

Detailed Assessment - Modelling

The other major tool in assessing air quality is to use dispersion models. In the USA Design Manual for Road and Bridges (DMRB) Screening Model was used to predict the annual mean concentrations in 2004 at all relevant locations. In the Detailed Assessment a more sophisticated model was used as discussed previously.

Introduction

Modelling of air quality was undertaken in June 2004. The objective of the modelling is to ascertain whether specific residential properties could potentially receive concentrations of pollutants which breach current and future air quality objectives in the UK. The modelling involves the use of a complex computerised model called "BREEZE Roads" to derive the annual averaged Nitrogen Dioxide (NO₂) and Particulates (PM₁₀) concentrations at specific receptors (residential properties) adjacent to the street. The modelling results are compared to the UK objective concentrations for the pollutants NO₂ and PM₁₀ for specific objective years these are to be found in Table 1.

Modelling Methodology

The Sussex Air Quality Steering Group Project Development Officer, Nigel Jenkins, undertook modelling using the BREEZE Roads model on behalf of Lewes District Council.

Model

BREEZE Roads – is an advanced dispersion model, which is based on Gaussian plume theory. It requires an amount of input data: site characteristics, meteorological data, traffic information, emission factors, and background pollutant concentrations.

Input Data:

- **Modelling Years: 2004, 2005, 2010**
- **Meteorological data source: Gatwick (years 2003)**
- **Traffic data source: supplied by East Sussex County Council (ESCC)**
 - 1) AADT for the appropriate roads, the date when the data was gathered is stated.
 - 2) AADT projected growth rates supplied by ESCC.
 - 3) % HDV derived for traffic
 - 4) Average speed estimated due to limited data from observations and local knowledge

Background pollutant source:

- NO_x and NO₂ background concentrations were taken from the National Atmospheric Emissions Inventory (NAEI) web-site (www.naei.org.uk) for the grid squares that Fisher St. was within.

Emission factors (EF)

- 1) Vehicle emission factors were calculated using the “Emission Factors Toolkit” (Final_EF2002 EF Version2a.xls) The EF inputs were as follows:
- 2) Road type: Urban or Rural
- 3) %HGV :
- 4) Speed

Site characteristics

- 1) Road type: Urban or Rural
- 2) Road width
- 3) Road slope
- 4) Receptor height
- 5) Surface roughness length
- 6) Canyon effects was taken into account where appropriate.

Derivation of NO₂ from NO_x.

BREEZE Roads models NO_x concentrations that are contributed from the road sources i.e. NO_x (road). To produce an annual averaged concentration of NO₂ i.e. NO₂(total), the NO_x(road) values need to be converted to produce a NO₂(total) value. LAQM TG(03) guidance proposes an approach to deriving NO₂ from NO_x for traffic sources. This approach was adopted in the verification and subsequent modelling results to derive the final NO₂(total) concentrations at receptors.

The calculation formula is:

$$\text{NO}_2(\text{road}) = ((-0.068 * \ln(\text{NO}_x(\text{total}))+0.53) * \text{NO}_x(\text{road}))$$

N.B. NO_x (total) = Modelled NO_x(road) + background NO_x concentration.

$$\text{NO}_2(\text{total}) = \text{NO}_2(\text{road}) + \text{background NO}_2 \text{ concentration.}$$

Street Canyon Effect

BREEZE Roads models NO_x concentrations that are contributed from the road sources however there is no complex calculation for the effects of a street canyon in the model. LAQM TG(03) recommends doubling the NO₂ component (NO₂(road)) of the calculation to produce a canyon effected NO₂ concentration. This approach has been adapted for the modelling in Fisher Street, Southover High Street and Malling Street, Lewes. The above calculation is therefore adjusted as follows:

$$\text{NO}_2(\text{road}) = \mathbf{2x} ((-0.068 * \ln(\text{NO}_x(\text{total}))+0.53) * \text{NO}_x(\text{road}))$$

$$\text{NO}_2(\text{total}) = \text{NO}_2(\text{road} \mathbf{x2}) + \text{background NO}_2 \text{ concentration.}$$

Model verification and adjustment

Methodology

The verification of the modelled concentrations is required to ascertain the accuracy of modelled results at other modelled locations in Sussex. To do this modelled results are compared to ratified monitoring results over a number of years. The modelled NO_x and resulting NO₂ need to be adjusted by an adjustment factor to produce corrected modelled results for future years. All results were modelled at 1.8m.

NO_x adjustment factor:

The BREEZE Roads model was run for the years 2000, 2001, 2002 and 2003 at the Hove Town Hall AURN Air Quality Monitoring Station (AQMS) in Hove. The calculated NO_x concentrations were compared with NO_x measurements for each year. This comparison was based on the roadside contributions only (Table 6). The final NO_x adjustment factor was derived from the average of the years 2000, 2001, 2002 and 2003.

NO₂ adjustment factor:

To derive the NO₂ adjustment factor, the corrected NO_x results were used to recalculate the NO₂ results for 2000, 2001, 2002 and 2003. These were compared with NO₂ measurements for each year and the adjustment factor was calculated. This is given as the average of the years 2000, 2001 and 2002 (Table 7).

Table 6 NO_x verification results

Year	NO_x (µg/m³) Monitor Total	NO _x (µg/m ³) Background Contribution	NO _x (µg/m ³) Modelled Road Contribution	NO_x (µg/m³) Modelled Total	NO_x (µg/m³) Adjustme nt Factor
2000	77.1	43.7	14.8	58.5	1.24
2001	92.0	42.2	12.4	54.6	1.41
2002	68.7	40.5	11.2	51.7	1.25
2003	64.3	39.1	10.0	49.1	1.24
Avg	75.5	41.3	12.1	53.5	1.30

Table 7: NO₂ verification results

Year	NO _x ->NO ₂ Road Contribution	NO ₂ (µg/m ³) Background Contribution	NO ₂ (µg/m ³) Modelled	NO ₂ (µg/m ³) Monitored Total	NO ₂ (µg/m ³) Adjustme nt Factor
2000	4.3	26.0	30.3	35.79	1.15
2001	4.2	25.4	29.6	38.35	1.23
2002	3.4	24.7	28.1	33.5	1.16
2003	3.1	24.1	27.2	38	1.29
Avg	3.9	25.4	29.3	35.9	1.21

The adjustment factors used for modelling NO₂ in Sussex for future years is:

Correction Factor (CF¹):

NO_x = 1.30

NO₂ = 1.21

1. Complete NO₂ calculation.

The calculation method used for the modelling of future NO₂ concentrations is as follows. However, for several locations where we had local monitoring data the calculation was adjusted to provide a local correction factor. This is “fine tuning” to “calibrate” the model against the local monitoring data. Those adjustments are marked in *italic CF²*.

NO₂(total) =

1. **NO₂ (road) =((-0.068 *Ln(NO_x(total))+0.53) * NO_x(road)*NO_x(CF¹))**

2. **((NO₂ (road) * NO₂ (CF¹))*NO₂(canyon)* CF²) + NO₂ background**

Example

From (Fisherst_04NO_x10%16ka.rds) receptor 1 – Fisher04 DA modelling input data.xls

NO_x Background = 26.3
 NO₂ Background = 18.4
 NO_x CF¹ = 1.3
 NO₂ CF¹ = 1.21
 NO₂ Canyon = 2.00
 NO₂ CF² = 2.96

NOx modelled = 5.2µg/m³

Table 2: NO₂ calculation example.

