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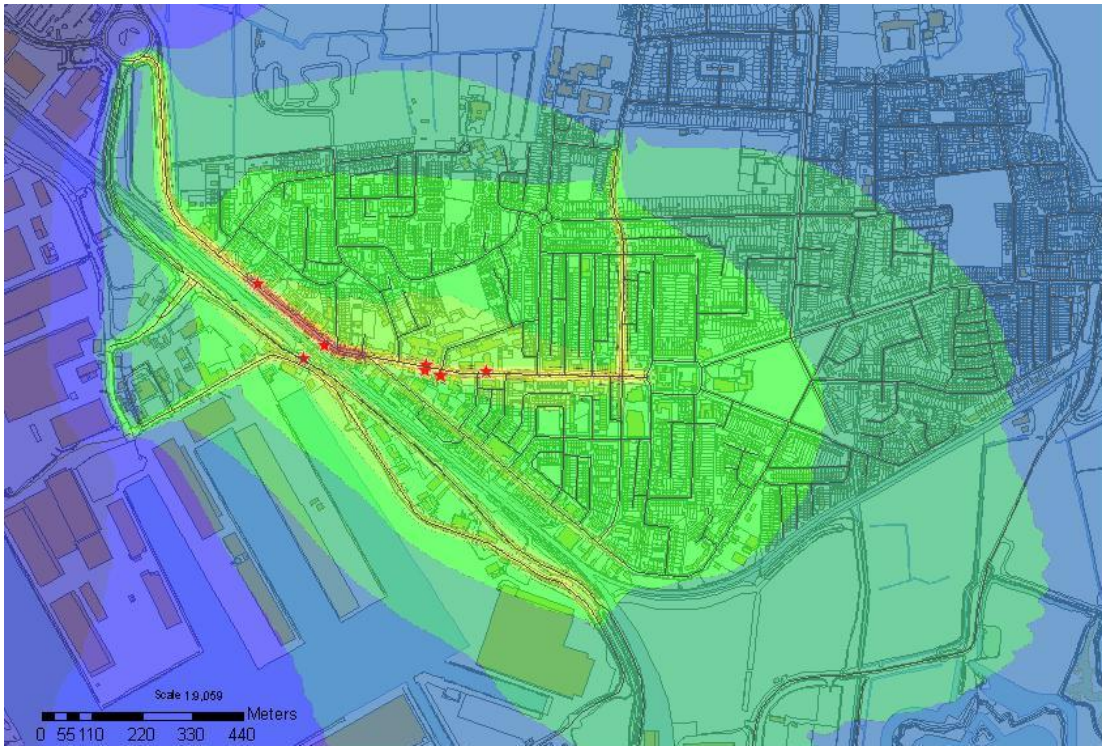

Thurrock Council

Further Assessment for NO_2
Tilbury

(as required by s.84(1) of the Environment Act 1995)

August 2013

Executive Summary

This is the 2013 Further Assessment for NO_2. This assessment fulfils the Council's next step of the Local Air Quality Management (LAQM) process and is required as a result of the findings of the Council's 2011 Detailed Assessment report for NO_2 for Tilbury. The report examines the pollutant nitrogen dioxide (NO_2) which is summarised below.

Nitrogen dioxide

The Previous 2011 Detailed Assessment report for NO_2 for Tilbury showed there to be an exceedence of NO_2, the area identified was along Calcutta Road and Dock Road, the diffusion tube as well as an automatic monitoring station along Calcutta Road confirmed an exceedence of the annual mean objective of 40 $\mu g\ m^{-3}$ for NO_2.

The new monitoring results and predictions have been used in this report. Also detailed modelling has been undertaken using an Advanced Dispersion Model (ADMS) [ADMS-Roads] in order to determine accurately the full extent of the exceedence of NO_2 and then declare an Air Quality Management Area (AQMA) around the area of exceedence of 40 $\mu g\ m^{-3}$. The monitoring data and air quality modelling confirm that there is an exceedence of the annual mean objective for NO_2 along Calcutta Road, Dock Road and part of St Chad's Road. The report thus meets the requirements of the technical guidance LAQM. TG (09) produced by the Department of Environment, Food and Rural Affairs (DEFRA).

The Council will from the finding of this report, continue to investigate further using continuous and non-continuous monitoring at the same locations, to assess whether concentrations of NO_2 will change and to trace long-term trends, and also periodically carry out further modelling to see if there is any significant change to the area of exceedence of NO_2.

This Report has identified an area of exceedence of NO_2, based on modelling which has been carried out and based on the year for 2012 this has then been verified by monitoring data at all diffusion tube locations within Tilbury and also by the automatic monitoring station (Thurrock 4) located along Calcutta Road for 2012. Based on this modelling result, it will then declare an Air Quality Management Area (AQMA).

Source apportionment has been conducted for Calcutta Road & Dock Road, the major sources of NO_2 identified are from Passenger Cars and also from the Regional Background. A source apportionment study for both roads shows that the air quality objective could be met by removing all the HGV's and Buses from the roads, however there would be issues in trying to enforce this measure, and removing public transport from the main trunk road into Tilbury would have a detrimental effect on servicing the local population. The report proposes that a modal shift away from using Cars to either public transport or Cycling would be the most beneficial measure to be introduced along these roads. The Council will also produce an Air Quality Action Plan for this Area, in order to improve the local air quality within this AQMA.

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1 Introduction to Further Assessment

This is the Further Assessment of air quality for Thurrock Council for NO_2, in Tilbury. This assessment fulfils the Council's next step of the Local Air Quality Management (LAQM) process and is required as a result of the findings of the Council's 2011 Detailed Assessment Report for NO_2. The report examines the pollutant nitrogen dioxide (NO_2).

The Detailed Assessment examined air quality across the whole of the Council's area in accordance with the Department for Food and Rural Affairs (DEFRA) guidance. The report concluded that the annual mean objective for NO_2 was widely being exceeded within Tilbury, specifically along both Dock Road and Calcutta Road. No other pollutants will be covered in this report. They will be reported on in the Council's 2013 Progress Report.

The new technical guidance (LAQM.TG09) was produced by DEFRA to aid local authorities with their duties. The guidance is designed to support local authorities in carrying out their duties under the Environment Act 1995. It confirms that LAQM forms a key part of the government's strategies to achieve the air quality objectives.

The guidance provides advice to local authorities for the purposes of undertaking their statutory review and assessments and on factors that need to be taken into account when assessing exposure. The standards from which the objectives derive are based on a potential risk to health, thus a single exposure of an individual above the standards is to be avoided. The objectives however also allow a number of occurrences where the standards might be exceeded for reasons of feasibility and practicality.

This report considers that only the long-term objective for NO_2 or annual mean objective is relevant when considering public exposure in this location. Supplementary evidence is included in this report for 1-hour NO_2 objective which rules out any further consideration, (i.e. any area found to have an annual mean concentration of 60 $\mu g\ m^{-3}$ is likely to have an exceedence of the 1-hour NO_2 objective as well) this report does not identify any such exceedence.

The aim of the Further Assessment is thus to identify the full extent of the exceedence for NO_2, and then to identify the possible sources through source apportionment work along the areas which are in exceedence. Then this source apportionment work will then assist the Council in targeting new Air Quality Action Plan (AQAP) measures which will be aimed at improving air quality in this area.

The Council is also required to confirm that there is the likelihood of relevant public exposure in the identified area. The Air Quality (England) Regulations as amended, refer to "the quality of air at locations which are situated outside of buildings or other natural or man made structures, above or below ground, and where members of the public are regularly present."

2 Introduction for nitrogen dioxide (NO_2)

2.1 Overview to Further Assessment of Nitrogen Dioxide

This section provides the Further Assessment for Thurrock Council, which fulfils the statutory requirement for this, the Council's next step, of the Local Air Quality Management (LAQM) process for nitrogen dioxide (NO_2).

2.2 Background

Local Air Quality Management forms a key part of the Government's strategies to achieve the air quality objectives under the Air Quality (England) Regulations 2000 and 2002. As part of its duties the Council completed its Detailed Assessment of NO_2 pollutant for Tilbury. The conclusion for NO_2 was that the Council needed to undertake a Further Assessment for one area only (Tilbury), specifically the area where monitoring has indicated that the annual mean objective (see Table 1) will not be met. The opportunity is taken in this report to formally prove the need to declare another AQMA for NO_2.

