Report on the Second Stage Review and Assessment of Air Quality in the Suffolk Coastal District.

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Executive Summary

As part of the requirements of Part IV of the Environment Act 1995, the Government adopted the United Kingdom Air Quality Strategy as a statement of its polices with respect to the assessment and management of air quality. In January 2000, the Government adopted the revised Air Quality Strategy for England, Scotland, Wales and Northern Ireland. The strategy continues to represent a comprehensive approach to maintaining and improving the quality of ambient air in the United Kingdom. It sets health-based air quality objectives to be achieved by prescribed target dates, and the process by which the strategy is to be implemented.

National policies on air pollution are expected to deliver a significant improvement in air quality throughout the country. The strategy recognises, however, that there is an important local dimension to air quality. Local authorities are required by the Environment Act 1995 to carry out periodic reviews of air quality within their areas to assess present and likely future quality against the air quality objectives prescribed in the Air Quality (England) Regulations 2000. These Regulations set objectives for seven pollutants: Benzene, 1,3-Butadiene, Lead, Carbon Monoxide, Nitrogen Dioxide, Sulphur Dioxide and Particulate Matter (PM_{10}).

The Review and Assessment of air quality in the Suffolk Coastal District is being carried out in three stages in accordance with the methodology detailed in the pollutant specific guidance issued by the Department of the Environment, Transport and the Regions (DETR). Suffolk Coastal's First Stage Review and Assessment Report (February 1999) indicated that, for Benzene and 1,3-Butadiene, the risk of the air quality objectives being exceeded was negligible and further review and assessment of these pollutants is not necessary at this time. This document reports on the Second Stage of the review and assessment process for the pollutants Lead, Carbon Monoxide, Nitrogen Dioxide, Sulphur Dioxide and Particulate Matter (PM_{10}). The aim of this report is to determine whether there is a significant risk that any of the specific emission sources identified for the above pollutants in Suffolk Coastal's First Stage report could lead to an exceedance of the air quality objectives.

This Second Stage Review and Assessment used screening models and monitoring data recommended in the pollutant specific guidance LAQM.TG4(00) and the approach adopted was precautionary.

The conclusions of this Second Stage Review and Assessment are as follows:

- The risk of the air quality objectives being exceeded for Lead and Carbon Monoxide is negligible, and further review and assessment will not be necessary at this time;

- The risk of the air quality objectives being exceeded for Nitrogen Dioxide, Sulphur Dioxide and Particulate Matter (PM_{10}) at relevant locations is significant and further review and assessment will be necessary. This will be in the form of continued Second Stage (where applicable) and a Third Stage review and assessment for the emission sources of concern.

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1. Introduction

This is the Second Stage Review and Assessment Report for Suffolk Coastal District Council which assists with the local air quality management process as laid down by Part IV of the Environment Act 1995.

The First Stage Review and Assessment Report, dated February 1999, identified which of the relevant specified National Air Quality Strategy pollutants, as well as localities of concern for each, should be the focus of this Second Stage Review and Assessment. In accordance with the Council's statutory obligations, the First Stage report was submitted to the Department of the Environment, Transport and the Regions (DETR). The DETR had no adverse comments to make in its response.

This Second Stage Review and Assessment Report should be read in conjunction with the Suffolk Coastal First Stage Review and Assessment Report (1999).

The overall purpose of the review and assessment process is to enable local authorities to appraise current and future air quality for their area against the objectives in the Air Quality Regulations. The Government recommends a phased approach involving three stages when conducting a review and assessment of air quality. All local authorities must undertake an initial First Stage screening process reviewing sources of pollution in the area followed, if necessary, by a more detailed Second Stage survey using simple monitoring and modelling techniques. If these surveys indicate that a prescribed air quality objective is likely to be exceeded by the relevant future year, then a Third Stage detailed assessment using accurate modelling, monitoring or other techniques should be undertaken. Where the Third Stage review indicates that objectives are likely to be exceeded, then the local authority is under a duty to declare an Air Quality Management Area. The authority will then be required to prepare a written action plan to improve air quality within its area in order to achieve the objectives.

The summary and recommendations from the Suffolk Coastal First Stage Review and Assessment Report demonstrated that the risk of exceedance of the air quality objectives for benzene and 1,3-butadiene is negligible and, therefore, the objectives will be met by the specified target dates. However, the First Stage Report also identified, for the following areas and activities, that there is a risk of exceedance of the respective air quality objectives for the pollutants:

Lead

- Emissions from Carless Refining & Marketing Limited at Harwich (site regulated under Part I of the Environmental Protection Act 1990, Part A Authorised Process) within the Tendring District.

Carbon Monoxide (CO)

- Two sites regulated under Part I of the Environmental Protection Act 1990, Part A Authorised Processes within 10km of the Suffolk Coastal District;

    - British Sugar plc, Sproughton, Ipswich, Suffolk, and
    - Ipswich Hospital, Heath Road, Ipswich, Suffolk.

- A segment of the A14 trunk road from the junction with the A12 to beyond the Orwell Bridge, which has a projected Annual Average Daily Traffic Flow (AADTF) of greater than 50,000 vehicles at the end of 2005.

Nitrogen Dioxide (NO_2)

- Three sites regulated under Part I of the Environmental Protection Act 1990, Part A and Part B Authorised Processes within 10km of the Suffolk Coastal District:

  - Carless Refining & Marketing Limited, Parkeston, Harwich, Essex;
  - British Sugar plc, Sproughton, Ipswich, Suffolk;
  - Ipswich Hospital, Heath Road, Ipswich, Suffolk.

- Road traffic on five segments of road within the Suffolk Coastal District which have a projected AADTF of greater then 20,000 vehicles at the end of 2005:

  - The A14 trunk road from Dock Spur roundabout at Felixstowe to the Ipswich Borough boundary at the Orwell Bridge;
  - The A1156 from the junction with the A12/A14 at Nacton to the Ipswich Borough boundary at Purdis Farm;
  - The A12 trunk road from the junction with the A14 at Nacton through to the Woods Lane (A1152) roundabout at Woodbridge;
  - The A1214 from its junction with the A12 at Kesgrave to the Ipswich Borough boundary at Rushmere St Andrew;
  - The A12 trunk road from the Woods Lane (A1152) roundabout at Woodbridge to the A1094 turn-off to Snape and Aldeburgh at Farnham.

Sulphur Dioxide (SO_2)

- Two sites regulated under Part I of the Environmental Protection Act 1990, Part A and Part B Authorised Processes within 10km of the Suffolk Coastal District:

  - Carless Refining & Marketing Limited, Parkeston, Harwich, Essex, and
  - British Sugar plc, Sproughton, Ipswich, Suffolk.

- Emissions from uncontrolled low-level sources from shipping at The Port of Felixstowe.

Particulate Matter (PM_{10})

- Two sites regulated under Part I of the Environmental Protection Act 1990, Part A and Part B Authorised Processes within the Suffolk Coastal District;

  - White Mountain Roadstone Limited, Foxhall Four Quarry, Foxhall Road, Brightwell, Suffolk, and
  - Roadworks (1952) Limited, Sinks Pit Quarry, Kesgrave, Suffolk.

- Four sites regulated under Part I of the Environmental Protection Act 1990, Part A and Part B Authorised Processes within 10km of the Suffolk Coastal District:

  - British Sugar plc, Sproughton, Ipswich, Suffolk;
  - Ipswich Port Authority, Ipswich, Suffolk;
  - Ipswich Hospital, Heath Road, Ipswich, Suffolk;
  - Needham Chalks Limited, Needham Market, Suffolk.

- Road traffic on four segments of road within the Suffolk Coastal District which have a projected AADTF of greater than 25,000 vehicles at the end of 2005:

    - The A14 trunk road from Dock Spur roundabout at Felixstowe to the Ipswich Borough boundary at the Orwell Bridge;
    - The A1156 from the junction with the A12/A14 at Nacton to the Ipswich Borough boundary at Purdis Farm;
    - The A12 trunk road from the junction with the A14 at Nacton through to the Woods Lane (A1152) roundabout at Woodbridge;
    - The A1214 from its junction with the A12 at Kesgrave to the Ipswich Borough boundary at Rushmere St Andrew.

- Emissions from uncontrolled low-level sources from shipping at The Port of Felixstowe and the four quarries within the District

- Annual average background levels of secondary particulates in excess of 8 $\mu g/m^3$ over the entire Suffolk Coastal District

- High PM_{10} emission estimates in the town of Felixstowe, particularly at the Port of Felixstowe

- The planned development of a gravel extraction quarry alongside the A14 at Bucklesham.

The aim of the Second Stage Report is to provide further screening of these pollutants and emission sources.

Since Suffolk Coastal reported on the First Stage of the review and assessment process, the Government has published the revised Air Quality Strategy for England, Scotland, Wales and Northern Ireland (DETR 1999, 2000) and has replaced the Air Quality Regulations 1997 with the Air Quality (England) Regulations 2000. These new regulations have the effect of tightening five of the existing objectives: for benzene, 1,3-butadiene, carbon monoxide, lead, and nitrogen dioxide (the hourly objective). The objectives for ozone, sulphur dioxide and nitrogen dioxide (the annual objective) remain the same. For particulates, since the existing objective is now considered to be unachievable, the Government has replaced the objective with the less stringent European Union limit value, which is currently the only alternative nationally recognised target. The Government has also set a number of new objectives to reflect the limit values agreed in the European Union Air Quality Daughter Directive for sulphur dioxide, nitrogen dioxide, lead and particulates (PM_{10}). As before, there is no objective for ozone; action in pursuit of this will be taken at national level. The full list of objectives as they appear in the Air Quality (England) Regulations 2000 can be seen in Table 1.

There are a number of other differences between these new Regulations and the 1997 Regulations. The relevant time period now varies from objective to objective, between 2003 and 2008. All pollutant objectives are also presented using a consistent measurement method, $\mu g/m^3$ or mg/m^3. This is simpler and has the advantage of being consistent with EU Air Quality Daughter Directive limit values.

Government guidance contained in *Framework for Review and Assessment of Air Quality* (DETR 2000) states that authorities which have completed part of their review and assessment (eg – Stage 1 but not Stage 2 or 3) before the introduction of the new regulations will **not** need to redo the stages already carried out, but should shift the focus of the remaining part of their review and assessment with immediate effect to the new objectives.

A review of the Suffolk Coastal First Stage findings has, however, been carried out in light of the revised air quality objectives. It has been established that the changes to the objectives alone will not necessitate any additional emissions sources in the District being progressed through to the Second Stage of the review and assessment process. There are, however, some additional sources which have been reviewed in this Second Stage report in light of the alterations to the pollutant specific guidance, LAQM.TG4(00). Further comments with respect to each of the pollutants considered in this Second Stage Review and Assessment Report can be found in the relevant chapters for each.

Table 1 Objectives specified in the Air Quality (England) Regulations 2000 for the purposes of Local Air Quality Management

Pollutant	**Objective**		**Date to be achieved by**
	Concentration *	**Measured as**	
Benzene	16.25 $\mu g/m^3$ (5 ppb)	Running annual mean	31 December 2003
1,3-Butadiene	2.25 $\mu g/m^3$ (1 ppb)	Running annual mean	31 December 2003
Carbon monoxide	11.6 mg/m^3 (10 ppm)	Running 8-hour mean	31 December 2003
Lead	0.5 $\mu g/m^3$ 0.25 $\mu g/m^3$	Annual mean Annual mean	31 December 2004 31 December 2008
Nitrogen dioxide	200 $\mu g/m^3$ (105 ppb) not to be exceeded more than 18 times a year 40 $\mu g/m^3$ (21 ppb)	1-hour mean Annual mean	31 December 2005 31 December 2005
Particles (PM_{10})	50 $\mu g/m^3$ not to be exceeded more than 35 times a year 40 $\mu g/m^3$	24-hour mean Annual mean	31 December 2004 31 December 2004
Sulphur dioxide	350 $\mu g/m^3$ (132 ppb) not to be exceeded more than 24 times a year 125 $\mu g/m^3$ (47 ppb) not to be exceeded more than 3 times a year 266 $\mu g/m^3$ (100 ppb) not to be exceeded more than 35 times a year	1-hour mean 24-hour mean 15-minute mean	31 December 2004 31 December 2004 31 December 2005
* conversions of ppb and ppm to $\mu g/m^3$ and mg/m^3 at 20°C and 1013 mb			

2. Second Stage Review And Assessment Methodology

The methodology used in the compilation of this report is in accordance with the Review and Assessment: pollutant specific guidance LAQM.TG4(00) (DETR 2000) hereafter referred to as LAQM.TG4(00).

Paragraph 1.12 of LAQM.TG4(00) advises that:
"… the Second Stage Review and Assessment is only intended to provide additional screening of pollutant concentrations in the area. It is not intended that it should provide accurate predictions of existing or future air quality across the whole of the authority's area. Rather, authorities should focus upon those locations where the maximum impact is expected to occur, bearing in mind the potential for public exposure. If this Second Stage screening indicates that there is a risk that an air quality objective may not be met by the relevant future year, then the authority will need to undertake a Third Stage review and assessment"

For the purpose of review and assessment, authorities are required to focus their work upon locations where members of the public are regularly present and likely to be exposed over the averaging period of the objective. This should include locations where likely future developments may affect exposure to existing sources of air pollution or may result in new sources. The following approach is suggested to define relevant locations for review and assessment:

- For the annual mean objectives (for Lead, CO, NO_2 and PM_{10}) the review and assessment should focus upon all background locations where members of the public might regularly be exposed, and building facades of residential properties, schools, hospitals, libraries, etc;

- For the 24-hour mean and 8-hour mean objectives (for CO, PM_{10} and SO_2) the review and assessment should focus upon all locations where the annual mean objective applies and also gardens of residential properties;

- For the 1-hour mean objectives (for NO_2 and SO_2) the review and assessment should focus upon all locations where the annual mean, 24-hour and 8-hour objectives apply, and also kerbside sites (i.e. -pavements of busy shopping streets) parts of car parks and railway stations, etc, which are not fully enclosed, and any outdoor locations to which the public might reasonably be expected to have access.

- For the 15-minute mean objective (for SO_2) the review and assessment should focus upon all locations where members of the public might reasonably be exposed for a period of 15 minutes or longer.

Authorities should not consider exceedances of the objectives at any location where public exposure over the relevant averaging period would not be realistic.

The review and assessment process requires the local authority to estimate pollutant concentrations in a future year. In order to carry out such predictions, it is necessary to consider the sources which release the pollutant, how these emissions will change in future years and how these emissions are dispersed in the atmosphere. For some pollutants, such as NO_2 and PM_{10}, it is also necessary to consider the complex chemical transformation reactions which occur. All of these processes are subject to a degree of uncertainty which must be borne in mind. Whilst it is not possible to accurately quantify the overall level of uncertainty, it is recommended that authorities modify their approach at different stages in

the review and assessment process in order to reflect the requirement for an increasing level of confidence for the predicted impacts.

For Second Stage Review and Assessments, it is recommended that a conservative approach is taken towards the assumptions that are used. This will tend to over-estimate the predicted concentrations such that, despite the degree of uncertainty that might be expected, the authority can be reasonably confident that it has identified all areas at risk of exceeding the air quality objectives.

LAQM.TG4(00) advised two alternative approaches to the Second Stage Review and Assessment, one based on monitoring data and the other based on screening models. This report has mainly focused on the latter. The general approach adopted in this report is that of a precautionary approach, as required in the above guidance.

The following main screening models were used (in accordance with the guidance) either to assess Suffolk Coastal District Council emission sources or by neighbouring local authorities for assessment of their emission sources:

- For road transport sources, the revised Highway Agency's Design Manual for Roads and Bridges (DMRB) model, May 1999.

- For industrial sources, the Environment Agency's Guidance for Estimating the Air Quality Impact of Stationary Sources (GN24), November 1998. GN24 methodology is summarised in Appendix A as Suffolk Coastal District Council did not use this model directly.

- For industrial sources where the Environment Agency methodology (GN24) was inapplicable, the Atmospheric Dispersion Modelling System-Screen version 1.5 (ADMS-Screen). This model was used by the DETR modelling help-line, run by Stanger Science and Environment, to predict emission estimates on behalf of local authorities. The results of ADMS-Screen provide a first estimate only, and give an indication of the need for more detailed modelling and assessment.

- LAQM.TG4(00) guidance was also used, most specifically for overlapping sources.

A brief outline of the DMRB methodology is given below. The guidance given in LAQM.TG4(00) is summarised in the review and assessment of each pollutant.

2.1 Design Manual for Roads and Bridges Methodology

The Design Manual for Roads and Bridges (DMRB), hereafter referred to as DMRB, includes a simple methodology for estimating the concentrations of air pollutants in the vicinity of roads. This methodology has been used for many years as a screening tool, primarily in support of assessments of new road building projects. The methodology is attractive as it implicitly includes the change in vehicle technologies year by year. It consists of a number of tables which allow the user to input vehicle flows of heavy and light vehicles, vehicle speeds and the year under consideration. A series of look-up tables are used to correct for vehicle speed, the year and the proportion of Heavy Duty Vehicles, to provide estimates of concentrations up to 200m from a road (beyond which it is presumed that the road traffic has no impact on ambient concentrations). A suitable version of the DMRB model in spreadsheet form has been developed by Stanger Science and Environment on behalf of the DETR. This spreadsheet is available on the internet and has been used in the preparation of this report. The internet site is http://www.stanger.co.uk/airqual/modelhlp

The DMRB requires input data on annual average daily traffic flows (AADTF), annual average speeds and the fraction of Heavy Duty Vehicles. This information was obtained from Suffolk County Council Environment and Transport Department, incorporating projections for future years based on National Road Traffic Forecasts (NRTF). This traffic data is summarised in Appendix B.

The DMRB also requires information on the distance of the receptor location from the road of concern. The nearest relevant receptor locations (as defined earlier in this Chapter) were, therefore, identified for each section of road considered as part of this review and assessment. Details of these receptor locations are given in the review and assessment of each pollutant.

The DMRB can provide default values for the background pollutant concentration, but guidance in LAQM.TG4(00) recommends that values from pollution climate mapping or actual monitoring data are used in preference. Suffolk Coastal District Council has monitored background concentrations of nitrogen dioxide at a number of locations using passive diffusion tubes since 1993 , and this data is summarised in Appendix C. This method can produce data which are equivalent to continuous reference methods and is useful for monitoring general trends over a number of years. However, the accuracy of the diffusion tube method is questionable; laboratories within the United Kingdom have been shown to systematically under or over-read diffusion tube concentrations by up to 30%. For this reason, **background** concentrations used in the review and assessment of nitrogen dioxide have been obtained from the National Air Quality Archive. Background values for other pollutants have also been obtained from the Archive. This archive of information has been prepared for the United Kingdom by the National Environmental Technology Centre (NETCEN) and may be viewed on the internet (at http://www.aeat.co.uk/netcen/airqual). The information is in the form of a series of interactive maps which allow the user to identify local authority boundaries and to select a particular area of interest in order to get the estimated concentration for individual 1 km x 1 km grid squares.

For each pollutant, the annual mean background estimates have been combined with the annual mean roadside predictions from the DMRB to derive the final estimated concentration. This is then compared with the relevant air quality objective.

3. Review and Assessment of Lead

3.1 Background

Lead is a naturally occurring metal, which may also be released into the atmosphere by human activities. It has many industrial applications such as the manufacture of batteries, and as a pigment in paint and glazes. It is also widely used in organic compounds of which its major use is as a petrol additive.

Lead can be absorbed into the body through the lungs, stomach and intestines. Studies have shown that exposure to high levels causes severe adverse effects on the blood, nervous system and kidneys. Effects of long-term exposure to low levels of lead are accumulation in bones, teeth, skin and muscle, and subsequent slow release into the blood. This has been shown to impair brain development and, ultimately, intellect of children.

3.2 Standards And Objectives

The Revised Air Quality Strategy for England, Scotland, Wales and Northern Ireland (DETR 1999, 2000), published in January 2000, retains the national air quality standard for lead as an annual mean of 0.5 $\mu g/m^3$. However, the target date for this objective has been brought forward to 31 December 2004. A new lower air quality objective has also been adopted. This is an annual mean of 0.25 $\mu g/m^3$, which is to be achieved by 31 December 2008.

Existing national policies are expected to deliver these air quality objectives at all rural, urban, background and roadside/kerbside sites, by 2004 and 2008 respectively. Only local authorities with significant industrial sources, which have the potential to result in elevated levels of lead in relevant locations, will be expected to undertake further review and assessments past Stage 1.

3.3 Review Of Lead In Respect Of The Revised Air Quality Strategy 2000

Revision of the target date by which the annual mean objective of 0.5$\mu g/m^3$ is to be achieved, from 2005 to 2004, has not altered the findings of the Suffolk Coastal First Stage Review and Assessment Report. This is because date-related factors had no bearing on determining whether sources required further review and assessment.

Similarly the new standard of 0.25 $\mu g/m^3$ to be achieved by 2008 has not altered the findings of the Suffolk Coastal First Stage Review and Assessment Report. Background levels of Lead within Suffolk Coastal were found to be 0.02 - 0.04 $\mu g/m^3$. Potential sources of Lead assessed did not emit significant levels to breach the 2008 air quality target.

3.4 Review And Assessment Of Lead

In Suffolk Coastal's First Stage Review and Assessment Report, the following source of Lead was identified as warranting further investigation in a Second Stage Review and Assessment:

- Carless Refining and Marketing Limited, Parkeston, Harwich, Essex.

3.4.1 Review And Assessment Of Carless Refining & Marketing Limited, Parkeston, Harwich

Carless Refining and Marketing Limited is within the Tendring District and was highlighted at Stage 1 as a potentially significant source of lead requiring further investigation. As the refinery is approximately 4 km from the Suffolk Coastal boundary, it is relevant for inclusion in our Second Stage Review and Assessment.

Amongst its other activities, the refinery produces a small quantity of leaded fuel, relative to overall production, in blending operations to provide fuel for vintage cars.

Following investigation Tendring District Council has discovered that lead is not added to the petrol at this site. Lead is added at another site at a later date. For this reason Tendring District Council concludes that further review and assessment is not necessary**.**

With respect to Suffolk Coastal District Council, the above findings mean that **further review and assessment will not be necessary.**

3.5 Conclusion

This Second Stage Review and Assessment has identified that for Carless Refining and Marketing Limited at Parkeston, Harwich, Essex the risk of the air quality objectives being exceeded at relevant locations in the Suffolk Coastal District is considered negligible and, therefore, **further review and assessment will not be necessary.**

Suffolk Coastal District Council concludes that further review and assessment of lead will not be necessary.

4. Review and Assessment of Carbon Monoxide

4.1 Background

Carbon monoxide (CO) is a colourless, odourless gas formed during the incomplete combustion of fossil fuels and organic materials. In the outdoor environment the main source of CO is from road transport, which increases near to busy and congested roads.

Carbon monoxide combines with haemoglobin in the blood more readily than oxygen and therefore reduces the blood's capacity to carry oxygen to the brain. Exposure to high levels can lead to tiredness, unconsciousness, brain damage and even death. Exposure to lower levels can cause diseases of the coronary arteries.

4.2 Standards and Objectives

The Revised Air Quality Strategy for England, Scotland, Wales and Northern Ireland (DETR 1999, 2000), published in January 2000, retains the national air quality standard for CO as an 8-hour running mean of 11.6 mg/m^3 (10 ppm). However, the target date for this objective has been brought forward to 31 December 2003.

The Government has recently agreed further reductions in vehicle emissions as part of the Auto-Oil programme. These are expected to deliver the revised air quality objective by the end of 2003, even at roadside locations. Only those local authorities with certain stationary sources in their area with the potential to cause elevated levels of CO in relevant locations are expected to need to proceed beyond the First Stage Review and Assessment.

4.3 Review of CO in respect of the Revised Air Quality Strategy 2000

Revision of the target date by which the objective is to be achieved, from 2005 to 2003, has not altered the findings of the Suffolk Coastal First Stage Review and Assessment Report. This is because date-related factors had no bearing on determining whether sources required further review and assessment.

4.4 Review and Assessment of CO

In Suffolk Coastal's First Stage Review and Assessment Report the following sources of CO were identified as warranting further investigation in a Second Stage review and assessment:

- British Sugar plc, Sproughton Road, Ipswich, Suffolk;
- Ipswich Hospital, Heath Road, Ipswich, Suffolk;
- A segment of the A14 trunk road within the Suffolk Coastal District from the junction with the A12 to beyond the Orwell Bridge.

4.4.1 Review and assessment of British Sugar Plc, Sproughton Road, Ipswich, Suffolk

British Sugar Plc is within the Babergh District and was highlighted at Stage 1 as a potentially significant source of CO requiring further investigation. As the factory is approximately 6 km from the Suffolk Coastal boundary it is relevant for inclusion in our Second Stage Review and Assessment.

British Sugar Plc. operates a process for the manufacture of sugar from sugar beet. For the review and assessment of CO the Combustion and Sulphitation plants at the factory are potentially significant sources. The Combustion plant consists of two large coal-fired boilers which produce steam for power generation used throughout the factory. CO is produced from incomplete combustion of the coal used in this process. The Sulphitation plant consists of an enclosed stove used to burn solid sulphur to produce sulphur dioxide used in the sugar production process. CO is produced from incomplete combustion during this process.

Babergh District Council has used the Environment Agency methodology (GN24) to model emissions of CO from British Sugar Plc (see Appendix A for model details). The model was used to estimate the maximum 8-hour ground level concentration of CO from each process at British Sugar, and the distance from each stack that this maximum concentration could occur. A summary of the results can be seen in Table 2 below. (A fuller table of results and input figures can be seen in Appendix D).