NOx (road)	NOx (total) (required calc.)	NO₂ (road)	NO₂ (corrected)	NO₂ (Total)
Model result	(NOx(road)* NOx CF ¹) + Bkgrd	((-0.068 *Ln(NOx(total)) + 0.53) * NOx(road) * NOx(CF ¹) * NO ₂ (CF ¹)	((NO ₂ (road) * *NO ₂ (canyon) * Fisher St CF ²)	NO ₂ (corr) + NO ₂ backgrd
5.243814	(5.243814 *1.3) + 26.3	((-0.068 *Ln(33.12)) + 0.53) * 5.243814 * 1.3 * 1.18	((2.35) *(2) * (2.96))	13.91 +18.4
5.243814	33.12	2.35	13.91	32.31

NO₂(total) = **32.31**

We can supply on request all of these calculations for each site.

PM₁₀ Verification

Methodology

The verification of the modelled concentrations is required to ascertain the accuracy of modelled results at other modelled locations in Sussex. To do this modelled results are compared to ratified monitoring results over a number of years. The modelled PM₁₀ was validated against a ratified set of data from an Air Quality Monitoring Station (AQMS). Once this is undertaken future predictions of the modelled data can be adjusted by the correction factor to produce corrected modelled results for future years.

PM₁₀ correction factor (CF)

The BREEZE Roads model was run for the year 2002 (as at the time 2003 was not available Jan. 04) at the Lewes District Council Air Quality Monitoring Station (AQMS) at Telscombe Cliffs. The predicted PM₁₀ concentrations were compared with PM₁₀ measurements for the entire year. All results were modelled at 1.8m above ground and all measurements are in gravimetric equivalent concentrations in micrograms per cubic meter (µg/m³). This comparison was based on the roadside contributions only. The final PM₁₀ correction factor was derived from the following calculation:

$$\begin{aligned}
 \text{PM}_{10} \text{ CF} &= 2002 \text{ monitored roadside conc.} / 2002 \text{ modelled roadside conc.} \\
 &= 12.9/8 \\
 &= \mathbf{1.61}
 \end{aligned}$$

This factor is applied to all modelling results for PM₁₀.

Air Quality Modelling Locations

Air Quality modelling was undertaken (Map 1)

- Fisher Street, Lewes
- High Street, Fisher Street and Station Street junction, Lewes
- Malling High Street, Lewes
- Southover High Street, Lewes
- Southway, Newhaven
- A27 Newmarket Hill section between Lewes and Brighton

Fisher Street, Lewes

Modelling of Fisher Street was undertaken with BREEZE Roads to ascertain the NO₂ concentrations for 2004 and 2005 and for PM₁₀ in 2004 and 2010. The model output a grid of results adjacent to the road and at specific receptors, the results are the annual average concentration in µg/m³. The principle receptors were identified as residential properties along Fisher Street. These houses and flats were identified as being the closest residential properties that may be affected by air pollutants. The modelling results reflect the relative predicted pollutant levels at each property and identifies if any of these properties were estimated to either breach or be within a certain percentage of breaching the UK Air Quality Objectives (AQO).

The modelling inputs for these properties are:

Input Data

- Modelling Years: 2004, 2005, 2010
- Meteorological data source: Gatwick (years 2003)
- Traffic data source: East Sussex County Council (ESCC)
- AADT Fisher St for 2001 = 5282
- AADT High St for 2001 = 8880
- AADT projected growth rates supplied by ESCC: 2003 – 05.
- % HDV derived for traffic = 10%
- Average speed estimated due to limited data from observations and local knowledge = 10mph or 16kph.

Background pollutant source

NO_x and NO₂ background concentrations were taken from the National Atmospheric Emissions Inventory (NAEI) web-site (www.naei.org.uk) for the grid squares that Fisher St. was within.

Emission factors (EF)

Vehicle emission factors were calculated using the “Emission Factors Toolkit” (Final_EF2002 EF Version2a.xls). However as Fisher St is a one-way street. The majority of vehicles prior to entering it climb up a steep narrow incline (Station Road) with a traffic light controlled intersection, it was determined that, under advice from the

“Modelling Help-desk”, a lower speed emission factor would be needed to represent this location. Therefore sensitivity tests for the emission factor was undertaken at lower these were 8kph(5mph) and 5kph(3mph). The emission factor selected was the lower 5kph EF.

The EF inputs were:

Road type: Urban

- %HGV:10%, This figure was derived from data East Sussex County Council supplied.
- Speed8 kph

Site characteristics:

Road type: Urban

Road width: 7 m

Road slope: 0 m

Receptor height: 1.5 m

Surface roughness length: 1 m

Canyon effects were taken into account.

Fisher Street NO₂ correction factor

In addition to the “Sussex” adjustment factor for NO₂ being introduced into the calculated NO₂ concentration, a local correction factor was also introduced due to local monitoring data from 2003. NO₂ diffusion tube monitoring data was available for comparison with model runs that were made for 2003 input data (10%HGV at 5kph). The 2003 sensitivity modelling runs results, at the same location and height of the NO₂ diffusion tube, were compared with the 2003 (bias corrected) NO₂ annual average results and a correction factor was calculated. It is important to note that this correction factor was only applied for future model results in Fisher Street.

Fisher Street correction factor (CF²) for NO₂:

Correction factor = (NO₂ (tube) – NO₂ (background)) / NO₂(roads) result (corrected for canyon & NO_x and NO₂ factors)

NO₂ (CF²) = 2.926

The modelling results for these properties are summarised below.

Nitrogen dioxide

Modelling results at 16kph

- There were no predicted exceedances of the 40µg/m³ AQO at any property in 2004 or 2005.
- There were no properties with 10% (1 Std Dev) of the AQO
- There were 10 (2004) and 9 (2005) properties that were within 20% (2 Std Dev) of the AQO

Modelling results at 8kph

- There were no predicted exceedances of the 40µg/m³ AQO at any property in 2004 or 2005.
- All the properties in 2004 and 10 properties in 2005 were within 10% (1 Std Dev) of the AQO

Table 8: NO₂ modelling input summary

Modelling Inputs	Met. Yr	AADT avg. speed (kph)	Roads modelled	Modelled Years
Table 5	2003	16	Fisher St & High St	2004, 2005
Table 6	2003	8	Fisher St & High St	2004, 2005

Table 9: NO₂ modelling for Fisher St at 16kph

Fisher St Receptors	2004 NO ₂ (µg/m ³)	% within AQO (40µg/m ³)	2005 NO ₂ (µg/m ³)	% within AQO (40µg/m ³)
17	33.4	84%	33.2	83%
12	33.4	84%	33.2	83%
13	33.5	84%	33.2	83%
11	33.2	83%	33.0	82%
9	32.2	81%	32.0	80%
12	32.6	82%	32.4	81%
14	32.7	82%	32.5	81%
18	32.5	81%	32.3	81%
20	32.4	81%	32.1	80%
22	31.9	80%	31.7	79%
24	31.3	78%	31.1	78%

Table 10: NO₂ modelling for Fisher St at 8kph

Fisher St Receptors	2004 NO₂ (µg/m³)	% within AQO (40µg/m³)	2005 NO₂ (µg/m³)	% within AQO (40µg/m³)
17	38.93	97%	38.2	95%
12	38.89	97%	38.1	95%
13	38.999	97%	38.2	96%
11	38.609	97%	37.8	95%
9	37.219	93%	36.5	91%
12	37.809	95%	37.1	93%
14	37.909	95%	37.2	93%
18	37.609	94%	36.9	92%
20	37.429	94%	36.8	92%
22	36.859	92%	36.2	91%
24	35.959	90%	35.3	88%

Fine Particulates PM₁₀

Modelling results at 16kph

- There were no predicted exceedances of the 40µg/m³ AQO at any property in 2004 or 20µg/m³ in 2010.
- There were no properties with 10% (1 Std Dev) of the AQO for 2004.
- All of the properties were predicted to be within 10% (1 Std Dev) of the AQO for 2010. Note: The provisional 2010 AQO of 20µg/m³ is stricter and due to background concentrations = 17.9µg/m³ the AQO only requires a small contribution from the road component to bring the predicted concentrations close to the AQO.