Table 1 Air Quality Objectives for nitrogen dioxide (NO_2)

Pollutant	Objective Concentration	Measured as	Date to be achieved by
Nitrogen Dioxide	200 μg m^{-3} not to be exceeded more than 18 times a year	1 hour mean	31 Dec 2005
	40 μg m^{-3}	Annual Mean	31 Dec 2005

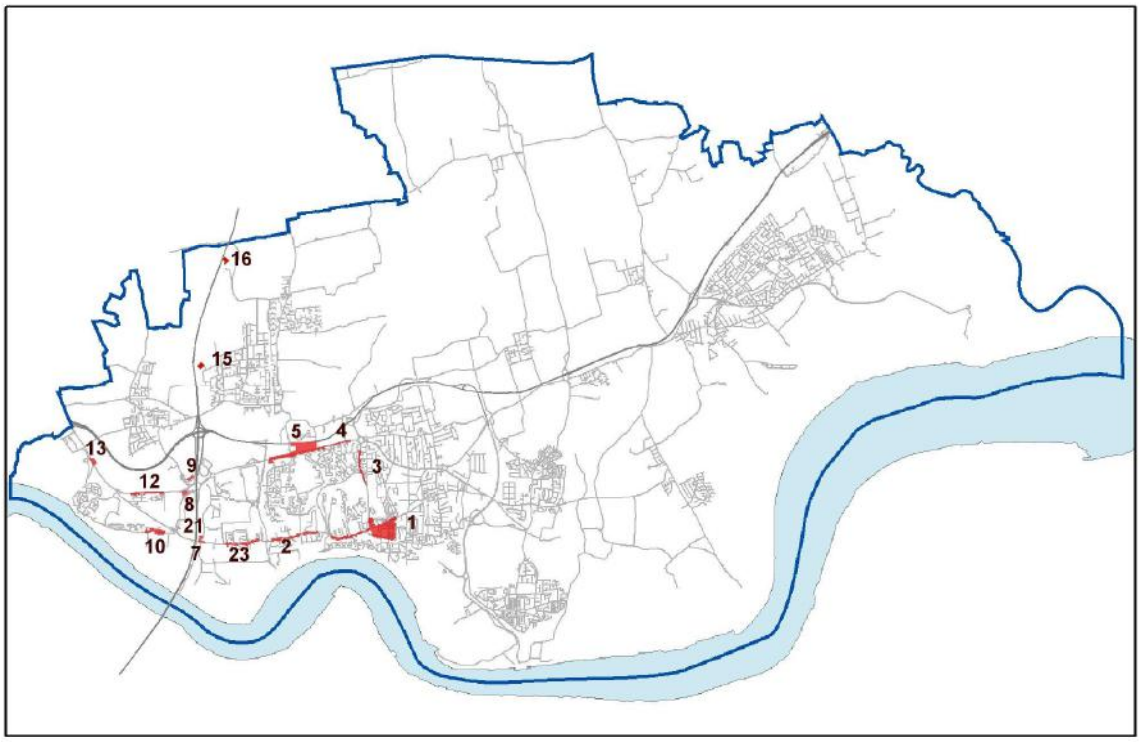
(It should be noted that the 1-hour mean (which is less stringent than the annual mean objective) also did not need to be assessed further in this report) as in accordance with the TG(09) Guidance any annual mean below 60 μg m^{-3} is most likely to be below the 1-hour objective for NO_2. The modelling undertaken in this report shows no area that exceeded this level. This argument is further bolstered by the fact that the maximum 1-hour NO_2 results from the Thurrock 4 continuous monitoring station since its entire operation from 2010 to 2012 fell considerably short of the 200 μg m^{-3} concentration.

The Council's current AQMA's are listed in Table 2 and shown in Figure 3 below

Table 2 Summary of existing Thurrock AQMA's

AQMA No.	Pollutant	Description of AQMA
1	NO_2	Grays town centre and London Road Grays
2	NO_2	London Road South Stifford and adjoining roads
3	NO_2	East side of Hogg Lane and Elizabeth Road
4	NO_2	West of Chafford Hundred Visitor Centre
5	NO_2 & PM_{10}	Warren Terrace, A13 and A1306
7	NO_2 & PM_{10}	Hotels next to M25
8	NO_2 & PM_{10}	Hotel next to Junction 31 of the M25
9	NO_2	Hotel next to Junction 31 of the M25
10	NO_2 & PM_{10}	London Road Purfleet near to Jarrah Cottages
12	NO_2	Watts Wood estate next to A1306
13	NO_2	London Road Aveley next to A1306
15	NO_2	Near to M25 on edge of Irvine Gardens, South Ockendon
16	NO_2	Next to M25 off Dennis Road
21	NO_2	Hotel on Stonehouse Lane
23	NO_2	London Road West Thurrock
(24)	NO_2	(Dock Road & Calcutta Road & St Chads Road) [AQMA Pending]

Figure 1 Map of Thurrock's AQMA's



2.3 Monitoring of NO_2

2.3.1 Continuous Monitoring

In 2010 the Council decided to undertake further more detailed monitoring, it commissioned a new continuous monitoring station, located within the grounds at St Mary's Catholic Primary School along Calcutta Road, Tilbury, which is approximately 38 metres east of the long running Calcutta Road (TL) diffusion tube monitoring site, which first flagged up the NO_2 exceedence back in 2007.

Table 3 (Thurrock 4) Monitored NO_2 results

Site	Parameter	2010	2011	2012
Thurrock 4 (Calcutta Road, Tilbury)	Annual mean ($\mu g\ m^{-3}$)	40.2	38.56	38.92
	Max 1-hour ($\mu g\ m^{-3}$)	157	158	153
	No of 1-hour exceedences	0	0	0
	Data Capture	93.4%	94.8%	98.9%

(Bold indicates was above air quality objective limit)

The NO_2 data from 2010 was found to be above the annual mean objective limit for NO_2, at 40.2 $\mu g\ m^{-3}$, However in 2011 & 2012 it was just below the objective at 38.56 $\mu g\ m^{-3}$ and 38.92 $\mu g\ m^{-3}$. The 1-hour mean objective of 200 $\mu g\ m^{-3}$ was not breached with the highest 1-hour concentration measured at 158 $\mu g\ m^{-3}$ in 2011, this objective will not be taken for further consideration in this report.

2.3.2 Diffusion Tube Monitoring

Thurrock Council currently has 8 diffusion tube monitoring locations within Tilbury. These monitoring sites were setup to determine the spatial extent of the NO_2 exceedence. 1 site designated (TL) on Calcutta Road is a long running site operating since 1999. It was this site that flagged up the initial exceedence of NO_2, back in 2008. In June 2009 the Council decided

to set up 5 additional monitoring sites (TILA), (TILB), (TILC), (TILD) & (TILE), to see if the exceedence covered a wider area. In September 2010 an additional site was setup a duplicated diffusion tube site (TK4 A&B) which was co-located with the Thurrock 4 continuous monitoring station, in order to calculate a local bias correction factor. And the final diffusion tube (TSR) was located recently in 2011, in an area considered as a background location near to Tilbury Sydney Road.

Figure 2 Map of Diffusion Tube locations in Tilbury

Table 4 Tilbury Diffusion Tubes monitored annual mean NO_2 results in ($\mu g\ m^{-3}$)

Site	Designation	Bias Factor For 2012	2005	2006	2007	2008	2009	2010	2011	2012	2012 (Rev)
Calcutta Road Tilbury (R)	TL	**TK4**	32.24	33.32	**42.53**	**43.24**	39.61	**40.5**	**44.08**	**46.88**	**42.19**
Dock Road (Tilbury) (R)	TILA	**TK4**					36.21	**41.16**	39.83	**49.89**	**44.9**
Broadway Intersection (Tilbury) (R)	TILB	**TK4**					39.17	**41.8**	**49.87**	**49.31**	**44.38**
St Andrews Road (Tilbury) (R)	TILC	**TK4**					35.95	**42.71**	**47.66**	**50.68**	**45.61**
Calcutta Road East (Tilbury) (R)	TILD	**TK4**					34.42	39.31	**41.34**	**45.2**	**40.68**
Calcutta Road North (Tilbury) (R)	TILE	**TK4**					28.65	34.04	**40.84**	**42.66**	38.39
Duplicate Tube Thurrock 4 (R)	TK4 A & B	**TK4**							38.89	**41.69**	37.52
Tilbury Sydney Road (UB)	TSR	**TK4**								38.46	34.61

**2012 (Rev) is data that has been adjusted due to the poor data capture from the diffusion tubes in 2012, as both June & July results were not included. It has been decided to factor the original results by decreasing the annual mean concentration by 10% to account for this discrepancy as the summer results are often lower than the annual mean, this will give a more representative result.*

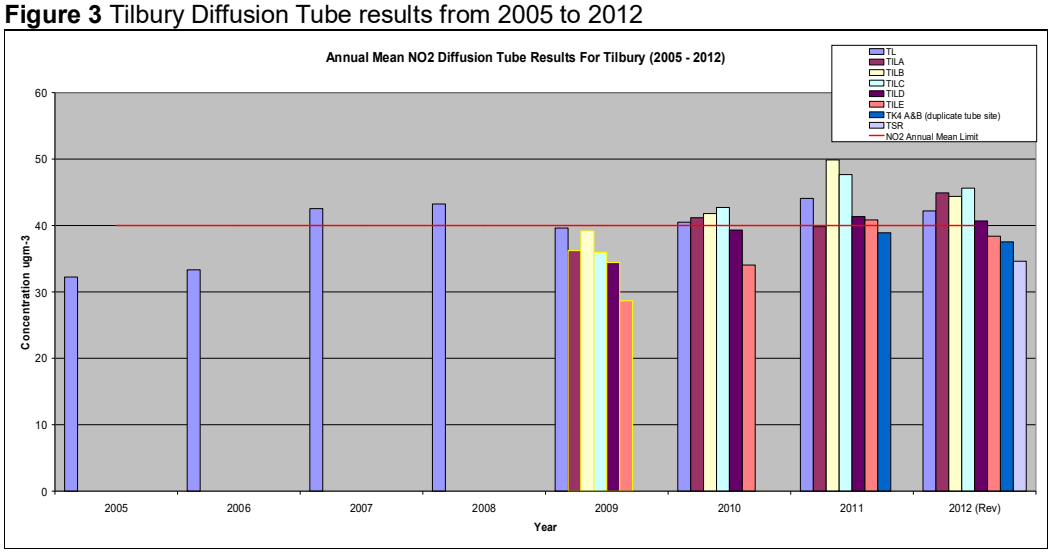
(Bold indicates was above the objective limit for NO_2)

(Purple indicates only less than 9 months data capture)

The bias factor derived was based from Thurrock 4 automatic monitoring site with co-located diffusion tubes, the factor applied to the diffusion tube results was **1.11**, this means diffusion tubes were under-predicting the automatic analyser for 2012.