Table 2 Modelled maximum 8-hour CO contribution from the Combustion and Sulphitation Plants at British Sugar Plc

	Maximum 8-hour CO concentration (mg/m^3)	Distance from stack to the maximum CO concentration (m)
Combustion Plant	0.003378	1050
Sulphitation Plant	0.000092	100 (estimated)

Babergh District Council conclude that, in the worst case scenario assuming maximum output from each process and estimated annual mean background CO levels ($0.1715mg/m^3$), the air quality objective is not exceeded and, therefore, further review and assessment of this emission source is not necessary.

With respect to Suffolk Coastal District Council, the results of the above modelling considered together with the 6 km distance of the factory from the Suffolk Coastal boundary mean that any emissions reaching Suffolk Coastal will be negligible and **further review and assessment will not be necessary.**

4.4.2 Review and assessment of Ipswich Hospital, Heath Road, Ipswich, Suffolk

Ipswich Hospital is within the Ipswich Borough and was highlighted at Stage 1 as a potentially significant source of CO requiring further investigation. As the hospital is approximately 0.5 km from the Suffolk Coastal boundary, it is relevant for inclusion in our Second Stage Review and Assessment.

Ipswich Hospital operates an incinerator for clinical waste on site. CO is produced from incomplete combustion of materials incinerated.

Ipswich Borough Council has undertaken a number of further investigations into emissions from the Ipswich Hospital incinerator, using methodology from LAQM.TG4(00) and dispersion modelling. Ipswich Borough has used the Atmospheric Dispersion Modelling System-Screen (ADMS-Screen) to estimate the maximum 1-hour mean, and peak annual average concentration of CO from the incinerator and the distance from the stack that these maximum concentrations could occur. A summary of the results can be seen in Tables 3 and 4 below. (A fuller table of results and input figures can be seen in Appendix E)

Table 3 Modelled maximum 1-hour CO contribution from the Ipswich Hospital Incinerator

Maximum 1-hour mean CO concentration (mg/m^3)	Distance downwind from source (m)
0.000588	82

Table 4 Modelled peak annual average CO contribution from the Ipswich Hospital Incinerator

Peak annual average CO concentration (mg/m^3)	Conversion of peak annual average CO concentration to 8-hour mean CO concentration (x 10) (mg/m^3)	Distance of peak from source (m)
0.00002	0.0002	288

Ipswich Borough has used the maximum 1-hour mean as an equivalent of the 8-hour mean. The 1-hour mean is more stringent than the 8-hour mean and therefore, can be used as the worst case scenario. LAQM.TG4(00) advises that the annual mean can be multiplied by 10 to give an idea of the 8-hour mean.

The results from the ADMS-Screen modelling for the maximum 1-hour mean CO concentration give the maximum distance that these concentrations could occur as 82m from the incinerator and for the peak annual average CO concentration a maximum distance of 288m from the incinerator. The nearest relevant receptor locations to the incinerator within the Suffolk Coastal District are approximately 500m away. Despite the fact that the model predicts that emissions will not reach the Suffolk Coastal District, the small margin of error involved suggests that it would be prudent to assume that they do. As such, the emission data will be added to the Suffolk Coastal background data, as follows.

LAQM TG4(00) identifies that the 8-hour mean CO concentration from stack emissions should be added to the estimated annual mean background CO levels for 2003. Annual mean background levels have been estimated by the National Environmental Technology

Centre for the United Kingdom and can be accessed on the internet within the National Air Quality Archive.

The highest estimated annual mean background level for the Suffolk Coastal – Ipswich Borough boundary at Rushmere St Andrew is 0.3 mg/m^3. The maximum 8-hour mean CO concentration from the incinerator is calculated as 0.000588 mg/m^3 from the 1-hour concentration, and 0.0002 mg/m^3 from the annual mean concentration. Taking the 1-hour concentration as the highest calculated emission concentration the total 8-hour mean CO concentration for receptors is:

$$0.3\ mg/m^3 + 0.000588\ mg/m^3 = 0.300588\ mg/m^3$$

This level is lower than the 8-hour mean objective of 11.6 mg/m^3 and, therefore, further review and assessment will not be necessary.

With respect to Suffolk Coastal District Council, the results of the above modelling and calculations, together with the 0.5 km distance of the incinerator from the Suffolk Coastal boundary mean that **further review and assessment will not be necessary.**

4.4.3 Review and assessment of a segment of the A14 Trunk Road from the junction with the A12 to beyond the Orwell Bridge.

This section of the A14 was highlighted at Stage 1 as requiring further investigation because the Annual Average Daily Traffic Flow (AADTF) was predicted to exceed 50,000 vehicles in 2005. This was in accordance with the original Pollutant Specific Guidance LAQM.TG4(98). However, since the completion of Suffolk Coastal's First Stage Report the guidance has now been revised by the DETR, and LAQM.TG4(00) states that it will only be necessary to proceed to the Second Stage in the following circumstances:

- For single carriageway roads, where AADTF exceeds 80,000 vehicles per day;
- For dual carriageways, where the AADTF exceeds 120,000 vehicles per day;
- In cases where two or more roads intersect, for example, at a junction where the traffic flows from each road should be added to give a combined total for assessment against the above criteria.

The above criteria apply to the revised air quality objective target date for CO of 31 December 2003.

Current and projected traffic flows on dual carriageways and major single carriageway roads in Suffolk Coastal are shown in Table 5 below. It can be seen that there are no single carriageway roads with a projected AADTF of greater than 80,000 for 2003, and likewise there are no segments of dual carriageway with a projected AADTF greater than 120,000 vehicles for 2003.

The A12, A14 and A1156 intersect at the Nacton roundabout. Using the "worst case" figures from Table 5 for this junction, the combined flow in 2003 is projected to be 102,192 vehicles per day. This figure is still lower than the 120,000 vehicles per day threshold for progression to Stage 2. **Therefore, further review and assessment will not be necessary**.

Table 5 Annual Average Daily Traffic Flows (AADTF) on dual carriageways and major single carriageway roads in the Suffolk Coastal District
(information provided by Suffolk County Council Environment and Transport Department, fuller details in Appendix B)

Section of Road	AADTF (Vehicles/Day) YEAR 2000	AADTF (Vehicles/Day) YEAR 2003
A14 from Dock Spur roundabout, Felixstowe to the A12 junction (dual carriageway)	30,466	31,968
A14 from the A12 junction to beyond the Orwell Bridge (dual carriageway)	47,141	49,944
A12 from A14 junction to the B1438 Woodbridge roundabout (dual carriageway)	27,430	28,776
A12 from B1438 Woodbridge roundabout to the B1116 junction at Wickham Market (single and dual carriageway)	24,509	25,704
A12 from B1116 junction at Wickham Market to A1094 turn-off to Snape (single carriageway)	15,149	15,888
A1156 from the A12/A14 junction to the Ipswich Borough boundary (single carriageway)	22,386	23,472
A1214 from the A12 junction to the first Grange Farm roundabout (single carriageway)	21,239	21,816
A1214 from the first Grange Farm roundabout to the Ipswich borough boundary at Rushmere.	27,624	28,368

4.5 Conclusion

This Second Stage Review and Assessment has indicated that for each of the following CO emission sources investigated, the risk of the air quality objectives being exceeded at relevant locations in the Suffolk Coastal District is negligible and, therefore, **further review and assessment will not be necessary;**

- British Sugar plc, Sproughton, Ipswich, Suffolk;

- Ipswich Hospital, Heath Road, Ipswich, Suffolk;
- Traffic using the A14 trunk road.

Suffolk Coastal District Council concludes that further review and assessment of CO will not be necessary.

5. Review and Assessment of Nitrogen Dioxide

5.1 Background

Nitrogen Dioxide (NO_2) is a gas produced by the reaction of Nitrogen and Oxygen in combustion processes in air. Nitrogen Oxide (NO) is formed initially and this is subsequently oxidised to form NO_2. In the atmosphere NO and NO_2 are always found together and are collectively known as Oxides of Nitrogen (NO_x). The largest source is human combustion of fossil fuels, i.e. - petrol, oil, coal and gas.

NO_2 is an irritant known to have serious effects, such as severe lung damage if inhaled at high concentrations and sometimes death. NO_2 has also been demonstrated to have effects at lower levels found in the environment, it is a respiratory irritant, can exacerbate asthma and may increase susceptibility to infections.

5.2 Standards and Objectives

The National Air Quality Regulations 1997 set two provisional objectives for NO_2 to be achieved by 31 December 2005:

- An annual mean concentration of 40 $\mu g/m^3$ (21 ppb);
- A maximum 1-hour mean concentration of 286 $\mu g/m^3$ (150 ppb).

The Revised Air Quality Strategy for England, Scotland, Wales and Northern Ireland (DETR 1999; 2000) includes changes to the maximum 1-hour concentration. These changes were based on limit values set in the Air Quality Daughter Directive which was agreed at Environment Council in June 1998 and both objectives are to be achieved by 31 December 2005:

- An annual mean concentration of 40 $\mu g/m^3$ (21 ppb)
- A 1-hour mean concentration of 200 $\mu g/m^3$ (100 ppb) with a maximum of 18 exceedances in a year (approximately equivalent to the 99.8^{th} percentile of hourly means).

The Government has recently agreed further reductions in industrial emissions as part of the EC Combustion Plant Directive and The National Emissions Ceiling Directive. More stringent control of vehicle emissions is also expected as part of the Auto-Oil programme. These will all serve to further reduce NO_x emissions by 2005. National studies have indicated that the annual mean objective is expected to be met at all urban background locations outside of London, but that the objective may be exceeded more widely at roadside sites near busy road links. LAQM TG4(00) suggests that, in general, only those local authorities with relevant locations in close proximity to busy roads are expected to proceed beyond the Second Stage Review and Assessment, although there are some areas with potentially significant industrial sources which will also need to be considered further.

5.3 Review of NO_2 in respect of the Revised Air Quality Strategy 2000

The new 1-hour objective is slightly more stringent than the original. Government-funded modelling studies suggest that, in general, achieving the annual mean concentration is more demanding than achieving the 1-hour mean. If the annual mean is achieved, the modelling suggests that the 1-hour objective will also be achieved.

Revision of the 1-hour air quality objective has not altered the findings of the Suffolk Coastal First Stage Review and Assessment Report. The full impact of the 1-hour objective did not require detailed examination at Stage 1 as only a rudimentary screening exercise was required.

5.4 Review and Assessment of NO_2

In Suffolk Coastal's First Stage Review and Assessment Report the following sources of NO_2 were identified as warranting further investigation in a Second Stage Review and Assessment:

- Carless Refining and Marketing Limited, Parkeston, Harwich, Essex;
- British Sugar Plc, Sproughton, Ipswich, Suffolk;
- Ipswich Hospital, Heath Road, Ipswich, Suffolk;
- Five segments of road within the Suffolk Coastal District with a projected Annual Average Daily Traffic Flow (AADTF) of greater than 20,000 vehicles by 31 December 2005:
    - The A14 trunk road from Dock Spur roundabout at Felixstowe to the Ipswich Borough boundary at the Orwell Bridge;
    - The A1156 from the A12/A14 junction at Nacton to the Ipswich Borough boundary at Purdis Farm;
    - The A12 trunk road from the A14 junction at Nacton through to the Woods Lane (A1152) roundabout at Woodbridge;
    - The A1214 from the A12 junction at Martlesham Heath to the Ipswich Borough boundary at Rushmere St Andrew;
    - The A12 trunk road from the Woods Lane (A1152) roundabout, Woodbridge to the A1094 turn-off to Snape and Aldeburgh at Farnham.

Due to additional information from Stage 1 consultations and continued monitoring data, Suffolk Coastal District Council has decided to include in this Second Stage review and assessment two additional sources of NO_2 which warrant further investigation:

- Traffic on the A1152 from the Woods Lane roundabout, Woodbridge to the former RAF Bentwaters roundabout at Rendlesham, including specifically the crossroads at Melton where the A1152 and B1438 intersect. These segments of road have been reviewed due to concerns about increased future traffic flows from the planned development of the former RAF Bentwaters air-base at Rendlesham and the St Audry's development at Melton, and decreased traffic speeds seen particularly at the Melton crossroads;
- Emissions from traffic monitored at several kerbside and background locations within the Suffolk Coastal District using NO_2 diffusion tubes.

5.4.1 Review and assessment of Carless Refining & Marketing Limited, Parkeston, Harwich, Essex

Carless Refining and Marketing Limited is within the Tendring District and was highlighted at Stage 1 as a potentially significant source of NO_2 requiring further investigation. As the factory is approximately 4 km from the Suffolk Coastal boundary, it is relevant for inclusion in our Second Stage Review and Assessment.

The refinery produces white spirit and kerosene via distillation of condensed North Sea gas. The condensate, or naphthalene, processed at the site leaves gas and liquid residues which are occasionally used as fuel in three Beverley hot oil thermal units and four boilers. These provide process heat for the site and distillation units. NO_2 will be produced from these thermal processes as a combustion product.

Tendring District Council has used the UK-ADMS dispersion model (version 3) to model emissions of NO_2 from Carless Refining and Marketing Ltd. The model was used to estimate the maximum 1-hour ground level concentration of NO_2 from the processes at two nearby sites, 250m and 500m from the refinery. A summary of the results can be seen in Table 6 below (a fuller table of results and input figures can be seen in Appendix F).

Table 6 Modelled maximum 1-hour ground level NO_2 contribution from Carless Refining and Marketing Limited

Location	Maximum 1-hour mean NO_2 concentration ($\mu g/m^3$)
250m from Source	14.13
500m from Source	7.26

Tendring District Council concludes from the above modelled concentrations that any impact from the refinery will be limited, and further review and assessment is only necessary in considering any combined impact of emissions from roads, shipping and the refinery in the **immediate vicinity** of the plant.

With respect to Suffolk Coastal, the results of the above modelling, together with the 4km distance of the refinery from the Suffolk Coastal boundary mean that any emissions reaching Suffolk Coastal will be negligible and **further review and assessment will not be necessary.**

5.4.2 Review and Assessment of British Sugar Plc, Sproughton, Ipswich

British Sugar Plc is within the Babergh District and was highlighted at Stage 1 as a potentially significant source of NO_2 requiring further investigation. As the factory is approximately 6 km from the Suffolk Coastal boundary it is relevant for inclusion in our Second Stage Review and Assessment.

British Sugar Plc operates a process for the manufacture of sugar from sugar beet. For the review and assessment of NO_2 the Combustion and Sulphitation Plants at the factory are potentially significant sources. The Combustion Plant consists of two large coal fired boilers which produce steam for power generation used throughout the factory. The Sulphitation Plant consists of an enclosed stove used to burn solid sulphur to produce SO_2. This is then added to sugar juice from the crushed beet to inhibit colour forming reactions which would take place during subsequent processing. NO_2 will be produced from both of these processes as a combustion product.

Babergh District Council has used the Environment Agency methodology (GN24) to model emissions of NO_2 from British Sugar Plc (see Appendix A for model details). The model was used to estimate the maximum annual mean ground level concentration of NO_x from the two processes at British Sugar and the distance from each stack that the maximum concentration could occur. A summary of the results can be seen in Table 7 below (a fuller table of results and input figures can be seen in Appendix D).

Due to the complexity of Babergh District Council's investigations into NO_2 emissions from, and regarding, British Sugar plc, a complete copy of the relevant section of the Second Stage Review and Assessment Report can be seen in Appendix D.

Table 7 Modelled maximum annual average and 99.8th percentile of 1-hour mean NO_x contribution from Combustion and Sulphitation Plants at British Sugar Plc

	Maximum annual mean NO_x concentration ($\mu g/m^3$)	Distance from Stack to the maximum NO_x concentration (m)	Maximum 99.8th percentile of 1-hour mean NO_x concentration ($\mu g/m^3$)	Distance from stack to the maximum NO_x concentration (m)
Combustion Plant	1.9448	513	32.98152	464
Sulphitation Plant	0.00864	100 (estimated)	0.2511	50 (estimated)

Babergh District Council concludes that, in the worst case scenario, assuming maximum output from each process and estimated local background levels (see calculations from the report in Appendix D), British Sugar plc as a source in isolation would not require further review and assessment.

Due to the close proximity of British Sugar plc to the A14 trunk road, Babergh District Council has undertaken investigations into the combined emission concentrations from the two sources. These investigations can be seen from the report copied in Appendix D. Babergh District Council concludes that no further review and assessment of these combined sources is required.

With respect to Suffolk Coastal District Council, the results of the above modelling, together with the 6 km distance of the factory from the Suffolk Coastal boundary, mean that any emissions reaching Suffolk Coastal District will be negligible and **further review and assessment will not be necessary.**

5.4.3 Review and Assessment of Ipswich Hospital, Heath Road, Ipswich

Ipswich Hospital is within the Ipswich Borough and was highlighted at Stage 1 as a potentially significant source of NO_2 requiring further investigation. As the hospital is only 0.5 km from the Suffolk Coastal boundary, it is relevant for inclusion in our Second Stage Review and Assessment.

Ipswich Hospital operates an incinerator for clinical waste on site. NO_2 is produced as a combustion product of materials incinerated.

Ipswich Borough Council has undertaken a number of further investigations into emissions from the Ipswich Hospital incinerator, using methodology from LAQM.TG4(00) and dispersion modelling. Ipswich Borough has used the Atmospheric Dispersion Modelling System-Screen (ADMS-Screen) to estimate the maximum 1-hour mean and peak annual average concentrations of NO_x from the incinerator and the distance from the stack that these maximum concentrations could occur. A summary of the results can be seen in Table 8 below (a fuller table of results and input figures can be seen in Appendix E).

Table 8 Modelled maximum 1-hour peak and annual average NO_x contribution from the Ipswich Hospital Incinerator

Maximum 1-hour mean NO_x concentration ($\mu g/m^3$)	Distance downwind from source (m)	Peak Annual Average NO_x concentration ($\mu g/m^3$)	Distance of Peak from Source (m)
10.33	82	0.34	288

The results from the ADMS-Screen modelling, shown in Table 8, for the maximum 1-hour mean NO_x concentration give the maximum distance that these concentrations could occur as 82m from the incinerator and, for the peak annual average NO_x concentration, a maximum distance of 288m from the incinerator. The nearest relevant receptor locations to the incinerator within the Suffolk Coastal District are approximately 500m away. Despite the fact that the model predicts that emissions will not reach the Suffolk Coastal District, the small margin of error involved suggests that it would be prudent to assume that they do. As such, the emission data will be added to the Suffolk Coastal background data, as follows.

LAQM.TG4(00) states that emissions from the incinerator will be in addition to the local background concentration in 2005. Annual mean background levels have been estimated by NETCEN for the United Kingdom and can be accessed on the internet in the form of an interactive map within the National Air Quality Archive.

Regarding the **annual average** NO_2 concentration, LAQM TG4(00) identifies that predicted NO_x emissions from the stack should be added to the estimated annual mean background levels of NO_x for 2005. The highest estimated annual mean background level for this area of Suffolk Coastal is 19.4 $\mu g/m^3$. The peak annual average NO_x concentration from the stack is 0.34 $\mu g/m^3$, see Table 8. Therefore, the total annual average NO_x concentration at receptor locations will be:

$$0.34\ \mu g/m^3 + 19.4\ \mu g/m^3 = 19.74\ \mu g/m^3\ NO_x$$

This annual mean NO_x level needs can then be converted to annual mean NO_2 using the following empirical relationship, as specified in LAQM.TG4(00):

$y = 1.5358 \times \chi^{0.7341}$
where y = annual mean NO_2 in $\mu g/m^3$
and χ = annual mean NO_x in $\mu g/m^3$

Therefore, the annual mean NO_2 concentration $= 1.5358 \times 19.74^{0.7341}$
$= \mathbf{13.72\ \mu g/m^3}$

This level is lower than the annual mean NO_2 objective of 40 $\mu g/m^3$ and, therefore, further review and assessment will not be necessary.

Regarding the **99.8th percentile of 1-hour mean** NO_2 concentration, LAQM.TG4(00) recommends that the assumption is made that all NO_x emissions from the stack are converted to NO_2. The following approach is then suggested in order to make an assessment, taking account of background concentrations:-

i. Derive the total oxidant concentration ($NO_2 + O_3$) at the nearest automatic monitoring station; this is because the highest concentrations of NO_2 from industry are expected when NO_x concentrations at the ground are elevated at the same time as oxidant concentrations, especially ozone (O_3).
   The nearest automatic monitoring station derived from LAQM.TG4(00) is Norwich City Centre and the 99.8th percentile of total oxidant concentrations was 129 $\mu g/m^3$ in 1998.

ii. If the predicted 99.8th percentile from the stack is less than the 99.8th percentile of $NO_2 + O_3$ then the NO_2 concentration can be assumed to equal the 99.8th percentile from the stack plus twice the annual mean background NO_2 concentration in 2005:
   The predicted 99.8th percentile from the stack (10.33 $\mu g/m^3$) is less than the 99.8th percentile of $NO_2 + O_3$ (129 $\mu g/m^3$) and the estimated annual mean background NO_2 concentration in 2005 is 16.2 $\mu g/m^3$.

   NO_2 concentration $= 10.33\ \mu g/m^3 + (2 \times 16.2\ \mu g/m^3)$
   $= 42.73\ \mu g/m^3$

This level is lower than the 1-hour mean objective of 200 $\mu g/m^3$ and, therefore, further review and assessment will not be necessary.

With respect to Suffolk Coastal District Council, the results of the above modelling and calculations, together with the 0.5 km distance of the incinerator from the Suffolk Coastal boundary mean that **further review and assessment will not be necessary.**

5.4.4 Review and assessment of emissions from traffic on the A14, A1156, A12 and A1214 roads

The following segments of road within the Suffolk Coastal District were highlighted at Stage 1 as requiring further investigation because the Annual Average Daily Traffic Flow (AADTF) on each was predicted to exceed 20,000 vehicles in 2005:

- The A14 trunk road from the Dock Spur roundabout at Felixstowe to the Ipswich Borough boundary at the Orwell Bridge;

- The A1156 from the A12/A14 junction at Nacton to the Ipswich Borough boundary at Purdis Farm;

- The A12 trunk road from the A14 junction at Nacton through to the Woods Lane (A1152) roundabout at Woodbridge;

- The A1214 from the A12 junction at Martlesham Heath to the Ipswich Borough boundary at Rushmere St Andrew;

- The A12 trunk road from the Woods Lane (A1152) roundabout at Woodbridge through to the A1094 turn-off to Snape and Aldeburgh at Farnham.

Estimates of the annual mean NO_2 contribution from the roads at the end of 2005 were calculated using Stanger's DMRB spreadsheet model (see section 2.1 in chapter 2 for model details). The spreadsheet is designed to produce an estimate of the total annual mean NO_2 concentration at the specified location. This consists of the estimated annual mean background NO_x level (derived from the National Air Quality Archive) plus the contribution of annual mean NO_x from the road traffic. These levels of NO_x are then automatically calculated into annual mean NO_2 levels by the spreadsheet.

Predicted traffic data for 2005 was obtained from Suffolk County Council, Environment and Transport Department, for each road and can be seen in Appendix B. Each road was split into segments dependent on alterations in traffic flow, vehicle speed, HGV percentage and major intersections. The nearest relevant receptor locations were identified for each road segment (as defined in chapter 2) and data entered into the spreadsheet.

A summary of results for each road can be seen from Tables 9 to 12, input data is summarised in Appendix B. (It should be noted that the spreadsheet model calculates the annual mean NO_2 concentration directly based on the relationship between NO_2 and NO_x at different locations from the kerbside).

The results from the DMRB spreadsheet in Tables 9 to 12 were compared to the relevant air quality objectives for NO_2 as specified in Table 1 in the first chapter. For receptors close to the façade of a building, the relevant objective is the annual mean of 40 ug/m^3. For receptors in outdoor locations where short-term exposures are likely, the relevant objective is the 1-hour mean of 200 ug/m^3 , not to be exceeded more than 18 times per year.

In accordance with the guidance in LAQM.TG4(00), it may be assumed, as a worst case scenario, that the 99.8th percentile of 1-hour mean NO_2 concentrations will not exceed five times the predicted annual mean at background sites (those beyond 30m from the kerbside), and 3.5 times the predicted annual mean at roadside/kerbside sites (those within 30m of the kerbside). These calculations for each receptor location can also be seen in Tables 9 to 12.

