# 8 Updating and Screening Assessment for Nitrogen Dioxide

## 8.1 THE NATIONAL PERSPECTIVE

The principal source of NOx emissions is road transport, which accounted for about 40 % of total UK emissions in 2003. Major roads carrying large volumes of high-speed traffic (such as motorways and other primary routes) are a predominant source, as are conurbations and city centres with congested traffic. Within most urban areas, the contribution of road transport to local emissions will be much greater than for the national picture.

Meeting the annual mean objective for 2005, and the corresponding limit value in 2010, is considerably more demanding than achieving the 1-hour objective. By 2005, the annual mean objective was being achieved at all urban background locations outside of London, but being exceeded more widely at roadside sites throughout the UK in close proximity to busy road links. Projections for 2010 indicate that the EU limit value may still be exceeded at urban background sites in inner London, and at roadside locations in other cities.

## 8.2 STANDARDS AND OBJECTIVES FOR NITROGEN DIOXIDE

The Government and the Devolved Administrations have adopted two Air Quality Objectives for nitrogen dioxide, an annual mean concentration of 40 $\mu gm^{-3}$, and a 1-hour mean concentration of 200 $\mu gm^{-3}$ not to be exceeded more than 18 times per year. The objectives were set to be achieved by the end of 2005.

## 8.3 CONCLUSIONS OF THE PREVIOUS ROUNDS OF REVIEW AND ASSESSMENT FOR NITROGEN DIOXIDE

The following conclusions were given for nitrogen dioxide in the first and second rounds of Review and Assessment for King's Lynn and West Norfolk:

- Stage 1 and 2 Review and Assessments found potentially significant traffic and industrial sources of nitrogen dioxide, and identified one roadside locality with relevant receptors that could potentially result in an exceedence of the nitrogen dioxide objective.
- Stage 3 Review and Assessment found that exceedence of the nitrogen dioxide objective was unlikely and an AQMA should not be declared, but that continued consideration and ongoing monitoring for nitrogen dioxide was appropriate in the town centre.
- Stage 4 Review and Assessment recommended an AQMA be declared for road traffic sourced nitrogen dioxide in the Railway Road vicinity, a street canyon.
- Updating and Screening Assessment (2003): no further screening for nitrogen dioxide was added to the Stage 4 conclusions.
- The Progress Report undertaken in 2004 considered the Railway Road AQMA as still valid. In addition, diffusion tube monitoring at Southgate indicated a potential area of exceedence due to traffic emissions. Extended diffusion tube monitoring and a detailed assessment for nitrogen dioxide was recommended at the Southgate and Austin Street location. Appendix 6 shows the current and proposed Railway Road AQMA boundaries.
- Detailed Assessment undertaken in 2005 determined that exceedences of the annual mean objective are likely at locations with relevant exposure outside of the existing AQMA, and recommended an extension to the AQMA to include residential properties along Railway Road, Blackfriars Road and London Road.

- As part of an assessment undertaken by a neighbouring authority, Fenland District Council, modelling indicated areas of exceedence at the border of Fenland DC and the Borough Council of King's Lynn and West Norfolk (KLWNBC). Since February 2006 KLWNBC has extended its monitoring regime along Elm High Road. The results will be reported and evaluated at the next progress report.

## 8.4 SCREENING ASSESSMENT OF NITROGEN DIOXIDE

### 8.4.1 Screening Checklist

The Technical Guidance LAQM.TG(03) requires assessment of nitrogen dioxide to consider the following sources, data or locations:

- Monitoring data outside an AQMA
- Monitoring data within an AQMA
- Narrow congested streets with residential properties close to the kerb
- Junctions
- Busy streets where people may spend 1-hour or more close to traffic
- Roads with high flow of buses and/or HGVs
- New roads constructed or proposed since last round of review and assessment
- Roads with significantly changed traffic flows or new, relevant exposure
- Bus Stations
- New industrial sources
- Industrial sources with substantially increased emissions or new relevant exposure
- Aircraft

These are evaluated in the following sections.

### 8.4.2 Background Concentrations for Nitrogen Dioxide

The average background nitrogen dioxide concentration in King's Lynn and West Norfolk, estimated for 2005 from the UK background maps (http://www.airquality.co.uk/archive/laqm/tools.php) was 15.5 $\mu gm^{-3}$, with a maximum concentration of 25.0 $\mu gm^{-3}$. In 2010 the estimated average will be 13.2 $\mu gm^{-3}$ with a maximum of 29.2 $\mu gm^{-3}$.