Modelling results at 8kph

- There were no predicted exceedances of the 40µg/m³ AQO at any property in 2004 or 20µg/m³ in 2010.
- There were no properties with 10% (1 Std Dev) of the AQO for 2004.
- All of the properties were predicted to be within 10% (1 Std Dev) of the AQO for 2010. Note: The provisional 2010 AQO of 20µg/m³ is stricter and due to background concentrations = 17.9µg/m³ the AQO only requires a small contribution from the road component to bring the predicted concentrations close to the AQO.

Table 11: PM₁₀ modelling input summary

Modelling Inputs	Met. Yr	AADT avg. speed (kph)	Roads modelled	Modelled Years
Table 5	2003	16	Fisher St & High St	2004, 2010
Table 6	2003	8	Fisher St & High St	2004, 2010

Table 12: PM₁₀ modelling for Fisher St at 16kph

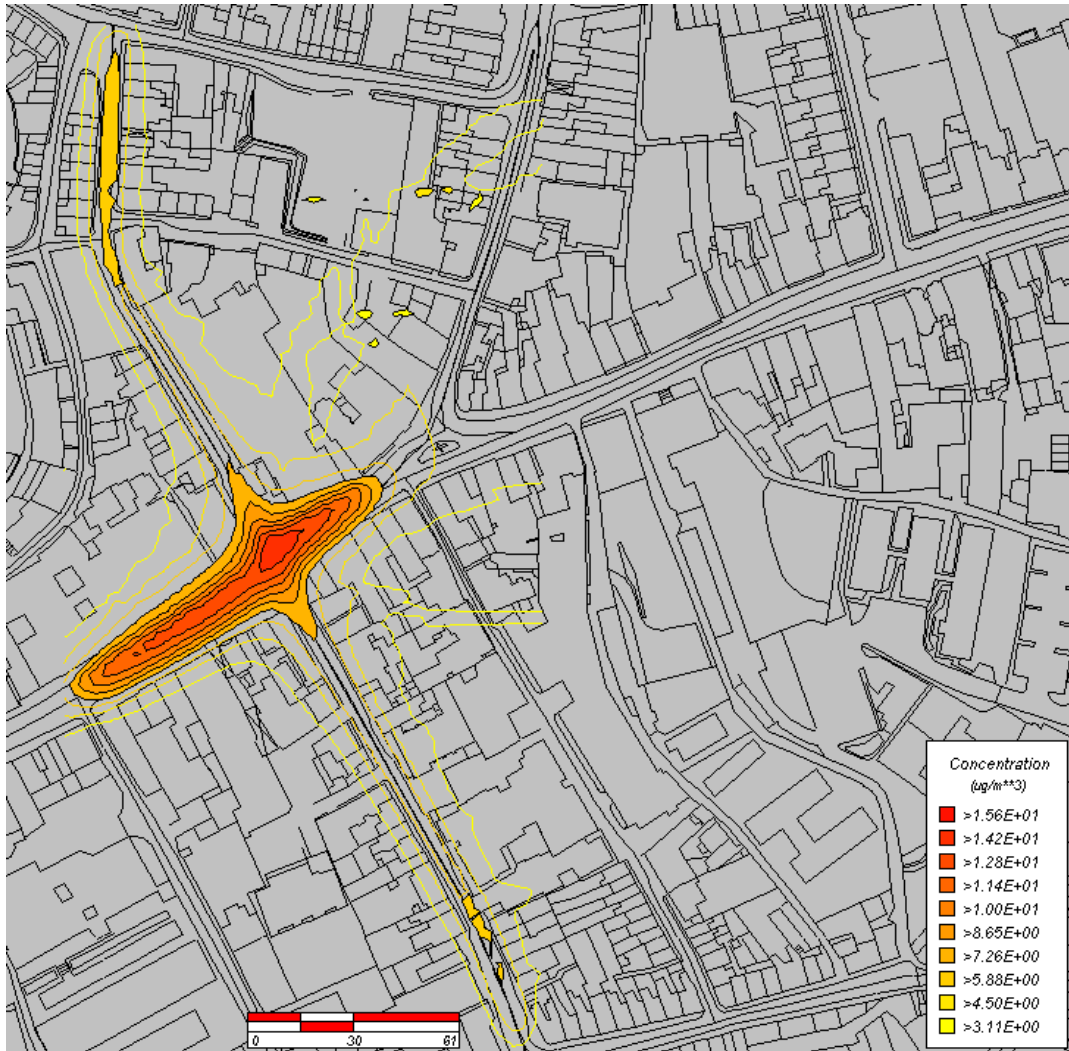
Southway Receptors	2004 PM₁₀ (µg/m³)	% within AQO (40µg/m³)	2010 PM₁₀ (µg/m³)	% within AQO (20µg/m³)
17	19.96	50%	18.20	91%
12	19.96	50%	18.20	91%
13	19.96	50%	18.20	91%
11	19.95	50%	18.19	91%
9	19.91	50%	18.17	91%
12	19.92	50%	18.18	91%
14	19.93	50%	18.18	91%
18	19.92	50%	18.18	91%
20	19.91	50%	18.17	91%
22	19.90	50%	18.16	91%
24	19.87	50%	18.15	91%