Table 9 A14 – Projected annual mean and 1-hour NO_2 concentrations for 2005 derived from DMRB

Road segment reference (refer to Appendix B for traffic data for each 'link' of road)	Receptor reference	Receptor description (distance to receptor from centre of road)	DMRB Annual mean NO_2 calculation (estimated background level # + traffic contribution) ($\mu g/m^3$)	Conversion to 99.8th percentile of 1-hour mean NO_2 using x3.5 (kerbside) and x5 (background) multiplications of annual mean from LAQM.TG4(00) ($\mu g/m^3$)	Progression to Stage 3 **YES/NO**
A14 (Link 1) from Dock Spur roundabout, Felixstowe to the Trimley junction	Site 1	Façade of nearest garden, Trimley (23m)	53	186 (x3.5)	**YES**
A14 (Link 1) from Dock Spur roundabout, Felixstowe to the Trimley junction	Site 2	Façade of nearest house, Trimley (34m)	46	160 (x3.5)	**YES**
A14 (Link 1) at Dock Spur roundabout (due to decreased traffic speeds of 30mph at roundabout)	Site 3	Façade of nearest garden, Felixstowe (24m)	55	191 (x3.5)	**YES**
A14 (Link 1) at Dock Spur roundabout (due to decreased traffic speeds of 30 mph at roundabout)	Site 4	Façade of nearest house, Felixstowe (38m)	43	213 (x5)	**YES**
A14 (Link 1) from Trimley junction to the A12 junction (calculations taken for Trimley)	Site 5	Façade of nearest garden, Trimley (18m)	55	191 (x3.5)	**YES**
A14 (Link 1) from Trimley junction to the A12 junction (calculations taken for Trimley)	Site 6	Façade of nearest house, Trimley (29m)	50	173 (x3.5)	**YES**
A14 (Link 1) from Trimley junction to the A12 junction (calculations taken for Levington)	Site 7	Façade of nearest garden, Levington (173m)	15	76 (x5)	**NO**
A14 (Link 1) from Trimley junction to the A12 junction (calculations taken for Levington)	Site 8	Façade of nearest farm building, Levington (39m)	41	203 (x5)	**YES**
A14 (Link 2) from A12 junction to beyond the Orwell Bridge	Site 9	Façade of nearest garden, Nacton (55m)	40	200 (x5)	**NO**
A14 (Link 2) from A12 junction to beyond the Orwell Bridge	Site 10	Façade of nearest house, Nacton (78m)	33	166 (x5)	**NO**
A14 (Link 2) & A1156 (Link 1) where the two roads run parallel at Nacton (property nearest A14)	Site 11	Façade of nearest garden, Nacton (55m to A14, 14m to A1156)	50	252 (x5)	**YES**
A14 (Link 2) & A1156 (Link 1) where the two roads run parallel at Nacton (property nearest A14)	Site 12	Façade of nearest house, Nacton (115m to A14, 37m to A1156)	32	159 (x5)	**YES**
A14 (Link 2) & A1156 (Link 1) where the two roads run parallel at Nacton (property nearest A1156)	Site 13	Façade of nearest garden, Nacton (18m to A1156, 186m to A14)	31	156 (x5)	**NO**
A14 (Link 2), A12 (Link 1) & A1156 (Link 1) roundabout where the three roads meet at Nacton	Site 14	Façade of nearest garden, Nacton (88m to A14, 187m to A1156, 335m to A12)	31	154 (x5)	**NO**

taken from the National Air Quality Archive

Table 10 A1156 – Projected annual mean and 1-hour mean NO_2 concentrations for 2005 derived from DMRB

Road segment reference (refer to Appendix B for traffic data for each 'link' of road)	Receptor reference	Receptor description (distance to receptor from centre of road)	DMRB Annual mean NO_2 calculation (estimated background level # + traffic contribution) ($\mu g/m^3$)	Conversion to 99.8th percentile of 1-hour mean NO_2 using x3.5 (kerbside) and x5 (background) multiplications of annual mean from LAQM.TG4(00) ($\mu g/m^3$)	Progression to Stage 3 **YES/NO**
A1156 (Link 1) from A12 junction at Nacton to Ipswich Borough boundary at Purdis Farm	Site 15	Façade of nearest garden, Purdis Farm (13m)	32	113 (x3.5)	**NO**
A1156 (Link 1) A12 junction at Nacton to Ipswich Borough boundary at Purdis Farm (due to decreased traffic speeds of 20 mph at roundabouts)	Site 16	Façade of nearest garden, Purdis Farm (30m)	28	98 (x3.5)	**NO**

Table 11 A1214 – Projected annual mean and 1-hour mean NO_2 concentrations for 2005 derived from DMRB

Road segment reference (refer to Appendix B for traffic data for each 'link' of road)	Receptor reference	Receptor description (distance to receptor from centre of road)	DMRB Annual mean NO_2 calculation (estimated background level + traffic contribution) ($\mu g/m^3$)	Conversion to 99.8th percentile of 1-hour mean NO_2 using x3.5 (kerbside) and x5 (background) multiplications of annual mean from LAQM.TG4(00) ($\mu g/m^3$)	Progression to Stage 3 **YES/NO**
A1214 (Link 1) from A12 junction at Martlesham Heath to the first Grange Farm roundabout at Kesgrave	Site 17	Façade of nearest garden, Kesgrave (5.8m)	29	103 (x3.5)	**NO**
A1214 (Link 1) from A12 junction at Martlesham Heath to the first Grange Farm roundabout at Kesgrave (due to decreased traffic speeds of 15 mph at roundabouts)	Site 18	Façade of nearest garden, Kesgrave (5.8m)	33	114 (x3.5)	**NO**
A1214 (Link 2) from the first Grange Farm roundabout at Kesgrave to Ipswich Borough boundary at Rushmere St Andrew	Site 19	Façade of nearest garden, Kesgrave (5.8m)	32	113 (x3.5)	**NO**
A1214 (Link 2) from the first Grange Farm roundabout at Kesgrave to Ipswich Borough boundary at Rushmere St Andrew due to decreased traffic speeds of 15 mph at roundabouts)	Site 20	Façade of nearest garden, Kesgrave (5.8m)	36	127 (x3.5)	**NO**

taken from the National Air Quality Archive

Table 12 A12 - Projected annual mean and 1-hour mean NO_2 concentrations for 2005 derived from DMRB

Road segment reference (refer to Appendix B for traffic data for each 'link' of road)	Receptor reference	Receptor description (distance to receptor from centre of road)	DMRB Annual mean NO_2 calculation (estimated background level # + traffic contribution) ($\mu g/m^3$)	Conversion to 99.8th percentile of 1-hour mean NO_2 using x3.5 (kerbside) and x5 (background) multiplications of annual mean from LAQM.TG4(00) ($\mu g/m^3$)	Progression to Stage 3 **YES/NO**
A12 (Link 1) from A14 junction, Nacton to B1438 Woodbridge roundabout (using average speed)	Site 21	Façade of nearest garden, Martlesham Heath (12m)	38	132 (x3.5)	**NO**
A12 (Link 1) from A14 junction, Nacton to B1438 Woodbridge roundabout (due to decreased traffic speeds of 20mph at all roundabouts)	Site 22	Façade of nearest garden, Martlesham Heath (22m)	39	135 (x3.5)	**NO**
A12 (Link 2) B1438 Woodbridge roundabout to B1116 at Wickham Market	Site 23	Façade of nearest garden, Woodbridge (11m)	35	122 (x3.5)	**NO**
A12 (Link 2) B1438 Woodbridge roundabout to B1116 at Wickham Market (due to decreased traffic speeds of 20mph at roundabouts)	Site 24	Façade of nearest garden, Woodbridge (13m)	39	133 (x3.5)	**NO**
A12 (Link 3) B1116 junction at Wickham Market to A1094 junction at Farnham (average speed 50mph)	Site 25	Façade of nearest garden, Marlesford (6.5m)	29	102 (x3.5)	**NO**
A12 (Link 3) B1116 junction at Wickham Market to A1094 junction at Farnham (due to decreased speed limit of 40mph)	Site 26	Façade of nearest garden, Stratford St Andrew (6.8m)	27	100 (x3.5)	**NO**
A12 (Link 3) B1116 junction at Wickham Market to A1094 junction at Farnham (due to decreased speed limit of 30mph)	Site 27	Façade of nearest garden, Farnham (3.7m)	37	128 (x3.5)	**NO**

taken from the National Air Quality Archive

Guidance in LAQM.TG4(00) advises that where there is an exceedance of the annual mean NO_2 objective, there will also be a risk that the 1-hour mean NO_2 objective will be exceeded and, in such scenarios, the local authority should proceed to a Third Stage review and assessment for both objectives.

The predictions in Tables 10 to 12 show that the annual mean NO_2 objective of 40 $\mu g/m^3$ is not likely to be exceeded at any of the nearest receptor locations on the A1156, A1214 and A12 roads at the end of 2004. **Therefore, regarding traffic emissions from the A1156, A1214 and A12, further review and assessment will not be necessary.**

The predictions in Table 9 show that the annual mean NO_2 objective of 40 $\mu g/m^3$ is likely to be exceeded at several receptor locations along the A14 trunk road at the end of 2004. **Therefore, regarding traffic emissions from the A14, further review and assessment at the Third Stage will be necessary.**

5.4.5 Review and assessment of traffic using the A1152, including specifically the crossroads at Melton where the A1152 & B1438 intersect

Concerns have been raised from the consultation process to date regarding emissions from traffic using the A1152 and, specifically, the Melton crossroads where the A1152 & B1438 intersect. These concerns are regarding increased future traffic flows using the A1152 and the Melton crossroads due to the planned development of the former RAF Bentwaters air-base at Rendlesham and the St Audry's development at Melton.

Planned development of the former RAF Bentwaters air-base includes the building of housing and related village centre activities, together with new miscellaneous commercial buildings, and the letting of the existing Mission Support building for commercial activities. To date, the Mission Support building, which would account for a substantial percentage of the increased traffic, has not been let. The housing is predicted to be available for occupancy in 2002 and associated village activities are unlikely to be viable until this is underway.

The planned St Audry's development at Melton is predominantly residential and includes sports and social activities associated with this use. There are also a small number of commercial buildings planned for the site.

Taking the above into consideration, which is highly dependant on market forces, Suffolk Coastal is unable at this time to realistically estimate annual average daily traffic flows for the end of the year 2005. The Suffolk County Council Environment & Transport Department has been able to provide traffic counts taken several years ago for points along the A1152 and the for B1438 at Melton; however, in order to run the DMRB model to estimate future traffic emissions, traffic predictions for the year 2005 are needed. It is currently our aim to carry out further review and assessment of these road segments.

Suffolk Coastal District Council has been monitoring NO_2 levels at the Melton crossroads using diffusion tubes since December 1999. There is one kerbside site, actually at the crossroads itself, and one background site in a nearby residential area. The background site is in place to ascertain whether there are any other NO_2 sources in the area and, therefore, to enable us to attribute levels at Melton crossroads to traffic emissions.

Results of the monitoring to date can be seen from Appendix C, Table C-5. The current projected annual average NO_2 concentration at Melton crossroads is 42.59 $\mu g/m^3$ and at the background site in Hall Farm Road, the current projected annual average is 10.35 $\mu g/m^3$.

We have not, as yet, gained enough data to be able to directly use the annual mean figure in any calculations; however, it gives a guide as to the current NO_2 levels at the crossroads,

which are likely to be above the NO_2 annual mean objective of 40 $\mu g/m^3$. It must, however, be stated that the crossroads tube is currently sited on one of the central island crossings and not directly on a building or boundary façade and, therefore, indicates the "worst case" scenario.

This Second Stage Review and Assessment has indicated that continued investigation of both current and future predicted NO_2 levels from traffic using the A1152 and, in particular, at Melton crossroads, will be necessary. **Suffolk Coastal District Council concludes that further review and assessment of these emissions will be necessary. This will be in the form of continued Second Stage and, if necessary, Third Stage investigations. The outcome will either be included in our Third Stage Review and Assessment report or be issued for consultation and published separately.**

5.4.6 Review and assessment of emissions from traffic monitored at several kerbside and background locations within the Suffolk Coastal District using NO_2 diffusion tubes.

Suffolk Coastal's First Stage Review and Assessment Report was based on the pollutant specific guidance LAQM.TG4(98) which advised that, where actual NO_2 monitoring had been undertaken, only those locations with levels exceeding 30 ppb (57.3 $\mu g/m^3$) should be investigated further in a Second Stage Review and Assessment. None of Suffolk Coastal's monitoring sites exceeded these levels at the time of the First Stage Review and Assessment.

The current pollutant specific guidance, LAQM.TG4(00), has revised the advice of LAQM.TG4(98). This revision provides a framework to calculate predicted concentrations for years from 1996 to 2005 in order to project monitored data forward to the year 2005. There are separate calculations, for kerbside and background sites; these can be seen in Appendix C. The calculations have been designed to take into account planned Government measures to reduce NO_2 emissions.

Suffolk Coastal currently monitors NO_2 levels from road traffic via diffusion tubes at a number of sites in the towns of Felixstowe, Kesgrave, Woodbridge, Farnham and Melton and has previously undertaken monitoring in Leiston. Monitoring results can be seen in Appendix C, together with conversion of the annual average concentrations (currently in ppb) to $\mu g/m^3$ and calculations to project these levels forward to 2005.

Calculations in Appendix C show that some of the kerbside sites are above the current annual mean objective of 40 $\mu g/m^3$ when projected forward. A summary of the kerbside site data from 1996 can be seen in Table 13 below. We have included results for the year 2000 to date. The annual average is calculated for 2000 from only a six month data set and so may prove not to be representative.

The results from Table 13 show that of all sites monitored, three have predicted NO_2 concentrations above the annual mean objective by 2005. These are Felixstowe, Woodbridge and Melton. Concentrations at all sites have increased during 1999 and 2000 which could be due to a change in the analytical laboratory used. LAQM.TG4(00) states that laboratories in the United Kingdom have been shown to under or over-read diffusion tube concentrations by up to 30%, which may account for the variations in results between 1999 and 2000.

Projection of 1999 data for the kerbside site at High Road West, Felixstowe, indicates a marginal exceedance of the objective in 2005. Projection of the data gathered to date in 2000 for this site does not exceed the 2000 objective. To determine the importance of this, the Council will assess the full data set at the end of 2000. Should the complete data set indicate an exceedance of the 40 $\mu g/m^3$ objective in 2005, further investigation will be undertaken. This will be in the form of the DMRB model for the road in question.

Table 13 Summary table of the annual average NO_2 concentration, from diffusion tube monitoring data, for kerbside sites within Suffolk Coastal and projection of these concentrations forward to the year 2005 (full data set in Appendix C)

Monitoring site	1996		1997		1998		1999		2000	
	Monitored concentration ($\mu g/m^3$)	Projected concentration for 2005 ($\mu g/m^3$)	Monitored concentration ($\mu g/m^3$)	Projected concentration for 2005 ($\mu g/m^3$)	Monitored concentration ($\mu g/m^3$)	Projected concentration for 2005 ($\mu g/m^3$)	Monitored concentration ($\mu g/m^3$)	Projected concentration for 2005 ($\mu g/m^3$)	Monitored concentration ($\mu g/m^3$)	Projected concentration for 2005 ($\mu g/m^3$)
Felixstowe	47.56	37.57	14.72	22.90	35.37	29.73	47.06	**40.41**	44.89	38.55
Kesgrave	No data	No data	10.66	16.58	30.10	25.30	38.30	32.89	34.95	30.01
Woodbridge	No data	No data	11.88	18.48	25.88	21.75	47.85	**41.09**	53.90	**46.28**
Leiston	No data	No data	11.65	18.12	27.18	22.84	36.69	31.51	No data	No data
Farnham	No data	No data	No data	No data	No data	No data	No data	No data	41.68	35.79
Melton	No data	No data	No data	No data	No data	No data	No data	No data	49.60	**42.59**

Projection of 1999 and 2000 data for the kerbside site at the junction of Lime Kiln Quay Road, The Thoroughfare and St John's Street in Woodbridge, indicates an exceedance of the standard in 2005. This site is characterised by periods of standing traffic enclosed by buildings close to the kerbside at the junction. The Council has received a number of complaints and concerns regarding this junction. At the time of this Second Stage Review and Assessment, Suffolk County Council has been unable to provide traffic data for this junction. Consequently, it has not been possible to run the DMRB model. Further review and assessment of NO_2 at this junction will, therefore, be necessary.

Projection of 2000 data for the kerbside site at the junction of the A1152 and B1438, at Melton crossroads, indicates an exceedance of the objective in 2005. The monitored levels have been discussed in section 5.4.5 earlier in this chapter. The conclusions are that the site required further review and assessment.

The Second Stage Review and Assessment has indicated that continued investigation of kerbside monitoring sites at High Road West in Felixstowe, the Lime Kiln Quay Road/Thoroughfare/St John's Street junction in Woodbridge, and Melton crossroads will be necessary. This will be in the form of continued Second Stage and, if necessary, Third Stage investigations.

5.5 Conclusion

This Second Stage Review and Assessment has identified that, for the following NO_2 emission sources, the risk of the air quality objectives being exceeded at relevant locations in the Suffolk Coastal District is negligible and, therefore, **further review and assessment will not be necessary:**

- Carless Refining & Marketing Limited, Parkeston, Harwich, Essex;
- British Sugar plc, Sproughton, Ipswich, Suffolk;
- Ipswich Hospital, Heath Road, Ipswich, Suffolk;
- Traffic using the A1156, A1214 and A12 roads;
- Past and present NO_2 monitoring sites in the towns of Kesgrave, Farnham and Leiston.

This Second Stage Review and Assessment has identified that, for the following NO_2 emission sources, there is a risk of the air quality objectives being exceeded at relevant locations in the Suffolk Coastal District and, therefore, **further review and assessment will be necessary:**

- Traffic using the A14 trunk road;
- Traffic using the A1152, including specifically the crossroads of the A1152 and B1438 at Melton, due to planned developments at the former RAF Bentwaters air-base, Rendlesham, and St Audry's, Melton. This is to include elevated levels of NO_2 seen from the current monitoring site at the Melton crossroads;
- Emissions from traffic monitored at High Road West, Felixstowe and Lime Kiln Quay Road/Thoroughfare/St John's Street junction, Woodbridge using NO_2 diffusion tubes.

Further review and assessment of the above NO_2 emission sources will be in the form of continued Second Stage (where applicable) and Third Stage review and assessment to determine the risk of exceedance of the air quality objectives at relevant locations more precisely.

6. Review and Assessment of SO_2

6.1 Background

SO_2 at normal temperature and pressure is a gas. It is soluble in water to form an acidic solution, as found in acid rain. In the United Kingdom, the principle source of SO_2 is burning of sulphur containing fuels, such as coal and oil.

SO_2 is a respiratory irritant when inhaled. Short-term, high level exposure causes irritation of the eyes, nose and throat and chemical injury of the airways leading to breathing difficulties. Longer-term lower level exposure can give chest tightness and narrowing of airways. It has been demonstrated that asthma suffers may be susceptible to SO_2 and it can provoke asthma attacks.

6.2 Standards and Objectives

The National Air Quality Regulations 1997 set a 15-minute mean objective of 226 $\mu g/m^3$ (100 ppb) to be achieved by 31 December 2005.

The Revised Air Quality Strategy for England, Scotland, Wales and Northern Ireland (DETR 1999; 2000) retains the 15-minute mean, and additionally adopts two new standards based on limit values set in the Air Quality Daughter Directive, these are both to be achieved by 31 December 2004.

The three current SO_2 air quality objectives are:

- A 15-minute mean concentration of 226 $\mu g/m^3$ with a maximum of 35 exceedances in a year (approximately equivalent to the 99.9th percentile) to be achieved by 31 December 2005;

- A 1-hour mean concentration of 350 $\mu g/m^3$ (132 ppb) with a maximum of 24 exceedances in a year (approximately equivalent to the 99.7th percentile) to be achieved by 31 December 2004;

- A 24-hour mean concentration of 125 $\mu g/m^3$ (47 ppb) with a maximum of 3 exceedances in a year (approximately equivalent to the 99th percentile) to be achieved by 31 December 2004.

LAQM.TG4(00) advises that the 15-minute objective is currently widely exceeded in the United Kingdom at both urban and rural sites. These exceedances are associated with emissions from both large and small combustion plants and domestic coal burning. Exceedances of the 1-hour and 24-hour objectives are confined to Belfast where there is still widespread domestic coal burning. A variety of measures are in place to significantly reduce emissions from large combustion plant. However, there still remains the potential for localised exceedances to occur in the vicinity of small combustion plant (less than 20MW) which burn coal or oil, and in areas where coal is the predominant form of domestic heating.

6.3 Review of SO_2 in Respect of the Revised Air Quality Strategy 2000

Of the three objectives, the 15-minute mean is the most stringent. The Government anticipates that if the 15-minute mean is achieved, then the other two objectives will also be achieved.

Introduction of these two new 1-hour mean and 24-hour mean objectives have not altered the findings of the Suffolk Coastal First Stage Review and Assessment Report. The full impact of the original 15-minute objective did not require detailed examination at Stage 1 as only a rudimentary screening exercise was required. As the 15-minute mean has been suggested to be the most stringent objective, this screening exercise will also have been appropriate for the two new 1-hour and 24-hour objectives.

6.4 Review and Assessment of SO_2

In Suffolk Coastal's First Stage Review and Assessment Report the following sources of SO_2 were identified as warranting further investigation in a Second Stage Review and Assessment:

- Carless Refining and Marketing Limited, Parkeston, Harwich, Essex;
- British Sugar Plc, Sproughton, Ipswich, Suffolk;
- Emissions from uncontrolled low-level sources of SO_2 from shipping at the Port of Felixstowe.

6.4.1 Review and assessment of Carless Refining and Marketing Limited, Parkeston, Harwich, Essex

Carless Refining and Marketing Limited is within the Tendring District and was highlighted at Stage 1 as a potentially significant source of SO_2 requiring further investigation. As the factory is approximately 4 km from the Suffolk Coastal boundary it is relevant for inclusion in our Second Stage Review and Assessment.

The refinery produces white spirit and kerosene via distillation of condensed North Sea gas. The condensate, or naphthalene, processed at the site leaves liquid residues, which are occasionally used as fuel in three Beverly hot oil thermal units and four boilers. These provide process heat for the site and distillation units. The naphthalene, and therefore these residues, contains trace quantities of Sulphur which, when combusted, produce SO_2.

Following investigation into monitoring records for the site the concentration of SO_2 emissions to air, from the thermal units, have been identified to be very low. These can be seen in Appendix F, Table F-1. These low emissions are due to the low sulphur content of the liquid residues used as fuel, and its clean burning characteristics.

Tendring District Council concludes that further review and assessment of this emission source is not necessary.

With respect to Suffolk Coastal District Council the results of the above investigations considered together with the 4 km distance of the factory from the Suffolk Coastal boundary mean that **further review and assessment will not be necessary.**

6.4.2 Review and assessment of British Sugar Plc, Sproughton, Ipswich, Suffolk

British Sugar Plc is within the Babergh District and was highlighted at Stage 1 as a potentially significant source of SO_2 requiring further investigation. As the factory is approximately 6 km from the Suffolk Coastal boundary it is relevant for inclusion in our Second Stage Review and Assessment.

British Sugar Plc operates a process for the manufacture of sugar from sugar beet. For the review and assessment of SO_2 the Combustion and Sulphitation Plants at the factory are potentially significant sources. The Combustion Plant consists of two large coal fired boilers which produce steam for power generation used throughout the factory. The sulphur content of the coal used gives rise to emissions of SO_2. The Sulphitation Plant consists of an enclosed stove used to burn solid sulphur to produce SO_2. This is then added to sugar juice from the crushed beet to inhibit colour forming reactions which would take place during subsequent processing.

Babergh District Council has used the Environment Agency methodology (GN24) to model emissions of SO_2 from British Sugar Plc (see Appendix A for model details). The model was used to estimate the maximum annual mean and 99.9th percentile of 1-hour means ground level concentration of SO_2 from each process at British Sugar, and the distance from each stack that these maximum concentrations could occur. A summary of the results can be seen in Table 14 below (a fuller table of results and input figures can be seen in Appendix D).

Table 14 Modelled maximum annual mean and 99.9th percentile of 1-hour mean contribution from the Combustion and Sulphitation Plants at British Sugar Plc

	Maximum annual mean SO_2 concentration ($\mu g/m^3$)	Distance from stack to the maximum annual mean SO_2 concentration (m)	Maximum 99.9th percentile of 1-hour mean SO_2 concentration ($\mu g/m^3$)	Distance from stack to the maximum 99.9th percentile of 1-hour mean SO_2 concentration (m)
Combustion Plant	5.32304	513	97.0672	464
Sulphitation Plant	0.02656	100 (estimated)	0.83	50 (estimated)

For the purpose of the Second Stage Review and Assessment LAQM.TG4(00) advises that the following relationship can be assumed:

- 99.9th percentile of 15-minute means = 1.36 x 99.9th percentile of 1-hour means (derived from GN24);
- 99.7th percentile of 1-hour means = 0.83 x 99.9th percentile of hourly means;
- 99th percentile of 24-hour means = 10 x annual mean.

Babergh District Council has used the above assumptions and calculations from GN24 to calculate emission concentrations for the three objectives in relation to the two processes at British Sugar Plc, the results of which can be seen in Table 15 below. Emissions from British Sugar Plc will need to be added to the local background concentration of SO_2 in 2004/2005. LAQM.TG4(00) advises that the background concentration at the end of 2004 and 2005 can be assumed to be half of the 1996 value, which for British Sugar Plc was 7.0 $\mu g/m^3$, meaning that the predicted value is therefore 3.5 $\mu g/m^3$. LAQM.TG4(00) also advises that:

- for the 15-minute mean objective, twice the estimated 2005 annual mean background concentration should be added;
- for the 1-hour mean objective, twice the estimated 2004 annual mean background should be added;
- for the 24-hour mean objective, the estimated 2004 annual mean background should be added.

These calculations for British Sugar Plc can be seen in Table 15 below.