### 8.4.3 Screening Assessment of Monitoring Data

#### *8.4.3.1 Automatic Monitoring Data*

Nitrogen dioxide has been monitored at the Railway Road automatic monitoring site since September 2002. The location was chosen to monitor traffic related $NO_2$ as recommended in the Stage 3 report after a possibility of an exceedence of the objectives was found. This site is located close to, but not within, the current Railway Road AQMA. Nitrogen dioxide concentrations are measured by ozone chemiluminesence. Quality Assurance audits are carried out at six monthly intervals by **netcen**, who also manage and ratify the data, applying similar quality assurance procedures to those employed for the national automatic networks.

A full year's ratified automatic monitoring data is available for 2005 at Railway Road, and is presented in Appendix 1. The site obtained 88.9 % data capture for nitrogen dioxide during 2005. The 2005 annual average nitrogen dioxide concentration was 31 $\mu gm^{-3}$, and the maximum hourly nitrogen dioxide concentration was 99 $\mu gm^{-3}$, both significantly less than the annual and hourly objective values of 40 $\mu gm^{-3}$ and 200 $\mu gm^{-3}$ respectively.

#### *8.4.3.2 Diffusion Tube Monitoring Data*

Nitrogen dioxide diffusion tubes are exposed at locations across King's Lynn and West Norfolk. Diffusion tube monitoring was carried out at 62 locations across the Borough during 2005, which included four triplicate monitoring sites (details in Appendix 1). In February 2006, this network was extended to 71 monitoring sites (plus one blank) with three being triplicate monitoring sites.

Diffusion tubes are still supplied and analysed by Gradko Laboratories, and are prepared using 20% TEA in water. A local bias adjustment factor of 0.91 can be calculated from the co-located

triplicate diffusion tubes and chemiluminesence analyser at Railway Road. Since automatic measurements are missing for the majority of June 2005, June automatic and diffusion tube measurements have been excluded when calculating the local bias adjustment factor. This is necessary to allow for any seasonal variation in bias.

The bias adjustment factor published by UWE using results from the intercomparison survey in 2005 was 0.99 (http://www.uwe.ac.uk/aqm/review/index.html). The UWE recommended factor is higher than that calculated using the local co-location study, although it is also noteworthy that King's Lynn did not participate in the UWE survey.

The **locally derived** bias adjustment factor is therefore considered more suitable for this USA, since it is based on fully ratified automatic data. In addition, this continues the 'protocol' set for previous review and assessments for King's Lynn and West Norfolk. Conclusions and recommendations regarding nitrogen dioxide concentrations have been based on local bias corrected results, although concentrations using both factors are presented in tables 8.1, 8.2 and 8.3 for comparison.

### *Monitoring Within the Current Railway Road AQMA*

Four diffusion tube sites are located within the current Railway Road AQMA. Of these, two were set up early in 2006 so have not yet produced an annual mean. Concentrations at these locations are listed below in table 8.1. Exceedences of the 2005 annual mean objective of 40 $\mu gm^{-3}$ are shown in **bold red** text. Using the locally derived bias adjustment factor, it can be seen that none of the locations within the current AQMA exceeded the 2005 annual mean objective of 40 $\mu gm^{-3}$; using the UWE factor, Railway Road 2 is marginally above the objective.

**Table 8.1** Annual Mean $NO_2$ concentrations at sites within the current Railway Road AQMA, $\mu gm^{-3}$ (2005)

| Tube ID | Site Name | Annual Mean (measured) | Annual Mean (*UWE* bias corrected)[a] | Annual Mean (***LOCAL*** bias corrected)[b] |
|---|---|---|---|---|
| 4 | Railway Road 6 | *New site* | --- | --- |
| 30 | Railway Road 7 | *New site* | --- | --- |
| 31 | St John's Terrace | 32 | 32 | 29 |
| 35 | Railway Road 2 | **41** | **40** | 37 |

[a] *UWE bias adjustment factor = 0.99* [b] *Local bias adjustment factor = 0.91*

### *Monitoring Within the Proposed Extended Railway Road AQMA*

Previous years' monitoring data and recent review and assessment recommendations have led to a proposal to extend the current Railway Road AQMA. The new boundaries and timescale for its implication have not yet been finalised, but diffusion tube monitoring locations within the proposed, extended Railway Road AQMA are shown in Table 8.2. Exceedences of the 2005 annual mean objective of 40 $\mu gm^{-3}$ are shown in **bold red** text.