(Table 4 summarises all the annual mean results for NO_2 from all the diffusion tube sites within Tilbury from 2005 to 2012. For 2012 the important column to note which is most representative to this report and for verification for modelling purposes is the **"2012 (Rev)"** column not the **"2012"** column. Concentrations have shown for the long running site at Calcutta Road (TL) to be slightly increasing over this period, although some years i.e. 2005, 2006 & 2009 were below the annual mean objective limit of 40 μg m^{-3}.

Figure 3 Tilbury Diffusion Tube results from 2005 to 2012



(Yellow outline on the bars indicates less than 9 months data capture)

(Figure 3) shows that NO_2 concentrations along Calcutta Road Tilbury site have remained over recent years above the NO_2 annual mean objective along with five other sites (Dock Road (TILA), Broadway Intersection (TILB) and St Andrews Road (TILC), Calcutta Road northside (TILE) and Calcutta Road Eastside (TILD)). The two duplicate sites co-located with Thurrock 4 continuous monitoring station were below 40 μg m^{-3}. So it is clear that NO_2 concentrations are widely exceeding the annual mean objective over a large area along Calcutta Road, Dock Road and St Andrews Road, although St Andrews Road does not have any relevant public exposure in relation to this objective limit.

3 Air Quality Modelling for NO_2

3.1 Outline of the Air Quality Model

In order to assess the full extent of exceedence of the annual mean objective for NO_2, so that an AQMA can be declared on a scientific basis rather than just an arbitory declaration, then detailed modelling has been used, by use of the Advanced Dispersion Model for Roads (ADMS-Roads), version 3.1 developed by Cambridge Environmental Research Consultants (CERC). This is a complex model with many variables to consider. The model has then been verified against monitoring sites within Tilbury to ensure that the results are as precise as possible.

3.2 Outline of the Model variables used

Detailed modelling has been conducted along the main roads in Tilbury. The roads modelled are:-

- **Dock Road**
- **Calcutta Road**
- **St Andrews Road**
- **Montreal Road**
- **St Chads Road**
- **Dock Road (South of Calcutta Road)**
- **St Chads Road**
- **Port of Tilbury Roads**

3.2.1 Road Traffic Data

Traffic data for these roads has been limited, and some assumptions have had to be made due to the lack of traffic data available.

Data was available for St Andrews Road, from use of 2010 road traffic data collected by the Department for Transport (DfT), this was high quality data showing many vehicle classes. Many of the assumptions made for the Port of Tilbury Roads were based on this data.

2009 road traffic data was used for Calcutta road, which was set up by Thurrock Council, this is also high quality data with many vehicle classes. The data recorded from this will be the basis of the assumptions used for Dock Road and also for the source apportionment for these roads further in this report, traffic data is listed in (Table 5).

All the roads used in the model had individual plots approximately 10 metres apart in order to enhance the resolution of the model. The plots were plotted using ArcGIS and these were plotted on X & Y coordinate based system.

The model uses the latest road traffic emission factors from the Emission Factors Toolkit (EFT), UK EFT, (v5.1) {(2 vehicle classes) i.e. Heavy Good Vehicles (HGVs) & Light Goods Vehicles (LGVs)}. The model scenario was run for the year 2012.

(Table 5) shows the parameters input in ADMS-Roads for all the roads modelled, it gives the details of both classifications of vehicles and their numbers per hour and per day.

Table 5 Road Vehicle Counts and Emissions Factors for Modelled Roads in Tilbury

Road	Vehicle Class	Average Speed (km/hr)	Vehicles (per hr)	Vehicles (per day)	NOx Emission Factors (g/km)
Calcutta Road	LGVs (i.e. Passenger Cars, Light Goods)	40	456	10944	0.361
	HGVs (i.e. Art, Rigid Lorries & Buses)	40	2	48	5.046
Dock Road	LGVs (i.e. Passenger Cars, Light Goods)	32	700	16800	0.397
	HGVs (i.e. Art, Rigid Lorries & Buses)	32	12	288	5.977
Dock Road [South (Post Calcutta Rd)]	LGVs (i.e. Passenger Cars, Light Goods)	48	150	3600	0.335
	HGVs (i.e. Art, Rigid Lorries & Buses)	40	1	24	5.046
Montreal Road	LGVs (i.e. Passenger Cars, Light Goods)	48	150	3600	0.335
	HGVs (i.e. Art, Rigid Lorries & Buses)	40	1	24	5.046
Port of Tilbury Road	LGVs (i.e. Passenger Cars, Light Goods)	32	5	120	0.397
	HGVs (i.e. Art, Rigid Lorries & Buses)	32	30	720	5.977
St Andrews Road	LGVs (i.e. Passenger Cars, Light Goods)	65	72	1728	0.312
	HGVs (i.e. Art, Rigid Lorries & Buses)	56	51	1224	3.975
St Andrews Road (South of Port Entrance)	LGVs (i.e. Passenger Cars, Light Goods)	65	72	1728	0.312
	HGVs (i.e. Art, Rigid Lorries & Buses)	56	21	504	3.975
St Chads Road	LGVs (i.e. Passenger Cars, Light Goods)	40	300	7200	0.361
	HGVs (i.e. Art, Rigid Lorries & Buses)	40	5	120	5.046

(Table 6) below shows the NO_x emission rates which were input into the model, emission rates are automatically calculated within the model itself based on the parameters input in (Table 5) above, and for which year the emission factors are based which in this case they were based on the year 2012.

Table 6 Road NO_x Emissions Rates on Modelled Roads in Tilbury

Road	NOx Emission Rate (g/km/s)
Calcutta Road	0.0485334
Dock Road	0.0971886
Dock Road [South (Post Calcutta Rd)]	0.0153683
Montreal Road	0.0153683
Port of Tilbury Road	0.0503640
St Andrews Road	0.0625483
St Andrews Road (South of Port Entrance)	0.0294230
St Chads Road	0.0370939

(Table 7) below, shows the time varying emissions factors applied into the model. The calculations were based on the road traffic counts of vehicles per hour carried out for Calcutta Road in 2009.

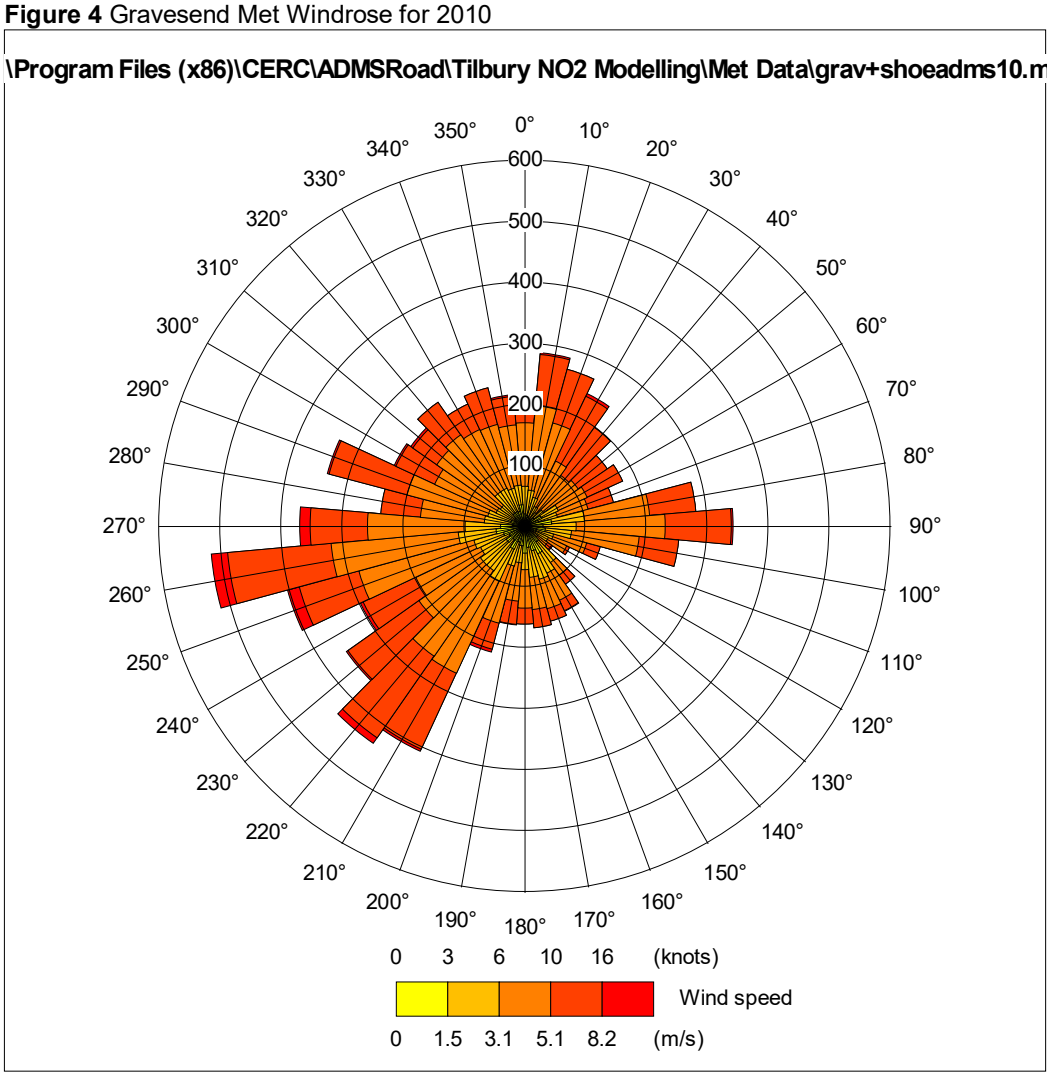
Table 7 Time Varying Emission Factors applied into AQ Model