Table 15 Calculations of total concentrations of SO_2 for the Babergh District Council with respect to the Combustion and Sulphitation Plants at British Sugar Plc

	99.9th percentile of 15-minute mean SO_2 ($\mu g/m^3$)	99.7th percentile of 1-hour mean SO_2 ($\mu g/m^3$)	99th percentile of 24-hour mean SO_2 ($\mu g/m^3$)
Combustion Plant	(1.36 x 97.0672) = 132.01139	(0.83 x 97.0672) = 80.565776	(10 x 5.32304) = 53.2304
Sulphitation Plant	(1.36 x 0.83) = 1.1288	(0.83 x 0.83) = 0.6889	(10 x 0.02656) = 0.2656
Estimated 2004/2005 annual mean background + calculations	(2 x 3.5) = 7.0	(2 x 3.5) = 7.0	3.5
Total concentration of SO2 (both Plant processes + background levels)	**147.14019**	**88.254676**	**56.996**
Air Quality Objective	226	350	125

Babergh District Council concludes that, in the worst case scenario, assuming maximum output from each process and estimated annual mean background levels as in Table 15, the three air quality objectives are not exceeded and, therefore, further review and assessment of this emission source is not necessary.

With respect to Suffolk Coastal District Council, the results of the above modelling considered together with the 6 km distance of the factory from the Suffolk Coastal boundary mean that any emissions reaching Suffolk Coastal will be negligible and **further review and assessment will not be necessary.**

6.4.3 Review and assessment of emissions from uncontrolled low-level sources of SO_2 from shipping at the Port of Felixstowe

LAQM.TG4(00) identifies that at major ports (such as Felixstowe), SO_2 emissions from shipping movements have the potential to impact significantly where there is the potential for public exposure within close proximity (within about 500m).

Felixstowe is regarded as one of the United Kingdom's major ports by virtue of the large volume of container freight that passes through it each year. In 1998, a total of 7,207 vessel movements were identified, the majority of these were cargo vessels, a smaller number were ferry movements. A breakdown of this total figure into vessel types and sizes can be seen in Appendix H. This information has been provided by the Greater London Authority who operate the DETR emissions help-line.

A potential for public exposure exists at Felixstowe due to the location of a number of domestic properties within 500m of the dock area.

These two considerations demonstrate that further investigation of the Port is required, as indicated by LAQM.TG4(00).

NETCEN have undertaken a modelling exercise on behalf of the DETR to predict the 99.9th percentile of 15-minute mean SO_2 concentration at 31 December 2005 on a 1km x 1km grid area basis. This information has been made available in the form of an interactive map on the internet. LAQM.TG4(00) advises that if the 99.9th percentile of 15-minute means for a selected grid square exceeds 160 µg/m^3, further investigation in the form of a Second Stage Review and Assessment should be undertaken.

To assist in the identification of likely emission sources, where such exceedances occur, information has also been provided describing the relative contribution of road transport, industrial, domestic and other sources of SO_2 to the total of emissions in a given postcode area.

In the Suffolk Coastal District, there are four 1 km x 1 km grid squares with a predicted 99.9th percentile of 15-minute means exceeding 160 µg/m^3 (see Appendix I). These grid squares are all within the Port of Felixstowe vicinity. Using the DETR's postcode specific emission inventory facility, it was discovered that 60% of total SO_2 emissions in the areas identified are from "other" sources. Clarification of this was sought from DETR, via their emissions help-line, who attributed this to shipping.

6.5 Conclusion

This Second Stage Review and Assessment has identified that, for the following SO_2 emission sources, the risk of the air quality objectives being exceeded at relevant locations in the Suffolk Coastal District is negligible and, therefore, **further review and assessment will not be necessary:**

- Carless Refining and Marketing Limited, Parkeston, Harwich, Essex;
- British Sugar plc, Sproughton, Ipswich, Suffolk.

This Second Stage Review and Assessment has identified that, for the following SO_2 emission sources, there is a risk of the air quality objective being exceeded at relevant locations in the Suffolk Coastal District and, therefore, **further review and assessment will be necessary:**

- Shipping at the Port of Felixstowe.

Further review and assessment of the above SO_2 emission source will be in the form of continued Second Stage and (where applicable) Third Stage review and assessment to determine the risk of exceedance of the air quality objectives at relevant locations more precisely.

7. Review and Assessment of Particulate Matter (PM_{10})

7.1 Background

Particulate Matter is comprised of a variety of constituents dependent on the nature of the specific source. It is characterised and defined by the diameter of the particles produced. The particles of concern are those less than 10 μm in diameter and these are known as PM_{10}. Particulate Matter is comprised of three main sources:

- Primary Particles: these are emitted directly from combustion processes, such as road traffic and power generation. These particles are generally less than 2.5 μm and are often below 1 μm in diameter.

- Secondary Particles: these are formed in the atmosphere, following their release as gases, by chemical processes. They are mainly formed from the oxidation of sulphur and nitrogen oxides to acids which are then neutralised by ammonia from agricultural sources (sulphates and nitrates formed from emissions of SO_2 and NO_x). The atmospheric persistence of particles formed in this way allows particles from European sources to reach the United Kingdom. These particles are generally less than 2 μm in diameter.

- Coarse/Other Particles: these are from a wide variety of non-combustion sources, including dust re-suspended from road traffic and mineral extraction works, and natural sources such as sea salt and pollen. The proximity of the Suffolk Coastal District to the North Sea coast and a number of estuaries gives rise to a high proportion of these coarse particulates. These particles are generally greater than 2 μm in diameter.

Study into the health effects of particles to date has been limited. It is widely held though that it is the smaller particles, especially those below 4 μm diameter, that are of particular concern. These can penetrate deep into the body and cause a range of effects from asthma and bronchitis to potentially causing death. Those most at risk from particulates are children, the elderly and those who already suffer from a heart or lung complaint.

7.2 Standards and Objectives

The National Air Quality Regulations 1997 set the objective for PM_{10} as a daily maximum running 24-hour mean of 50 $\mu g/m^3$ with a maximum of four exceedances in a year (approximately equivalent to the 99^{th} percentile of 24-hour means) to be achieved by 31 December 2005.

The Revised Air Quality Strategy for England, Scotland, Wales and Northern Ireland (DETR 1999; 2000) includes changes to the original 24-hour mean objective, and adopts also an annual mean objective (see below). Revised objectives were proposed because work carried out by the Airborne Particles Expert Group indicated that the original objective was unrealistic and limit values set in the Air Quality Daughter Directive (AQDD) which was agreed at Environment Council in June 1998 were as below. The two current objectives are based on measurements using the European gravimetric transfer reference sampler or equivalent and are both to be achieved by 31 December 2004:

- An annual mean concentration of 40 $\mu g/m^3$ (gravimetric);
- A fixed 24-hour mean concentration of 50 $\mu g/m^3$ (gravimetric) with a maximum of 35 exceedances in a year.

LAQM.TG4(00) advises that the proposed 24-hour mean objective is potentially a difficult standard against which to carry out an assessment, due to day-to-day variations in PM_{10} concentration and composition. It is, therefore, recommended that the initial stages of review and assessment (Stage 1 and 2) are carried out by calculating the annual mean PM_{10} concentration and then estimating the 90th percentile concentration. The 90th percentile of daily means in a calendar year is approximately equivalent to 35 exceedance days. An empirical relationship between the annual mean concentration and the 90th percentile of daily means has been derived from analysis of UK monitoring data. Any approach based upon an empirical relationship needs to be precautionary and a "best fit" line has been drawn which ensures exceedances will not be underestimated, apart from in very extreme circumstances. This gives the equation:

$$PM_{10} \text{ (90}^{th} \text{ percentile of daily means)} = PM_{10} \text{ (annual mean)} \times 1.79$$

The proposed 24-hour objective is, therefore, highly unlikely to be exceeded if the annual mean concentration is below 28 $\mu g/m^3$ (gravimetric).

LAQM.TG4(00) states that the principal focus of Local Air Quality Management should be towards the control of PM_{10} emissions at a local level. Government research confidently expects PM_{10} concentrations to fall by the end of 2004 when the objectives are to be met. Analysis has indicated that, with existing national policy measures and "atypical" meteorology (a higher frequency of easterly winds occurring about once every five years and transporting pollutants from mainland Europe to the United Kingdom), exceedances of the objectives might be found in the following areas and, therefore, these areas should form the focus of more detailed review and assessment:

- urban background sites in central London;
- areas adjacent to busy roads, particularly within major urban areas;
- areas with significant emissions from domestic burning of solid fuel;
- areas in the vicinity of industrial plant or which have significant uncontrolled or fugitive emissions.

7.3 Review of PM_{10} in respect of the Revised Air Quality Strategy 2000

The revised 24-hour objective is less stringent than the original in that the number of exceedances in a year has increased considerably. Monitoring studies also suggest that the new 24-hour objective is more stringent than the annual mean objective.

Revision of the 24-hour objective and the introduction of the new annual mean objective, therefore, has not altered the findings of the Suffolk Coastal First Stage Review and Assessment Report. The revised objectives are less stringent than the original which was in place during the completion of the First Stage Report.

7.4 Review and Assessment of PM_{10}

In Suffolk Coastal's First Stage Review and Assessment Report the following sources of PM_{10} were identified as warranting further investigation in a Second Stage Review and Assessment:

- White Mountain Roadstone Limited, Foxhall Four Quarry, Foxhall Road, Brightwell, Suffolk.

- Roadworks (1952) Limited, Sinks Pit Quarry, Kesgrave, Suffolk.

- British Sugar Plc., Sproughton, Ipswich, Suffolk.

- Ipswich Port Authority, Ipswich, Suffolk.

- Ipswich Hospital, Heath Road, Ipswich, Suffolk.

- Needham Chalks Limited, Needham Market, Suffolk .

- Four segments of road within the Suffolk Coastal District with a projected annual average daily traffic flow of greater than 25,000 vehicles by 31 December 2004:

    - The A14 trunk road from Dock Spur roundabout at Felixstowe to the Ipswich Borough boundary at the Orwell Bridge;
    - The A1156 from the A12/A14 junction at Nacton to the Ipswich Borough boundary at Purdis Farm;
    - The A12 trunk road from the Foxhall Road roundabout at Foxhall through to the Woods Lane (A1152) roundabout at Woodbridge;
    - The A1214 from the Dobbs Lane junction at Kesgrave to the Ipswich Borough boundary at Rushmere St. Andrew.

- Sources from shipping at the Port of Felixstowe.

- Uncontrolled and fugitive emissions from the four quarries within Suffolk Coastal;

    - Foxhall Four Quarry, Foxhall Road, Brightwell, Suffolk
    - Sinks Pit Quarry, off the A1214, Kesgrave, Suffolk
    - Waldringfield Quarry, Waldringfield Road, Brightwell, Suffolk
    - Thorington Quarry, Park Farm, off the A12, Thorington

- Annual average background levels of secondary particulates in excess of 8 $\mu g/m^3$ over the entire Suffolk Coastal District:

- High PM_{10} emission estimates in the town of Felixstowe, particularly at the Port of Felixstowe.

- Planned development of a gravel extraction quarry alongside the A14 at Bucklesham.

Due to additional information from the First Stage consultation, continued monitoring data and new advice on PM_{10} in the revised Pollutant Specific Guidance LAQM.TG4 (00) (DETR 2000), Suffolk Coastal District Council has decided to include in this Second Stage Review and Assessment three additional potentially significant sources of PM_{10} which warrant further investigation, and areas where the "footprints" of two or more emission sources combine:

- Traffic on the A1152 from the Woods Lane roundabout, Woodbridge to the former RAF Bentwaters roundabout at Rendlesham, including specifically the crossroads at Melton where the A1152 and B1438 intersect. These segments of road have been reviewed due to concerns about increased future traffic flows from the planned development of the former RAF Bentwaters airbase at Rendlesham and the St Audry's development at Melton, and decreased traffic speeds seen, particularly at the Melton crossroads.

- Emissions from traffic monitored at three kerbside locations within the Suffolk Coastal District. Increased levels of NO_2 have been recorded at these sites and, therefore, it is suspected that PM_{10} levels may be similarly elevated as these pollutants share road traffic as a common emission source.

- Uncontrolled and fugitive emissions from the four current commercial landfill sites within Suffolk Coastal, as specified in the revised pollutant specific guidance LAQM.TG4(00):

– Grove Farm, Clopton, Suffolk;
– Sweffling Lagoons, Sweffling, Suffolk;
– Waldringfield Quarry, Waldringfield Road, Brightwell, Suffolk;
– Foxhall Landfill Site, Foxhall Road, Brightwell, Suffolk.

- Combined emission "Footprint" of White Mountain Roadstone Limited, A12 traffic, Foxhall Four Quarry and Foxhall Landfill Site.

- Combined emission "Footprint" of Roadworks (1952) Limited and Sinks Pit Quarry.

7.4.1 Review and Assessment Of White Mountain Roadstone Limited, Foxhall Four Quarry, Foxhall Road, Brightwell, Suffolk

White Mountain Roadstone Limited is within the Suffolk Coastal District and was highlighted at Stage 1 as a potentially significant source of PM_{10} requiring further investigation in the Second Stage Review and Assessment.

White Mountain Roadstone Limited operates a roadstone coating process using mobile plant. This mobile plant is positioned within the southern end of Foxhall Four Quarry and is not currently mobile. Coated roadstone, used for the surfacing of roads, is produced from aggregates, filler and bitumen. Aggregates are imported either from within the quarry or from other quarries by road and deposited in discrete stockpiles. Filler and bitumen are imported by road tanker and stored on the site in tanks. The aggregates are dried and heated to the required temperature and then screened into four sizes and held in storage bins. The aggregate and bitumen are then mixed and discharged directly into lorries and conveyed away.

LAQM.TG4(00) identifies that, for a Second Stage Review and Assessment, the Environment Agency methodology (GN24) should be used to estimate emissions from the process. Information was gathered for White Mountain Roadstone Limited to put into GN24, this can be seen in Table 16 below. Appendix A shows details of the GN24 model, including its limitations. For White Mountain Roadstone Limited, we were unable to use GN24 for two reasons:

– The stack is near the southernmost quarry face. The quarry face rises to more than 40% of the stack height (stack height = 21.7m, quarry face = 13.8m) and lies closer than five stack heights distance from the stack (it is within 50m). In addition, the westernmost

quarry face, which is at Foxhall Landfill Site, actually rises 5.4m above the stack, although this is greater than five stack heights distance;

– The effective stack height (21.7m – 13.8m = 6.9m) is, therefore, outside the range covered by the model, i.e. – outside 20 to 200m.

An alternative model, in the form of the Atmospheric Dispersion Modelling System-Screen (ADMS-Screen), was used for White Mountain Roadstone Limited. This model was run by Stanger Science and Environment via the modelling help-line on behalf of the DETR. The model was run for an effective stack height of 7m to estimate the maximum 1-hour mean and peak annual average concentration of Particulate Matter (PM) from the mobile plant, and the distance from the stack that these maximum concentrations could occur. Input figures for the model can be seen in Table 16 below.

For this review and assessment of PM_{10}, we have decided to use the peak annual mean emissions only as LAQM.TG4(00) provides an assessment methodology to derive the 90^{th} percentile of 24-hour means using this annual mean figure. The maximum 1-hour estimates are not relevant in this review and assessment as there are no current objectives in the Revised Air Quality Strategy 2000 for this measurement.

Table 16 Measurements necessary for modelling emissions of PM_{10} from White Mountain Roadstone Limited.

Effective stack height (m)	21.7 = total stack height 13.8 = quarry face height therefore, 6.9 = effective stack height
Stack diameter (m)	1.23
Exit velocity (m/s)	11.4
Temperature at exit point (°C)	60.4
Pollutants	PM_{10}
Rate of emission of pollutants (g/s)	0.2458

Table 17 Modelled peak annual average Particulate Matter (PM) contribution from White Mountain Roadstone Limited

Peak annual average PM concentration ($\mu g/m^3$)	Distance of peak from source (m)
2.83	60

Results from the ADMS-Screen modelling for the peak annual mean PM concentrations are shown in Table 17 and give the maximum distance that these concentrations could occur as 60m from the stack. The nearest relevant receptor locations to the stack are domestic properties which are approximately 250m away. Despite the fact that the model predicts that emissions from this source will not reach receptor locations, the small margin of error involved suggests that it would be prudent to assume that they do. As such, the emission data will be added to the Suffolk Coastal background data, as follows.

Regarding the **annual average** PM_{10} concentration LAQM.TG4(00) identifies that emissions from the stack should be added to the estimated annual mean background levels of PM_{10} for 2004. Annual mean background levels have been estimated by NETCEN for the United Kingdom and can be accessed on the internet in the form of an interactive map within the National Air Quality Archive. The highest estimated annual mean background PM_{10} level for this area of Suffolk Coastal is 23.4 $\mu g/m^3$. The peak annual average PM concentration from the stack is 2.83 $\mu g/m^3$, see Table 17. Stanger Science and Environment advise that, as a worst case, all PM can be considered to be PM_{10}. Therefore, the total annual average PM_{10} concentration at receptor locations will be:

23.4 $\mu g/m^3$ + 2.83 $\mu g/m^3$ = **26.23 $\mu g/m^3$.**

This level is lower than the annual mean objective of 40 $\mu g/m^3$ and, as a source in isolation, will not require further review and assessment.

Regarding the **90th percentile of 24-hour means** for $PM_{10,}$ LAQM.TG4(00) identifies that an assessment may be carried out as follows:

i) Determine the 90th percentile background concentration for 2004 by multiplying the estimated annual mean background concentration by 1.79:
= 23.4 $\mu g/m^3$ x 1.79 = 41.886 $\mu g/m^3$

ii) Determine the highest annual mean PM_{10} concentration from the stack in 2004:
= 2.83 $\mu g/m^3$

iii) Calculate the 90th percentile contribution from the stack by multiplying the annual mean by 4:
= 2.83 $\mu g/m^3$ x 4 = 11.32 $\mu g/m^3$

iv) Determine whether the 90th percentile contribution from the stack **[PM_{10},stack]** is higher than the 90th percentile background contribution **[PM_{10},background]:**
[PM_{10},stack] = 11.32 $\mu g/m^3$
[PM_{10},background] = 41.886 $\mu g/m^3$
Therefore, **[PM_{10},background]** is higher

v) If **[PM_{10},background]** is higher, then the total 90th percentile concentration in 2004 can be estimated from:
[PM_{10},background] + (**[PM_{10},stack]** x 0.6)
Therefore, 41.886 $\mu g/m^3$ + (11.32 $\mu g/m^3$ x 0.6) = **48.678 $\mu g/m^3$**.

This is below the 24-hour mean objective of 50 $\mu g/m^3$ and, as a source in isolation, will not require further review and assessment.

However, there are potential combined impacts of emissions from White Mountain Roadstone Limited with those from A12 vehicular emissions and uncontrolled and fugitive emissions from both the Foxhall Four Quarry itself and the Foxhall Landfill Site. These combined impacts are considered in section 7.4.16 later in this chapter.

7.4.2 Review and assessment of Roadworks (1952) Limited, Sinks Pit Quarry, Kesgrave, Suffolk

Roadworks (1952) Limited is within the Suffolk Coastal District and was highlighted at Stage 1 as a potentially significant source of PM_{10} requiring further investigation in the Second Stage Review and Assessment.

Roadworks (1952) Limited operates a roadstone coating process using mobile plant. This mobile plant is positioned towards the southern end of Sinks Pit Quarry and is not currently mobile. Coated roadstone, used for the surfacing of roads, is produced from aggregates, filler and bitumen. Aggregates are imported either from within the quarry or from other quarries by road and deposited in discrete stockpiles. Filler and bitumen are imported by road tanker and stored on the site in tanks. The aggregates are dried and heated to the required temperature and then screened into four sizes and held in storage bins. The aggregate and bitumen are then mixed and discharged directly into lorries and conveyed away.

LAQM.TG4(00) identifies that, for a Second Stage Review and Assessment, the Environment Agency methodology (GN24) should be used to estimate emissions from the process. Information was gathered for Roadworks (1952) Limited to put into GN24, this can be seen in Table 18 below. Appendix A shows details of the GN24 model, including its limitations. For Roadworks (1952) Limited, we were unable to use GN24 for one reason:

- The stack height is 14.4m and is, therefore, outside the range covered by the model, i.e. – outside 20 to 200m.

An alternative model, in the form of the Atmospheric Dispersion Modelling System-Screen (ADMS-Screen), was used for Roadworks (1952) Limited. This model was run by Stanger Science and Environment via the modelling help-line on behalf of the DETR. The model was run for the stack height of 14.4m to estimate the maximum 1-hour mean and peak annual average concentration of Particulate Matter (PM) from the mobile plant and the distance from the stack that these maximum concentrations could occur. Input figures for the model can be seen in Table 18 below.

For this review and assessment of PM_{10}, we have decided to use the peak annual mean emissions only as LAQM.TG4(00) provides an assessment methodology to derive the 90^{th} percentile of 24-hour means using this annual mean figure. The maximum 1-hour estimates are not relevant in this review and assessment as there are no current objectives in the Revised Air Quality Strategy 2000 for this measurement.

Table 18 Measurements necessary for modelling emissions of PM_{10} from Roadworks (1952) Limited.

Stack height (m)	14.4
Stack diameter (m)	0.91
Exit velocity (m/s)	9.4
Temperature at exit point (°C)	105
Pollutants	PM_{10}
Rate of emission of pollutants (g/s)	0.16

Table 19 Modelled peak annual average Particulate Matter (PM) contribution from Roadworks (1952) Limited

Peak annual average PM concentration ($\mu g/m^3$)	Distance of peak from source (m)
0.98	115

Results from the ADMS-Screen modelling for the peak annual mean PM concentrations are shown in Table 19 and give the maximum distance that these concentrations could occur as 115m from the stack. The nearest relevant receptor locations to the stack are domestic properties which are approximately 245m away. Despite the fact that the model predicts that emissions from this source will not reach receptor locations, the small margin of error involved suggests that it would be prudent to assume that they do. As such, the emission data will be added to the Suffolk Coastal background data, as follows.

Regarding the **annual average** PM_{10} concentration, LAQM.TG4(00) identifies that emissions from the stack should be added to the estimated annual mean background levels of PM_{10} for 2004. Annual mean background levels have been estimated by NETCEN for the United Kingdom and can be accessed on the internet in the form of an interactive map within the National Air Quality Archive. The highest estimated annual mean background PM_{10} level for this area of Suffolk Coastal is 23.1 $\mu g/m^3$. The peak annual average PM concentration from the stack is 0.98 $\mu g/m^3$, see Table 19. Stanger Science and Environment advise that, as a worst case, all PM can be considered to be PM_{10}. Therefore, the total annual average PM_{10} concentration at receptor locations is:

23.1 $\mu g/m^3$ + 0.98 $\mu g/m^3$ = **24.08 $\mu g/m^3$** .

This level is lower than the annual mean objective of 40 $\mu g/m^3$ and, as a source in isolation, will not require further review and assessment.

Regarding the **90th percentile of 24-hour means** for $PM_{10,}$ LAQM.TG4(00) identifies that an assessment may be carried out as follows:

i) Determine the 90th percentile background concentration for 2004 by multiplying the estimated annual mean background concentration by 1.79:
= 23.1 $\mu g/m^3$ x 1.79 = 41.349 $\mu g/m^3$

ii) Determine the highest annual mean PM_{10} concentration from the stack in 2004:
= 0.98 $\mu g/m^3$

iii) Calculate the 90th percentile contribution from the stack by multiplying the annual mean by 4:
= 0.98 $\mu g/m^3$ x 4 = 3.92 $\mu g/m^3$

iv) Determine whether the 90th percentile contribution from the stack **[PM_{10},stack]** is higher than the 90th percentile background contribution **[PM_{10},background]**:
[PM_{10},stack] = 3.92 $\mu g/m^3$
[PM_{10},background] = 41.349 $\mu g/m^3$
Therefore, **[PM_{10},background]** is higher

v) If **[PM_{10},background]** is higher, then the total 90th percentile concentration in 2004 can be estimated from:

[PM_{10},background] + **([PM_{10},stack]** x 0.6)

Therefore, 41.349 $\mu g/m^3$ + (3.92 $\mu g/m^3$ x 0.6) = **43.701 $\mu g/m^3$**

This is below the 24-hour mean objective of 50 $\mu g/m^3$ and, as a source in isolation, will not require further review and assessment.

However, there are potential combined impacts of emissions from Roadworks (1952) Limited with those from uncontrolled and fugitive emissions from the Sinks Pit Quarry itself. These combined impacts are considered in section 7.4.17 later in this chapter.

7.4.3 Review and Assessment of British Sugar Plc, Sproughton, Ipswich

British Sugar Plc is within the Babergh District and was highlighted at Stage 1 as a potentially significant source of PM_{10} requiring further investigation. As the factory is approximately 6 km from the Suffolk Coastal boundary, it is relevant for inclusion in our Second Stage Review and Assessment.

British Sugar Plc operates a process for the manufacture of sugar from sugar beet. For the review and assessment of PM_{10}, the Combustion and Lime Kiln Plants at the factory are potentially significant sources. The Combustion Plant consists of two large coal fired boilers which produce steam for power generation used throughout the factory. The Lime Kiln Plant produces calcium hydroxide which is required in the sugar production process. PM_{10} is emitted from both of these processes as a combustion product.

Babergh District Council has used the Environment Agency methodology (GN24) to model emissions of PM_{10} from the Combustion Plant (see Appendix A for model details). The model was used to estimate the maximum annual mean ground level concentration of PM_{10} from the Combustion Plant and the distance from the stack that the maximum concentration could occur. A summary of the results can be seen in Table 20 below (a fuller table of results and input figures can be seen in Appendix D).