Using the local bias adjustment factor, the only site currently exceeding the 2005 objective for nitrogen dioxide is Railway Road 1, where an annual mean of 43 $\mu gm^{-3}$ was measured in 2005. This tube is mounted on a lamp post (kerbside), and the Borough Council has confirmed that there are no relevant receptors for the annual mean objective at this location. Nitrogen dioxide concentrations at many sampling locations are very close to the objective of 40 $\mu gm^{-3}$, thus supporting the council's decision to extend the AQMA. The new sampling sites set up early in 2006 have not yet produced annual means, but should be considered in the next progress report.

Various exceedences of the annual mean objective are predicted using the UWE bias adjustment factor. However, this factor is not deemed as appropriate as the locally derived factor, and may be considered to represent a conservative estimate of concentrations.

**Table 8.2** Annual Mean $NO_2$ concentrations at sites within the *proposed, extended* Railway Road AQMA, $\mu gm^{-3}$ (2005)

| Tube ID | Site Name | Annual Mean (measured) | Annual Mean (*UWE* bias corrected)[a] | Annual Mean (***LOCAL*** bias corrected)[b] |
|---|---|---|---|---|
| 1 | Railway Road 1 | **47** | **47** | **43** |
| 2 | Railway Road 4 | *New site* | --- | --- |
| 3 | Railway Road 5 | *New site* | --- | --- |
| 7,8,9 | Railway Road Monitoring Station | 34 | 34 | 31 |
| 12 | London Road 1 | **43** | **42** | 39 |
| 13 | London Road 2 | 37 | 36 | 33 |
| 14 | London Road 3 | 39 | 38 | 35 |
| 15 | London Road 4 | **42** | **41** | 38 |
| 16 | London Road 5 | **42** | **41** | 38 |
| 17 | Southgates | **44** | **44** | 40 |
| 22 | London Road 9 | *New site* | --- | --- |
| 23 | London Road 10 | *New site* | --- | --- |
| 24 | London Road 6 | **42** | **42** | 38 |
| 25 | London Road 7 | **42** | **41** | 38 |
| 26 | London Road 8 | 39 | 38 | 35 |
| 32 | St John's Terrace / Blackfriars | 38 | 38 | 34 |
| 36 | Railway Road 3 | 38 | 38 | 35 |
| 38 | Blackfriars 2 | **41** | **40** | 37 |
| 39 | Blackfriars 1 | 37 | 37 | 34 |
| 40 | Norfolk Street | 36 | 36 | 33 |
| 41 | Blackfriars 3 | *New site* | --- | --- |
| 42 | Littleport Street | 37 | 37 | 34 |
| 51 | Austin Street 1 | **44** | **43** | 39 |
| 52 | Austin Street 2 | *New site* | --- | --- |

[a] *UWE bias adjustment factor = 0.99* [b] *Local bias adjustment factor = 0.91*

***Monitoring Outside the Proposed Extended Railway Road AQMA***

Concentrations at locations outside the proposed, extended Railway Road AQMA are detailed below in Table 8.3. None of the locations outside the proposed, extended AQMA boundaries exceeded the 2005 annual mean objective of 40 $\mu gm^{-3}$, using the local bias adjustment factor.

Using the UWE bias adjustment factor, there may have been one exceedence of the annual mean objective for $NO_2$ at the bus station in 2005. However, no further action needs to be taken as public exposure will only be short-term, and it is unlikely that the 1-hour mean of 200 $\mu gm^{-3}$ will be exceeded more than 18 times a year. The new sampling sites set up in 2006 have not yet produced annual means and should be considered in the next progress report.

**Table 8.3** Annual Mean $NO_2$ concentrations at sites outside the proposed Railway Road AQMA, $\mu gm^{-3}$ (2005)

| Tube ID | Site Name | Annual Mean (measured) | Annual Mean (*UWE* bias corrected)[a] | Annual Mean (***LOCAL*** bias corrected)[b] |
|---|---|---|---|---|
| 5 | Bus Station 1 | *New site* | --- | --- |
| 6 | Bus Station 2 | *New site* | --- | --- |
| -- | Bus Station (now closed) | **42** | **42** | 38 |
| 10 | Mill Fleet 1 | *New site* | --- | --- |
| 11 | Mill Fleet 2 | *New site* | --- | --- |
| 18 | Wisbech Road KL | *New site* | --- | --- |
| 19 | Nora 1 | *New site* | --- | --- |
| 20 | Hardwick Road | 31 | 30 | 28 |
| 21 | Vancouver Avenue 1 | 29 | 29 | 26 |
| 27,28,29 | The Walks | 22 | 22 | 20 |