Local Time (hrs)	Weekdays	Saturdays	Sundays
0	0.12	0.29	0.48
1	0.05	0.18	0.2
2	0.05	0.12	0.13
3	0.08	0.14	0.11
4	0.11	0.13	0.12
5	0.48	0.27	0.2
6	0.78	0.46	0.37
7	1.05	0.61	0.51
8	1.52	0.9	0.66
9	1.45	1.31	1.18
10	1.34	1.64	1.77
11	1.48	1.72	1.99
12	1.55	1.9	2.26
13	1.61	1.76	1.93
14	1.52	1.73	1.89
15	1.83	1.6	1.77
16	1.86	1.53	1.46
17	1.99	1.82	1.53
18	1.26	1.63	1.53
19	0.92	1.48	1.26
20	1.1	0.93	0.9
21	0.85	0.83	0.81
22	0.59	0.55	0.61
23	0.43	0.47	0.29

3.2.2 Meteorological Data

The model used meterological data obtained from the UK Met Office, from the closest most representative site, which is from Gravesend which is approximately 3 miles away from Tilbury. The data used was hourly sequential data and was for the year 2010. (windrose seen below in Figure 4)

Figure 4 Gravesend Met Windrose for 2010



3.2.3 Background Pollutant Data

The background data used in the model was from various sites for different pollutants. For NO_2 data was used from the TSR diffusion Tube site for 2012 as the urban background in Tilbury is higher than at the Urban Background Automatic monitoring station (Thurrock 1) located in Grays approximately 3 miles away. The NO_2 background used in the model was **33.61 μg m^{-3}**, which is 1 μg m^{-3} lower than the revised 2012 results shown in (Table 4) of 34.61 μg m^{-3}. The reason this value was altered was after running various model verification runs against the monitoring data, the model tended to over-predict the monitored sites and thus by decreasing the Urban Background by 1 μg m^{-3} the model showed much better agreement with all the monitored sites.
For oxides of nitrogen NO_x the urban background site at (Thurrock 1) was used for 2012, which was **50 μg m^{-3}**. All other pollutants were based on Thurrock 1 for 2012, except for CO which was based on 2007 data. (see Table 8)

Table 8 ADMS Urban Background Measurements used in Model

Pollutant	Concentration	Units	Site used
NOx	50	ug/m-3	TK1 (2012)
NO2	33.61	ug/m-3	TSR (2012)
VOC	0.25	ug/m-3	Objective based
O3	36	ug/m-3	TK1 (2012)
SO2	1.86	ug/m-3	TK1 (2012)
PM2.5	10.7	ug/m-3	TK3 (2012)
PM10	17.84	ug/m-3	TK1 (2012)
CO	0.2	ppm	TK1 (2007)
Benzene	0	ppb	n/a
Butadiene	0	ppb	n/a
TSP	0	ug/m-3	n/a

3.2.4 Point Sources Data

Some point sources were also input into the model, as they were seen that they might have some contribution to the general background concentrations, abeit very small. Tilbury Power Station was incorporated into the model. The data input was based on a worse case scenario with maximum contribution from all three main stacks. The data was obtained from an Assessment they carried out in August 2012 for conversion to a Biomass plant, the values input reflect a pre-biomass state i.e. using coal as the fuel source. (see Table 9 & 10)

Table 9 Tilbury Power Station Model inputs for Main Stacks

Name	Pressure Cp J/°C/kg	Mol. Mass (g)	Density (kg/m-3)	T or RHO?	Actual or NTP	Source	Stack Height (m)	Stack Diameter (m)	Velocity (m/s)	Temp (°C)	X	Y
Tilbury Stack 1 (North Main)	1012	28.966	1.225	T	Actual	Point	157	8.38	5	148	566057	175684
Tilbury Stack 2 (South Main)	1012	28.966	1.225	T	Actual	Point	171	8.38	5	148	566063	175558
Tilbury PS OCGTs	1012	28.966	1.225	T	Actual	Point	72.4	5.2	5	390	566155	175740

Table 10 Emission rates of NO_x & NO_2 from Main Stacks

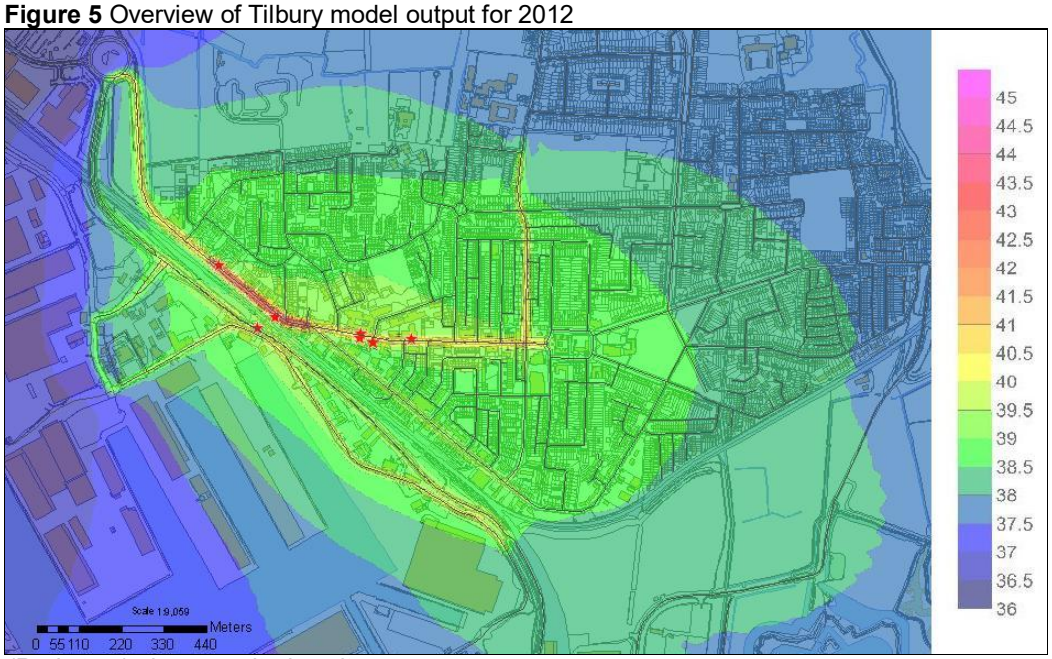
Name	Emission of NO_x (g/s)	Emission of NO_2 (g/s)
Tilbury Stack 1 (North Main)	91.10	4.555
Tilbury Stack 2 (South Main)	48.70	2.435
Tilbury PS OCGTs	16.80	1.680

4 Results For Air Quality Model Run For NO_2

The locations of the major roads are modelled to a high degree of accuracy and in this case it is within 1m. The output was plotted precisely over the ArcGIS OS Map data, which gives details of individual houses and allows easy estimation of the exposure of the local population to concentrations above the AQS and objectives. The pollution contours also show the rapid fall off in concentrations within a fairly close distance from the roadside.

The predictions confirm that the air quality objective is exceeded, in areas close to the centre of roads and close to junctions, (Figure 5) gives an idea of the areas exceeding the objective. The yellow to red areas are above the annual mean objective of 40 μg m^{-3} for NO_2. Note the areas exceeding follow along the main roads.

