffic lights at 85 Thoroughfare in St. John's Street	12	38	33	32

Figures in **bold** indicate predicted exceedence of the UK objective
K – Kerbside
R – Roadside

Comparison of monitoring data with AQ objectives

Diffusion tubes at sites WBG1, WBG6 and WBG8 show an exceedence of the annual mean NO_2 objective in 2004. It is predicted that WBG1 and WBG6 are also likely to exceed the objective in 2005. The remainder of the diffusion tube sites do not show an exceedence and are not predicted to do in 2005. It should be noted that the results above are slightly different from the Council's Progress Report (published in May 2005) as a higher bias adjustment factor was used by the Council.

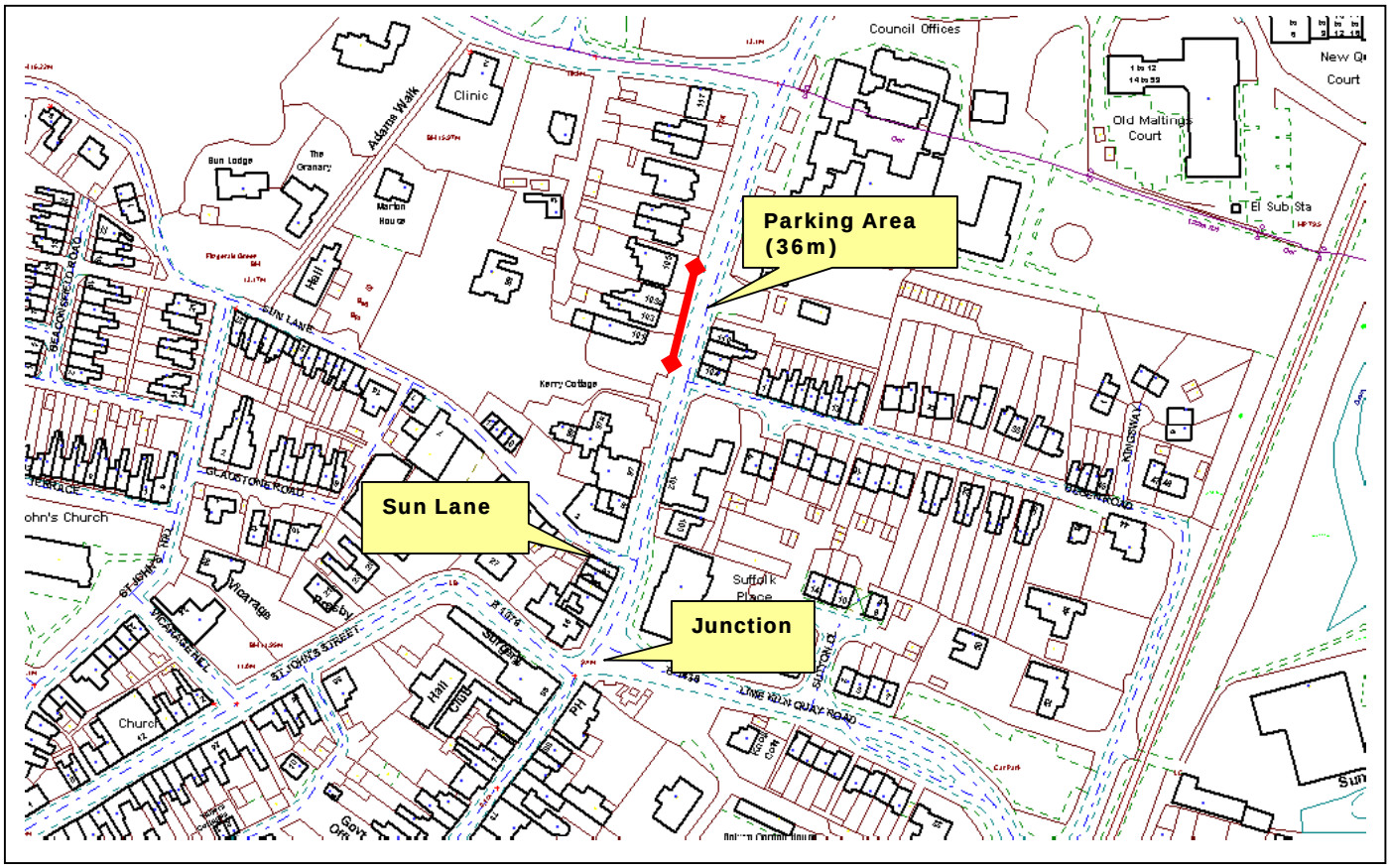
WBG1, WBG6 and WBG8 are all aligned along the western side of the pavement on the Thoroughfare / Melton Hill arm of the junction. WBG1 and 6 are located within 10m of the traffic light situated on this arm of the junction, whilst WBG8 is located approximately 36m from the traffic light. In July 2005 the Council carried out a survey over an 12-hour period to record the queuing and congestion level at this junction. According to the survey the average number of vehicles queuing on the Thoroughfare / Melton Hill arm of the junction over the 12-hour period was 9 vehicles at any one time (see appendix 1 for details).