| Tube ID | Site Name | Annual Mean (measured) | Annual Mean (*UWE* bias corrected)[a] | Annual Mean (***LOCAL*** bias corrected)[b] |
|---|---|---|---|---|
| 33 | Waterloo Street | 29 | 29 | 26 |
| 34 | Portland Street | 28 | 28 | 26 |
| 37 | Wellsley Street | 38 | 38 | 35 |
| 43 | Gaywood Road 2 | 32 | 32 | 29 |
| 44 | The Swan, Gayton Road | 38 | 38 | 34 |
| 45 | Wootton Road 2 | *New site* | --- | --- |
| 46 | Wootton Road 1 | *New site* | --- | --- |
| 47 | Lynn Road 1 | *New site* | --- | --- |
| 48 | Lynn Road 2 | *New site* | --- | --- |
| 49 | Gaywood Road 3 | 35 | 34 | 31 |
| 50 | Gaywood Road 1 | 33 | 32 | 29 |
| 53 | Edward Benefer Way | 35 | 35 | 32 |
| 54,55,56 | Kilham's Way | 16 | 16 | 15 |
| 57 | Low Road, South Wootton | 26 | 25 | 23 |
| 58 | Castle Rising Road, South Wootton | 24 | 24 | 22 |
| 59 | Tennyson Ave 1 | 25 | 25 | 22 |
| 60 | Tennyson Ave 2 | 28 | 27 | 25 |
| 61 | Wisbech Road 1 | 27 | 27 | 24 |
| 62 | Wisbech Rd Elm 1 | 28 | 28 | 26 |
| 63 | Wisbech Rd Elm 3 | *New site* | --- | --- |
| 64 | Wisbech Rd Elm 4 | *New site* | --- | --- |
| 65 | Wisbech Rd Elm 5 | *New site* | --- | --- |
| 66 | Wisbech Rd Elm 6 | *New site* | --- | --- |
| 67 | Wisbech Rd Elm 2 | 33 | 32 | 29 |
| 68 | London Road Downham Market | *New site* | --- | --- |
| 69 | Railway Rd Downham Market | 27 | 26 | 24 |
| 70 | Bridge St Downham Market | 31 | 30 | 28 |
| 71 | Lynn Road Downham | 33 | 33 | 30 |
| 72 | Bexwell Road Downham Market | 35 | 34 | 31 |
| 73 | Buckenham Drive Stoke Ferry | 19 | 19 | 17 |
| 74 | High Street Stoke Ferry | 22 | 22 | 20 |
| 75 | Furlong Road Stoke Ferry | 23 | 23 | 21 |
| 76 | West Winch 1 | *New site* | --- | --- |
| 77 | West Winch 2 | *New site* | --- | --- |
| 78 | BLANK | *New site* | --- | --- |

[a] *UWE bias adjustment factor = 0.99* [b] *Local bias adjustment factor = 0.91*

### 8.4.4 Screening Assessment of Road Traffic Sources

Traffic flow data were taken from the NAEI 2004 roads database and from traffic count data for roads in King's Lynn for 2005 supplied by Norfolk County Council (Appendix 2). For screening purposes, appropriate receptor distances based on the closest property where public exposure was likely and annual average speeds for the road were used. Norfolk County Council's traffic planners have set a target of less than 10% increase in King's Lynn town centre traffic between 2000 and 2006. To date (including the 2005 traffic census) an increase of just 1.6% has been seen.

Table 8.4 shows nitrogen dioxide concentrations in 2005 calculated using DMRB for major roads in the area. The roads have been assessed using both information from the NAEI traffic database, and data provided by the Norfolk County Council. There are two significant street canyons in the area – Railway Road and London Road. The traffic contribution to the $NO_2$ concentration has been doubled in order to take this into consideration.

Table 8.4 shows no exceedences of the 2005 annual mean objective estimated for roads in the borough using the DMRB traffic model. While 2005 diffusion tube data shows an exceedence at Railway Road 1, the DMRB screening model indicates that the annual mean objective it is unlikely to have been exceeded at relevant receptors. This may be because the DMRB takes into account the distances to the nearest receptors, while the monitoring data often measures kerbside concentrations (which is the case at Railway Road 1, located on a lamp post) or possibly due to the lack of reliable information about traffic speeds, queuing and congestion.