Table 13: PM₁₀ modelling for Fisher St at 8kph

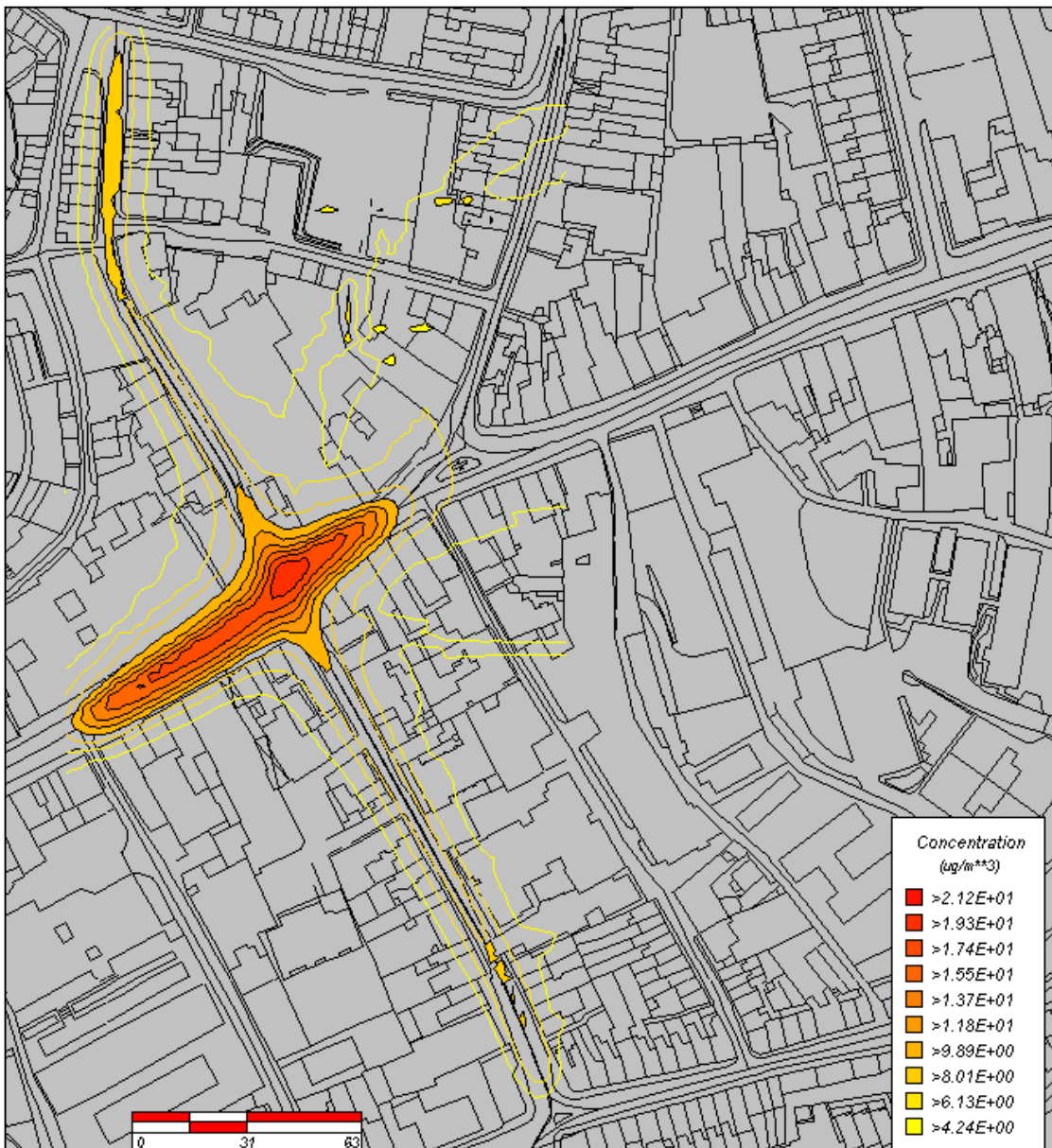
Receptors	2004 PM₁₀ (µg/m³)	% within AQO (40µg/m³)	2010 PM₁₀ (µg/m³)	% within AQO (20µg/m³)
17	19.97	50%	18.20	91%
12	19.97	50%	18.20	91%
13	19.97	50%	18.20	91%
11	19.96	50%	18.20	91%
9	19.92	50%	18.17	91%
12	19.94	50%	18.18	91%
14	19.94	50%	18.19	91%
18	19.93	50%	18.18	91%
20	19.92	50%	18.18	91%
22	19.91	50%	18.17	91%
24	19.88	50%	18.16	91%

Modelled Output Maps

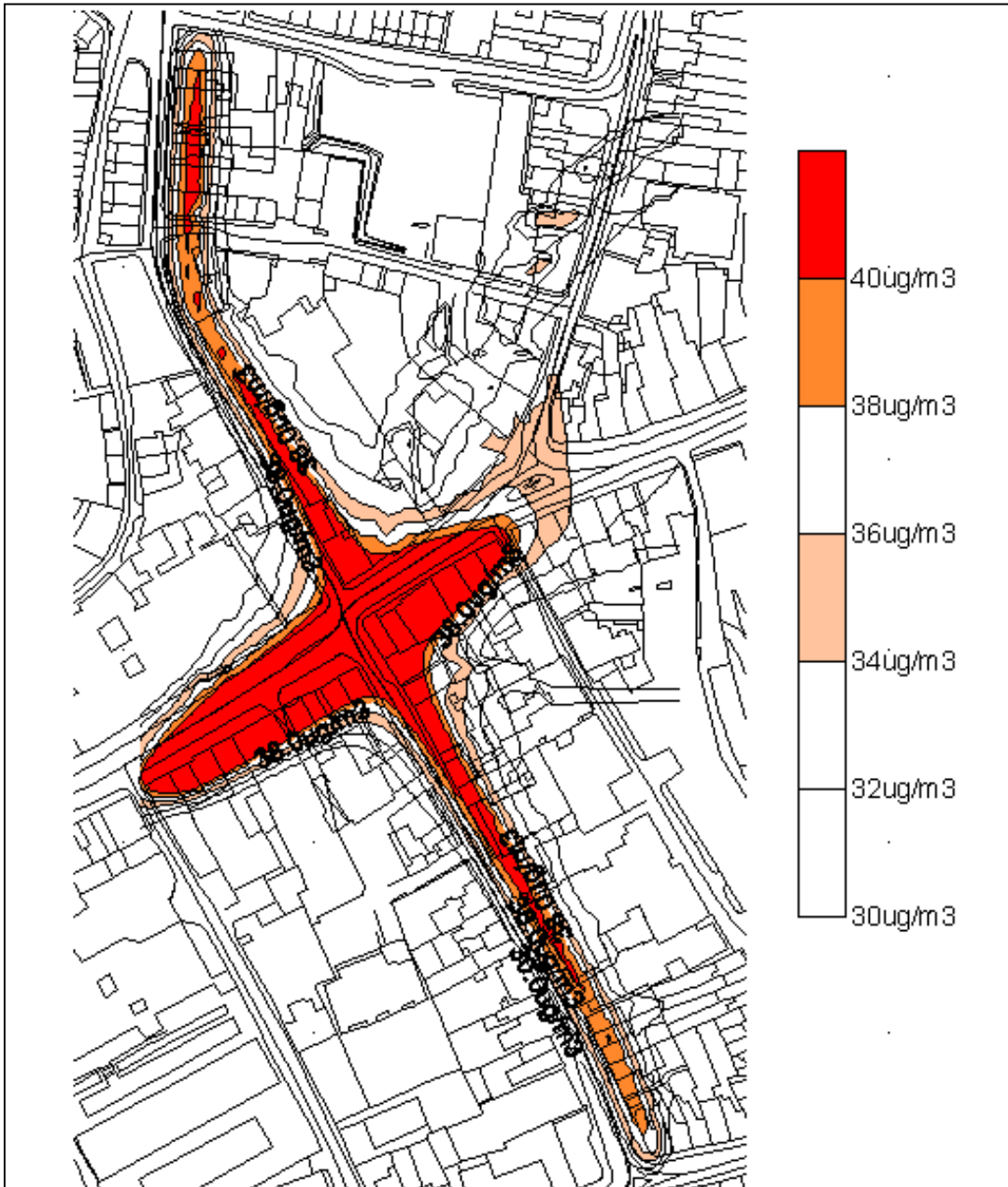
Map 5: Modelled annual average concentrations for NOx (road) for 2005 (16kph)