The Council has also made a visual inspection at the junction to investigate any extra factors that may be adding to the high concentrations of nitrogen dioxide measured along this array of diffusion tubes. Sun Lane is a side road that joins the Thoroughfare / Melton Hill arm of the junction approximately 40 metres from the traffic light (see Figure 1). Sun Lane and its junction with Thoroughfare is very narrow which provides difficulties for any vehicles when entering or exiting. A number of large delivery vehicles need to access Sun Lane on a regular basis and, due to the width restrictions, need to reverse in from Thoroughfare using the full

width of the road. Additional queuing has been seen to occur on Thoroughfare / Melton Hill and at the junction when this happens.

There is also an area on Melton Hill where vehicles are allowed to park. The parking area is 36m long and begins outside property 101 Thoroughfare, approximately 120 m from the junction (see Figure 2). This reduces the width of the carriageway at this location. When a bus or a large vehicle, such as a lorry, is travelling on the road at the point of the parked vehicles traffic from both directions cannot pass simultaneously as the road is not wide enough. The queue from the traffic lights at the junction often extends beyond this parking area, providing additional problems for traffic to pass if any larger vehicles are involved. In this instance the traffic travelling away from the junction along Thoroughfare / Melton Hill will queue down towards the junction. This situation can occur several times a day. In addition, high emissions will occur from vehicles turning from either St Johns Street or Lime Kiln Quay Road into Thoroughfare and up the hill to Melton Hill. Low gear will be required with acceleration up the hill. This results in a complex emissions profile.

Figure 2. An enlarged view of the area around the Woodbridge junction, with the parking area shown in a red line.



Detailed modelling of NO_2

The concentrations of NO_2 at Woodbridge junction have been modelled using ADMS-3.2 as a dispersion kernel model. This is a fully approved sophisticated dispersion model which has been used in many applications of road emission assessment.

The roads were defined as volume sources, 3m deep, and were broken up in to a series of adjoining segments. The length of these segments was dictated by the way in which the OS LandLine data was digitised and varied from one or two metres in length (where the road rapidly changed direction) to hundreds of metres in length (where the road was essentially straight). The OS LandLine data was used to provide the co-ordinates of the centre line of the road, and the road widths. Therefore, the position of the volume sources (here the roads) were accurate to approximately a metre.

Where queuing of vehicles was reported, emissions from stationary vehicles exhausts were estimated on the basis that the engine power output and hence emissions were the same as those at a speed of 5 kph. Queuing vehicles were assumed to be 5 m apart.

Model input data

Traffic count data were provided by SCDC for the roads of concern and they were made in 2004. These have been converted to 2005 figures using the traffic flow forecasts provided by SCDC. In addition, information was provided on traffic growth arising from planned developments at the Woodbridge Junction. The planned developments include:

- Rendlesham Enterprise Park and New Rendlesham development, Rendlesham
- Annington development, at Sutton
- St Audrys Park development, at Melton
- Deben Mill development, at Woodbridge
- Ufford Park Hotel expansion, at Ufford
- Oak Lane Car Park development, at Woodbridge

Hourly data for Wattisham was obtained for 2002 from the Meteorological Office for input into the ADMS v3.2 dispersion model. Background emissions of oxides of nitrogen (NO_x) from sources not modelled in detail have been taken from the UK National Atmospheric Emissions Inventory (www.naei.org.uk) and scaled to the year of interest where necessary following the recommended procedure in LAQM.TG(03). The contribution to emissions from the roads modelled in detail have been omitted where this would lead to double counting of the local impact of emissions.