**Table 8.4** Estimated $NO_2$ concentrations near roads in King's Lynn and West Norfolk in 2005

| ID | Data source | Road | Location of census point | Distance from link centre to receptor (m) | AADTF (combined veh/day) | Annual average speed (km/h) | Total HDV (%) | Annual Mean $NO_2$ ($\mu gm^{-3}$) |
|---|---|---|---|---|---|---|---|---|
| 1 | NAEI | A148 | Grimston Road, South Wootton | 10 | 16006 | 50 | 5.63 | 20.4 |
| 2 | NAEI | A1101 | Rectory Road, Outwell | 10 | 7218 | 80 | 5.68 | 14.3 |
| 3 | NAEI | A10 (T) | Downham Market | 5 | 11874 | 50 | 13.15 | 20.7 |
| 4 | NAEI | A148 | East of Hillington | 5 | 9839 | 50 | 8.76 | 16.3 |
| 5 | NAEI | A149 | South of hospital | 10 | 23614 | 80 | 8.52 | 26.7 |
| 6 | NAEI | A1122 | Bridge Road, Downham Market | 10 | 7883 | 80 | 8.53 | 16.2 |
| 7 | NAEI | A47 | River Great Ouse bridge | 10 | 36484 | 30 | 11.67 | 32.3 |
| 8 | NAEI | A148 | West of Hillington | 5 | 8776 | 50 | 8.10 | 15.7 |
| 9 | NAEI | A149 | Lynn Road, Heacham | 5 | 12671 | 50 | 2.97 | 14.7 |
| 10 | NAEI | A1122 | Downham Rd/ High St, Fincham | 5 | 6170 | 50 | 11.08 | 14.6 |
| 11 | NAEI | A17 (T) | Trunk Road, Holbeach | 10 | 15464 | 60 | 14.89 | 26.7 |
| 12 | NAEI | A148 | Lynn Road, Gaywood | 5 | 25258 | 40 | 2.67 | 24.1 |
| 13 | NAEI | A10 (T) | South Runcton | 15 | 10347 | 80 | 7.12 | 15.3 |
| 14 | NAEI | A47 | East Winch | 5 | 13583 | 50 | 12.92 | 21.6 |
| 15 | NAEI | A134 | Lynn Road, Wereham | 5 | 10087 | 50 | 16.64 | 20.4 |
| 16 | NAEI | A148 | Harpley | 5 | 6945 | 80 | 11.74 | 15.2 |
| 17 | NAEI | A148 | Wootton Road | 5 | 12264 | 40 | 2.21 | 17.7 |
| 18 | NAEI | A149 | North of hospital | 5 | 20324 | 50 | 9.56 | 23.8 |
| 19 | NAEI | A1101 | Three Holes, Upwell | 5 | 3511 | 50 | 6.46 | 11.6 |
| 20 | NAEI | A1122 | Downham Road, Bexwell | 5 | 10733 | 50 | 10.60 | 18.8 |
| 21 | NAEI | A1078 | Low Road, South Wootton | 5 | 15268 | 40 | 5.06 | 20.7 |
| 22 | NAEI | A47 | Walton Highway | 5 | 15053 | 50 | 12.13 | 23.1 |
| 23 | NAEI | A10 (T) | Fordham / Denver | 10 | 10555 | 80 | 7.38 | 15.9 |
| 24 | NAEI | A47 | East of Saddlebow Road r/about | 10 | 27480 | 80 | 14.87 | 32.5 |
| 25 | NAEI | A134 | Lynn Road, Shouldham Thorpe | 5 | 5751 | 30 | 21.65 | 18.7 |
| 26 | NAEI | A148 | Hillington | 5 | 10035 | 30 | 8.62 | 17.5 |
| 27 | NAEI | A149 | Brancaster Staithe | 5 | 3627 | 30 | 2.60 | 10.2 |
| 28 | NAEI | A1076 | Queen Elizabeth Hospital | 5 | 16140 | 20 | 2.87 | 21.8 |
| 29 | NAEI | A149 | Campbells Meadow, Hardwick Rd | 5 | 21302 | 30 | 3.23 | 25.8 |
| 30 | NAEI | A134 | Stoke Ferry | 5 | 7509 | 50 | 15.66 | 24.4 |
| 31 | NAEI | A10 (T) | West Winch | 5 | 15558 | 50 | 13.77 | 25.4 |
| 32 | NAEI | A148 | St. James Road | 3 | 22216 | 30 | 3.32 | 24.9 |
| 33 | NAEI | A1101 | Holly End, Wisbech | 5 | 9715 | 30 | 8.51 | 18.2 |
| 34 | NAEI | A148 | Saddlebow Road | 5 | 10939 | 30 | 4.52 | 24.4 |
| 35 | NAEI | A148 | Railway Road | 3 | 17120 | 30 | 3.34 | 32.6 * |
| 36 | NAEI | A1078 | Blackfriars Road | 5 | 11345 | 30 | 4.62 | 23.3 |
| 37 | NAEI | A1078 | John Kennedy Rd / Austin St | 5 | 14881 | 30 | 4.68 | 24.9 |
| 38 | NAEI | A1101 | Wash Road, Welney | 5 | 2815 | 30 | 10.40 | 11.7 |
| 39 | NAEI | A10 (T) | Ferry Bank, Southery Fens | 5 | 7601 | 80 | 10.89 | 15.5 |
| 40 | NAEI | A148 | Grimston Road, South Wootton | 5 | 16721 | 30 | 5.73 | 20.6 |
| 41 | NAEI | A134 | Stradsett | 5 | 5999 | 30 | 21.14 | 19.1 |
| 42 | NAEI | A148 | Saddlebow Road | 5 | 10129 | 30 | 6.79 | 25.2 |
| 43 | Council | A1078 | Edward Benefer Way | 5 | 16946 | 30 | 3.3 | 21.8 |
| 44 | Council | A1076 | Gayton Road | 5 | 16623 | 30 | 1.63 | 20.4 |
| 45 | Council | A149 | Hardwick Road | 5 | 22710 | 30 | 2.05 | 21.4 |
| 46 | Council | A148 | London Road | 5 | 26505 | 30 | 1.82 | 27.1 * |
| 47 | Council | A148 | NORR | 5 | 11528 | 30 | 2.63 | 19.8 |
| 48 | Council | C80 | Wisbech Road | 5 | 8462 | 30 | 0.88 | 17.5 |
| 49 | Council | A148 | Wootton Road | 5 | 15422 | 30 | 1.07 | 19.8 |