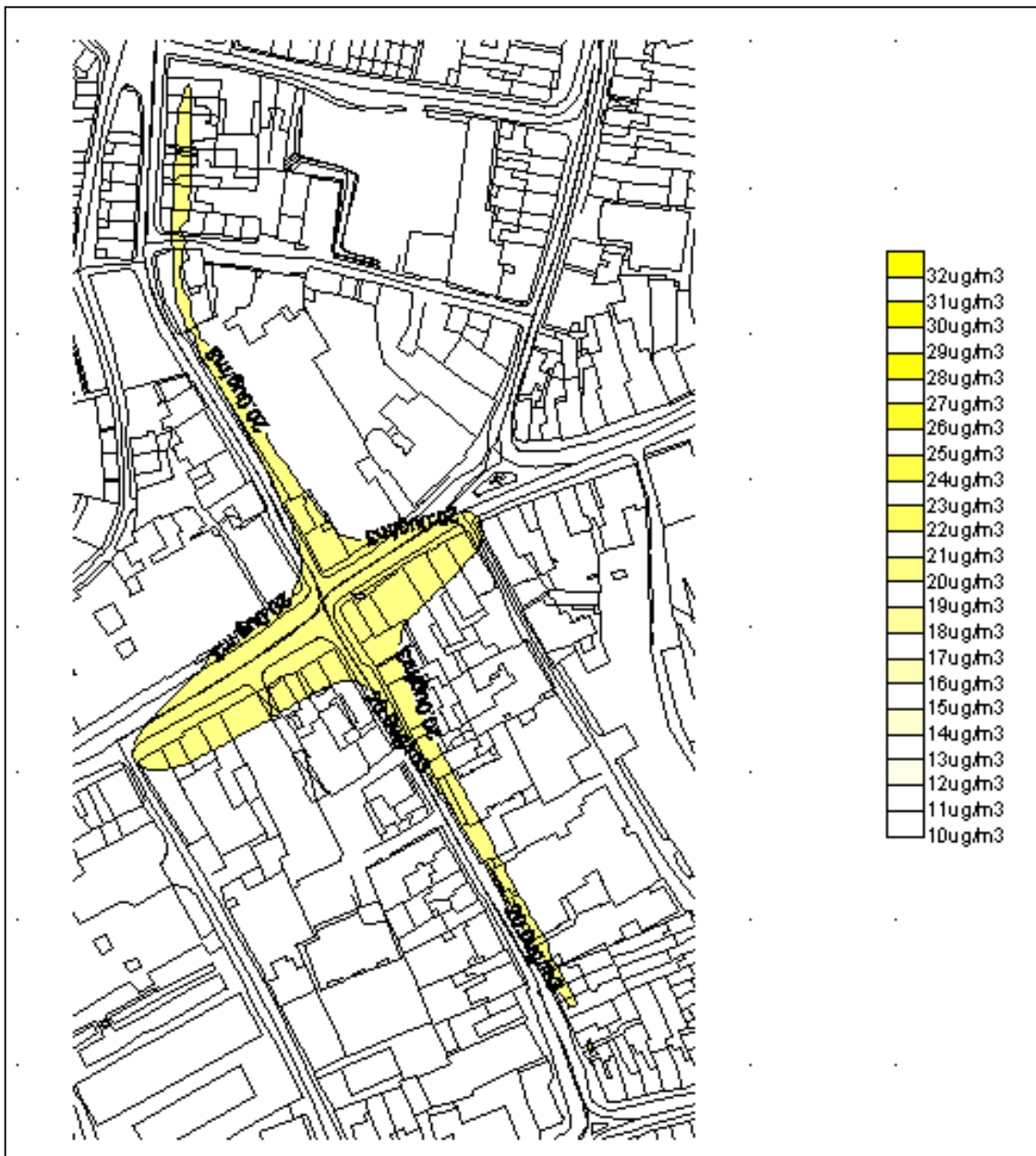
Map 6: Modelled annual average concentrations for NO_x(road) for 2005 (8kph)



Map 7: Modelled annual average concentrations for NO₂(total) for 2005 (8kph)



Map 8: Modelled annual average concentrations for PM₁₀(total) for 2004 (8kph)



Malling Street, Lewes Town

Introduction

Modelling of air quality was undertaken for Lewes District Council for Malling Street, in Lewes Town Centre, in June 2004.

Modelling of Malling Street, Lewes was undertaken with BREEZE Roads to ascertain the NO₂ concentrations for 2004 and 2005 and PM₁₀ in 2004 and 2010. The model outputs a grid of results adjacent to the road and at specific receptors, the results are the annual average concentration in µg/m³. The principle receptors were identified as residential properties along Malling St. House numbers (in no specific order) identified were: 159, 53, Gillingham House, Franklyn House, 149 and 149a. These houses were identified as being the closest residential properties that may be affected by air pollutants. The modelling results reflect the relative predicted pollutant levels at each property and identifies if any of these properties were estimated to either breach or be within a certain percentage of breaching the UK Air Quality Objectives (AQO). The modelling results for these properties are summarised below.

Input Data

Modelling Years: 2004, 2005, 2010

Meteorological data source: Gatwick (years 2003)

Traffic data source: East Sussex County Council (ESCC)

- AADT Malling St for 2001 = 21200
- AADT projected growth rates supplied by ESCC: 2003 – 05.
- % HDV derived for traffic = 4%
- Average speed estimated due to limited data from observations and local knowledge = 10mph or 16kph.

Background pollutant source:

NO_x and NO₂ background concentrations were taken from the National Atmospheric Emissions Inventory (NAEI) web-site (www.naei.org.uk) for the grid squares that Malling Street. lies in.

Emission factors (EF)

Vehicle emission factors were calculated using the “Emission Factors Toolkit” (Final_EF2002 EF Version2a.xls). Malling Street is a single carriage two-way street that is on the level with buildings in close proximity to the road. The emission factor for this road was determined as follows:

The EF inputs were as follows:

- Road type: Urban
- %HGV : 4%
- Speed: 16kph

Site characteristics

Road type: Urban
Road width: 8 m
Road slope: 0 m
Receptor height: 1.5 m
Surface roughness length: 1 m
Street canyon adjustment applied

Malling Street NO₂ correction factor

In addition to the “Sussex” adjustment factor for NO₂ being introduced into the calculated NO₂ concentration, a local correction factor was also introduced due to local monitoring data from 2003. NO₂ diffusion tube monitoring data was available for comparison with model runs that were made for 2003 input data (4% HGV at 16kph). The 2003 sensitivity modelling runs results, at the same location and height of the NO₂ diffusion tube, were compared with the 2003 (bias corrected) NO₂ annual average results and a correction factor was calculated. The correction factor will be only applied for future model results in Malling Street.

Malling Street correction factor (CF²) for NO₂:

Correction factor = (NO₂ (tube) – NO₂ (background)) / NO₂(roads) result (corrected for canyon & NO_x and NO₂ factors)

NO₂ (CF²) = 1.40

Summary of Results

Nitrogen dioxide

Modelling results at 16kph:

- There were no predicted exceedances of the 40µg/m³ AQO at any property in 2004 or 2005.
- There were no properties with 10% (1 Std Dev) of the AQO and only 2/6 were with 20% of the AQO.

Modelling results at 8kph

- 8kph is not a realistic AADT speed, however it has been used to demonstrate that a drop in vehicle speed may have an effect on predicted concentrations. Malling Street during commuter times hours suffers from periods of congestion in both directions. Using a much slower speed reflects this period of the day.
- There were no predicted exceedances of the 40µg/m³ AQO at any property in 2004 or 2005
- 4/6 properties in 2004 and no properties in 2005 were within 10% (1 Std Dev) of the AQO.
- All the properties in 2004 and 2005 were close or within 20% (2 Std Dev) of the AQO.