Figure 5 Overview of Tilbury model output for 2012



(Red stars) show monitoring sites

Table 11 Model Results vs Monitored Results Comparison 2012 (μg m^{-3})

site	Modelled NO2	Monitored NO2	(Revision) Monitored NO2	Difference Monitored to Modelled	Difference (Rev) Monitored to Modelled	(Rev) % difference Monitored to Modelled
***(TK4)**	39.4	41.69	41.69	2.29	2.29	5.81%
TL	39.8	46.88	42.19	7.08	2.39	6.01%
TILA	40.5	49.89	44.90	9.39	4.40	10.87%
TILB	40.7	49.31	44.38	8.61	3.68	9.04%
TILC	39.4	50.68	45.61	11.28	6.21	15.77%
TILD	40	45.2	40.68	5.2	0.68	1.70%
TILE	39.8	42.66	38.39	2.86	-1.41	-3.53%
TSR	38.9	38.46	34.61	-0.44	-4.29	-11.02%
	39.8125	**45.59625**	**41.56**			**4.33%**
	Model Average	**Monitored Average**	**(Revised) Monitored Average**			**Overall (Rev) monitored vs modelled %**

(TK4) indicates is the Continuous monitoring site not co-located diffusion tube site

(Table 11) shows the difference between the modelled results against the monitored results. The yellow column is the unadjusted results based on 10 months of diffusion tube data. The Orange columns are adjusted results which account for the loss of 2 months data capture over 2012 for June & July, and are adjusted by taking away 10% due to the fact that the summer months typically have lower concentrations as was referred to earlier in this report in (Table 4).

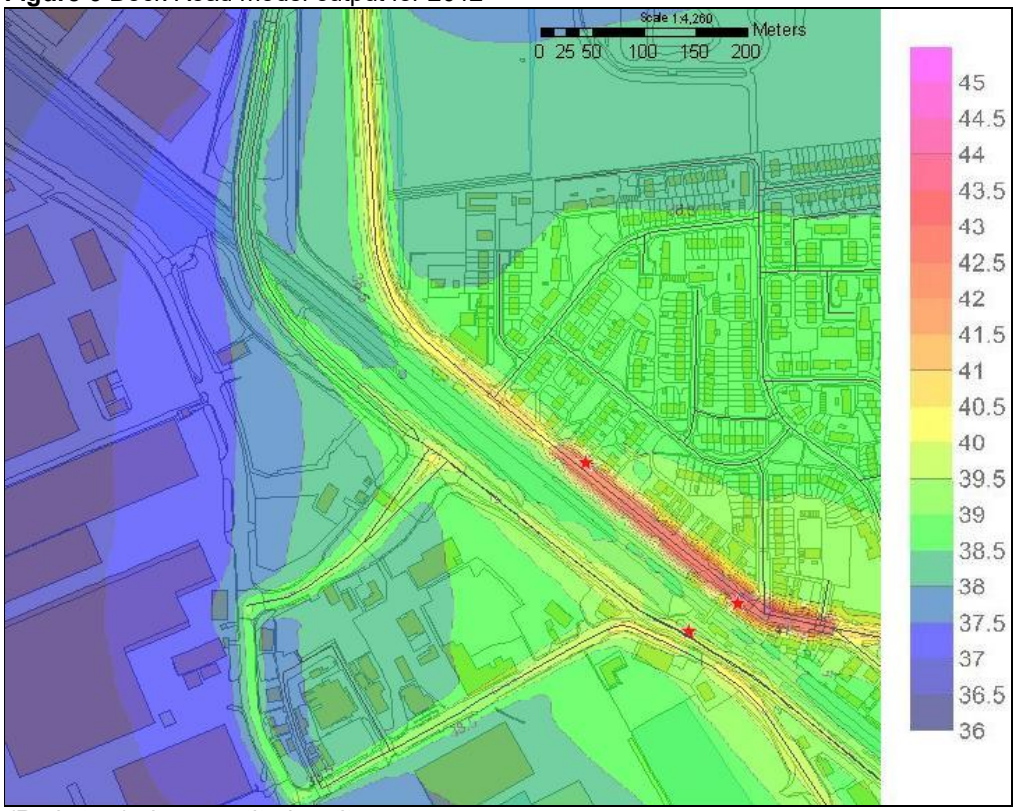
The model shows reasonable agreement with the revised monitored data, although it under predicts slightly. But most important is that the model over predicts at the background site (TSR), this gives confidence that the model at least gives a more pragmatic response when looking at areas away from the road. For the roadside sites the agreement is much closer albeit under predicts slightly. Overall the difference between all the site locations is within 10%, and an overall average of 4.3% which is sufficient.

However one site at St Andrews Road (TILC) was above 10% at 15.7%. This difference from modelled to monitored is most likely due to the close proximity to the Port of Tilbury and its fugitive emissions, by which the limitations of the model can not account for. Also St Andrews Road has no relevant public exposure so the results of the modelling are not relevant for this location.

4.1 Dock Road Model Results

Dock Road has the highest recorded exceedences of the annual mean objective approaching 45 μg m^{-3} at the road centreline. There are a relatively large number of properties which fall within the 40 μg m^{-3} exceedence line along Dock Road. All properties within the line and their property boundaries will be designated in the new AQMA. (Figure 6) shows the extent of exceedence along Dock Road shown in yellow, orange, red and pink areas. The area of exceedence is limited to within a few metres of the road edge.

Figure 6 Dock Road model output for 2012



(Red stars) show monitoring sites

4.2 Calcutta Road Model Results

The modelling for Calcutta Road also has some areas along it that are above the 40 μg m^{-3} marked in yellow and orange in (Figure 7), these are mainly located within or along the road itself. However the 40 μg m^{-3} exceedence line does go through a number of properties along this road, these properties and their boundaries will be incorporated into the new AQMA.

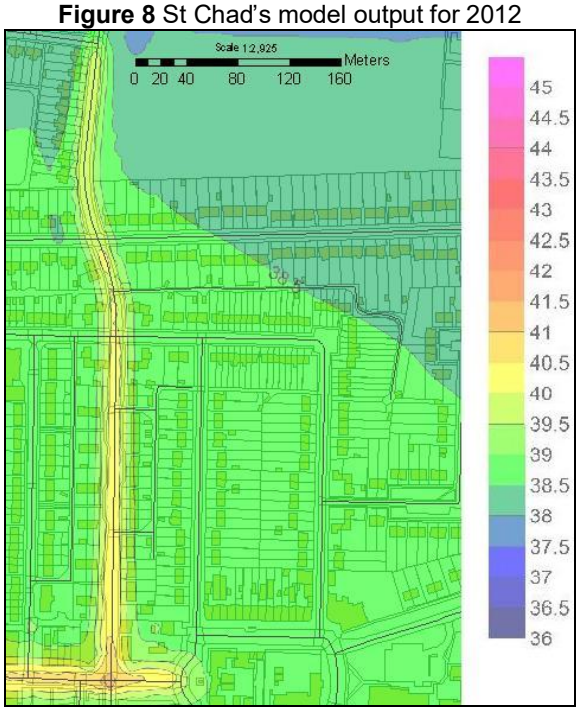
Figure 7 Calcutta Road model output for 2012

(Red stars) show monitoring sites

4.3 St Chad's Road Model Results

The modelling for St Chad's road (Figure 8) does show that some properties near to the junction with Calcutta Roads fall just within the exceedence line of 40 μg m^{-3}, these properties and their boundaries will be incorporated into the new AQMA.

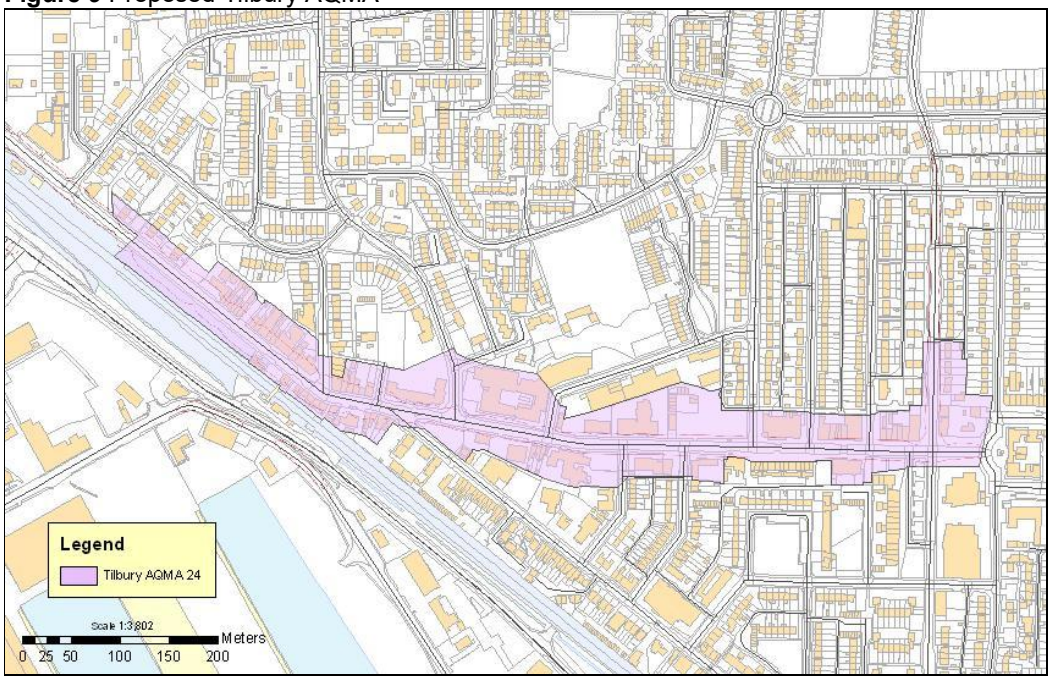
Figure 8 St Chad's model output for 2012



4.4 Proposed Air Quality Management Area (AQMA) based on Results of Modelling

Based on the modelled results where the 40 μg m^{-3} exceedence line runs through a property with relevant public exposure i.e. a Residential Property or School etc. Then the Whole Property and boundary of the property will be included within the AQMA not along the exceedence line itself. (Figure 9) shows the proposed area for the AQMA.