Bias adjustment of the model

A comparison was undertaken between the annual mean NO_2 concentrations predicted at the locations of the automatic monitor and the NO_2 diffusion tubes and those actually measured. Agreement between the model and the measured results indicated an underprediction from the model. Bias correction of the model is a normal procedure and has been undertaken in accordance to the Government Technical Guidance. The urban background site, WBG3, shows very good agreement between the modelled and measured results. However, where the vehicle emissions are more difficult to estimate owing to the day to day changing nature of the traffic flow, the underprediction was evident (on average 28%). The modelled NOx background concentrations were also compared with the estimated background air pollution maps obtained from http://www.airquality.co.uk/archive/laqm/tools.php?tool=background and they are also in good agreement. Hence the model gives a good prediction for the background concentration while it is underpredicting the roadside contribution of NO_2.

The underprediction of roadside contribution of NO_2 by the model is due to the complex pattern of queuing and congestion at the arm of Melton Hill of the junction. Along Melton Hill, parked cars, lorry delivery points and the narrowness of the road can make passing difficult for vehicles in places, especially for Heavy Duty Vehicles (HDVs). This would lead to congestion effects which are variable and difficult to predict in modelling. Although lorry reversing from Melton Hill into Sun lane has been taken into account in the modelling, there is still discrepancy between modelling and monitoring results. Indeed, high NO_2 concentrations measured along these roads would be surprising on a road of an Annual Average Daily Traffic (AADT) flow of 12,200 vehicle per day unless significant emissions also arose as a result of queuing and congestion.

Figure 2 shows the plot of modelled concentrations against the measured results in 2004. A best-fit line is drawn on the plot and the equation for this line is obtained and has been used as the bias correction for the modelled results in 2005.

Figure 3 show modelled nitrogen dioxide concentrations at Woodbridge Junction in 2005. The model predicts that the annual average objective for 40 $\mu g\ m^{-3}$ of nitrogen dioxide is likely to be exceeded at two properties on the west side of Melton Hill in 2005.

Figure 2. Comparison of modelled and measured annual average nitrogen dioxide concentrations