As part of this assessment, the following items from the checklist have been considered:

- Street Canyons: Narrow congested streets with residential properties close to the kerb. Railway Road and London Road (*) have been identified as significant street canyons – to avoid missing potential exceedences of the objective in street canyons, the predicted annual mean $NO_2$ 'road traffic component' concentration has been multiplied by a factor of 2 before adding to the background concentration in the DMRB model.

- Busy streets where people may spend 1-hour or more, close to traffic: The main shopping streets are pedestrianised, with no relevant exposure to traffic. The automatic analyser at Railway Road (a main town centre route and street canyon) was installed to measure the concentrations of $NO_2$ and $PM_{10}$ as a result of traffic in the Railway Road street canyon. No exceedences of the $NO_2$ annual mean objective or the 1-hour mean objective were recorded in 2005 and it is predicted that no exceedences will be seen at the other shopping areas located on Norfolk Street and London Road.
- Roads with "an unusually high proportion of HDVs": Box 6.2 of the Technical Guidance describes this as greater than 25% buses and/or HDVs when evaluating $NO_2$. No such roads have been identified in the Borough.
- New roads constructed or proposed since the last round of review and assessment – none have been identified.
- Roads with significantly changed traffic flows or new, relevant exposure – the NORA site will generate increased traffic flow along Nar Ouse Way as and when the various stages of development take place. This could also affect traffic flows within the Air Quality Management Area. It is intended that continued use of a diffusion tube at Kellard House, near to the junction of Nar Ouse Way with Southgates roundabout, will monitor any resultant changes in $NO_2$ levels.

### 8.4.5 Busy Junctions

Annual average $NO_2$ concentrations near busy road junctions in the district have been estimated for 2005 using the DMRB (Table 8.5). The junctions assessed have relatively high combined traffic flows from both of the road links, or, in the case of the Stradsett junction, a high flow of HDVs.

The DMRB screening model indicates that the 2005 annual mean objective for $NO_2$ is unlikely to have been exceeded at the identified receptors near busy road junctions (table 8.5). However, there are possible sources of error in the values calculated due to uncertainties in the speeds used, exact distances to receptors and lack of definitive information about queuing and congestion. The DMRB model is predicting slightly lower annual average $NO_2$ concentrations than the corresponding diffusion tubes in the area; slower junction approach speeds would marginally increase the $NO_2$ concentrations predicted below. Diffusion tube results should be used in parallel with DMRB predictions when estimating annual average $NO_2$ concentrations at these locations.