Figure 9 Proposed Tilbury AQMA



The proposed AQMA runs through approximately 78 property boundaries, of these 2 are Schools and 1 is a Health Care Facility. The vast majority of the rest of the properties are predominantly residential, they range from either single dwellings to flats with many residential blocks contained within, the flats are less numerous than the single dwellings however. There are some commercial premises which may have mixed use with possible residential space on the second floors of these properties, these have been included as a pre-caution. The mixed commercial properties are located at the far eastern end of Calcutta Road and also along the eastern end of Dock Road.

5 Source Apportionment for NO_2

5.1 Methodology

To better understand the air quality improvement needed to achieve the Air Quality Standards and Objectives, it is necessary to determine the individual source emissions that contribute to the overall predicted pollution concentration. Both pollutant emissions, location and atmospheric processes, including meteorology, determine the pollution concentration in any given area.

The pollutant under investigation in this stage of the Local Air Quality Management (LAQM) process, i.e. NO_2, further complicates the understanding of source apportionment. For NO_2, the contribution that different sources make to the predicted concentrations can only be fully understood by examining the contribution of NO_x sources as the primary emission.
The approach used in this source apportionment exercise is based on the example in (Box 7.1) within the LAQM Technical Guidance 2009 issued by DEFRA

The approach used in this source apportionment looks at the number of vehicles and vehicle classes for the two main roads in Tilbury both for Dock Road and Calcutta Road. Emission factors are then applied which are sourced from the National Atmospheric Emissions Inventory (NAEI), for each vehicle class for NO_x in (g/km) *this summary table can be found in Appendix 1 outlining the emission from each vehicle class*.

Data is also included from the Defra Background Maps for 2012 for both NO_x and NO_2 for locally derived concentrations which are the Total Background of NO_x and NO_2 [TB-NOx & TB-NO2], and for the Total Regional Background NOx & NO_2 [RB-NOx & RB-NO2]. A series of calculations are then conducted to find out what the Local Background NO_x [RB-NOx], Regional Background NO_2 [RB-NO2], Local Background NO_2 [LB-NO2] and Local NO_2 [L-NO2] concentrations are based on the actual measured concentration [T-NO2] which is the diffusion tube measurement. This was done for both Dock Road & Calcutta Road which the details of this work are shown in sections 5.2 & 5.3.

5.2 Source Apportionment for Dock Road

The Background data for Dock Road was sourced from the DEFRA Background Pollution Maps for 2012 concentrations. The measured monitoring site used for this road was Broadway Intersection Diffusion Tube Monitoring site (TILB) for 2012 which best represents the worst case monitoring along this road (Table 12) shows all the inputs and calculations used in this source apportionment.

Table 12 Calculation inputs for NOx & NO2 for Dock Road Source Apportionment

	Measurement	Equation Coding	ug/m-3		
	(Total Measured NO2)	T-NO2	44.38	TILB (diffusion tube 2012)	
Info from National Background Maps	(Total Background NO2)	TB-NO2	19.37		2012 data
Info from National Background Maps	(Total Background NOx)	TB-NOx	28.73		2012 data
Info from National Background Maps	(Regional Background NOx)	RB-NOx	26.47	*Average for all of Thurrock*	2012 data
calculated i.e.	(Local Background NOx)	LB-NOx	2.26	*{ (LB-NOx)= TB-NOx - RB-NOx }*	
calculated i.e.	(Regional Background NO2)	RB-NO2	17.85	*{ (RB-NO2)= TB-NO2 x (RB-NOx / TB-NOx) }*	
calculated i.e.	(Local Background NO2)	LB-NO2	1.52	*{ (LB-NO2)= TB-NO2 x (LB-NOx / TB-NOx) }*	
calculated i.e.	Local NO2	L-NO2	25.01	*{ (L-NO2)= T-NO2 - TB-NO2 }*	

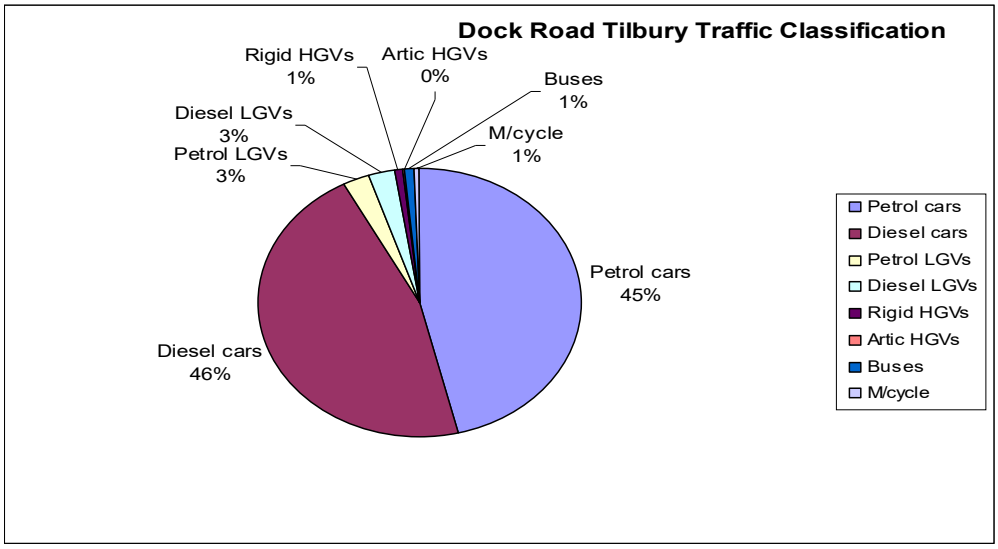
Road traffic data as well as information on different vehicle classes is required in order to assess the overall and individual source contributions, (Table 13 & Figure 10) gives an overview of the total vehicles and classes for Dock Road.

Table 13 Calculation of different vehicle classes for Dock Road

Vehicle type	No of Vehicles (vpd)	Vehicle %
Petrol cars	7877	46.11%
Diesel cars	7877	46.11%
Petrol LGVs	462	2.70%
Diesel LGVs	462	2.70%
Rigid HGVs	112	0.66%
Artic HGVs	64	0.37%
Buses	114	0.67%
M/cycle	114	0.67%
Total	**17082**	**100.0%**

(*Please note these vehicle classes have an assumption of 50% split between Diesel Vehicles & Petrol Vehicles)
The Vehicle numbers for Dock Road are "estimated" based on up-scaling of the Calcutta Road Traffic data used in the actual modelling.

Figure 10 Dock Road Vehicle Type Classification

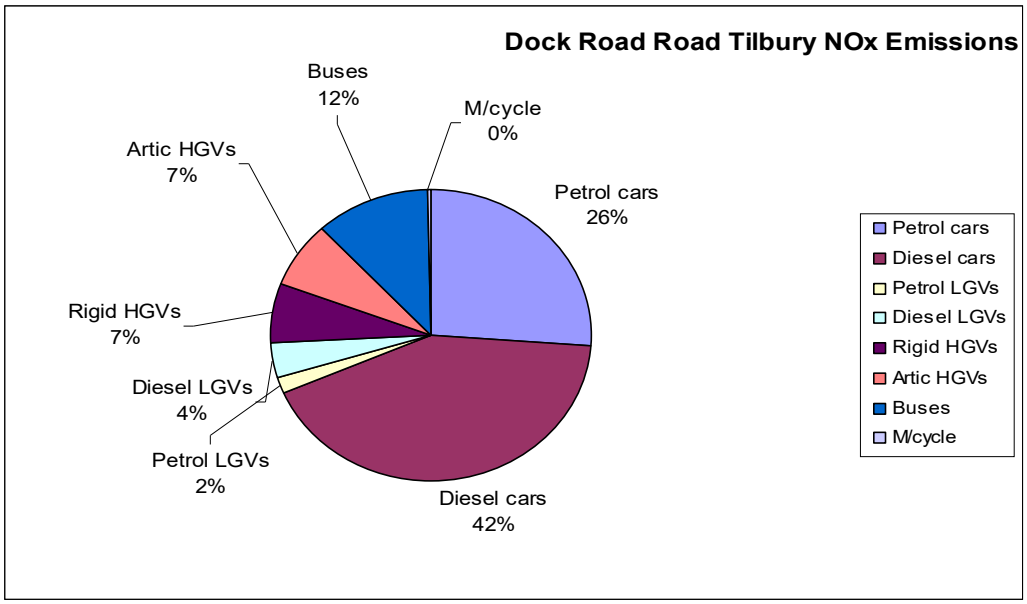


The total NOx contribution for each vehicle class can then be calculated, (Table 14 & Figure 11) shows the individual vehicle class NOx source contributions for Dock Road.