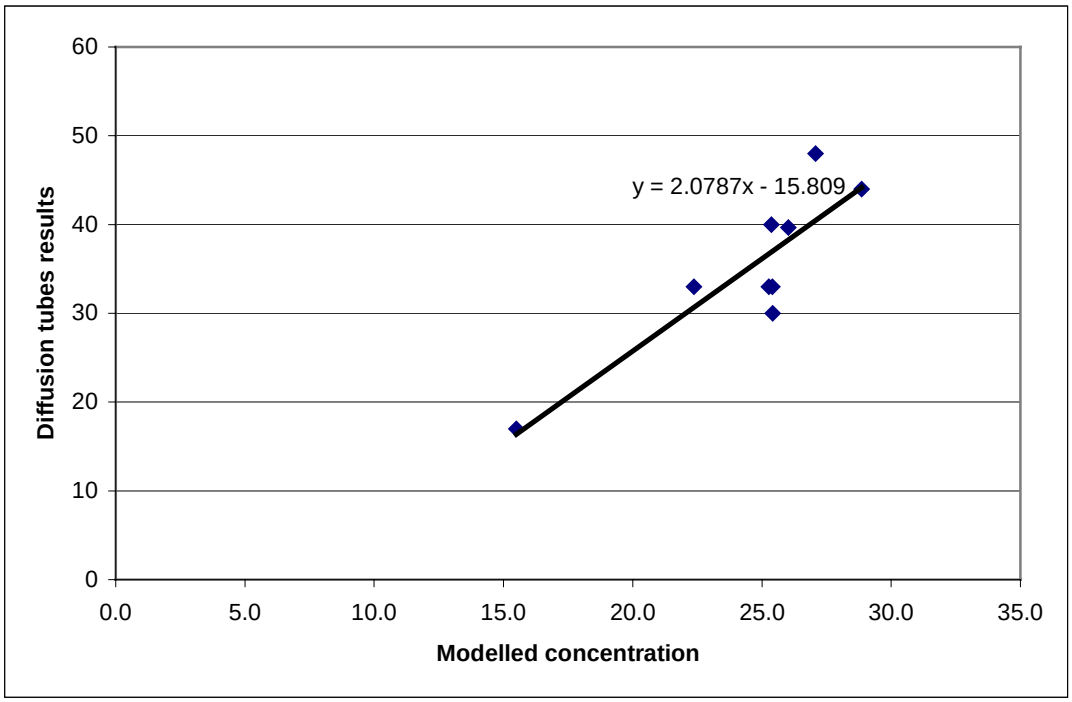
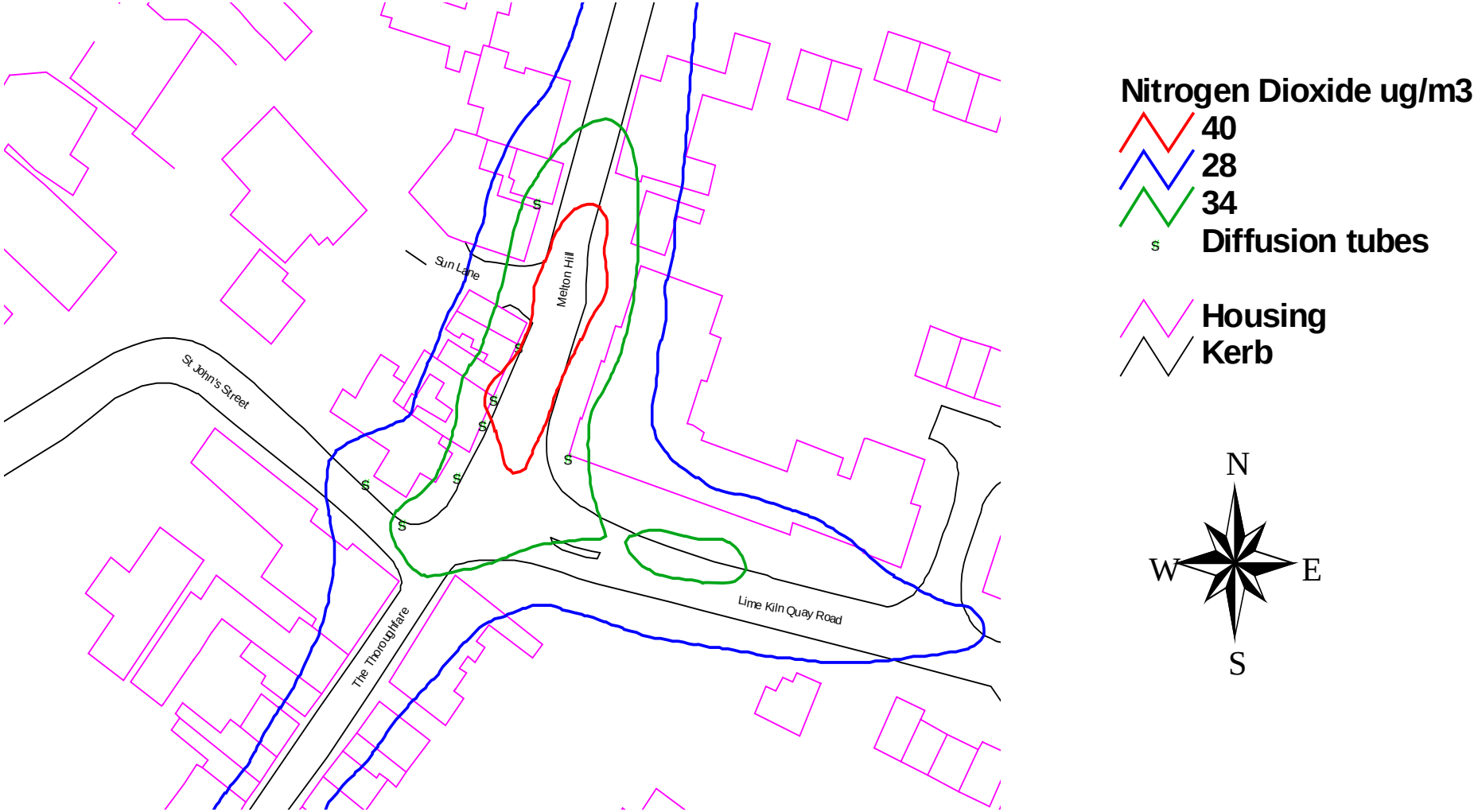