Table 14: NO₂ modelling input summary.

Modelling Inputs	Met. Yr	AADT avg. speed (kph)	Roads modelled	Modelled Years
Table 5	2003	16	Malling St	2004, 2005
Table 6	2003	8	Malling St	2004, 2005

Table 15: NO₂ modelling for Malling Street at 16kph.

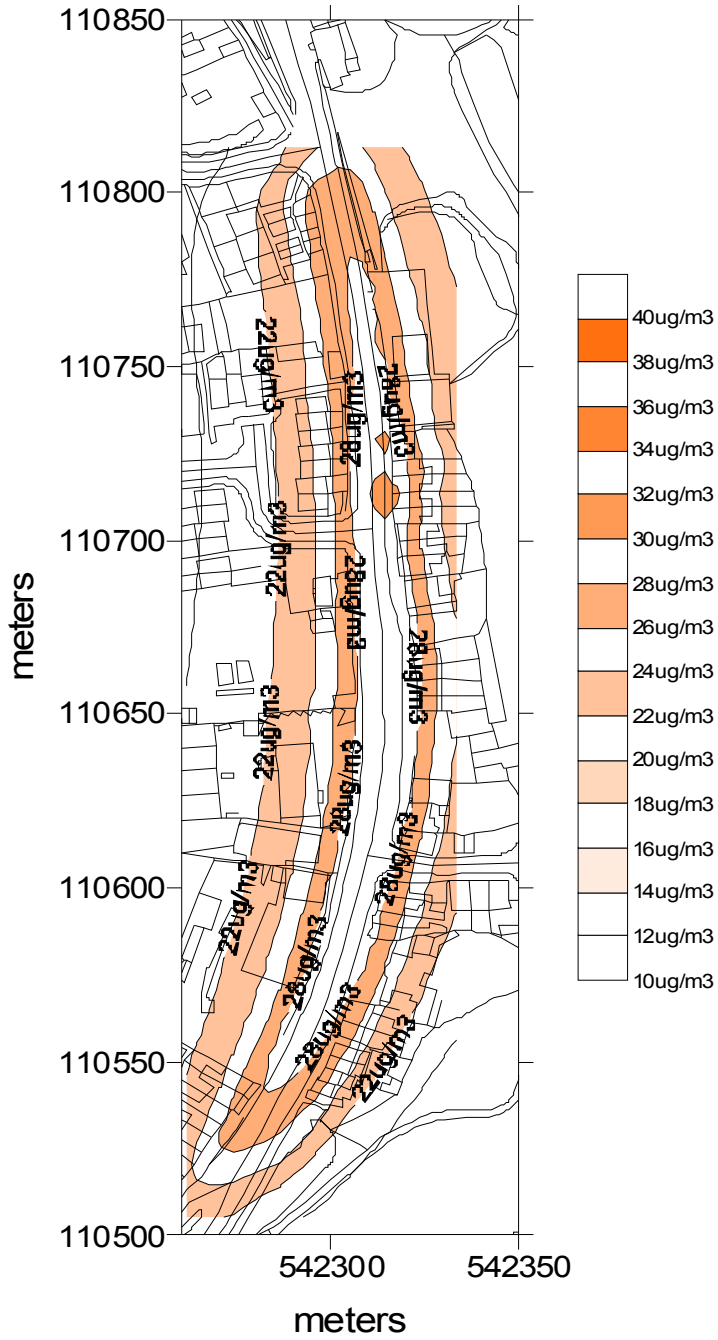
Malling St Receptors	2004 NO₂ (µg/m³)	% within AQO (40µg/m³)	2005 NO₂ (µg/m³)	% within AQO (40µg/m³)
159	33.1	83%	30.6	76%
53	34.0	85%	31.4	78%
Gillingham	31.6	79%	29.3	73%
Franklin	31.2	78%	28.9	72%
149	31.6	79%	29.3	73%
149a	31.7	79%	29.4	73%

Table 16: NO₂ modelling for Malling Street at 8kph.

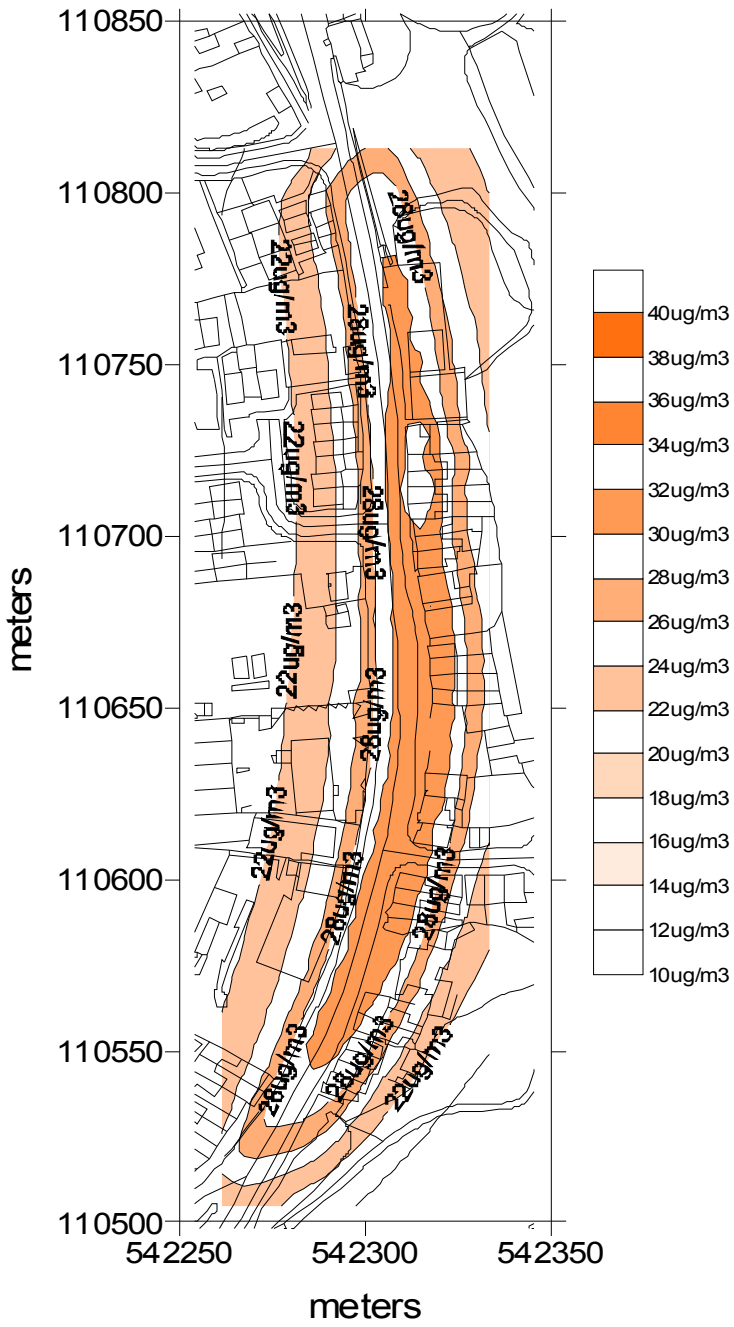
Malling St Receptors	2004 NO₂ (µg/m³)	% within AQO (40µg/m³)	2005 NO₂ (µg/m³)	% within AQO (40µg/m³)
159	35.9	90%	33.2	83%
53	37.0	92%	34.2	85%
Gillingham	34.1	85%	31.7	79%
Franklin	33.6	84%	31.3	78%
149	34.1	85%	31.7	79%
149a	34.2	86%	31.8	79%

Modelled output maps.