Babergh District Council was unable to use GN24 to model emissions of PM_{10} from the Lime Kiln Plant as the stack height, at 17.5m, is less than the minimum to which the model applies, see Appendix A for model details. ADMS-Screen modelling has, therefore, been carried out to estimate the maximum peak annual average concentration of Particulate Matter (PM) and the distance from the stack that the maximum concentration could occur. A summary of the results can be seen in Table 21 below:

Table 20 Modelled maximum annual mean PM_{10} contribution from Combustion Plant at British Sugar Plc

Maximum annual mean PM_{10} concentration ($\mu g/m^3$)	Distance from stack to maximum PM_{10} concentration (m)
2.98248	513

Table 21 Modelled peak annual average PM_{10} contribution from Lime Kiln Plant at British Sugar Plc

Peak annual average PM concentration ($\mu g/m^3$)	Distance of peak from source (m)
3.39	4.5

Babergh District Council has assumed a worst case scenario and added the emissions from both stacks, even though they are highly unlikely to have a significant combined impact beyond the factory boundary (100m at minimum). The total is, therefore, 6.3724 $\mu g/m^3$. However, the British Sugar factory only operates for approximately five months in a twelve month period, therefore, calculations of emissions over this time give:

$$6.3724\ \mu g/m^3 \times (5/12) = 2.6552\ \mu g/m^3$$

Babergh District Council has also included emissions from the A14 trunk road in its calculations. These may combine with factory emissions. Emissions of PM_{10} from road traffic on the A14 at the nearest receptor, in Gipping Way Sproughton, have been calculated using DMRB and found to be 0.50 $\mu g/m^{3.}$

Calculations specified in LAQM.TG4(00) have been undertaken by Babergh District Council to combine the factory and A14 emission sources together with the estimated annual mean background PM_{10} concentration (23.6 $\mu g/m^3$). Production of the 90th percentile of 24-hour mean as a total has then been calculated from this. The resulting concentration is **49.511139 $\mu g/m^3$**.

Babergh District Council concludes, following the above calculations, that further review and assessment is not necessary.

With respect to Suffolk Coastal District Council, the results of the above modelling, together with the 6 km distance of the factory from the Suffolk Coastal boundary, mean that any emission reaching the Suffolk Coastal District will be negligible and **further review and assessment will not be necessary.**

7.4.4 Review and Assessment of Ipswich Port Authority, Ipswich, Suffolk

Ipswich Port Authority is within the Ipswich Borough and was highlighted at Stage 1 as a potentially significant source of PM_{10} requiring further investigation. As Ipswich Port Authority is approximately 2 km from the Suffolk Coastal boundary, it is relevant for inclusion in our Second Stage Review and Assessment.

Ipswich Port Authority handles and stores small quantities of coal. Potential PM_{10} emissions are, therefore, uncontrolled. The DETR refers to these types of emissions as fugitive. The Revised Pollutant Specific Guidance LAQM.TG4(00) suggests that impacts from fugitive emission sources from Part A and B Authorised Processes should only be considered at a distance of up to 1 km. Ipswich Port Authority is more than 1 km from the Suffolk Coastal boundary and, therefore, **further review and assessment will not be necessary.**

7.4.5 Review and Assessment of Ipswich Hospital, Heath Road, Ipswich, Suffolk

Ipswich Hospital is within the Ipswich Borough boundary and was highlighted at Stage 1 as a potentially significant source of PM_{10} requiring further investigation. The hospital is approximately 0.5 km from the Suffolk Coastal boundary and so is relevant for inclusion in our Second Stage Review and Assessment.

Ipswich Hospital operates an incinerator for clinical waste on site. $PM_{10,}$ is produced as a combustion product of materials incinerated.

Ipswich Borough has undertaken a number of further investigations into emissions from the Ipswich Hospital incinerator using methodology from LAQM.TG4(00) and dispersion modelling. Ipswich Borough has used the ADMS-Screen model to estimate the maximum 1-hour mean and peak annual average concentration of Particulate Matter (PM) from the incinerator, and the distance from the stack that these maximum concentrations could occur. A summary of the results can be seen in Table 22 below (a fuller table of results and input figures can be seen in Appendix E).

For this review and assessment of PM_{10}, we have decided to use the peak annual mean emissions only as LAQM.TG4(00) provides an assessment methodology to derive the 90th percentile of 24-hour means using this annual mean figure. The maximum 1-hour estimates are not relevant in this review and assessment as there are no current objectives in the Revised Air Quality Strategy 2000 for this measurement.

Table 22 Modelled peak annual average PM contribution from the Ipswich Hospital incinerator

Peak annual average PM concentration ($\mu g/m^3$)	Distance of peak from source (m)
0.0027	288

Results from the ADMS-Screen modelling for the peak annual mean PM concentrations are shown in Table 22 and give the maximum distance that these concentrations could occur as 288m from the stack. The nearest relevant receptor locations to the stack within the Suffolk Coastal District are domestic properties which are approximately 500m away. Despite the fact that the model predicts that emissions from this source will not reach the Suffolk Coastal District, the small margin of error involved suggests that it would be prudent to assume that they do. As such, the emission data will be added to the Suffolk Coastal background data, as follows.

Regarding the **annual average** PM_{10} concentration, LAQM.TG4(00) states that emissions from the stack should be added to the estimated annual mean background levels of PM_{10} for 2004. Annual mean background levels have been estimated by NETCEN for the United Kingdom and can be accessed on the internet in the form of an interactive map within the National Air Quality Archive.

The highest estimated annual mean background level for the Suffolk Coastal-Ipswich Borough boundary at Rushmere St Andrew is 23.3 $\mu g/m^3$. The peak annual average PM concentration from the stack is 0.0027 $\mu g/m^3$, see Table 22. It has been advised that, as a

worst case, all PM can be considered to be PM_{10}. Therefore, the total annual average PM_{10} concentration at receptor locations is:

23.3 μg/m^3 + 0.0027 μg/m^3 = **23.3027 μg/m^3**.

This level is lower than the annual mean objective of 40 μg/m^3 and, therefore, further review and assessment will not be necessary.

Regarding the **90th percentile of 24-hour means** for PM_{10}, LAQM.TG4(00) identifies that an assessment may be carried out as follows:

i) Determine the 90th percentile background concentration for 2004 by multiplying the estimated annual mean background concentration by 1.79:
= 23.3 μg/m^3 x 1.79 = 41.707 μg/m^3

ii) Determine the highest annual mean PM_{10} concentration from the stack in 2004:
= 0.0027 μg/m^3

iii) Calculate the 90th percentile contribution from the stack by multiplying the annual mean by 4:
= 0.0027 μg/m^3 x 4 = 0.0108 μg/m^3

iv) Determine whether the 90th percentile contribution from the stack [**PM_{10},stack**] is higher than the 90th percentile background contribution [**PM_{10},background**]:
[PM_{10},stack] = 0.0108 μg/m^3
[PM_{10},background] = 41.707 μg/m^3
Therefore, **[PM_{10},background]** is higher

v) If **[PM_{10},background** is higher, then the total 90th percentile concentration in 2004 can be estimated from:
[PM_{10},background] + (**[PM_{10},stack]** x 0.6)
Therefore, 41.707 μg/m^3 + (0.0108 μg/m^3 x 0.6) = **41.71348 μg/m^3**.

This level is lower than the 24-hour mean objective of 50 μg/m^3 and, therefore, further review and assessment will not be necessary.

With respect to Suffolk Coastal District Council, the results of the above modelling and calculations, together with the 0.5 km distance of the incinerator from the Suffolk Coastal boundary mean that **further review and assessment will not be necessary.**

7.4.6 Review and Assessment of Needham Chalks Limited, Needham Market, Suffolk

Needham Chalks Limited is within the Mid-Suffolk District and was highlighted at Stage 1 as a potentially significant source of PM_{10} requiring further investigation. As Needham Chalks Limited is approximately 9 km from the Suffolk Coastal boundary, it is relevant for inclusion in our Second Stage Review and Assessment.

The Revised Pollutant Specific Guidance LAQM.TG4(00) suggests that impacts from medium size sources from Part A and B Authorised Processes should only be considered at a distance of up to 5 km. Needham Chalks Limited is more than 5 km from the Suffolk Coastal boundary and, therefore, **further review and assessment will not be necessary.**

7.4.7 Review and assessment of emissions from traffic on the A14, A1156, A12 and A1214 roads

The following segments of road within the Suffolk Coastal District were highlighted at Stage 1 as requiring further investigation because the AADTF on each was predicted to exceed 25,000 vehicles in 2004:

- The A14 trunk road from Dock Spur roundabout at Felixstowe to the Ipswich Borough boundary at the Orwell Bridge;
- The A1156 from the A12/A14 junction at Nacton to the Ipswich Borough boundary at Purdis Farm;
- The A12 trunk road from the A14 junction at Nacton through to the Woods Lane (A1152) roundabout at Woodbridge;
- The A1214 from the A12 junction at Martlesham Heath to the Ipswich Borough boundary at Rushmere St Andrew.

Estimates of the annual mean PM_{10} contribution from these roads at the end of 2004 were calculated using Stanger's DMRB spreadsheet model (see section 2.1 in chapter 2 for model details).

Predicted traffic data for 2004 was obtained from the Suffolk County Council Environment & Transport Department for each road and can be seen in Appendix B. Each road was split into segments dependant on alterations in traffic flow, vehicle speed, HGV percentage and major intersections. The nearest relevant receptor locations were identified for each road segment (as defined in chapter 2) and data entered into the spreadsheet.

A summary of results for each road can be seen in Tables 23 to 26, input data is summarised in Appendix B.

For each receptor location, the annual mean PM_{10} contribution from the road was predicted using DMRB and added to the estimated annual mean PM_{10} background concentration in 2004. Annual mean background levels have been estimated by NETCEN for the United Kingdom and are compiled as part of the National Air Quality Archive.

Guidance in LAQM.TG4(00) advises that where the total annual mean PM_{10} concentration is predicted to be greater than 28 $\mu g/m^3$ there is a risk of the objective being exceeded and the authority should proceed to a Third Stage review and assessment.

The predictions in Tables 23 to 26 show that the criterion of 28 $\mu g/m^3$ is not likely to be exceeded at any of the nearest relevant receptor locations on the A14, A1156, A1214 and A12 roads at the end of 2004. Therefore, regarding traffic emissions from the A14, A1156, A1214 and A12, **further review and assessment will not be necessary**.

Table 23 A14 – Projected annual mean PM10 concentrations for 2005 derived from DMRB

Road segment reference (refer to Appendix B for traffic data for each 'link' of road)	Receptor reference	Receptor description (distance to receptor from centre of the road)	DMRB calculated annual mean PM_{10} concentration from traffic ($\mu g/m^3$)	Estimated annual mean background PM_{10} concentration # ($\mu g/m^3$)	Total annual mean PM_{10} concentration (estimated background level + traffic contribution ($\mu g/m^3$)	Progression to Stage 3 **YES/NO** (yes = where annual average >28 $\mu g/m^3$)
A14 (Link 1) from Dock Spur roundabout, Felixstowe to the Trimley junction	Site 1	Façade of nearest garden, Trimley (23m)	3.13	23.4	26.53	**NO**
A14 (Link 1) at Dock Spur roundabout (due to decreased traffic speeds of 30 mph at roundabout)	Site 2	Façade of nearest garden, Felixstowe (24m)	2.45	23.4	25.85	**NO**
A14 (Link 1) from Trimley junction to theA12 junction	Site 3	Façade of nearest garden, Trimley (18m)	3.62	23.4	27.02	**NO**
A14 (Link 2) from A12 junction to beyond the Orwell Bridge	Site 4	Façade of nearest garden, Nacton (55m)	1.90	23.5	25.40	**NO**
A14 (Link 2) and A1156 (Link 1) where the two roads run parallel at Nacton	Site 5	Façade of nearest garden, Nacton (55m to A14, 14m to A1156)	3.30	23.5	26.80	**NO**
A14 (Link 2), A12 (Link 1) and A1156 (Link 1) roundabout where the three roads meet at Nacton	Site 6	Façade of nearest garden, Nacton (88m to A14, 187m to A1156, 335m to A12)	0.97	23.5	24.47	**NO**

Taken from National Air Quality Archive information

Table 24 A1156 – Projected annual mean PM10 concentrations for 2005 derived from DMRB

Road segment reference (refer to Appendix B for traffic data for each 'link' of road)	Receptor reference	Receptor description (distance to receptor from centre of the road)	DMRB calculated annual mean PM_{10} concentration from traffic ($\mu g/m^3$)	Estimated annual mean background PM_{10} concentration # ($\mu g/m^3$)	Total annual mean PM_{10} concentration (estimated background level + traffic contribution ($\mu g/m^3$)	Progression to Stage 3 **YES/NO** (yes = where annual average >28 $\mu g/m^3$)
A1156 (Link 1) from A12 junction at Nacton to Ipswich Borough boundary at Purdis Farm	Site 7	Façade of nearest garden, Purdis Farm (13m)	1.43	23.7	25.13	**NO**
A1156 (Link 1) from A12 junction at Nacton to Ipswich Borough boundary at Purdis Farm (due to decreased traffic speeds of 20 mph at roundabouts)	Site 8	Façade of nearest garden, Purdis Farm (30m)	1.10	23.7	24.80	**NO**

Taken from National Air Quality Archive information

Table 25 A1214 – Projected annual mean PM10 concentrations for 2005 derived from DMRB

Road segment reference (refer to Appendix B for traffic data for each 'link' of road)	Receptor reference	Receptor description (distance to receptor from centre of the road)	DMRB calculated annual mean PM_{10} concentration from traffic ($\mu g/m^3$)	Estimated annual mean background PM_{10} concentration # ($\mu g/m^3$)	Total annual mean PM_{10} concentration (estimated background level + traffic contribution ($\mu g/m^3$)	Progression to Stage 3 **YES/NO** (yes = where annual average >28 $\mu g/m^3$)
A1214 (Link 1) from A12 junction at Martlesham Heath to the first Grange Farm roundabout at Kesgrave.	Site 9	Façade of nearest garden, Kesgrave (5.8m)	1.56	23.0	24.56	**NO**
A1214 (Link 1) from A12 junction at Martlesham Heath to the first Grange Farm roundabout at Kesgrave (due to decreased traffic speeds of 15 mph at roundabouts)	Site 10	Façade of nearest garden, Kesgrave (5.8m)	2.06	23.0	25.06	**NO**
A1214 (Link 2) from the first Grange Farm roundabout at Kesgrave to the Ipswich Borough boundary at Rushmere.	Site 11	Façade of nearest garden, Kesgrave (5.8m)	2.03	23.0	25.03	**NO**
A1214 (Link 2) from the first Grange Farm roundabout at Kesgrave to the Ipswich Borough boundary at Rushmere (due to decreased traffic speeds of 15 mph at roundabouts)	Site 12	Façade of nearest garden, Kesgrave (5.8m)	2.68	23.0	25.68	**NO**

Taken from National Air Quality Archive information

Table 26 A12 – Projected annual mean PM10 concentrations for 2005 derived from DMRB

Road segment reference (refer to Appendix B for traffic data for each 'link' of road)	Receptor reference	Receptor description (distance to receptor from centre of the road)	DMRB calculated annual mean PM_{10} concentration from traffic ($\mu g/m^3$)	Estimated annual mean background PM_{10} concentration # ($\mu g/m^3$)	Total annual mean PM_{10} concentration (estimated background level + traffic contribution ($\mu g/m^3$)	Progression to Stage 3 **YES/NO** (yes = where annual average >28 $\mu g/m^3$)
A12 (Link 1) from A14 junction at Nacton to B1438 Woodbridge roundabout (using average speed)	Site 13	Façade of nearest garden, Martlesham Heath (12m)	2.16	23.3	25.46	**NO**
A12 (Link 1) from A14 junction at Nacton to B1438 Woodbridge roundabout (due to decreased traffic speeds of 20mph at roundabouts)	Site 14	Façade of nearest garden, Martlesham Heath (22m)	2.31	23.0	25.31	**NO**
A12 (Link 2) B1438 Woodbridge roundabout to Woods Lane (A1152) roundabout, Woodbridge	Site 15	Façade of nearest garden, Woodbridge (11m)	1.97	23.10	25.07	**NO**
A12 (Link 2) B1438 Woodbridge roundabout to Woods Lane (A1152) roundabout, Woodbridge (due to decreased traffic speeds of 20mph at roundabouts)	Site 16	Façade of nearest garden, Woodbridge (13m)	2.60	23.10	25.70	**NO**

Taken from National Air Quality Archive information

7.4.8 Review and assessment of emissions from shipping at The Port of Felixstowe

LAQM.TG4(00) identifies that at major ports (such as Felixstowe), PM_{10} emissions from shipping movements have the potential to impact significantly where there is the potential for public exposure within close proximity (within about 500m).

Felixstowe is regarded as one of the United Kingdom's major ports by virtue of the large volume of container freight that passes through it each year. In 1998, a total of 7,207 vessel movements were identified, the majority of these were cargo vessels, a smaller number were ferry movements. A breakdown of this total figure into vessel types and sizes can be seen in Appendix H. This information has been provided by the Greater London Authority which operate the DETR emissions help-line.

A potential for public exposure exists at Felixstowe due to the location of a number of domestic properties within 500m of the dock area.

These two considerations demonstrate that further investigation of the Port is required, as indicated by LAQM.TG4(00).

The impact of emissions from shipping at UK ports is currently being assessed in a DETR sponsored research project, carried out by the London Research Centre in conjunction with AEA Technology. At the time of the review, the DETR report has not been concluded. This information is required in order to carry out our Second Stage Review and Assessment of this source of PM_{10} . Suffolk Coastal District Council will review impacts from shipping at Stage 2 when the DETR research becomes available. The outcome will either be included in our Third Stage Review and Assessment report, or be issued for consultation and published separately.

7.4.9 Review and assessment of uncontrolled and fugitive emissions from four quarries within Suffolk Coastal

There are four quarries within the Suffolk Coastal District which were identified as potentially significant sources of PM_{10} requiring further investigation. This was done at Stage 1 on the basis of the DETR's original Pollutant Specific Guidance LAQM.TG4(98). The four quarries identified for investigation in the Second Stage Review and Assessment are;

- Foxhall Four Quarry, Foxhall Road, Brightwell, Suffolk;
- Sinks Pit Quarry, off the A1214, Kesgrave, Suffolk;
- Waldringfield Quarry, Waldringfield Road, Brightwell, Suffolk;
- Thorington Quarry, Park Farm, off the A12, Thorington.

The guidance has been revised by LAQM.TG4(00) and the following assessment is based on the amended First Stage guidance. Guidance in LAQM.TG4(00) advises that:

- if there are relevant locations for public exposure (as defined in chapter 2) within 400-1000m of the dust emission sources, there should be no need to proceed further if the estimated 2004 annual mean background PM_{10} concentration is below 26 $\mu g/m^3$ (gravimetric);

- if there are relevant locations within 200-400m of the dust emission sources, there should be no need to proceed further if the estimated 2004 annual mean background PM_{10} concentration is below 25 $\mu g/m^3$ (gravimetric);

- where there are relevant locations for public exposure closer than 200m to the source, authorities are advised to investigate whether any dust nuisance complaints have been reported as this may indicate the existence of potential problems. The absence of complaints in an area cannot be used as a definitive method of determining that the objective will not be exceeded and authorities are advised to take account of local background levels and their own professional judgement, based on a visual inspection of the operations.

Each of the quarries has receptor locations in the form of domestic properties within 1000m. A summary for each quarry of proximity to receptor sites, estimated annual mean background PM_{10} concentrations for 2004 (derived from the National Air Quality Archive), and receipt of complaints can be seen in Table 27 below:-

Table 27 Data necessary for review and assessment of the four quarries within the Suffolk Coastal District

Site	Number of receptor locations within 0-200m of the site (distance to nearest receptor where applicable)	Number of receptor locations within 200-400m of the site	Estimated annual mean background PM_{10} concentration for 2004 in $\mu g/m^3$ (gravimetric)	Receipt of any complaints within the last 5 years
Foxhall Four Quarry	0	2	23.4	NO
Sinks Pit Quarry	19 (~15m)	25 (including Kesgrave High School)	23.0	YES
Waldringfield Quarry	0	5	22.9	NO
Thorington Quarry	0	1	22.7	NO

Table 27 shows that Foxhall Four Quarry, Waldringfield Quarry and Thorington Quarry do not have any receptor locations within 200m of the site. Each of them has receptor locations within 200-400m of the site. The estimated 2004 background PM_{10} concentrations for the three sites are below 25 $\mu g/m^3$ (gravimetric), specifically 23.4 $\mu g/m^3$ (gravimetric), 22.9 $\mu g/m^3$ (gravimetric) and 22.7 $\mu g/m^3$ (gravimetric) respectively. The Council has not received any complaints relating to dust from any of the three sites within the last five years. Visual inspection of the sites has also failed to identify any potential dust problems at the nearest receptor locations. It is evident that operations at these three quarries do not meet the revised criterion for progression to the Second Stage. Further review and assessment of these quarries as a source in isolation will not be necessary.

With regard to Foxhall Four Quarry there are potential combined impacts of emissions from quarrying activities with those from White Mountain Roadstone Limited sited within the quarry, A12 traffic and uncontrolled and fugitive emissions from the Foxhall Landfill Site. These combined impacts are considered in section 7.4.16 later in this chapter.

Table 27 shows that Sinks Pit Quarry has 19 receptor locations within 100m of the site, the nearest boundary at only 15m. There are an additional 25 receptor locations, including Kesgrave High School, within 200-400m of the site. The estimated 2004 background PM_{10} concentration for the site is below 25 $\mu g/m^3$ (gravimetric) at 23.0 $\mu g/m^3$ (gravimetric). The Council has received a number of complaints relating to dust from the quarry within the last five years.

There are also potential combined impacts of emissions from quarrying actives with those from Roadworks (1952) Limited, sited within the quarry. These are considered in section 7.4.17 later in this chapter.

Therefore, it is evident that further investigation into the impacts of quarrying activities from Sinks Pit Quarry is needed. This will be in the form of Second Stage and, if necessary, Third Stage investigations.

7.4.10 Review and assessment of current annual average background concentrations of secondary particulates in excess of 8 $\mu g/m^3$

Suffolk Coastal District Council's First Stage Review and Assessment Report identified the current annual mean background concentration due to secondary particulates across the whole of the Suffolk Coastal District was identified as being in excess of 8 $\mu g/m^3$ (information taken from the National Air Quality Archive). The pollutant specific guidance at the time, LAQM.TG4(98), advised that this could lead to an exceedance of the air quality objective for PM_{10} of 50 $\mu g/m^3$ measured as the 99th percentile of daily maximum running 24-hour averages.

This objective has since been revised as the standard was thought to be unachievable. The less stringent EU limit values of 50 $\mu g/m^3$ (gravimetric) as a fixed 24-hour mean with a maximum of 35 exceedances in a year has been adopted in its place. The pollutant specific guidance has subsequently been revised, LAQM.TG4(00). The 8 $\mu g/m^3$ secondary background concentration criterion is now no longer identified as a significant risk against the new less stringent air quality objective. Therefore, **further review and assessment will not be necessary,**

7.4.11 Review and assessment of high PM_{10} emission estimates in the town of Felixstowe, particularly at the Port of Felixstowe

In the First Stage Review and Assessment process the Council was required to identify any 1km x 1km grid squares in the district with low level dispersed sources emitting greater than 10 tonnes in 1996. This information was obtained from the National Atmospheric Emissions Inventory which forms part of the National Air Quality Archive available on the internet. The only grid square identified was at the Port of Felixstowe in the harbour which had estimated PM_{10} emissions in excess of 50 tonnes in 1996. This was, therefore, highlighted at Stage 1 as a potentially significant source of PM_{10} requiring further investigation in the Second Stage Review and Assessment.

A breakdown of sources for this grid square was obtained from the National Atmospheric Emissions Inventory which gives all of the emissions as arising from "other" sources. Clarification of this definition was sought from the DETR emissions help-line. "Other" sources for this area were determined to be derived from shipping.

PM_{10} emissions from shipping movements at the Port of Felixstowe have been discussed earlier in this chapter in section 7.4.8. **The above emission estimates indicate that further review and assessment of emissions from shipping will be necessary. This will be in the form of continued Second Stage and, if necessary, Third Stage investigations.**

7.4.12 Review and assessment of the planned development of a gravel extraction quarry alongside the A14 at Bucklesham

The planned development of a gravel extraction quarry at Bucklesham, within the Suffolk Coastal District, was highlighted at Stage 1 as a potentially significant source of PM_{10} requiring further investigation in the Second Stage Review and Assessment.

As for the four existing quarries within the Suffolk Coastal District, advice from the revised pollutant specific guidance LAQM.TG4(00) was used in order to undertake a review and assessment. See section 7.4.9 earlier in this chapter for details on this advised assessment procedure.

The site of the planned gravel extraction quarry was assessed, as in section 7.4.9, as if it was a currently working quarry. The pertinent information arising from this assessment is as follows:

- there are receptor locations within 1000m of the quarry;
- there are four receptor locations within 200-400m of the quarry;
- there are three receptor locations within 0-200m of the quarry. The distance to the nearest receptor locations is ~ 40m;
- the estimated annual mean background PM_{10} concentration for 2004 (derived from the National Air Quality Archive) is 22.85 $\mu g/m^3$ (gravimetric);
- no quarrying activities have yet taken place and so we have received no dust complaints.

It can be seen from the above information that there are receptor locations within 200m of the planned site, however, the estimated 2004 background PM_{10} concentration is below 25 $\mu g/m^3$ (gravimetric) at 22.85 $\mu g/m^3$ and, obviously, we have not received any complaints relating to dust to date.

We have also considered whether there is the possibility of PM_{10} emissions from vehicular traffic on the A14 combining with potential quarry emissions. Emissions from traffic need only be considered at a distance of up to 200m from the road. There are two receptor locations which fall at ~ 300m from the proposed quarry boundary and are also within 200m from the A14, the actual distance being 84m.