Figure. 3: Predicted nitrogen dioxide concentrations for **2005** at Woodbridge Junction, Suffolk Coastal



Summary of the likelihood of exceeding the objectives for nitrogen dioxide

The modelling results showed that it is at most ***probable*** (with probability between 50% and 80%) that an exceedence of the annual objective would occur in 2005 at:

- Junction of Lime Kiln Quay Road, Thoroughfare amd St. John's Street in Woodbridge (Woodbridge Junction)

At all receptor locations it was assessed that the risk of the UK objective for hourly NO_2 in 2005 being exceeded was at most ***unlikely*** (with probability between 5% and 20%).

Summary and Recommendations

A risk of exceedence of the UK objective for NO_2 at the Woodbridge Junction was predicted in the Council's previous round of Review and Assessment but a declaration was not considered necessary at that time. Consequently, further monitoring was undertaken at the above location.

The up-to-date diffusion tube results show that the annual mean NO_2 objective is likely to be exceeded in 2005, and the modeling results also indicate that there is a marginal exceedence for two properties at Melton Hill, Woodbridge. It is therefore recommended that Suffolk Coastal District Council should consider declaring an Air Quality Management Area (AQMA) at the Woodbridge Junction. While the decision for defining the boundary of the AQMA is entirely up to each individual local authority, this should include the area of exceedence. It is therefore recommended that this should at least include properties on the North western side of Melton Hill.

Following the declaration of the AQMA, Suffolk Coastal are required under Section 84(1) of the Environment Act to carry out a Further Assessment of existing and likely future air quality and report within 12 months of designating the AQMA. They must also consult on this and make it available to the public. Local Authorities who declare an AQMA are also required under the Act to draw up an Air Quality Action Plan. This should consider all options for improving air quality in the area and that the options chosen have been considered on their cost and effectiveness. At Woodbridge Junction this should focus on the relief of the traffic queuing and congestion. Clear timescales for the implementation of the measures should be made.

Yours sincerely

Beth Conlan

Dr Beth Conlan

Appendices

Appendix 1 - Road Traffic Data
Appendix 2 - Nitrogen dioxide monitoring data

Appendix 1

Contents:

- Road Traffic Data

A1.1 Traffic data provided by Suffolk Coastal District Council.

Road	Year	AADT	% HGV	% Buses and Coaches	Average Speed (kph)
Melton Hill, B1438	2004	12221	0.54	1.77	NA
Lime Kiln Quay Road, B1438	2004	12117	0.61	1.91	NA
The Thoroughfare	2004	814	0.56	0.42	NA
St John's Street	2004	4239	0.38	0.38	NA

A1.2 Average number of vehicles queuing each hour at the junction of Lime Kiln Quay Road/ St. John's Street/ Thoroughfare (count taken between 0800 and 1815 hours on Tuesday 12/7/05)

	Average number of vehicles queuing
Lime Kiln Quay Road	9
St. John's Street	7
Thoroughfare/Melton Hill	9

A1.3 Suffolk Coastal Tempro Growth Factors

From	To	NRTF Central	Suffolk Coastal Growth Central
2004	2005	1.017	1.020
2004	2010	1.097	1.118

Appendix 2

Contents:

- Continuous monitoring data
- Diffusion Tube Data

Air Pollution Report

Produced by netcen on behalf of Suffolk Coastal District Council

SUFFOLK COASTAL WOODBRIDGE
05 April 2004 to 31 March 2005

These data have been fully ratified by netcen

POLLUTANT	NO_X	NO_2
Number Very High	-	0
Number High	-	0
Number Moderate	-	0
Number Low	-	8144
Maximum 15-minute mean	944 µg m^{-3}	275 µg m^{-3}
Maximum hourly mean	829 µg m^{-3}	151 µg m^{-3}
Maximum running 8-hour mean	421 µg m^{-3}	127 µg m^{-3}
Maximum running 24-hour mean	245 µg m^{-3}	82 µg m^{-3}
Maximum daily mean	240 µg m^{-3}	74 µg m^{-3}
Average	83 µg m^{-3}	37 µg m^{-3}
Data capture	94.0 %	94.0 %