**Table 8.5** Estimated nitrogen dioxide concentrations near road junctions in King's Lynn and West Norfolk, 2005

| Receptor number | Road ID | Road | Road Name | Distance from receptor (m) | AADTF (combined veh/day) | Annual average speed (km/h) | Total HDV (%) | Annual Mean $NO_2$ ($\mu gm^{-3}$) |
|---|---|---|---|---|---|---|---|---|
| 1 Southgates | 29 | A149 | Hardwick Road | 15 | 21302 | 10 | 3.23 | 27.3 |
| | 46 | A148 | London Road | 40 | 18722 | 10 | 4.52 | |
| 2 Gaywood Clock | 28 | A1076 | Gayton Road | 16 | 16140 | 10 | 2.87 | 28.1 |
| | 12 | A148 | Lynn Road | 7 | 25258 | 10 | 2.67 | |
| | 17 | A148 | Wootton Road | 9 | 12264 | 20 | 2.21 | |
| 3 Saddlebow | 24 | A47 | East of roundabout | 15 | 27480 | 80[a] | 14.87 | 29.8 |
| | 34 | A148 | Saddlebow Road | 25 | 10939 | 30 | 4.52 | |
| 4 Stradsett | 10 | A1122 | Downham Road | 5 | 6170 | 50[b] | 11.08 | 26.0 |
| | 41 | A134 | Stradsett | 20 | 5999 | 20 | 21.14 | |
| 5 Hardwick R/about | 5 | A47/A149 | Queen Elizabeth Way | 64 | 23614 | 20 | 8.52 | 20.3 |
| | 29 | A47/A149 | Hardwick Road | 64 | 17443 | 20 | 12.92 | |
| | 31 | A10 | Winch Road | 266 | 15558 | 20 | 13.77 | |
| 6 New Inn | 21 | A1078 | Low Road | 11 | 15268 | 10 | 5.06 | 28.6 |
| | 17 | A148 | Wootton Road | 20 | 12264 | 10 | 2.21 | |

[a] Speed representative of traffic continuing along A47 dual carriageway
[b] Speed representative of traffic continuing along A1122

#### *8.4.5.1 Elm High Road Roundabout, Wisbech*

The junction of Elm High Road (A1101) and the A47 in Wisbech is very close to the border of neighbouring Fenland. Fenland District Council has recently undertaken detailed modelling for $NO_2$ in Wisbech, which includes Elm High Road and this roundabout. Areas of potential exceedence have been identified that extend to within the boundaries of King's Lynn and West Norfolk, and are hence of relevance to both Fenland and King's Lynn & West Norfolk.

The Borough Council of King's Lynn and West Norfolk has already set up four additional diffusion tube sites along Elm High Road, which are strategically placed to monitor $NO_2$ concentrations at the nearest receptors along the road and around the roundabout. The two existing diffusion tubes (Wisbech Road Elm 1 and 2) have not previously shown any exceedences. Data obtained for the first nine months of 2006 indicate that concentrations are well below the annual mean objective for $NO_2$ at all Elm High Road sites, although it should be remembered that $NO_2$ concentrations are seasonal with higher concentrations seen during colder months, and annual means based on less than nine tubes should be treated with caution. In addition, these results had not yet been bias-adjusted.

It is therefore recommended that the Borough Council of King's Lynn and West Norfolk monitor and review the diffusion tube results from this area over the coming months and present them in the next Progress Report. A decision should then be taken as to whether a Detailed Assessment of this area is required.

### 8.4.6 Screening Assessment of Industrial Sources

The Guidance LAQM.TG(03) lists the following processes as significant potential sources of nitrogen dioxide:

***Part A*** (percentage of total emissions from all UK plant in this sector to the UK total in brackets)

Iron and steel (19)
Petroleum processes (16)
Combustion processes (34)
Cement/lime manufacture (9)
Carbonisation (6)
Gasification (4)
Inorganic chemicals (4)

***Part B***

Glass manufacture

No new industrial sources have started operating in the district since the last round of review and assessment. There are no Part A processes in King's Lynn and West Norfolk or adjoining authorities reporting significant emissions of nitrogen oxides to the Environment Agency. Several Part B processes are present in the area (Appendix 3), however these processes are not associated with glass manufacture.

### 8.4.7 Screening Assessment of Other Transport Sources

***Bus Stations***

The number of bus movements at King's Lynn bus station is estimated to be around 730 movements Monday to Friday, with 620 on Saturdays and 236 on Sundays. These counts do not include the community bus, however it is considered unlikely that the total number will exceed 1000 movements per day.

It is possible that members of the public may spend 1-hour or more around the King's Lynn bus station. A worst-case scenario (using conservative UWE bias-adjustment factors) predicted a possible exceedence of the annual mean objective for $NO_2$ at the bus station. However, it is unlikely that the 1-hour objective at this location will have been exceeded. Additional diffusion tubes were located within the bus station as of early 2006 and these results will be reported and evaluated at the next progress report. Further assessment is therefore not required for the bus station for either the annual mean or the 1-hour objective.