Map 9: Modelled annual average concentrations for NO₂ for 2005 (16kph)



Map 10: Modelled annual average concentrations for NO₂ for 2005 (8kph)



Fine Particulates PM₁₀

Modelling for fine particles was not undertaken at this location given that modelling for nitrogen dioxide found that there was no property exceeding the air quality objective for nitrogen dioxide in 2004 or 2005.

It is likely that the 2010 provisional air quality objective is likely to be exceeded at this locations as it will be at many other road side locations in the Lewes district. The provisional 2010 AQO of 20µg/m³ is stricter and due to background concentrations of 17.9µg/m³ the AQO only requires a small contribution from the road component to bring the predicted concentrations close to the AQO.

A27 Newmarket Hill/Kingston Roundabout near Lewes.

Introduction

Modelling of air quality was undertaken for Lewes District Council for A27, near the **Lewes/Kingston Round about**, in June 2004. Modelling of A27 was undertaken with BREEZE Roads to ascertain the NO₂ concentrations for 2004 and 2005. The model outputs a grid of results adjacent to the road and at specific receptors, the results are the annual average concentration in µg/m³. The principle receptors were identified as a residential property along A27. **House is the property at 69 Newmarket Hill, Lewes.** This house was identified as being the closest residential properties that may be affected by air pollutants. The modelling results reflect the relative predicted pollutant levels at the property and identifies if any of this property was estimated to either breach or be within a certain percentage of breaching the UK Air Quality Objectives (AQO).

Input Data:

Modelling Years: 2004, 2005, 2010

Meteorological data source: Gatwick (years 2003)

Traffic data source: East Sussex County Council (ESCC)

- AADT A27 for 2003 = 25240 each way as it is dual carriageway.
- AADT projected growth rates supplied by ESCC: 2003 – 05.
- % HDV derived for traffic = 5%
- Average speed estimated from observations and local knowledge = 20mph or 32kph. At this location traffic at times can be travelling much faster than this. At other times the junction is prone to congestion. Given that emissions tend to be greater at slow speeds we have undertaken modelling using the worse case scenario.

Background pollutant source

NO_x and NO₂ background concentrations were taken from the National Atmospheric Emissions Inventory (NAEI) web-site (www.naei.org.uk) for the grid squares that A27 was within.

Emission factors (EF)

Vehicle emission factors were calculated using the “Emission Factors Toolkit” (Final_EF2002 EF Version2a.xls). A27 is a two carriage two-way street that is on the level with buildings in close proximity to the road. The emission factor for this road was determined as follows:

The EF inputs were as follows:

- Road type: Urban
- %HGV : 5%
- Speed: 32kph

Site characteristics

Road type: Motorway/A-road Dual carriageway

Road width: 11 m/carriageway

Road slope: 0 m

Receptor height: 1.5 m

Surface roughness length: 1 m

Nitrogen dioxide results NO₂

Modelling results at 32kph:

- There were no predicted exceedances of the 40µg/m³ AQO at any property in 2004 or 2005.
- The results for both 2004 and 2005 were below 55% of the AQO

Table 17: NO₂ modelling input summary.

Modelling Inputs	Met. Yr	AADT avg. speed (kph)	Roads modelled	Modelled Years
Table 5	2003	32	A27	2004, 2005

Table 18: NO₂ modelling for A27 at 32kph.

A27 Receptor	2004 NO ₂ (µg/m ³)	% within AQO (40µg/m ³)	2005 NO ₂ (µg/m ³)	% within AQO (40µg/m ³)
House	21.86	55%	21.49	54%

Fine Particulates PM₁₀

Modelling results at 32kph

- There is no predicted exceedance of the 40µg/m³ AQO in 2004 or 20µg/m³ in 2010.
- Note: The provisional 2010 AQO of 20µg/m³ is stricter and due to background concentrations = 17.7µg/m³ the AQO only requires a small contribution from the road component to bring the predicted concentrations close to the AQO.

Table 19: PM₁₀ modelling input summary.

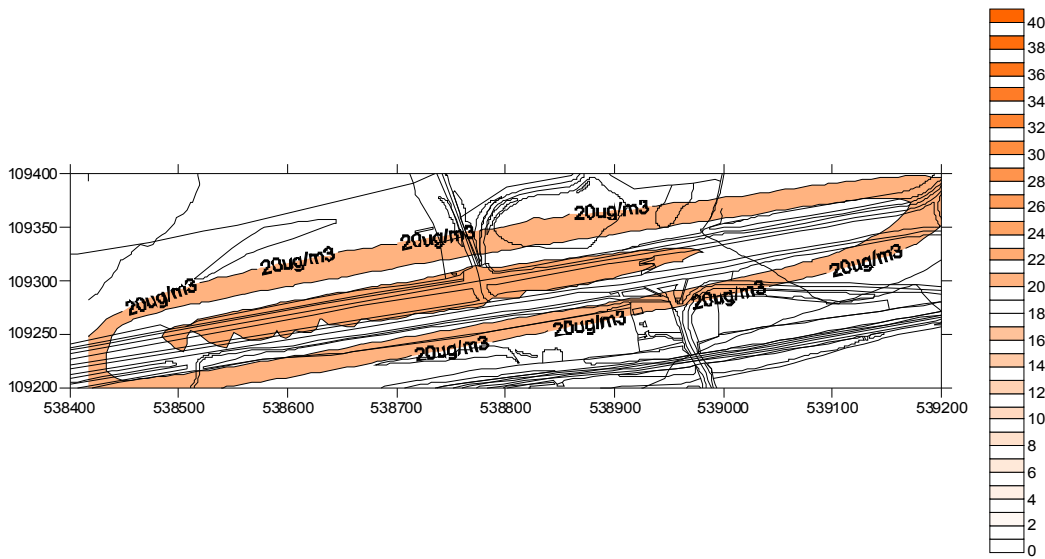
Modelling Inputs	Met. Yr	AADT avg. speed (kph)	Roads modelled	Modelled Years
Table 6	2003	32	A27	2004, 2010

Table 20: PM₁₀ modelling for A27 at 32kph.