Table 14 Total NOx contribution for each Vehicle Class for Dock Road

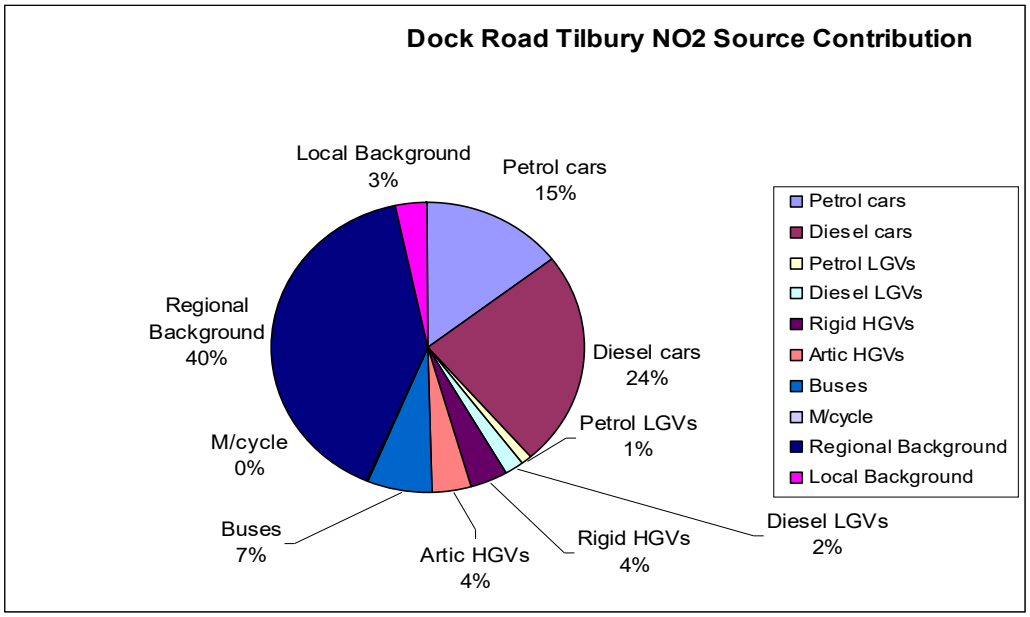
Vehicle type	TOTAL Emission each Class g/km NOx	% Emission each Class
Petrol cars	2155.31	26.20%
Diesel cars	3479.52	42.30%
Petrol LGVs	152.00	1.85%
Diesel LGVs	303.94	3.70%
Rigid HGVs	568.20	6.91%
Artic HGVs	575.19	6.99%
Buses	974.91	11.85%
M/cycle	16.43	0.20%
Total	**8225.50**	**100.00%**

Figure 11 Dock Road Percentage of NOx Emission Contribution for each Vehicle Class



The majority of NO_x emissions from vehicles emanate from predominantly Passenger Cars which account for 68% of the emissions, broken down into 42% for Diesel Cars and 26% for Petrol Cars. Buses are the next third largest emitter at 12%.

Figure 12 Dock Road different NO_2 Source Contributions



For NO_2 contributions along Dock Road, most of the overall source contribution comes from the Regional Background which accounts for 40% which the Council cannot directly tackle. The main Road Traffic source is from Passenger Cars with 39% in total, with diesel Cars at 24% and Petrol Cars at 15%. Buses account for 7% of total NO_2 source contribution. So any measures for decreasing NO_2 will mainly require a more national focus on any reduction of NO_2, as reducing the main component of Cars would not be a viable option along this road.

5.3 Source Apportionment for Calcutta Road

The Background data for Calcutta Road was sourced from the DEFRA Background Pollution Maps for 2012 concentrations. The measured monitoring site used for this road was Tilbury Calcutta Road Diffusion Tube Monitoring site (TL) for 2012 which best represents the worst

case monitoring along this road (Table 15) shows all the inputs and calculations used in this source apportionment.

Table 15 Calculation inputs for NOx & NO2 for Calcutta Road Source Apportionment

	Measurement	Equation Coding	ug/m-3		
	(Total Measured NO2)	T-NO2	42.19	TL (diffusion tube 2012)	
Info from National Background Maps	(Total Background NO2)	TB-NO2	19.37		2012 data
Info from National Background Maps	(Total Background NOx)	TB-NOx	28.73		2012 data
Info from National Background Maps	(Regional Background NOx)	RB-NOx	26.47	*Average for all of Thurrock*	2012 data
calculated i.e.	(Local Background NOx)	LB-NOx	2.26	*{ (LB-NOx)= TB-NOx - RB-NOx }*	
calculated i.e.	(Regional Background NO2)	RB-NO2	17.85	*{ (RB-NO2)= TB-NO2 x (RB-NOx / TB-NOx) }*	
calculated i.e.	(Local Background NO2)	LB-NO2	1.52	*{ (LB-NO2)= TB-NO2 x (LB-NOx / TB-NOx) }*	
calculated i.e.	Local NO2	L-NO2	22.82	*{ (L-NO2)= T-NO2 - TB-NO2 }*	

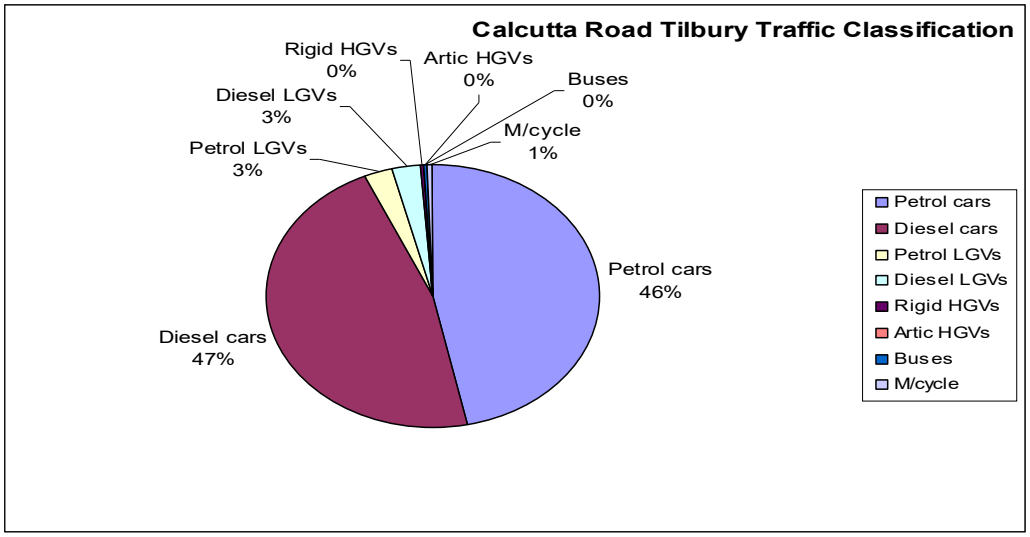
Road traffic data as well as information on different vehicle classes is required in order to assess the overall and individual source contributions, (Table 16 & Figure 13) gives an overview of the total vehicles and classes for Calcutta Road.

Table 16 Calculation of different vehicle classes for Calcutta Road

Vehicle type	No of Vehicles (vpd)	Vehicle %
Petrol cars	5135	46.68%
Diesel cars	5135	46.68%
Petrol LGVs	304	2.76%
Diesel LGVs	304	2.76%
Rigid HGVs	19	0.17%
Artic HGVs	11	0.10%
Buses	19	0.17%
M/cycle	74	0.67%
Total	**11001**	**100.0%**

(*Please note these vehicle classes have an assumption of 50% split between Diesel Vehicles & Petrol Vehicles)

Figure 13 Calcutta Road Vehicle Type Classification

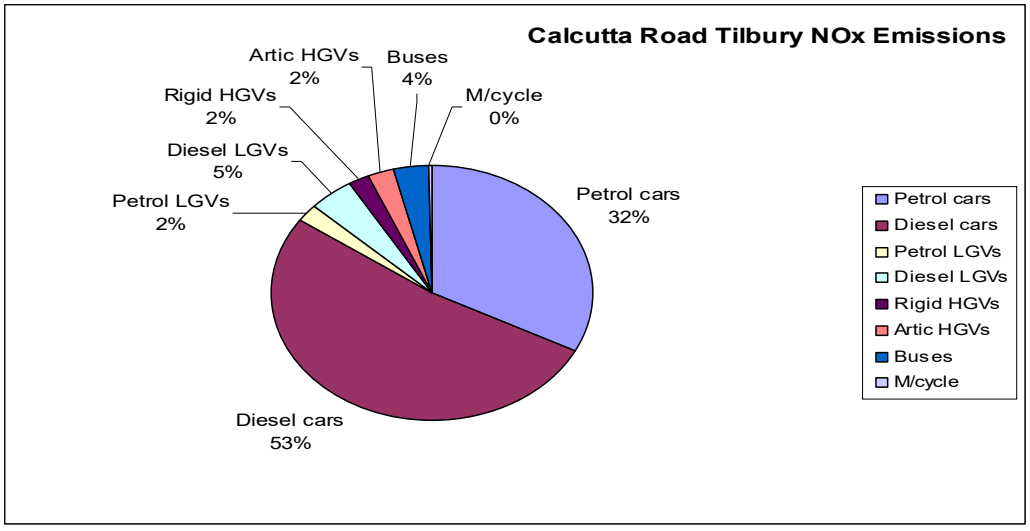


The total NOx contribution for each vehicle class can then be calculated, (Table 17) shows the individual vehicle class NOx source contributions for Calcutta Road.