***Airports***

There are no airports in King's Lynn and West Norfolk or neighbouring authorities that have a throughput of 5 million passengers per year and/or 500,000 tonnes of freight.

***Ports***

There is a port at King's Lynn but the contribution from the 700-800 vessel movements is deemed insignificant in terms of $NO_2$ contribution.

## 8.5 CONCLUSIONS FOR NITROGEN DIOXIDE IN THE BOROUGH

There are no significant industrial sources of nitrogen dioxide in the Borough of King's Lynn and West Norfolk. The previous round of Review and Assessment recommended an extension to the existing Railway Road AQMA, which is being implemented as suggested. Diffusion tubes indicate exceedences of the annual average nitrogen dioxide objective at locations within the proposed, extended AQMA, but no exceedences with relevant exposure were seen elsewhere in the borough.

A neighbouring local authority (Fenland District Council) has modelled a potential exceedence of the $NO_2$ objective in Wisbech, a town that lies just within the Fenland local authority boundaries. Part of the exceedence is predicted in the borough of King's Lynn and West Norfolk. Both local authorities have deployed additional $NO_2$ diffusion tubes along the length of Elm High Road, including the roundabout with the A47 and all relevant receptors in the vicinity.

It is therefore recommended that the Borough Council ensure that all diffusion tubes are located on the façades of the relevant nearest receptors rather than at kerbside locations. All diffusion tube results from this area should be monitored and reviewed over the coming months and presented in the next Progress Report. A decision should then be taken as to whether a Detailed Assessment of this area is required.

To summarise, the Borough Council of King's Lynn and West Norfolk is not required to undertake a Detailed Assessment for $NO_2$ at this stage.

| | Source, location or data that need to be assessed | Updating and Screening Assessment |
|---|---|---|
| A | Monitoring data outside an AQMA | An extension to the existing Railway Road AQMA has been proposed. A single exceedence of the annual mean objective found outside the existing AQMA is within the boundaries of the proposed extension. The conservative UWE bias adjustment factors predicted other possible exceedences outside the current AQMA: one was outside the proposed AQMA (but with no relevant exposure) but most were within the boundaries of the proposed AQMA extension. |
| B | Monitoring data within an AQMA | No exceedences of the annual mean objective were identified within the existing AQMA through diffusion tube and automatic monitoring, although the conservative UWE bias adjustment factor does predict a possible borderline exceedence at Railway Rd 2. |
| C | Narrow congested streets with residential properties close to the kerb | The Railway Road and London Road street canyons were appropriately considered in this assessment. The road traffic contribution of nitrogen dioxide was doubled by the DMRB to take this into account. |
| D | Junctions | Busy junctions, those with high proportions of HGVs, and those that were close to the $NO_2$ objective in the previous round of review and assessment were modelled using the DMRB. The $NO_2$ annual mean was predicted to be met at all relevant receptors at the junctions. |

| | | |
|---|---|---|
| E | Busy streets where people may spend 1-hour or more close to traffic | The main shopping streets are pedestrianised, with no relevant exposure to traffic. Automatic analysers confirm no recorded exceedences of the $NO_2$ annual mean or 1-hour mean objective in 2005. It is predicted that no exceedences will be seen at the other shopping streets. |
| F | Roads with high flow of buses and/or HGVs | There are no roads in the borough with an unusually large proportion (>25%) of buses and/or HGVs. |
| G | New roads constructed or proposed since previous rounds of review and assessment | There have been no newly constructed or proposed since previous rounds. |
| H | Roads close to the objective during the previous rounds of review and assessment | All such roads have been considered in the DMRB model. |
| I | Roads with significantly changed traffic flows | The NORA site will generate increased traffic flow along Nar Ouse Way as and when the various stages of development take place. This should be revisited in the next progress report. |
| J | Bus stations | There are fewer than 1000 bus movements per day, and is no relevant exposure within 10 m. Diffusion tube data indicates annual means are below the air quality objective, and that the short-term objective will not be exceeded. |
| K | New industrial sources | There are no new industrial sources that have the potential to emit significant quantities of $NO_2$ |
| L | Industrial sources with substantially increased emissions | No industrial sources have substantially increased (>30%) their emissions. |
| | ***Conclusion*** | It is therefore recommended that the Borough Council of King's Lynn and West Norfolk monitor and review the diffusion tube results from this area over the coming months and present them in the next Progress Report. A decision should then be taken as to whether a Detailed Assessment of this area is required, in co-operation with Fenland District Council.<br><br>***The Borough Council of King's Lynn and West Norfolk is not required to undertake a Detailed Assessment for $NO_2$ at this stage.*** |