The DMRB model has been run for these properties, see section 2.1 in chapter 2 for model details. The resulting PM_{10} emissions from the A14 for these receptor locations is 0.55 $\mu g/m^3$ (gravimetric). When this is added to the estimated 2004 background PM_{10} concentration, a total concentration of 23.4 $\mu g/m^3$ (gravimetric) is found. This level is still below the 25 $\mu g/m^3$ (gravimetric) criterion stated within LAQM.TG4(00).

At the present time, the Council's conclusions are that operations at the quarry, including additional PM_{10} emissions from the A14 trunk road, do not meet the criterion in LAQM.TG4(00) for progression to the Second Stage and further review and assessment will not be necessary. However, at such time that the quarry site becomes active and if any dust complaints are received from relevant receptor locations, the Council will undertake further investigations.

7.4.13 Review and assessment of traffic using the A1152, including specifically the crossroads at Melton where the A1152 & B1438 intersect

Concerns have been raised from the consultation process to date regarding emissions from traffic using the A1152 and, specifically, the Melton crossroads where the A1152 & B1438 intersect. These concerns are regarding increased future traffic flows using the A1152 and the Melton crossroads due to the planned development of the former RAF Bentwaters air-base at Rendlesham and the St Audry's development at Melton.

Planned development of the former RAF Bentwaters air-base includes the building of housing and related village centre activities, together with new miscellaneous commercial buildings and the letting of the existing Mission Support building for commercial activities. To date, the Mission Support building, which would account for a substantial percentage of the increased traffic, has not been let. The housing is predicted to the available for occupancy in 2002 and associated village activities are unlikely to be viable until this is underway.

The planned St Audry's development at Melton is predominantly residential and includes sports and social activities associated with this use. There are also a small number of commercial buildings planned for the site.

Taking the above into consideration, which is highly dependant on market forces, Suffolk Coastal is unable at this time to realistically estimate annual average daily traffic flows for the end of the year 2004. The Suffolk County Council Environment & Transport Department has been able to provide traffic counts taken several years ago for points along the A1152 and the B1438 at Melton, however, in order to run the DMRB model, 2005 traffic predictions are needed. Our aim is to obtain traffic predictions for the year 2005 in order to carry out further review and assessment of these road segments.

This Second Stage Review and Assessment has indicated that continued investigation of future and predicted PM_{10} levels from traffic using the A1152 and, in particular, Melton crossroads, will be necessary. **Suffolk Coastal District Council concludes that further review and assessment of these emissions will be necessary. This will be in the form of continued Second Stage and, if necessary, Third Stage investigations.**

7.4.14 Review and assessment of emissions from traffic monitored at three kerbside locations within the Suffolk Coastal District with elevated levels of NO_2

Suffolk Coastal District Council currently monitors NO_2 levels from road traffic using diffusion tubes at a number of sites within the District, see Appendix C for results. Review and assessment of recorded NO_2 levels seen at monitoring sites indicates that there are three sites which require further investigation: High Road West, Felixstowe; Lime Kiln Quay Road/The Thoroughfare/St John's Street junction, Woodbridge; and the Melton crossroads. Further details on these investigations and findings can be seen in section 5.4.6 in chapter 5.

PM_{10} and NO_2 share road traffic as a common emission source and, therefore, it is suspected that PM_{10} levels may be similarly elevated at these sites.

Further investigation of these three sites will, therefore, be undertaken as for NO_2, see section 5.4.6. **This will be in the form of continued Second Stage and, if necessary, Third Stage investigations.**

7.4.15 Review and assessment of uncontrolled and fugitive emissions from four landfill sites within the Suffolk Coastal District

The revised pollutant specific guidance LAQM.TG4(00) advises that, in addition to quarrying activities, uncontrolled and fugitive emissions from other sources such as landfill sites should also be considered. In the Suffolk Coastal District, there are four current commercial landfill sites which require a First Stage review and assessment. These are:

- Grove Farm, Clopton, Suffolk, which landfills inert waste in the form of clay fillings;
- Sweffling Lagoons, Sweffling, Suffolk, which landfills treated sewage/ sewage sludge;
- Waldringfield Quarry, Waldringfield Road, Brightwell, Suffolk, which landfills the excavated quarry with inert waste;
- Foxhall Landfill Site, Foxhall Road, Brightwell, Suffolk, which landfills domestic, commercial, industrial and asbestos waste.

The assessment of landfill sites considers the same elements as assessment of quarries. Details of the process can be seen in section 7.4.9 earlier in this chapter.

Each of the landfill sites has relevant receptor locations in the form of domestic properties within 1000m. Each of the quarries has receptor locations in the form of domestic properties within 1000m. A summary for each quarry of proximity to receptor sites, estimated annual mean background PM_{10} concentrations for 2004 (derived from the National Air Quality Archive), and receipt of complaints can be seen in Table 28 below.

Table 28 Data necessary for review and assessment of the four landfill sites within the Suffolk Coastal District

Site	Number of receptor locations within 0-200m of the site (distance to nearest receptor where applicable)	Number of receptor locations within 200-400m of the site	Estimated annual mean background PM_{10} concentration for 2004 in $\mu g/m^3$ (gravimetric)	Receipt of any complaints within the last 5 years
Grove Farm, Clopton	0	8	22.7	NO
Sweffling Lagoons, Sweffling	0	4	22.7	NO
Waldringfield Quarry, Brightwell	0	5	22.9	NO
Foxhall Landfill Site, Brightwell	0	0	23.4	NO

Table 28 shows that the landfill sites at Grove Farm, Sweffling Lagoons and Waldringfield Quarry do not have any receptor locations within 200m of the site. They do, however, have receptor locations within 200-400m of the site. The estimated 2004 background PM_{10}

concentrations for the three sites are below 25 μg/m^3 (gravimetric), being 22.7 μg/m^3 (gravimetric), 22.7 μg/m^3 (gravimetric) and 22.9 μg/m^3 (gravimetric) respectively. The Council has not received any complaints relating to dust from any of the three sites within the last five years. Visual inspection of the sites has also failed to identify a potential dust problem at the nearest receptor locations. It is evident that operations at these three landfill sites do not meet the revised criterion for progression to the Second Stage and **further review and assessment of these landfill sites will not be necessary.**

From Table 28, it can be seen that Foxhall Landfill Site does not have any receptor locations within 400m of the site. It does, however, have receptor locations within 1000m of the site. The estimated 2004 background PM_{10} concentration for the site is below 26 μg/m^3 (gravimetric), being 23.4 μg/m^3 (gravimetric). The Council has not received any complaints relating to dust within the last five years. Visual inspection of the site has also failed to identify a potential dust problem at the nearest receptor locations. It is evident that operations at this landfill site do not meet the revised criterion for progression to the Second Stage and further review and assessment of this site as a source in isolation will not be necessary.

There are, however, potential combined impacts of emissions from landfill activities at Foxhall site with those from White Mountain Roadstone Limited, A12 traffic and uncontrolled and fugitive emissions from Foxhall Four Quarry. These combined impacts are considered in the next section of this chapter.

7.4.16 Review and assessment of the combined emission "footprint" of White Mountain Roadstone Limited, A12 traffic, Foxhall Four Quarry, and Foxhall Landfill Site

Review and assessment of White Mountain Roadstone Limited, A12 traffic, Foxhall Four Quarry and Foxhall Landfill Site as sources in isolation conclude that further review and assessment will not be necessary (see sections 7.4.1, 7.4.7, 7.4.9, and 7.4.15 earlier in this chapter respectively). However, due to the proximity of the four sources of PM_{10}, it is necessary to take account of their potential combined impact as the worst case scenario.

LAQM.TG4(00) does not provide advice on how to calculate combined impacts from this variety of sources. We have, therefore, considered firstly the combined impacts of annual mean emissions from White Mountain Roadstone Limited and the A12.

- 2004 annual mean background PM_{10} concentration (derived from the National Air Quality Archive):
  = 22.85 μg/m^3 (gravimetric)

- contribution of A12 road traffic emissions to the annual mean concentration (using the DMRB model):
  = 1.61 μg/m^3 (gravimetric)

- maximum peak annual average emissions from White Mountain Roadstone Limited:
  = 2.83 μg/m^3 (gravimetric)

- therefore, total annual mean PM_{10} concentration (addition of the above):
  = 22.85 + 1.61 + 2.83 = 27.29 μg/m^3 (gravimetric).

The guidance in LAQM.TG4(00) for progression of quarries and landfill sites to the Second Stage Review and Assessment where there are relevant receptor locations within 200-400m is dependant on annual mean background PM_{10} concentrations and receipt of dust

complaints by the local authority. We have decided to take the above calculated total annual mean PM_{10} concentration of 27.29 $\mu g/m^3$ as an annual mean background against which to compare the quarry and landfill sites. This background concentration is above 25 $\mu g/m^3$ and, therefore, LAQM.TG4(00) advises that further investigations be undertaken.

Due to the lack of present DETR guidance regarding emissions from this number and variety of sources, **Suffolk Coastal District Council concludes that further review and assessment will be necessary. This will be in the form of continued Second Stage and, where necessary, Third Stage investigations.**

7.4.17 Review and assessment of the combined emission "footprint" of Roadworks (1952) Limited and Sinks Pit Quarry

Review and assessment of Roadworks (1952) Limited as a source in isolation concludes that further review and assessment will not be necessary, see section 7.4.2 earlier in this chapter. Review and assessment of Sinks Pit quarrying activities, however, concludes that further review and assessment is necessary for the quarry, see section 7.4.9 earlier in this chapter.

It will be necessary, therefore, in continued investigations to consider emissions from Roadworks (1952) Limited, together with emissions from the quarry itself, as the worst case scenario.

Further review and assessment of these two combined sources will, therefore, be necessary. This will be in the form of continued Second Stage and, where necessary, Third Stage investigations.

7.5 Conclusion

This Second Stage Review and Assessment has identified that, for the following PM_{10} emission sources, the risk of the air quality objectives being exceeded at relevant locations in the Suffolk Coastal District is negligible and, therefore, **further review and assessment will not be necessary:**

- British Sugar plc, Sproughton, Ipswich, Suffolk;
- Ipswich Port Authority, Ipswich, Suffolk;
- Ipswich Hospital, Heath Road, Ipswich, Suffolk;
- Needham Chalks Limited, Needham Market, Suffolk;
- Traffic using the A14, A1156, A1214 and A12 roads;
- Waldringfield Quarry, Waldringfield Road, Brightwell, Suffolk;
- Thorington Quarry, Park Farm, off the A12, Thorington, Suffolk;
- Annual average background levels of secondary particulates in excess of 8 $\mu g/m^3$ over the entire Suffolk Coastal District;
- The planned gravel extraction quarry alongside the A14 at Bucklesham, Suffolk;
- Grove Farm Landfill Site, Clopton, Suffolk;
- Sweffling Lagoons Landfill Site, Sweffling, Suffolk;
- Waldringfield Quarry Landfill Site, Waldringfield Road, Brightwell, Suffolk.

This Second Stage Review and Assessment has identified that, for the following PM_{10} emission sources, there is a risk of the air quality objectives being exceeded at relevant locations in the Suffolk Coastal District and, therefore, **further review and assessment will be necessary:**

- Shipping at the Port of Felixstowe;

- Future predicted levels of traffic using the A1152, including specifically the crossroads of the A1152 and B1438 at Melton due to planned developments at the former RAF Bentwaters air-base, Rendlesham and St Audry's, Melton. This is to include elevated levels of NO_2 seen from the current monitoring site at the Melton crossroads;

- Emissions from traffic at High Road West, Felixstowe, and Lime Kiln Quay Road/Thoroughfare/St John's Street junction, Woodbridge ;

- The emission "footprint" of White Mountain Roadstone Limited, traffic using the A12 and uncontrolled and fugitive emissions from Foxhall Four Quarry and Foxhall Landfill Site at Brightwell, Suffolk;

- The emission footprint of Roadworks (1952) Limited and Sinks Pit Quarry, Kesgrave, Suffolk.

Further review and assessment of the above PM_{10} emission sources will be in the form of continued Second Stage (where applicable) and Third Stage review and assessment to determine the risk of exceedance of the air quality objectives at relevant locations more precisely.

8. Summary and Recommendations

8.1 Summary

Suffolk Coastal's First Stage Review and Assessment demonstrated that it is likely the air quality objectives for Benzene and 1,3-Butadiene will be met in the Suffolk Coastal District by the relevant target dates, and further review and assessment of these pollutants will not be necessary at the present time.

This Second Stage Review and Assessment has demonstrated that it is likely the air quality objectives for Lead and Carbon Monoxide will be met in the Suffolk Coastal District by the relevant target dates, and further review and assessment of these pollutants will not be necessary at the present time.

This Second Stage Review and Assessment has demonstrated, however, that there is a significant risk that air quality objectives for Nitrogen Dioxide, Sulphur Dioxide and Particulate Matter (PM_{10}) will not be met at locations within the Suffolk Coastal District by the relevant target dates. For the stated emission sources of these pollutants, further review and assessment will be necessary to determine the risk of exceedance more precisely:

Nitrogen Dioxide

- Traffic using the A14 trunk road.
- Traffic using the A1152, including specifically the crossroads of the A1152 and B1438 at Melton, due to planned developments at the former RAF Bentwaters air-base, Rendlesham, and St Audry's, Melton. This is to include elevated levels of NO_2 seen from the current monitoring site at the Melton crossroads.
- Emissions from traffic monitored at High Road West, Felixstowe and Lime Kiln Quay Road/Thoroughfare/St John's Street junction, Woodbridge using NO_2 diffusion tubes.

Sulphur Dioxide

- Shipping at the Port of Felixstowe.

Particulate Matter (PM_{10})

- Shipping at the Port of Felixstowe;
- Future predicted levels of traffic using the A1152, including specifically the crossroads of the A1152 and B1438 at Melton due to planned developments at the former RAF Bentwaters air-base, Rendlesham and St Audry's, Melton. This is to include elevated levels of NO_2 seen from the current monitoring site at the Melton crossroads.
- Emissions from traffic at High Road West, Felixstowe, and Lime Kiln Quay Road/Thoroughfare/St John's Street junction, Woodbridge.
- The emission "Footprint" of White Mountain Roadstone Limited, traffic using the A12 and uncontrolled and fugitive emissions from Foxhall Four Quarry and Foxhall Landfill Site at Brightwell, Suffolk.

- The emission footprint of Roadworks (1952) Limited and Sinks Pit Quarry, Kesgrave, Suffolk.

8.2 Recommendations

It is recommended that continued Second Stage Review and Assessment (where applicable), and Third Stage review and assessment be undertaken for the above mentioned emission sources of Nitrogen Dioxide, Sulphur Dioxide and Particulate Matter (PM_{10}) in the Suffolk Coastal District.

The Third Stage Review and Assessment will require a detailed and robust assessment of the potential impacts of emission sources and is likely to entail sophisticated modelling and monitoring tools. Suffolk Coastal District Council will also need to ensure that any assumptions within the Third Stage review and assessment process are considered in-depth and that the data collected and used are quality-assured to a high standard. The Council will need to identify both the magnitude and geographical extent of any exceedances of the objectives at this stage. Suffolk Coastal District Council will also need to have confidence that its decision to declare an Air Quality Management Area, or not, is soundly based.

9. References

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Appendix A

Summary of the Environment Agency Methodology (GN24)

(Taken from the Report on the Second Stage Review and Assessment of air quality in the Babergh District (April 2000))

ENVIRONMENT AGENCY METHODOLOGY (GN24)

The air dispersion model used in the production of GN24 is the Atmospheric Dispersion Modelling System (ADMS) developed by Cambridge Environmental Research Consultants Limited. ADMS is widely used in the United Kingdom and is an example of the new generation of air dispersion models developed in the last decade to take account of improvements in scientific understanding of atmospheric dispersion.

For the purposes of this Second Stage report, the results from the GN24 model have been used to:

- Judge the risk posed by industrial emission sources to the achievement of the Air Quality Strategy objectives and to decide if more detailed modelling and analysis are warranted.

- Identify appropriate distances over which air quality impacts are likely to extend from industrial stacks.

Accuracy of the GN24 Model

GN24 contains a set of look-up charts which use contours to summarise the results of computerised dispersion calculations for a wide range of release conditions. The charts are used to estimate the air quality impacts of stationary industrial sources, as given by the maximum ground level concentration and its distance from the stack. A comparison of the GN24 screening method with separate computer calculations indicates an over-estimation of between 20% and 30% which provides one of a number of the conservative approaches taken.

Overview of the GN24 Model

- **Step 1: Case Definition** identifies specific situations for which estimated stack impacts are required and collates basic geographical and engineering information for each situation. It covers information on site and local area characteristics, air quality criteria, operational parameters and mass emission rates for each pollutant and situation of interest.

- **Step 2: Identification of Discharge Conditions** derives values of the discharges of heat and momentum in the stack plume for individual cases for use in later stages of impact estimation.

- **Step 3: Estimate of Pollutant Dispersion** uses look-up charts to estimate the maximum concentration contributed by the process to air pollution at ground level and of the distance of this maximum from the source.

- **Step 4: Ambient and Predicted Environmental Concentrations** is concerned with obtaining a value of the local ground level concentration of pollutant(s) due to other processes. This value is then added to the estimate of the maximum concentration contributed by the process to predict the maximum environmental concentration due to all sources.

- **Step 5: Definition and Evaluation of Groups** considers situations where the releases from a few stacks in the same area make a combined contribution to the predicted environmental concentration. Guidance is given on how to estimate the total ground level concentration on a conservative basis.

- **Step 6: Comparison with Air Quality Objectives**. The GN24 model can only be used to predict the annual mean and 99.9^{th} and 100^{th} percentiles of hourly mean ground level pollutant concentrations. These do not relate to all of the air quality objections for all pollutants. For comparison with other air quality objectives, GN24 and LAQM.TG4(00) provide some conservative factors for converting these impact values to the relevant criterion. Such a comparison leads to the decision concerning further investigation of industrial processes as part of a Third Stage review and assessment.

Limitations of the GN24 Method

GN24 applies primarily to situations where a stack(s) is releasing a gaseous or gas-like pollutant(s) with a buoyant plume(s) and where there are no significant nearby buildings or slopes to complicate dispersion. It is less applicable in other situations and, hence, it is necessary to check if any of the following apply:-

i) The stack is in an area where there are significant local variations in ground level, ie – where the ground rises above the stack height within a distance of 10 stack heights.

ii) The stack is near a building which rises to more than about 40% of the stack height and which lies closer than 5 stack height's distance from the stack.

iii) The pollutant in the release comprises particles with diameters of more than a few tens of micrometres. Such particles are large enough for their dispersion to be affected by settling under gravity, so that they are not dispersed in the assumed gas-like manner.

iv) The bulk density of the efflux gases is significantly higher or lower than for air under the same conditions, or the release temperature is significantly below ambient air temperature.

v) The efflux heat and momentum are such that, when plotted on the look-up chart, the situation lies in the shaded region of the chart where there is additional uncertainty up to a factor of two associated with the results.

vi) The stack height is outside the range covered, ie – outside the range 20 to 200 metres. If the stack exceeds 200m then this height should be used, although the user should bear in mind that the result will be conservative; however, it the stack is less than 20m, the guidance is inapplicable.

Conservatisms associated with the GN24 Model

The following are aspects of the method which, if applicable, will tend to over-estimate the impact of industrial sources, ie – to make it conservative:

- It may have been assumed, pessimistically, that all the emitted pollutants are of a particular type, eg – that all oxides of nitrogen are nitrogen dioxide or that all particulates are PM_{10}.

- The stack height used may be lower than the true height because charts are only available for selected stack heights.

- The surface roughness used may be higher than the true roughness because charts are only available for selected surface roughnesses.

- The mass emission rate of pollutants may have been a “worst case” value which is unlikely to persist throughout the operating period of interest.

- The ambient concentration may already contain some contribution from stack impacts which would introduce an element of “double counting” into the predicted environmental concentration.

- It may have been assumed, pessimistically, that high-percentile events in the series of ambient concentrations occur at the same time as high-percentile events in the series of process contributions.

- When reading the chart, it may have been necessary to estimate the value of concentration by extrapolating upwards to the nearest highest contour value.

Uncertainties associated with the GN24 Model

The following are aspects of the method which, if applicable, will tend to make the estimated predicted environmental concentration vary from the true value but not always in the same direction (more or less); these aspects are, therefore, uncertainties:

- Uncertainties in the discharge data.

- Uncertainties associated with meteorological data for three reasons. Firstly, because the Meteorological Type chosen may not be very representative of the stack locality, Secondly, because of meteorological variations from year to year. Thirdly, because the charts are based on statistically grouped meteorological data (rather than on ungrouped sequential data) which introduces an extra uncertainty.

- Tests of the human error associated with reading from the charts indicate that most users can read to within 10% but that larger errors can occur, ie – mostly within 20% but up to a factor of two in extreme cases.

- The value read from the charts may come from the area shaded grey in the lower part of each chart where release temperatures are close to ambient and an extra uncertainty of up to a factor of two may arise.

- The estimates will be affected by the uncertainties inherent in all atmospheric dispersion modelling. These inherent uncertainties tend to be lower for long-term statistics such as annual means, and higher for short-term statistics such as 100th percentiles of 1-hour averages. It is difficult to generalise but, for new-generation models, these inherent uncertainties are likely to be in the order of a few 10s of percent for long-term estimates and may approach a factor of two for short-term estimates.

Input Information used in the Review and Assessment

The data inputs used for the Second Stage review and assessment were derived from emissions databases supplied by the businesses concerned and the Environment Agency's Emissions Inventory, which is available on the internet (at http://193.122.103.90/WIYBY/html/h_isr.htm). The detailed information used for each process included:

- Stack heights, efflux velocities, volume flow rates, stack gas temperature, number of flues and flue diameters.

- Exact locations for each process and building dimensions, ie – those buildings associated with the industrial process.

- Pollutant emissions from each stack.

- Operational characteristics of the processes.

In some instances, where data inputs were not available, it was necessary to use assumptions. These were only made after careful consideration. In all cases, the assumptions were supported from other sources or were adopted with the precautionary approach in mind.

Other information required for the GN24 method includes a value for surface roughness and meteorological data. The former accounts for the turbulence of air movements caused by obstacles, such as buildings on the ground, whilst the latter reflects that different meteorological conditions prevail in different parts of the United Kingdom. The only stacks modelled using GN24 were at British Sugar plc, Sproughton and, therefore, meteorological data used were "Type 2" (locations within 10km of the east coast of Britain), with a surface roughness of 0.5 (defined as "parkland, open suburbia").

The calculation of efflux heat and momentum was required for each stack so that the look-up charts could be used. Where a multi-flue stack required assessment, it was also necessary to combine the discharge conditions for the screening model, ie – the volume flow rates and emissions combined through a flue of equivalent diameter. The dimensions and number of individual flues in the stack determine the equivalent radius.

It should be noted that present day industrial emissions information was used for the purposes of the screening model. This again provides a conservative approach since it assumes that there will be no reduction in emissions between now and the future target date of the air quality objective of concern.

Appendix B

Traffic data obtained from Suffolk County Council, Environment & Transport Department, for input into the Design Manual for Roads and Bridges Model

Table B-1 Traffic data from Suffolk County Council, Environment & Transport Department, used within the Design Manual for Roads and Bridges Model

Road Link Description	Road Link reference	AADTF 2000	AADTF 2003	AADTF 2004	AADTF 2005	% Heavy Duty Vehicles	Average Speed (km/hr)
A14, from Dock Spur roundabout at Felixstowe to the A12 junction at Nacton	A14, Link 1	30,466	31,968	32,472	33,000	19.7	96
A14, from the A12 junction at Nacton to beyond the Ipswich Borough boundary at the Orwell Bridge	A14, Link 2	47,141	49,944	50,760	51,576	17.9	101
A1156 from the A12/A14 junction at Nacton to the Ipswich Borough boundary at Purdis Farm	A1156, Link 1	22,386	23,472	23,856	24,240	3.6	59
A12, from the A14 junction at Nacton through to the B1438 Woodbridge roundabout	A12, Link 1	27,430	28,776	29,232	29,712	7.1	86
A12, from the B1438 Woodbridge roundabout to the B1116 junction at Wickham Market	A12, Link 2	24,509	25,704	26,112	26,544	7.3	78
A12, from the B1116 junction at Wickham Market to the A1094 turn-off to Snape and Aldeburgh at Farnham	A12, Link 3	15,149	15,888	16,152	16,416	8.5	106
A1214, from the A12 junction at Martlesham Heath to the first Grange Farm roundabout at Kesgrave.	A1214, Link 1	21,239	21,816	22,008	22,224	4.5	55
A1214, from the first Grange Farm roundabout to the Ipswich Borough boundary at Rushmere	A1214, Link 2	27,624	28,368	28,608	28,896	4.5	55

Note: for modelling purposes, Suffolk County Council does not predict significant changes in percentage of Heavy Duty Vehicles or average speeds over the period specified in the table.

Appendix C

Monthly Nitrogen Dioxide air quality concentrations recorded at four sites within Felixstowe, Kesgrave, Woodbridge, Leiston, Farnham and Melton since 1993

Some sites have been existing since 1993, others have been added since then, and one group of sites (Leiston) are now discontinued.