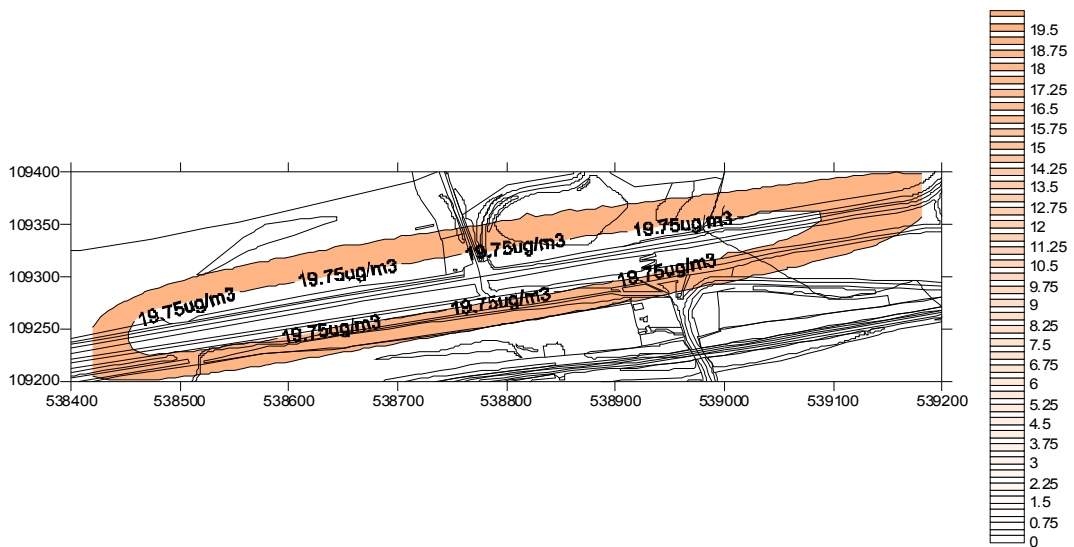
A27 Receptors	2004 PM ₁₀ (µg/m ³)	% within AQO (40µg/m ³)	2010 PM ₁₀ (µg/m ³)	% within AQO (20µg/m ³)
House	19.73	49%	18.01	90%

Modelled output map.

Map11: Modelled annual average concentrations for NO₂ for 2005 (32kph)



Map 12: Modelled annual average concentrations for PM₁₀ for 2004 (32kph)



Southover High Street, Lewes Town

Introduction

Modelling of air quality was undertaken for Lewes District Council for Southover Street, in Lewes Town Centre, in June 2004. The objective of the modelling is to ascertain whether specific residential properties could potentially receive concentrations of pollutants which breach current and future air quality objectives in the UK. The modelling involves the use of a complex computerised model called "BREEZE Roads" to derive the annual averaged Nitrogen Dioxide (NO₂) and Particulates (PM₁₀) concentrations at specific receptors (residential properties) adjacent the street.

Input Data

Modelling Years: 2004, 2005, 2010

Meteorological data source: Gatwick (years 2003)

Traffic data source: East Sussex County Council (ESCC)

- AADT Southover St for 2003 = 6605
- AADT projected growth rates supplied by ESCC: 2003 – 05.
- % HDV derived for traffic = 9%
- Average speed estimated due to limited data from observations and local knowledge = 15mph or 24kph.

Background pollutant source

NO_x and NO₂ background concentrations were taken from the National Atmospheric Emissions Inventory (NAEI) web-site (www.naei.org.uk) for the grid squares that Southover High Street was within.

Emission factors (EF)

Vehicle emission factors were calculated using the "Emission Factors Toolkit" (Final_EF2002 EF Version2a.xls). Southover High Street is a single carriage two-way street that is on the level with buildings in close proximity to the road. The emission factor for this road was determined as follows:

The EF inputs were as follows:

- Road type: Urban
- %HGV : 9%
- Speed: 24kph

Site characteristics

Road type: Urban

Road width: 8 m

Road slope: 0 m

Receptor height: 1.5 m

Surface roughness length: 1 m

Southover High Street NO₂ correction factor

In addition to the “Sussex” adjustment factor for NO₂ being introduced into the calculated NO₂ concentration, a local correction factor was also introduced due to local monitoring data from 2003. NO₂ diffusion tube monitoring data was available for comparison with model runs that were made for 2003 input data (9% HGV at 24kph). The 2003 sensitivity modelling runs results, at the same location and height of the NO₂ diffusion tube, were compared with the 2003 (bias corrected) NO₂ annual average results and a correction factor was calculated. The correction factor will be only applied for future model results in Southover High St.

Southover High Street correction factor (CF²) for NO₂:

Correction factor = (NO₂ (tube) – NO₂ (background)) / NO₂(roads) result (corrected for canyon & NO_x and NO₂ factors)

$$\text{NO}_2 \text{ (CF}^2\text{)} = \quad \quad \quad \mathbf{2.29}$$

Summary of Results

Nitrogen dioxide NO₂

Modelling results at 24kph

- There were no predicted exceedances of the 40µg/m³ AQO at any property in 2004 or 2005.
- There was 1 property within 10% (1 Std Dev) of the AQO in 2004.
- There were 2/4 (2004) and 3/4(2005) properties that were within 20% (2 Std Dev) of the AQO

Modelling results at 16kph

- There were no predicted exceedances of the 40µg/m³ AQO at any property in 2004 or 2005.
- There were 2 properties within 5% (1/2 Std Dev) of the AQO in 2004, however by 2005 no properties were predicted to be with 10% (1 Std Dev) of AQO.

Table 20: NO₂ modelling input summary.

Modelling Inputs	Met. Yr	AADT avg. speed (kph)	Roads modelled	Modelled Years
Table 5	2003	24	Southover St	2004, 2005
Table 6	2003	16	Southover St	2004, 2005

Table 21: NO₂ modelling for Southover High Street at 24kph.

Southover St Receptors	2004 NO ₂ (µg/m ³)	% within AQO (40µg/m ³)	2005 NO ₂ (µg/m ³)	% within AQO (40µg/m ³)
47	28.94	72%	33.27	83%
41	29.12	73%	28.59	71%
35	35.18	88%	34.48	86%
51	35.97	90%	35.25	88%

Table 22: NO₂ modelling for Southover St at 16kph.

Southover St Receptors	2004 NO ₂ (µg/m ³)	% within AQO (40µg/m ³)	2005 NO ₂ (µg/m ³)	% within AQO (40µg/m ³)
47	30.59	76%	32.70	82%
41	30.80	77%	28.18	70%
35	37.75	94%	33.84	85%
51	38.65	97%	34.59	86%

Fine Particulates PM₁₀

PM₁₀ modelling was undertaken for Southover High Street for the AQO year 2004 and the provisional year 2010.

Modelling results at 24kph

- There were no predicted exceedances of the 40µg/m³ AQO at any property in 2004 .
- There were no properties within 10% or 20%(1 and 2 Std Dev) of the AQO in 2004.
- There were 4 properties that were within 10% (1 Std Dev) of the 2010 provisional AQO

Modelling results at 16kph

- There were no predicted exceedances of the 40µg/m³ AQO at any property in 2004.
- There were 24 properties within 10% (1 Std Dev) of the 2010 provisional AQO.

Table 23: PM₁₀ modelling input summary.

Modelling Inputs	Met. Yr	AADT avg. speed (kph)	Roads modelled	Modelled Years
Table 5	2003	24	Southover St	2004, 2010
Table 6	2003	16	Southover St	2004, 2010

Table 24: PM₁₀ modelling for Southover High Street at 24kph.

Southover St Receptors	2004 PM₁₀ (µg/m³)	% within AQO (40µg/m³)	2010 PM₁₀ (µg/m³)	% within AQO (20 µg/m³)
47	19.9	50%	18.1	91%
41	19.7	50%	18.1	91%
35	19.9	50%	18.1	91%
51	20.0	50%	18.2	91%

Table 25: PM₁₀ modelling for Southover High Street at 16kph.

Southover St Receptors	2004 PM₁₀ (µg/m³)	% within AQO (40µg/m³)	2010 PM₁₀ (µg/m³)	% within AQO (20µg/m³)
47	20.0	50%	18.1	91%
41	19.8	50%	18.1	91%
35	20.1	50%	18.1	91%
51	20.1	50%	18.2	91%