All mass units are at 20'C and 1013mb
NO_X mass units are NO_X as NO_2

Pollutant	Air Quality (England) Regulations 2000 and (Amendment) Regulations 2002	Exceedences	Days
Nitrogen Dioxide	Annual mean > 40 µg m^{-3}	0	-
Nitrogen Dioxide	Hourly mean > 200 µg m^{-3}	0	0

netcen
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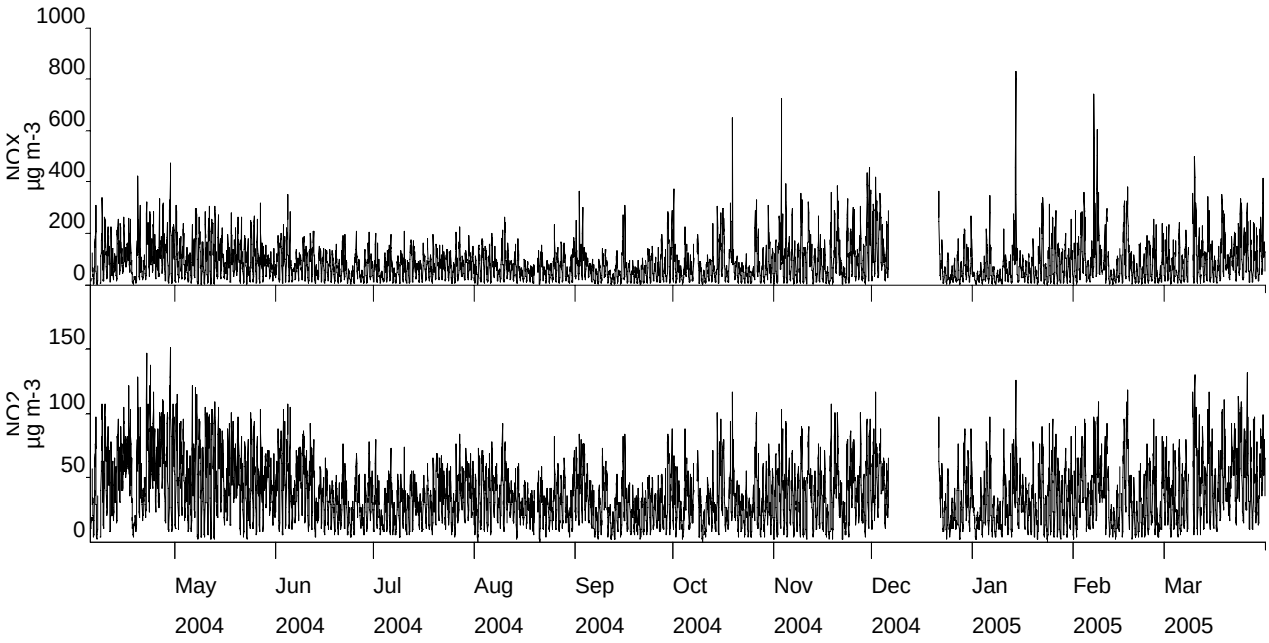
Air Pollution Report

Produced by netcen on behalf of Suffolk Coastal District Council

Suffolk Coastal Woodbridge Air Monitoring
Hourly Mean Data for 05 April 2004 to 31 March 2005



netcen is an operating division of AEA Technology plc

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Monthly and annual mean nitrogen dioxide (NO_2) concentrations recorded at sites in Woodbridge during 2004, figures in micrograms per cubic metre

Annual mean concentration ratified where relevant.