TABLE C-1 **MONTHLY NITROGEN DIOXIDE CONCENTRATIONS RECORDED AT FOUR SITES IN FELIXSTOWE 1993 - 1996**

		TIME IN MONTHS												Annual Average (ppb)	Conversion to ug/m3	Conversion to 2005 concentration (ug/m3) *
YEAR	SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC			
1993	**FLX 1**	no data	no data	no data	23.6	21.2	16.9	16.8	18.4	21.4	18.8	no data	27.2	**20.5**	**39.16**	**N/A**
	FLX 2	no data	no data	23.4	15.6	no data	no data	16.6	17	14.8	12.8	23.9	26	**18.8**	**35.91**	**N/A**
	FLX 3	no data	no data	19	15.6	10.6	7.4	13.2	13.8	12.3	11.2	20.8	21.9	**14.6**	**27.89**	**N/A**
	FLX 4	no data	no data	21.4	No data	10.8	8.8	11.9	13.2	12.6	10.8	21.3	23.5	**14.9**	**28.5**	**N/A**
1994	**FLX 1**	30.5	31.8	28.1	23.6	23.2	22.5	24.2	20.7	22.3	28.9	31.6	36.9	**27.0**	**51.57**	**N/A**
	FLX 2	26.7	24.8	23.2	18.1	13.9	16.1	18.2	14.4	19.7	26.3	26.6	26.5	**21.2**	**40.49**	**N/A**
	FLX 3	24.7	21.8	20	13.6	16.4	13.4	13.3	10.3	13.9	18.3	20.1	22.6	**17.4**	**33.23**	**N/A**
	FLX 4	23.1	21.7	20.1	15.3	10.2	11.3	12.6	10.7	13.1	21.9	22.2	22	**17.0**	**32.47**	**N/A**
1995	**FLX 1**	25.9	27.5	25.7	17.2	22.5	18.2	24.9	23.2	25.7	24.4	28.3	25.9	**24.1**	**46.03**	**N/A**
	FLX 2	21.9	24.7	22.2	No data	18.9	11.3	16.6	12.1	17.7	21.2	20.3	20.3	**18.8**	**35.91**	**N/A**
	FLX 3	19	20.2	13.4	10.8	14.4	10.9	13	8.7	14.9	11.3	19.9	18.6	**14.6**	**27.89**	**N/A**
	FLX 4	19	21.6	16.7	9.9	15	9.1	14.8	9.5	14.5	13.8	21.5	20	**15.5**	**29.61**	**N/A**
1996	**FLX 1**	no data	24.2	25.2	27.9	19.2	no data	21.6	no data	no data	29.7	30.7	20.7	**24.9**	**47.56**	**37.57**
	FLX 2	21.5	17.3	14.4	21.2	14.5	no data	17	16.4	12.3	24.6	24	17.5	**18.2**	**34.76**	**27.46**
	FLX 3	18.7	16.4	12.8	16.7	11.5	10.2	12.5	12.5	10.3	no data	25.4	18.5	**15.0**	**28.65**	**21.2**
	FLX 4	17.3	17.3	14.2	18.9	10.6	11	12.4	14.5	11.4	23	no data	15.1	**15.1**	**28.84**	**21.34**

KEY: **FLX 1** Kerbside site, kerbside lampost outside Police Station, High Road West
FLX 2 Intermediate site, drainpipe on Police Station drainpipe, High Road West
FLX 3 Background site, lampost outside 14 Princes gardens (changed from hanging basket on 14 Princes Gardens in October 1996)
FLX 4 Background site, lampost outside 37 Lynwood Avenue (changed from Ranelagh Road Veterinary car park in October 1996)

* Conversion of 2000 concentration to 2005 concentration using correction factors in LAQM.TG4(00).
For kerbside and intermediate sites the conversion calculation is; measured 2000 NO2 concentration x (0.79 / 0.92)
For background sites the conversion calculation is; measured 2000 NO2 concentration x (0.74 / 0.90)

TABLE C-2 **MONTHLY NITROGEN DIOXIDE CONCENTRATIONS RECORDED IN 1997**

SITE	TIME IN MONTHS												Annual Average (ppb)	Conversion to ug/m3	Conversion to 2005 concentration (ug/m3) *
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC			
FLX 1	31.3	27.8	no data	12.9	5.61	11.05	8.02	10.13	8.1	17.97	16.23	12.77	**14.72**	**28.12**	**22.9**
FLX 2	26.8	22.5	21.7	8	5.47	7.74	6.66	7.67	7.67	8.83	18.27	15.38	**13.06**	**24.94**	**20.31**
FLX 3	17.9	27.7	22.2	9.9	6.83	7.55	6.41	7.45	8.97	6.51	15.97	16.15	**12.80**	**24.45**	**18.85**
FLX 4	29.2	28.1	23.4	8.6	5.67	4.58	5.75	9.46	7.58	7.68	12.32	13.35	**12.97**	**24.77**	**19.09**
KSG 1	no data	no data	no data	7.3	8.24	10.04	11.3	10.37	8.95	14.83	11.15	13.8	**10.66**	**20.36**	**16.58**
KSG 2	no data	no data	no data	8.5	5.09	6.49	5.87	8.99	6.57	no data	10.02	no data	**7.36**	**14.06**	**11.51**
KSG 3	no data	no data	no data	7	4.54	6.37	3.54	7.87	5.72	6.86	10.46	12.53	**7.21**	**13.77**	**10.61**
KSG 4	no data	no data	no data	no data	5.48	5.87	6.08	8.11	6.81	7.37	no data	no data	**6.62**	**12.64**	**9.74**
WBG 1	no data	no data	no data	16.1	7.25	14.23	13.29	14.25	11.17	10.11	14.45	6.06	**11.88**	**22.69**	**18.48**
WBG 2	no data	no data	no data	no data	7.32	3.76	7.7	9.87	8.03	10.19	9.34	10.47	**8.34**	**15.93**	**12.97**
WBG 3	no data	no data	no data	6.4	5.03	no data	4.92	6.34	5.53	3.31	15.49	9.24	**7.03**	**13.43**	**10.35**
WBG 4	no data	no data	no data	no data	4.53	5.64	6.3	6.25	4.45	7.75	12.36	9.22	**7.06**	**13.48**	**10.39**
LEI 1	no data	no data	no data	15.5	no data	12.62	11.34	10.02	12	10.35	10.52	10.83	**11.65**	**22.25**	**18.12**
LEI 2	no data	no data	no data	6	7.3	5.51	6.76	5.51	no data	7.61	11.51	9.46	**7.46**	**14.25**	**11.61**
LEI 3	no data	no data	no data	6	5.42	5.36	no data	7.8	no data	6.52	10.44	10.45	**7.43**	**14.19**	**10.94**
LEI 4	no data	no data	no data	6.3	2.77	5.6	3.73	6.67	4.3	6.81	2.67	3.92	**4.75**	**9.07**	**6.99**

KEY:

FLX 1 Kerbside site, kerbside lampost outside Police Station, High Road West
FLX 2 Intermediate site, drainpipe on Police Station drainpipe, High Road West
FLX 3 Background site, lampost outside 14 Princes Gardens
FLX 4 Background site, lampost outside 37 Lynwood Avenue
KSG 1 Kerbside site, kerbside lampost outside 183 Main Road
KSG 2 Intermediate site, drainpipe on 181 Main Road (changed from drainpipe of 'Happy Shopper', 179 Main Road in November 1997)
KSG 3 Background site, lampost outside 1 Knights Lane, Grange Farm
KSG 4 Background site, Kesgrave high School, Main Road
WBG 1 Kerbside site, drainpipe on Suffolk Place, Lime Kiln Quay Road
WBG 2 Intermediate site, drainpipe on 97a Thoroughfare
WBG 3 Background site, lampost outside 8 Kingston Farm Road (changed from lampost outside 22 Westholme Close in July 1997)
WBG 4 Background site, Farlingaye High School, Ransom Road
LEI 1 Kerbside site, drainpipe on Cyds Cafe, 55 High Street
LEI 2 Intermediate site, garage guttering on The Bread Shop, High Street (changed from drainpipe on The Black Horse PH in July 1997)
LEI 3 Background site, lampost outside 17 Farrow Close (changed from lampost outside 19 Harling Way in October 1997))
LEI 4 Background site, Leiston High School, Seaward Avenue

* Conversion of 2000 concentration to 2005 concentration using correction factors in LAQM.TG4(00).
For kerbside and intermediate sites the conversion calculation is; measured 2000 NO_2 concentration x (0.79 / 0.92)
For background sites the conversion calculation is; measured 2000 NO_2 concentration x (0.74 / 0.90)

TABLE C-3 MONTHLY AVERAGE NITROGEN DIOXIDE CONCENTRATIONS RECORDED IN 1998

SITE	TIME IN MONTHS												Annual Average (ppb)	Conversion to ug/m3	Conversion to 2005 concentration (ug/m3) *
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC			
FLX 1	12.8	18.7	12.1	15.3	no data	no data	10.39	14.22	19.28	24.6	30.9	26.9	**18.52**	**35.37**	**29.73**
FLX 2	13	17.4	11.2	7.3	no data	no data	9.91	11.12	12	18.9	24.9	22.9	**14.86**	**28.38**	**23.85**
FLX 3	14.4	19.2	12	13.5	no data	no data	11.8	7.9	11.54	19.2	26.8	27.2	**16.35**	**31.23**	**24.85**
FLX 4	14.7	25.9	9.8	9.4	no data	no data	6.11	8.6	15.12	17.2	25.1	24.8	**15.67**	**29.93**	**23.82**
KSG 1	18.9	8.9	10.5	no data	no data	no data	8.89	no data	8.47	21.6	26.6	22.2	**15.76**	**30.1**	**25.3**
KSG 2	16.3	13.2	11	9	no data	no data	7.82	8.48	11.73	13.5	19.3	13.6	**12.39**	**23.66**	**19.88**
KSG 3	11.7	11	9.4	10	no data	no data	5.52	7.8	8.99	13.6	20.9	18.7	**11.76**	**22.46**	**17.87**
KSG 4	6.7	16.6	8.2	9.9	no data	no data	5.46	9.21	9.46	14.7	18.6	18.2	**11.70**	**22.35**	**17.78**
WBG 1	10.6	10.9	9.8	8.1	no data	no data	10.21	10.15	15.08	16.3	24.2	20.2	**13.55**	**25.88**	**21.75**
WBG 2	10.8	13.9	12	12.3	no data	no data	7.15	11.03	4.54	15	21	19.6	**12.73**	**24.31**	**20.43**
WBG 3	9.9	12.7	13.5	10.4	no data	no data	5.41	7.56	9.06	11.9	18.4	16.8	**11.56**	**22.08**	**17.57**
WBG 4	9.1	12.2	9.2	10.8	no data	no data	4.94	7.88	9.54	12.2	18.1	15.4	**10.94**	**20.9**	**16.63**
LEI 1	12.1	12.2	17.5	12.6	no data	no data	8.68	11.39	9.96	16.9	22.2	18.8	**14.23**	**27.18**	**22.84**
LEI 2	9.7	13.3	9.1	no data	no data	no data	6.65	8.06	7.11	10.6	18	14.6	**10.79**	**20.61**	**17.32**
LEI 3	9.3	11.8	10.8	8.4	no data	no data	6.62	6.47	8.27	9.6	15.7	15.2	**10.22**	**19.52**	**15.53**
LEI 4	9	11.7	6.7	9.1	no data	no data	4.57	4.95	8.51	8.8	11.6	14.2	**8.91**	**17.02**	**13.54**

KEY:

FLX 1 Kerbside site, kerbside lampost outside Police Station, High Road West
FLX 2 Intermediate site, drainpipe on Police Station drainpipe, High Road West
FLX 3 Background site, lampost outside 14 Princes Gardens
FLX 4 Background site, lampost outside 37 Lynwood Avenue
KSG 1 Kerbside site, kerbside lampost outside 203 Main Road (changed from 187 Main Road September 1998 and from 183 Main Road May 1998)
KSG 2 Intermediate site, drainpipe on 181 Main Road (changed from drainpipe of 'Happy Shopper', 179 Main Road in November 1997)
KSG 3 Background site, lampost outside 1 Knights Lane, Grange Farm
KSG 4 Background site, Kesgrave high School, Main Road
WBG 1 Kerbside site, drainpipe on Suffolk Place, Lime Kiln Quay Road
WBG 2 Intermediate site, drainpipe on 97a Thoroughfare
WBG 3 Background site, lampost outside 8 Kingston Farm Road (changed from lampost outside 22 Westholme Close in July 1997)
WBG 4 Background site, Farlingaye High School, Ransom Road
LEI 1 Kerbside site, drainpipe on Cyds Cafe, 55 High Street
LEI 2 Intermediate site, garage guttering on The Bread Shop, High Street (changed from drainpipe on The Black Horse PH in July 1997)
LEI 3 Background site, lampost outside 17 Farrow Close (changed from lampost outside 19 Harling Way in October 1997))
LEI 4 Background site, Leiston High School, Seaward Avenue

N.B. Concentrations for **May and June 1998** are missing due to tubes not being supplied for June and those from May therefore being over-exposed

* Conversion of 2000 concentration to 2005 concentration using correction factors in LAQM.TG4(00).
For kerbside and intermediate sites the conversion calculation is; measured 2000 NO2 concentration x (0.79 / 0.92)
For background sites the conversion calculation is; measured 2000 NO2 concentration x (0.74 / 0.90)

TABLE C-4 MONTHLY AVERAGE NITROGEN DIOXIDE CONCENTRATIONS RECORDED IN 1999

SITE	TIME IN MONTHS												Annual Average ppb	Conversion to ug/m3	Conversion to 2005 concentration (ug/m3) *
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC			
FLX 1	27.9	30.2	31	17.9	21.8	18.8	13.9	19.4	26.5	31.4	26.7	30.2	**24.64**	**47.06**	**40.41**
FLX 2	20.9	23.6	26.4	15.2	18.4	16	13.8	16.2	20.8	22.9	19.1	24.7	**19.83**	**37.88**	**32.53**
FLX 3	26.3	25.6	25.7	9.8	14.1	11.1	13.8	12.3	17.7	19.6	no data	25.7	**18.34**	**35.03**	**28.8**
FLX 4	18.8	20.6	23	9	15	10.3	9.7	11.7	16.6	20.3	16.5	24.9	**16.37**	**31.27**	**25.71**
KSG 1	21.5	23.8	24.4	16.1	16.2	no data	12.6	no data	16.6	21.1	22.8	25.4	**20.05**	**38.3**	**32.89**
KSG 2	15.7	17.1	17.5	12.1	12.6	11.5	10.2	11.8	12.5	16.4	14.9	15.2	**13.96**	**26.66**	**22.89**
KSG 3	16.6	18.6	no data	10.4	10.9	9	8	10.5	13.6	17.8	19.4	19.3	**14.01**	**26.76**	**22**
KSG 4	17	17.4	17.5	9.9	10.6	9.4	7.8	10.9	13.7	16.9	14.9	18.5	**13.71**	**26.19**	**21.53**
WBG 1	21.4	19.4	22.9	23.1	27.2	27.1	23.6	no data	29.5	25.5	30.8	no data	**25.05**	**47.85**	**41.09**
WBG 2	20.1	17.9	21	13.7	12.6	14.3	11.4	14.4	19.5	16.6	17.4	18.7	**16.47**	**31.46**	**27.01**
WBG 3	16.1	15.1	14.9	7.7	8.9	5.9	4.9	8.1	10.5	14.3	14.3	14.9	**11.30**	**21.58**	**17.74**
WBG 4	13.3	14.8	16.7	no data	9.2	9.9	6.7	8.7	13.8	17.8	15.5	18.1	**13.14**	**25.1**	**20.64**
LEI 1	19.2	no data	23.3	21.4	17	14.4	17.7	19.3	no data	no data	21.4	no data	**19.21**	**36.69**	**31.51**
LEI 2	15.8	12.1	18.4	8.4	9.2	7.2	6.8	9.4	10.6	13.6	14.6	no data	**11.46**	**21.89**	**18.8**
LEI 3	14.3	12.2	14.5	6.4	6.7	5.4	5	6.1	9	12.4	10.6	no data	**9.33**	**11.29**	**9.28**
LEI 4	11.1	9	13.9	6.6	7.1	6.3	no data	6.1	9.9	12	10.7	no data	**9.27**	**17.71**	**14.56**
FAR 1	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	23.5	**N/A**	**N/A**	**N/A**
FAR 2	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	**no data**	**no data**	**no data**
MEL 1	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	27	**N/A**	**N/A**	**N/A**
MEL 2	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	**no data**	**no data**	**no data**

KEY:

FLX 1 Kerbside site, kerbside lampost outside Police Station, High Road West
FLX 2 Intermediate site, drainpipe on Police Station drainpipe, High Road West
FLX 3 Background site, lampost outside 14 Princes Gardens
FLX 4 Background site, lampost outside 37 Lynwood Avenue
KSG 1 Kerbside site, kerbside lampost outside 203 Main Road (changed from 187 Main Road in September 1998 and from 183 Main Road in May 1998)
KSG 2 Intermediate site, drainpipe on 181 Main Road (changed from drainpipe of 'Happy Shopper', 179 Main Road in November 1997)
KSG 3 Background site, lampost outside 1 Knights Lane, Grange Farm
KSG 4 Background site, Kesgrave high School, Main Road
WBG 1 Kerbside site, signpost outside 89 Thoroughfare (changed from drainpipe on Suffolk Place, Lime Kiln Quay Road in April '99)
WBG 2 Intermediate site, drainpipe on 97a Thoroughfare
WBG 3 Background site, lampost outside 8 Kingston Farm Road (changed from lampost outside 22 Westholme Close in July 1997)
WBG 4 Background site, Farlingaye High School, Ransom Road
LEI 1 Kerbside site, lampost by The Black Horse, High street (changed from drainpipe on Cyds Cafe, 55 High Street in November 1999)
LEI 2 Intermediate site, garage guttering on The Bread Shop, High Street (changed from drainpipe on The Black Horse PH in July 1997)
LEI 3 Background site, lampost outside 17 Farrow Close (changed from lampost outside 19 Harling Way in October 1997)
LEI 4 Background site, Leiston High School, Seaward Avenue
LEISTON SITE DISCONTINUED AS FROM DECEMBER 1999
FAR 1 Kerbside site, 40 mph street sign, The Street (A12)
FAR 2 Background site, The Walled Garden (drainpipe), Park Road, Benhall
MEL 1 Kerbside site, traffic lights, Melton crossroads
MEL 2 Background site, drainpipe on 106 hall Farm Road (changed from lampost outside 15/17 Hall Farm Close)

* Conversion of 2000 concentration to 2005 concentration using correction factors in LAQM.TG4(00).
For kerbside and intermediate sites the conversion calculation is; measured 2000 NO_2 concentration x (0.79 / 0.92)
For background sites the conversion calculation is; measured 2000 NO_2 concentration x (0.74 / 0.90)

TABLE C-5 MONTHLY AVERAGE NITROGEN DIOXIDE CONCENTRATIONS RECORDED IN 2000

SITE	TIME IN MONTHS												Annual Average ppb	Conversion to ug/m3	Conversion to 2005 concentration (ug/m3) *
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC			
FLX 1	31.2	27.5	23.4	19.6	15.8	no data							**23.50**	**44.89**	**38.55**
FLX 2	26.9	26.1	19.8	14.4	12.5	14.6							**19.05**	**36.39**	**31.25**
FLX 3	26.4	23.8	20.2	14.1	12.9	12.9							**18.38**	**35.12**	**29.87**
FLX 4	24.9	22.8	17.3	12	8.9	10.8							**16.12**	**30.79**	**26.19**
KSG 1	26	21	21.5	15	12.3	14							**18.30**	**34.95**	**30.01**
KSG 2	17.2	11.7	15	11	10.1	10.7							**12.62**	**24.1**	**20.69**
KSG 3	20.5	16.7	15.8	9.8	9	10.2							**13.67**	**26.11**	**22.21**
KSG 4	21.2	16.7	15.3	10.1	8.7	8.5							**13.42**	**25.63**	**21.8**
WBG 1	no data	27.9	30.4	26.5	28.6	27.7							**28.22**	**53.9**	**46.28**
WBG 2	20.2	20.5	17.4	16.6	12.5	12.6							**16.63**	**31.76**	**27.27**
WBG 3	16.9	13.1	13.2	10.4	no data	7.2							**12.16**	**23.23**	**19.76**
WBG 4	17.4	17.1	14.9	9.6	8	9.4							**12.73**	**24.31**	**20.68**
FAR 1	28.8	20.1	24.7	19.5	21.1	16.7							**21.82**	**41.68**	**35.79**
FAR 2	13.2	10.3	8.2	6.7	5.4	5.3							**8.18**	**15.62**	**13.29**
MEL 1	30.3	25.9	24.5	23.3	26	25.8							**25.97**	**49.6**	**42.59**
MEL 2	16.4	13.1	10.5	8.4	6.7	7							**10.35**	**19.77**	**16.82**

KEY:

FLX 1 Kerbside site, kerbside lampost outside Police Station, High Road West
FLX 2 Intermediate site, drainpipe on Police Station drainpipe, High Road West
FLX 3 Background site, lampost outside 14 Princes Gardens
FLX 4 Background site, lampost outside 37 Lynwood Avenue

KSG 1 Kerbside site, kerbside lampost outside 203 Main Road (changed from 187 Main Road in September 1998 and from 183 Main Road in May 1998)
KSG 2 Intermediate site, drainpipe on 181 Main Road (changed from drainpipe of 'Happy Shopper', 179 Main Road in November 1997)
KSG 3 Background site, lampost outside 1 Knights Lane, Grange Farm
KSG 4 Background site, Kesgrave high School, Main Road

WBG 1 Kerbside site, signpost outside 89 Thoroughfare (changed from drainpipe on Suffolk Place, Lime Kiln Quay Road in April '99)
WBG 2 Intermediate site, drainpipe on 97a Thoroughfare
WBG 3 Background site, lampost outside 8 Kingston Farm Road (changed from lampost outside 22 Westholme Close in July 1997)
WBG 4 Background site, Farlingaye High School, Ransom Road

FAR 1 Kerbside site, 40 mph street sign, The Street (A12)
FAR 2 Background site, The Walled Garden (drainpipe), Park Road, Benhall

MEL 1 Kerbside site, traffic lights, Melton crossroads
MEL 2 Background site, drainpipe on 106 hall Farm Road (changed from lampost outside 15/17 Hall Farm Close)

* Conversion of 2000 concentration to 2005 concentration using correction factors in LAQM.TG4(00).
For kerbside and intermediate sites the conversion calculation is; measured 2000 NO_2 concentration x (0.79 / 0.90)

For background sites the conversion calculation is; measured 2000 NO_2 concentration x (0.74 / 0.87)

Appendix D

Further information regarding measured and modelling emissions of CO, NO_2, SO_2 and PM_{10} from British Sugar plc, Sproughton, Ipswich, Suffolk

Combustion Plant – Technical Information used for modelling all emissions

Sulphitation and Lime Kiln Plant – Technical Information used for modelling all emissions

Maximum 8-hour Carbon Monoxide contribution from Combustion and Sulphitation Plant at British Sugar Plc

Review and Assessment of the "Footprint" of dispersed emissions from British Sugar Plc, Sproughton and the A14. NO_2 section from Babergh District Council's Second Stage Review and Assessment Report

Annual Mean SO_2 contribution from Combustion and Sulphitation Plant at British Sugar Plc

99.9^{th} percentile SO_2 contribution from Combustion and Sulphitation Plant at British Sugar Plc

Annual Mean PM_{10} contribution from Combustion and Sulphitation Plant at British Sugar Plc

Table 3: British Sugar Plc, Combustion Plant – Technical Information used for Modelling Emissions

	Power Generation Boiler	Animal Feed Drying Process
Type	Aalborg Water Tube Steam Generation Boiler	Maxecon Shell Steam Boiler
Grid Reference	613500 244800	613500 244800
Environment Agency Reference	IPC Authorisation AA2224	IPC Authorisations AA224 and AG5927
Rating	49.8 MWth	8 MWth boiler and 24 MWth drier plant
Fuel type	Coal (Washed Smalls)	Heavy Fuel Oil (boiler)
Sulphur content	Max 1.3%	2.9% w/w maximum
Start-up time	80 hrs (based on two cold start ups per annum	72 hrs (based on six start-up's per annum)
Normal operating time	3552 hrs (based on average campaign length and steam trials	3306 hrs (based on historical information)
Abnormal operating time	24 hrs (based on statutory testing and historical information)	12 hrs (based on six emergency shutdowns)
Shutdown time	24 hrs (based on two normal shutdowns)	12 hrs (based on six start-up's per annum)
Stack height	52 m	52 m
Stack location	613632 244781	613632 244781
Number of flues	1 (one of two in multi-flue chimney)	1 (one of two in multi-flue chimney)
Internal diameter	1.65 m	1.67 m
Release temperature	155^{o} C (428K)	130^{o} C (403 K)
Flue efflux velocity	14.96 m/s	24.45 m/s
Carbon monoxide emission rate	0.59 g/s (measured)	N/A
Oxides of nitrogen emission rate	5.9 g/s (measured)	8.4 g/s (measured)
Total particulates emission rate	3.93 g/s (measured)	18.0 g/s (measured)
Sulphur dioxide emission rate	32.34 g/s	6.8 g/s (measured)

Table 4: British Sugar Plc, Sulphitation Plant and Lime Kiln – Technical Information used for Modelling Emissions

	Sulphitation Plant	Lime Kiln
Grid Reference	613500 244800	613500 244800
Environment Agency reference	IPC Authorisation AL8517	IPC Authorisation AI 0675
Start-up time	2 Hrs (based on annual start-up)	80 hrs (based on annual start-up)
Normal operating time	3480 hrs (based on average campaign length)	3480 hrs (based on average campaign length)
Abnormal operating time	0 hrs	0 hrs
Shutdown time	2 hrs (based on annual shutdown time)	80 hrs (based on annual shutdown time)
Stack height	23.5 m	17.5 m
Number of flues	1	1
Internal diameter	0.15 m	0.3 m
Release temperature	85^{o} C (358 K) average	54^{o} C (327K)
Flue efflux velocity	0-53.4 m/s. Mid-range value of 27.0 m/s used	17.2 m/s
Carbon monoxide emission rate	0.011 g/s (based on "worst case" 60 mg/m^3)	N/A
Oxides of nitrogen emission rate	0.0027 g/s (based on "worst case" 20 mg/m^3)	N/A
Total particulates emission rate	N/A	0.019 g/s
Sulphur dioxide emission rate	0.0083 g/s (based on "worst case" 50 mg/m^3)	N/A

Table 6: Maximum 8-hour Carbon Monoxide Contribution from Combustion and Sulphitation Plant at British Sugar Plc

	Combustion Plant	Sulphitation Plant
Actual stack height	52	23.5
Charted stack height	50	20.0
Surface roughness (m)	0.5	0.5
GN24 chart used	59	56
Efflux heat (MW)	9.24	0.034468
Efflux momentum (m^4/s^2)	1161.21	10.1837
Initial NGLC – amount ($ng/m^3/g/s$)	8180	120,000
Initial NGLC – distance (m)	525	50 (estimated)
Conversion required for 8-hour mean	Yes	Yes
Conversion factor – amount	0.7	0.7
Conversion factor – distance	2.0	2.0
Final NGLC – amount ($ng/m^3/g/s$)	5,726	8,400
Final NGLC – distance	1,050	100 (estimated)
Carbon monoxide emission rate (g/s)	0.59	0.011
Max. 8-hour concentration (ng/m^3)	3,378.34	92.4
Max. 8-hour concentration ($\mu g/m^3$)	3.378	0.092
Conversion of max. 8-hour concentration in $\mu g/m^3$ to mg/m^3 (x 1000)	0.003378	0.000092

6.7 **Review and Assessment of the "Footprint" of Dispersed Emissions from British Sugar Plc, Sproughton and the A14: Annual Mean Objective**

6.7.1 The proximity of the British Sugar factory to the A14 makes it necessary to take account of the potential combined impact of the different sources. The process of considering these impacts is detailed below.