Table 17 Total NOx contribution for each Vehicle Class for Calcutta Road

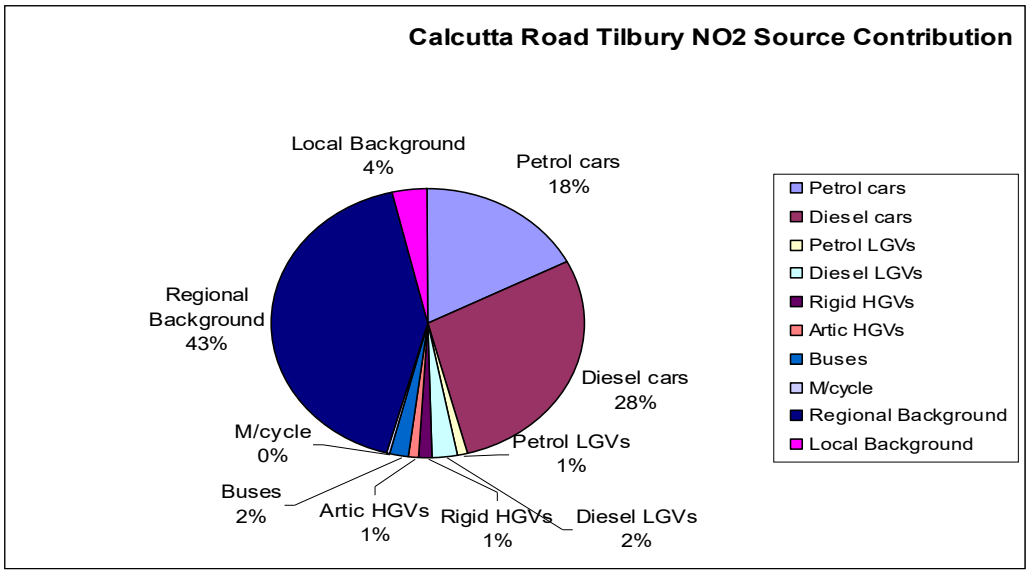
Vehicle type	TOTAL Emission each Class g/km NOx	% Emission each Class
Petrol cars	1405.04	32.36%
Diesel cars	2268.29	52.24%
Petrol LGVs	100.02	2.30%
Diesel LGVs	200.00	4.61%
Rigid HGVs	96.39	2.22%
Artic HGVs	98.86	2.28%
Buses	162.48	3.74%
M/cycle	10.66	0.25%
Total	**4341.75**	**100.00%**

Figure 14 Calcutta Road Percentage of NOx Emission Contribution for each Vehicle Class



The majority of NO_x emissions from vehicles emanate from predominantly Passenger Cars which account for 85% of the emissions, broken down into 53% for Diesel Cars and 32% for Petrol Cars. Buses are next, the third largest emitter at 4%.

Figure 15 Calcutta Road different NO_2 Source Contributions



For NO_2 along Calcutta Road most of the overall source contribution comes from the Regional Background which accounts for 43% which the Council cannot directly tackle. The main Road Traffic source is from Passenger Cars with 46% in total, with diesel Cars at 28% and Petrol Cars at 18%. Buses account for only 2% of total NO_2 source contribution. So any measures for decreasing NO_2 will mainly require a more national focus on any reduction of NO_2, as reducing the main component of Cars would not be a viable option along this road.

6 Scenario Testing of Source Apportionment Results

Based on the source apportionment work conducted in (Section 5) of this report, some scenario testing has been carried out to see what would be required in terms of motor vehicle reductions in order to make the annual mean air quality objective compliant along Dock Road & Calcutta Road.

As the majority of vehicles that travel along Dock Road & Calcutta Road are predominantly Cars the amount of reduction required in order to meet the annual mean objective of 40 $\mu g\ m^{-3}$ would require an enormous reduction of these vehicles and would not present a feasible solution to the air quality problem issue along these two roads. However it would be possible to meet the air quality objective based on reducing a combination of both, HGV's, Buses and or LGV's. (Table 18 & 19 shows how this could be achieved)

Table 18 Scenarios for NO_2 reduction required from the removal of vehicle classes on Dock Road & Calcutta Road

Location	2012 Base	2012 Removal HGVs + LGVs + Buses	2012 Removal of HGVs + Buses	2012 Removal of HGVS+ LGVs
Calcutta Road	**42.19**	**38.73**	**40.31**	**39.59**
Dock Road	**44.38**	**36.55**	**37.94**	**39.52**

(Red indicates Air Quality Objective would not be met)

Table 19 The Number of Reduction of Vehicles by Class in order for full compliance of NO_2 for Dock Road & Calcutta Road

Location	2012 Base	2012 Removal HGVs + LGVs + Buses	2012 Removal of HGVs + Buses	2012 Removal of HGVS+ LGVs
Calcutta Road	No Change N/A	(HGV 30 + LGV 608 + BUS 19) **TOTAL 657**	(HGV 30 + BUS 19) **TOTAL 49**	(HGV 30 + LGV 608) **TOTAL 638**
Dock Road	No Change N/A	(HGV 176 + LGV 924 + BUS 114) **TOTAL 1214**	(HGV 176 + BUS 114) **TOTAL 290**	(HGV 176 + LGV 924) **TOTAL 1100**

(Red indicates Air Quality Objective would not be met)

For Calcutta Road either an option of complete removal of HGV's, LGV's & Buses or HGV's & LGV's would enable compliance of the annual mean objective for NO_2.

For Dock Road either an option of complete removal of HGV's, LGV's & Buses or HGV's & Buses or HGV's & LGV's would enable compliance of the annual mean objective for NO_2.

These measures would be extreme however, it is unlikely that the Council could fully enforce these measures, or would be favourable in the eye of the general public in limiting the use of public transportation.

So a focus on trying to encourage people to adopt a modal shift from using Cars to alternative methods of transportation, i.e. Public transport or uptake of Cycling would prove to be a better more feasible option. However some elements of these scenarios i.e. removal of HGV's could also be implemented alongside these softer measures to bring the levels of pollution down along these two roads.

7 Conclusion

The diffusion tube monitoring results along Calcutta Road & Dock Road, Tilbury still confirm that there is an exceedence of the annual mean air quality objective of 40 ug m^{-3}, although for the last 2 years the automatic monitoring station (Thurrock 4) on Calcutta Road has been just below the air quality objective.

The air quality modelling results which have been verified against the monitoring data for 2012 confirm that there are areas along Calcutta Road, and partially along St Chad's Road near to the intersection with Calcutta Road which are above the annual mean air quality objective for NO_2. Based on the model results the Council should declare an AQMA around the boundaries of any property which represents relevant public exposure which come into contact with the de-marketed exceedence line of 40 ug m^{-3} from the modelling results. Approximately 78 property boundaries will be incorporated into the new AQMA.

Source Apportionment work has been conducted in order to assess what the main source contributions of NO_2 are and where they may be coming from along both Calcutta Road & Dock Road.

The results showed that by far the main contributor of NO_2 is from the regional background for both cases. For Dock road this accounted for 40% of total NO_2 source contribution, and for Calcutta Road it was 43%. The Council has no direct influence or control over the regional background as this can only be influenced from a national level, in order to get any reductions of NO_2 from this component. The second main source came from Cars with 39% for Dock Road and 46% for Calcutta Road, (these were then further broken down into two components of Diesel Cars & Petrol Cars). The Council could not feasibly mitigate against Cars along these two roads as they are the main trunk roads through Tilbury. Any targeted measures would require a modal shift away from using Cars to either Public Transport or to greener methods of transportation such as Cycling.

Scenario Testing based on the source apportionment of these two roads was carried out and found that it would be possible to meet the air quality objective, if all the HGV's, Buses & or LGV's were removed from the roads, this action would be both drastic, and not entirely enforceable by the Council, and would mean that no public transportation could flow into Tilbury.

8 Recommendations

Undertake consultation on the findings arising from this report with statutory and other consultees as required

Designate a new Air Quality Management Area (AQMA) in Tilbury along Dock Road and Calcutta Road based on the modelled results from this report on the annual mean air quality objective of 40 ug m^{-3} for NO_2

Continue to monitor at all locations within Tilbury both automatic and non automatic monitoring sites

Produce an Air Quality Action Plan for NO_2 along Calcutta Road & Dock Road, Tilbury.

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