Site	Time in months												Annual mean ($\mu g/m^3$)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
WBG 1a	60.2	59.0	60.3	59.9	51.4	52.2	47.1	50.3	41.9	43.7	47.5	64.1	see WBG 1 mean
WBG 1b	63.6	64.0	52.7	59.8	57.5	47.5	51.0	41.2	52.7	53.6	52.5	65.9	see WBG 1 mean
WBG 1c	60.1	66.0	48.3	60.7	55.8	52.7	49.7	47.6	48.8	53.5	66.1	62.3	see WBG 1 mean
WBG 1 a,b,c - mean	61.3	63.0	53.8	60.1	54.9	50.8	49.3	46.4	47.8	50.3	55.4	64.1	**54.8**
WBG 3	26.7	24.7	23.1	27.2	12.0	10.3	11.5	11.3	12.5	22.2	23.3	35.6	**20.0**
WBG 5a	40.8	41.1	41.1	39.5	36.8	24.4	25.3	20.5	30.6	37.4	31.5	44.0	see WBG 5 mean
WBG 5b	41.0	38.7	40.2	39.7	35.7	26.5	24.4	24.3	31.2	37.5	32.5	47.7	see WBG 5 mean
WBG 5c	38.3	36.8	40.5	38.8	37.7	23.5	27.7	25.7	33.7	37.2	37.6	46.1	see WBG 5 mean
WBG 5 a,b,c - mean	40.0	38.9	40.6	39.3	36.7	24.8	25.8	23.5	31.8	37.4	33.9	45.9	**34.9**
WBG 6	55.8	49.2	59.5	52.1	58.9	33.8	45.3	43.7	49.0	51.1	no data	59.6	**50.7**
WBG 7	37.9	28.5	33.4	30.8	25.7	18.7	**End**	~	~	~	~	~	**29.2**
WBG 8	50.2	51.8	42.8	46.3	45.2	43.8	45.4	34.7	45.4	48.6	47	56.3	**46.5**
WBG 9	40.3	43.6	39.7	31.2	22.9	17.1	**End**	~	~	~	~	~	**32.5**
WBG 10	42.7	42.1	46.1	41.7	41.9	27.7	29.7	32.1	35.5	40.6	37	42.4	**38.3**
WBG 11	36.1	37.2	36.8	28.3	24.8	17.5	**End**	~	~	~	~	~	**30.1**
WBG 12	41.7	36.9	34.8	37.0	28.6	28.1	**End**	~	~	~	~	~	**34.5**
WBG 13	45.8	49.3	42.9	41.4	41.0	13.3	31.6	30.6	33.4	40.1	43.0	49.0	**38.5**
WBG 14	40.7	44.9	44.7	38.5	38.2	28.5	28.4	30.3	30.8	33.4	48.7	46.4	**37.8**
WBG 15a	~	~	~	45.4	no data	34.5	38.4	34.8	34.3	44.8	56.8	58.1	see WBG 15 mean
WBG 15b	~	~	~	49.9	40.5	35.7	38.5	38.4	28.8	48.1	51.3	58.0	see WBG 15 mean
WBG 15c	~	~	~	36.7	38.3	no data	43.5	41.0	35.1	44.8	53.5	55.8	see WBG 15 mean
WBG 15 a,b,c - mean	~	~	~	44.0	39.4	35.1	40.1	38.1	32.7	45.9	53.9	57.3	**42.9**

Key:

WBG 1a,b,c	Kerbside site, signpost outside 93 Thoroughfare, Woodbridge **(Triplicate site)**
WBG 3	Urban Background site, lampost outside 8 Kingston Farm Road, Woodbridge
WBG 5a,b,c	Roadside site, drainpipe on Suffolk Place, Lime Kiln Quay Road, Woodbridge **(Triplicate site)**
WBG 6	Roadside site, drainpipe on 87 Thoroughfare, Woodbridge
WBG 7	Roadside site, drainpipe on 93a Thoroughfare (located in Sun Lane), Woodbridge. **Site DISCONTINUED from June 2004**
WBG 8	Roadside site, drainpipe on 95 Thoroughfare, Woodbridge
WBG 9	Roadside site, signpost on Thoroughfare at entrance to Deben Road, Woodbridge. **Site DISCONTINUED from June 2004**
WBG 10	Roadside site, signpost in St. John's Street (opposite Surgery), Woodbridge
WBG 11	Roadside site, drainpipe on 83 Thoroughfare (opposite Red Lion PH), Woodbridge. **Site DISCONTINUED from June 2004**
WBG 12	Roadside site, drainpipe on 8 Lime Kiln Quay Road, Woodbridge. **Site DISCONTINUED from June 2004**
WBG 13	Roadside site, traffic lights at front of 85 Thoroughfare, Woodbridge
WBG 14	Kerbside site, traffic lights at 85 Thoroughfare in St. John's Street, Woodbridge
WBG 15 a,b.c	Roadside site, drainpipe on 87 Thoroughfare, Woodbridge **(co-location with continuous monitor). New site from April 2004 (Triplic**