6.7.2 The values of efflux heat and momentum calculated in paragraphs 4.9.2 and 4.10.2 have been used with the GN24 look-up charts to estimate the maximum ground level annual mean concentrations of NO_x from the Combustion and Sulphitation Plant and the distance from each stack to the maximum. Copies of Chart 34 (used for the Sulphitation Plant) and Chart 37 (used for the Combustion Plant) are attached at Appendix 1. The calculation of the maximum ground level annual mean concentration from each process is summarised in Table 11.

Table 11: Annual Mean NO_x Contribution from Combustion and Sulphitation Plant at British Sugar Plc

	Combustion Plant	Sulphitation Plant
Actual stack height	52	23.5
Charted stack height	50	20.0
Surface roughness (m)	0.5	0.5
GN24 chart used	37	34
Efflux heat (MW)	9.24	0.034468
Efflux momentum (m^4/s^2)	1161.21	10.1837
Initial NGLC – amount ($ng/m^3/g/s$)	136	3200
Initial NGLC – distance (m)	513	100 (estimated)
Conversion required for annual mean	No	No
Final NGLC – amount ($ng/m^3/g/s$)	136	3200
Final NGLC – distance	513	100 (estimated)
NO_x emission rate (g/s)	14.3	0.0027
Max. annual mean NO_x concentration (ng/m^3)	1944.8	8.64
Max. annual mean NO_x concentration ($\mu g/m^3$)	1.9448	0.00864

6.7.3 As the two stationary sources are close together on the same industrial site there is the potential for their impacts to combine. A conservative approach has been taken by summing the predicted maximum annual mean NO_x concentrations:

Combined annual mean NO_x concentration from Combustion and Sulphitation Plant = 1.9448 $\mu g/m^3$ + 0.00864 $\mu g/m^3$ = 1.95344 $\mu g/m^3$.

6.7.4 The combined emissions from these industrial sources will be in addition to the local background concentration in 2005. For assessment of the annual mean objective, the predicted combined maximum annual mean NO_x concentration arising from the stacks must be added to the 2005 annual mean background NO_x concentration. The highest 2005 annual mean background NO_x concentration in the Babergh district in the vicinity of the factory, derived from the National Air Quality Archive is 36.4 $\mu g/m^3$. The resulting annual

mean NO_x concentration is therefore equal to: 1.95344 µg/m^3 + 36.4 µg/m^3 = 38.35344 µg/m^3. For comparison with the air quality objective this has been converted to a total NO_2 concentration using the following empirical relationship, as specified in LAQM.TG4(00):

$y = 1.5358x^{0.7341}$
where y = annual mean NO_2 in µg/m^3
and *x* = annual mean NO_x in µg/m^3

i.e. the total annual mean $NO_2 = 1.5358 \times 38.3448^{0.7341}$
$= 22.33207$ µg/m^3

This is well below the annual mean objective of 40 µg/m^3 and as a source in isolation the British Sugar factory would not require further consideration. However, the potential combined impact with vehicular emissions from the A14 must be considered.

6.7.5 The predicted combined emissions from the two industrial sources of 1.95344 µg/m^3 as NO_x is only 5.4% of the 2005 background NO_x concentration (36.4 µg/m^3) and is therefore insignificant for the purposes of comparison with the air quality objective. It should also be noted that the combined annual mean concentration from the industrial sources has been calculated using instantaneous measurements of NO_x emission rates averaged out over a 12 month period. In reality, the annual sugar beet campaign at the British Sugar factory lasts for only 5 months, and the plant is shut down for the rest of the year. Although there will be seasonal variations in the annual mean concentration, a more realistic, albeit crude, estimate of the combined industrial emissions would therefore be: 1.95344 µg/m^3 x (5/12) = 0.81393 µg/m^3. This is even less significant when compared against the 2005 background NO_x concentration.

6.7.6 The nearest location in the Babergh district at which long-term exposure to the industrial emissions and the A14 traffic emissions might occur is Gipping Way, Sproughton, a distance of approximately 700 m east of the stacks. A conservative approach has been taken in this assessment by summing the predicted annual mean concentrations from the two industrial sources concerned. As a “worst case scenario” it could be assumed that the position of maximum combined impact occurs at the predicted final NGLC distance of 513 m from the Combustion Plant chimney. In reality this will not occur as the maximum annual mean concentration from the Sulphitation Plant is predicted to occur at approximately 100 m from the Sulphitation stack (refer to Table 11). At a distance of some 700 m the combined impact of the two stacks, which has already been shown to be insignificant, will be further reduced.

6.7.7 Finally, the prevailing winds near the British Sugar factory are from a south-westerly direction (as shown in Figure 1) which will tend to direct the plumes from the two stacks away from the A14 and Gipping Way, Sproughton. Although unquantified, this will have an impact in reducing the contribution from the stacks to the annual mean NO_2 concentration at these locations.

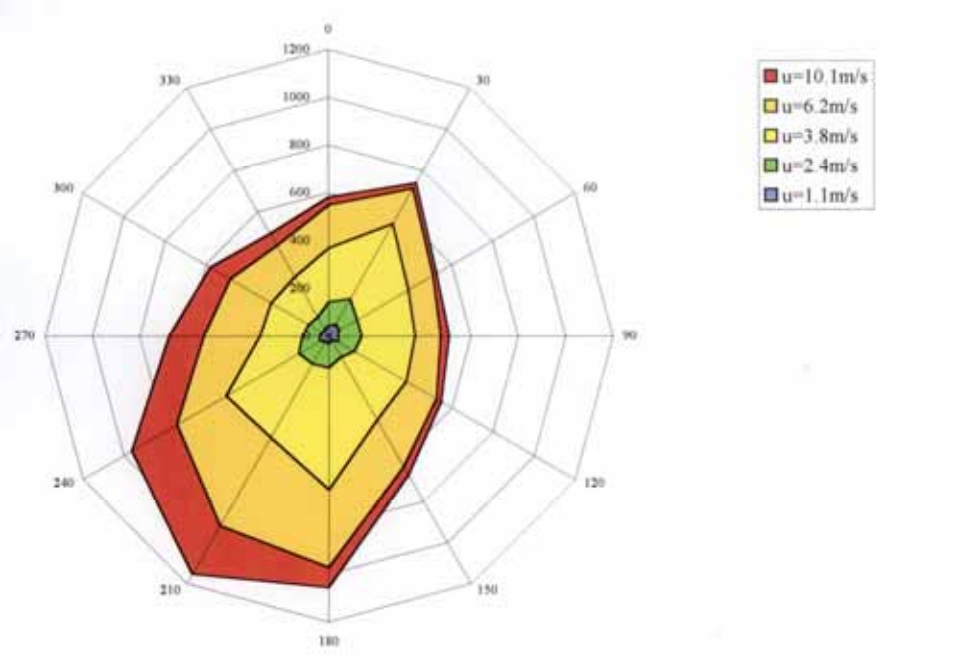

Figure 1: Wattisham 1997 Wind Rose

Wattisham is the nearest Meteorological Office site (with suitable records) to British Sugar Plc at Sproughton, situated approximately 15 km north-west of the factory. The wind rose shows the frequency of occurrence of wind from different directions for a number of wind speed ranges.

6.7.8 An overall assessment has indicated that, in terms of the annual mean objective, NO_2 emissions from the British Sugar factory are unlikely to combine significantly with vehicular emissions from the A14 to affect the nearest relevant locations in the Babergh district at Gipping Way, Sproughton. No further review and assessment of these combined sources is therefore required.

6.8 <u>Review and Assessment of the "Footprint" of Dispersed Emissions from British Sugar Plc, Sproughton and the A14: 1-Hour Mean Objective</u>

6.8.1 For comparison with the 1-hour mean objective, LAQM.TG4(00) states that the 99.8th percentile of 1-hour mean NO_x concentrations is equivalent to 0.93 times the 99.9th percentile (as predicted by GN24). The calculation of the maximum ground level 99.9th percentile concentrations from the Combustion and Sulphitation Plant using GN24 is summarised in Table 12. Copies of Chart 45 (used for the Sulphitation Plant) and Chart 48 (used for the Combustion Plant) are attached at Appendix 1.

6.8.2 Although it is unlikely that peak 1-hour concentrations from different stacks will overlap, the impacts from these two industrial sources have been combined in the following calculations as a "worst case scenario":

Combined 99.8th percentile of 1-hour NO_2 concentrations from Combustion and Sulphitation Plant = 32.98152 µg/m^3 + 0.2511 µg/m^3 =33.23262 µg/m^3.

Table 12: 99.8th Percentile NO_x Contribution from Combustion and Sulphitation Plant at British Sugar Plc

	Combustion Plant	Sulphitation Plant
Actual stack height	52	23.5
Charted stack height	50	20.0
Surface roughness (m)	0.5	0.5
GN24 chart used	48	45
Efflux heat (MW)	9.24	0.034468
Efflux momentum (m^4/s^2)	1161.21	10.1837
Initial NGLC – amount ($ng/m^3/g/s$)	2480	100,000
Initial NGLC – distance (m)	464	50 (estimated)
Conversion required for 99.9th percentile concentration	No	No
Final NGLC – amount ($ng/m^3/g/s$)	2480	100,000
Final NGLC – distance	464	50 (estimated)
NO_x emission rate (g/s)	14.3	0.0027
99.9th percentile NO_x concentration (ng/m^3)	35464	270
99.9th percentile NO_x concentration ($\mu g/m^3$)	35.464	0.27
99.8th percentile NO_x concentration ($\mu g/m^3$) = 99.9th percentile x 0.93	32.98152	0.2511

6.8.3 Since the Combustion Plant and Sulphitation Plant are both combustion processes the NO_x emissions will be primarily in the form of nitric oxide (NO) i.e. a ratio of about 95% NO : 5% NO_2. As the plumes are advected downwind, NO is oxidised to NO_2 at a rate that is determined by the rate that oxidants diffuse into the plumes. As a "worst case scenario", LAQM.TG4(00) therefore advises that it should be assumed that **all** NO_x emissions from these sources are converted to NO_2.

6.8.4 The highest hourly mean concentrations of NO_2 due to the impact of industrial sources would be expected when NO_x concentrations at the ground are elevated at the same time as oxidant concentrations, especially ozone (O_3). A simple approach is therefore to assume the limiting case is when the maximum NO_2 concentration is either the maximum ozone or the maximum NO_x from the stacks. The following approach, suggested in LAQM.TG4(00), has been taken to account for the background concentration:

- The 99.8th percentile of total oxidant concentrations (NO_2 + O_3) at the nearest national automatic monitoring station with 75% data capture in 1998 was derived from LAQM.TG4(00). In this case the nearest site to the British Sugar factory is Norwich City Centre and the 99.8th percentile of total oxidant concentrations was 129 $\mu g/m^3$ in 1998.

- The predicted combined 99.8th percentile from the two stacks (33.23262 $\mu g/m^3$) is less than the 99.8th percentile of total oxidant concentrations (129 $\mu g/m^3$). As the limiting factor is therefore the maximum NO_x from the stacks, the total NO_2 concentration can be assumed to equal the 99.8th percentile from the stacks plus a conservative estimate of the likely background NO_2 concentration during the worst hour, taken as twice the annual mean NO_2 value. The highest 2005 annual mean background NO_2 concentration

in the Babergh district in the vicinity of the factory derived from the National Air Quality Archive is 24.1 µg/m^3. The total NO_2 concentration is therefore equal to: 33.23262 µg/m^3 + (2 x 24.1 µg/m^3) = 81.43262 µg/m^3. This is well below the 1-hour objective of 200 µg/m^3 and as a source in isolation the British Sugar factory would not require further consideration. However, the potential combined impact with vehicular emissions from the A14 must be considered.

6.8.5 For the prediction of the 1-hour objective, LAQM.TG4(00) states that it can be assumed that peak hourly concentrations from stacks and ground level sources such as roads will not generally coincide. The estimated 99.8th percentile NO_2 contribution from the stacks should be added to twice the annual mean NO_2 contribution from the road and the background combined.

6.8.6 The nearest locations in the Babergh district at which short-term exposure to the industrial emissions and the A14 traffic emissions might occur are the gardens of houses on Gipping Way, Sproughton and the River Gipping public footpath east of the A14. The annual mean NO_2 contribution from the A14 combined with the background concentration at these locations has already been modelled using DMRB in paragraph 6.3.1 and the results displayed in Table 7, (Sites 13 and 14). The estimated total 99.8th percentile NO_2 concentration at these relevant locations is therefore:

- Gipping Way, Sproughton

NO_2 contribution from British Sugar factory =		81.43262 µg/m^3
NO_2 contribution from A14 + background =	33.55 µg/m^3 x 2 =	67.10000 µg/m^3
Total 1-hour mean NO_2 concentration in 2005 =		148.53262 µg/m^3

- River Gipping Footpath

NO_2 contribution from British Sugar factory =		81.43262 µg/m^3
NO_2 contribution from A14 + background =	58.44 µg/m^3 x 2 =	116.88000 µg/m^3
Total 1-hour mean NO_2 concentration in 2005=		198.31262 µg/m^3

6.8.7 The predicted concentration at both locations is below the 1-hour objective of 200 µg/m^3. Although the assessment for the River Gipping footpath is only marginally below the air quality objective, it should be noted that the objective is for the 1-hour mean not to be exceeded more than 18 times per year. In order to receive this maximum exposure a person would have to remain at a point on the footpath within 15 m of the A14 for at least one hour 18 times a year – this is highly unlikely to occur in reality. No further review and assessment of these combined sources is therefore required.

Table 15: Annual Mean SO_2 Contribution from Combustion and Sulphitation Plant at British Sugar Plc

	Combustion Plant	Sulphitation Plant
Actual stack height	52	23.5
Charted stack height	50	20.0
Surface roughness (m)	0.5	0.5
GN24 chart used	37	34
Efflux heat (MW)	9.24	0.034468
Efflux momentum (m^4/s^2)	1161.21	10.1837
Initial NGLC – amount ($ng/m^3/g/s$)	136	3200
Initial NGLC – distance (m)	513	100 (estimated)
Conversion required for annual mean	No	No
Final NGLC – amount ($ng/m^3/g/s$)	136	3200
Final NGLC – distance	513	100 (estimated)
SO_2 emission rate (g/s)	39.14	0.0083
Max. annual mean SO_2 concentration (ng/m^3)	5323.04	26.56
Max. annual mean SO_2 concentration ($\mu g/m^3$)	5.32304	0.02656

Table 16: 99.9th Percentile SO_2 Contribution from Combustion and Sulphitation Plant at British Sugar Plc

	Combustion Plant	Sulphitation Plant
Actual stack height	52	23.5
Charted stack height	50	20.0
Surface roughness (m)	0.5	0.5
GN24 chart used	48	45
Efflux heat (MW)	9.24	0.034468
Efflux momentum (m^4/s^2)	1161.21	10.1837
Initial NGLC – amount ($ng/m^3/g/s$)	2480	100,000
Initial NGLC – distance (m)	464	50 (estimated)
Conversion required for 99.9th percentile concentration	No	No
Final NGLC – amount ($ng/m^3/g/s$)	2480	100,000
Final NGLC – distance	464	50 (estimated)
SO_2 emission rate (g/s)	39.14	0.0083
99.9th percentile SO_2 concentration (ng/m^3)	97067.2	830
99.9th percentile SO_2 concentration ($\mu g/m^3$)	97.0672	0.83

Table 14: Annual Mean PM_{10} Contribution from Combustion Plant at British Sugar Plc

	Combustion Plant
Actual stack height	52
Charted stack height	50
Surface roughness (m)	0.5
GN24 chart used	37
Efflux heat (MW)	9.24
Efflux momentum (m^4/s^2)	1161.21
Initial NGLC – amount ($ng/m^3/g/s$)	136
Initial NGLC – distance (m)	513
Conversion required for annual mean	No
Final NGLC – amount ($ng/m^3/g/s$)	136
Final NGLC – distance	513
Total particulates emission rate (g/s)	21.93
Max. annual mean PM_{10} concentration (ng/m^3)	2982.42
Max. annual mean PM_{10} concentration ($\mu g/m^3$)	2.98248

Appendix E

Input data and results of ADMS-Screen modelling for NO_x, PM and CO emissions from the Ipswich Hospital Incinerator as carried out by Stanger Science and Environment on behalf of Ipswich Borough Council.

ADMS-Screen modelling for Ipswich Borough Council

The following is a summary of the concentrations for the pollutants requested, as predicted by ADMS-Screen. The results for each pollutant are presented as:

- The maximum 1-hour average; and
- The peak annual average.

The full output file produced by ADMS-Screen can be provided on request.

ADMS-Screen Modelling Input Data for stack

Stack height (m)	48.0
Stack diameter (m)	0.85
Temperature (°C)	135
Vertical velocity (m/s)	13
Building present	Yes
Height (m)	12
Length (m)	34
Width (m)	26

Results

Table 1 below shows the mass emission rates for each of the pollutants and the pollutant concentrations predicted by ADMS-Screen with a stack height of 48.0m.

Table E-1 Results

Pollutant	Mass emission rate (g/sec)	Max 1-hour mean ($\mu g/m^3$)	Distance downwind from source (m)	Meteor-logical conditions	Wind speed (m/sec)		Peak Annual Average ($\mu g/m^3$)	Distance of peak from source (m)	Direction of peak relative to source (°)
NO_x	0.492	10.33	82	vC	1.0		0.34	288	240
PM	0.00389	0.082	82	vC	1.0		0.0027	288	240
CO	0.028	0.588	82	vC	1.0		0.02	288	240

Note: 'vC' indicates Very Convective atmospheric stability.

Conversion of CO emissions from $\mu g/m^3$ to mg/m^3

Maximum 1-hour mean CO is 0.588 $\mu g/m^3$, to convert to mg/m^3 multiply by 1000 = 0.00058 $\mu g/m^3$

Peak annual average CO is 0.02 $\mu g/m^3$, to convert to mg/m^3 multiply by 1000 = 0.00002 $\mu g/m^3$

Appendix F

Further information regarding measured and modelled emissions of NO_2 and SO_2 from Carless Refining & Marketing Limited, Parkeston, Harwich, Essex

Highest recorded NO_x and SO_x emission concentrations from thermal units on site (recorded between February 1999 and August 1999)

Information on release parameters from thermal units on site provided by Carless Refining & Marketing Limited

Modelled ground level concentrations of NO_2 from Carless Refining & Marketing Limited using the UK-ADMS dispersion model (version 3)

Table F-1 Highest recorded NO_x and SO_x emission concentrations from thermal units on site (recorded between February 1999 and August 1999)

Emission component	Fuel employed	Highest Measured Concentration (mg/m^3) at standard reference conditions)							Achievable Release Conc (mg/m^3)
		Beverley A	Beverley B	Beverley C	Boiler 1	Boiler 2	Boiler 3	Boiler 4	
NO_x (as Nitrogen Dioxide)	Gas from vents	241	219	-	342	-	79	-	200
	Residue	181	217	336	279	258	-	270	200
	Natural Gas	-	-	-	-	155	104	-	140
SO_x (as Sulphur Dioxide)	Gas from vents	15	5	-	12	-	<1	-	35-200
	Residue	<1	14	9	<1	41 (<1 typical)	-	7	155
	Natural Gas	-	-	-	-	<1	4	-	5

(-) no measurements recorded
taken from Environment Agency IPC Guidance Notes S2 1.01 "*Combustion Processes: Large Boilers and Furnaces 50 MW(th) and over*", as referred to in IPC Guidance Note S2 1.10.

Table F-2 Information on release parameters from thermal units on site provided by Carless Refining & Marketing Limited

Parameter	Beverley A	Beverley B	Beverley C	Boiler 1	Boiler 2	Boiler 3	Boiler 4
Stack height (m)	24.4	24.4	24.5	24.4	26.2	7	7
Stack diameter (m)	1.25	1.25	0.62	0.46	0.61	0.25	0.45
Min efflux temperature (°C)	260	260	260	180	180	240	240
Max efflux temperature (°C)	480	480	480	330	330	260	260
Max volume flow rate (m^3/hr)	12630	12630	12630	8016	8016	1583	1583

Table F-3 Modelled ground level concentrations of NO_2 from Carless Refining & Marketing Limited using the UK-ADMS dispersion model (version 3)

Location	Modelled annual mean NO_2 concentration (ppb)	Conversion of modelled annual mean NO_2 concentration to $\mu g/m^3$ (x 1.91)
250m	7.4	14.13
500m	3.8	7.26

Appendix G

Summary table showing consultation responses received with respect to Suffolk Coastal District Council's First Stage Review and Assessment Report

Table G-1

Summary table showing consultation responses received (in broad categories) with respect to Suffolk Coastal District Council's First Stage Review and Assessment

Subject of response		Number of responses received
Traffic emissions	General A12 A1152, including Melton crossroads A14 A1120	1 2 4 1 1
Planned gravel extraction quarry at Bucklesham		1
Emissions from current working landfill operations		1
Emissions from the Port of Felixstowe		1
Emissions from agriculture		1
Emissions from landfill gas		1

Appendix H

Breakdown of shipping movements recorded at the Port of Felixstowe in 1998

(information provided by the DETR emission help-line operated by the Greater London Authority)

Table H-1

Breakdown of shipping movements recorded at the Port of Felixstowe in 1998 (information provided by the DETR emission help-line operated by the Greater London Authority)

Vessel description	Number of shipping movements recorded in 1998
Tankers from 1 - 4,999 tonnes	47
Tankers from 5,000 - 19,999 tonnes	21
Tankers from 20,000 – 100,000 tonnes	1
Roll-on-Roll-off vessels (ferry & cargo) from 1 – 4,999 tonnes	246
Roll-on-Roll-off vessels (ferry & cargo) from 5,000 - 19,999 tonnes	2,294
Roll-on-Roll-off vessels (ferry & cargo) from 20,000 – 100,000 tonnes	44
Fully cellular container vessels from 1 – 4,999 tonnes	298
Fully cellular container vessels from 5,000 – 19,999 tonnes	756
Fully cellular container vessels from 20,000 – 100,000 tonnes	1,738
Other dry cargo vessels from 1 – 4,999 tonnes	1,323
Other dry cargo vessels from 5,000 – 19,999 tonnes	343
Other dry cargo vessels from 20,000 – 100,000 tonnes	96
TOTAL SHIPPING MOVEMENTS	**7,207**

Appendix I

1km x 1km grid squares with an estimated 99.9th percentile of 15-minte mean SO_2 concentration above 160 $\mu g/m^3$ in 2005 in the Suffolk Coastal District.

Information from the National Air Quality Archive estimated by NETCEN.

Table I-1

1km x 1km grid squares with an estimated 99.9th percentile of 15-minte mean SO_2 concentration above 160 μg/m^3 in 2005 in the Suffolk Coastal District. (Information from the National Air Quality Archive estimated by NETCEN)

TM Grid Reference	Grid Square Description	99.9th percentile of 15-mintue mean SO_2 concentration (μg/m^3) for 2005
(6)265 (2)345	Port of Felixstowe harbour area	186.3
(6)275 (2)345	Port of Felixstowe harbour area	303.2
(6)285 (2)345	Port of Felixstowe harbour area	242.5
(6)295 (2)345	Port of Felixstowe harbour area	303.1