

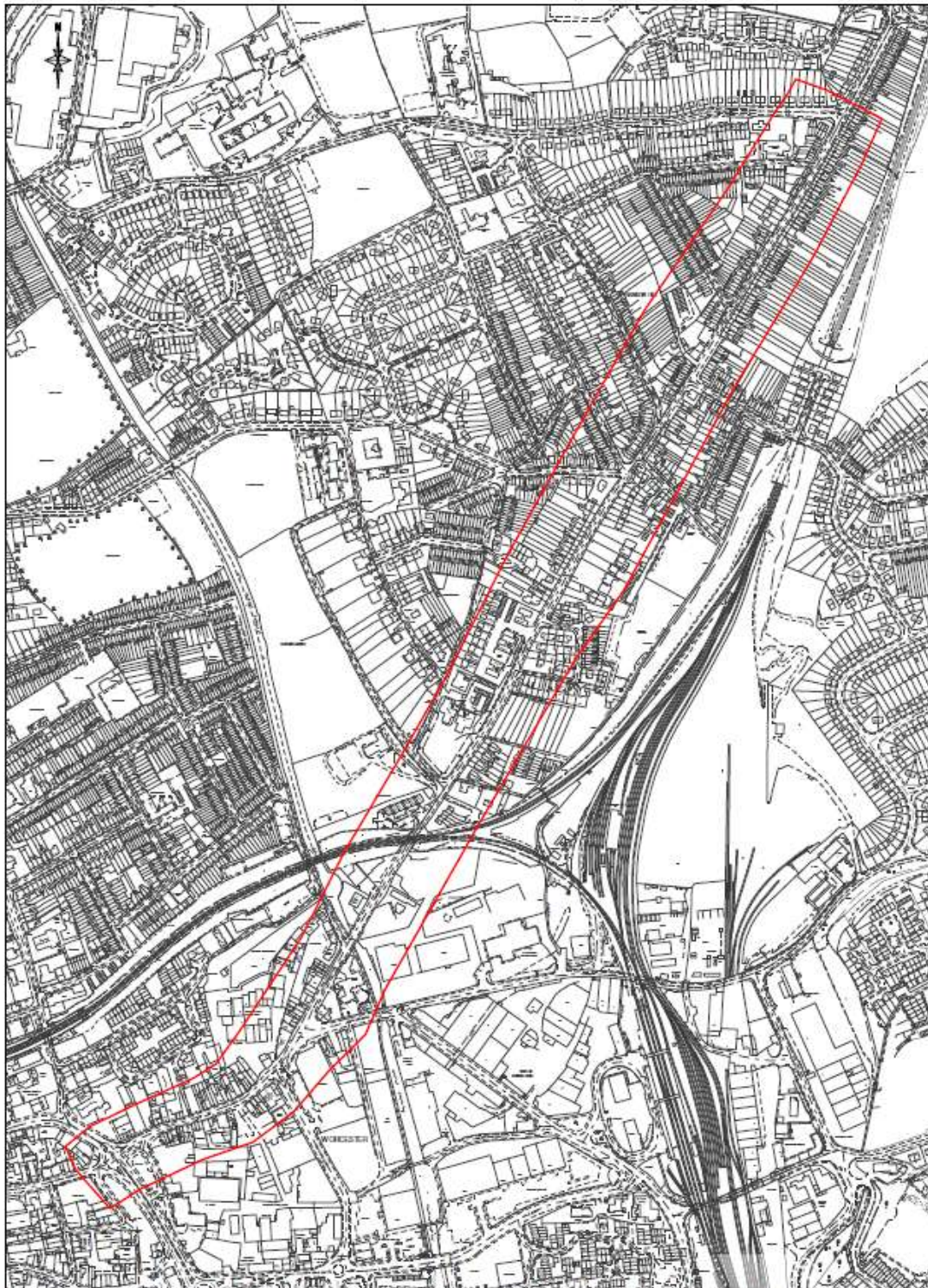
3.6 Lowesmoor/Rainbow Hill AQMA - Worcester City Council

Date of Detailed Assessment: October 2008

Date of Declaration: 23rd April 2009

Date of Further Assessment: July 2010

Figure 3-17 Plan of Lowesmoor/Rainbow Hill AQMA
Lowesmoor and Rainbowhill, Worcester



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Scale 1:4000

The Lowesmoor / Rainbow Hill AQMA comprises the majority of the single carriageway B4550 Astwood Road leading south west from the Green Lane mini roundabout junction, up and down Rainbow Hill and into Lowesmoor after the junction with the B4205 Tolladine Road. The distance between Green Hill and the western end of Lowesmoor on the fringes of the City centre is just over 1.5km.

To the north of the AQMA Astwood Road continues north wards before turning west as the B4482 Bilford Road which connects to the A38 Droitwich Road. Just north of the AQMA boundary the B4550 turns east towards the Brickfields area, at another mini roundabout with the New Chequers Inn, under a very narrow railway bridge and then turns immediately northwards to the Blackpole Industrial area. Beyond Blackpole the route connects up to the A449 and A38 and J6 of the M5 providing an alternative route to the busy and often congested A38 Droitwich Road/Tything for many commuters into Worcester.

There are many side roads leading to other residential areas in Worcester from Rainbow Hill. Two in particular provide cut throughs to Barbourne Road and The Tything: Green Lane and Lansdowne Road although the former has speed restrictions in place.

Beyond the railway bridge near the bottom of Rainbow Hill, 250m from the junction with Tolladine Road, the residential properties cease and there are industrial areas either side of the carriageway for approximately 150m to the Lowesmoor Bridge over the canal. Beyond this are further residential properties before the Bridge Inn PH and commercial properties continue to the junction with Tolladine Road. Shrub Hill train station is accessible from Tolladine Road.

At the mini roundabout junction the AQMA continues south west onto Lowesmoor Terrace and then turns right onto Lowesmoor via a filter lane and through a set of traffic lights. At the end of Lowesmoor there are priority lanes for buses and cyclists going straight on to St Nicholas Street whilst other traffic turns left onto the City Walls Road dual carriageway.

The current boundary of the AQMA loosely follows the $36 \mu\text{g}/\text{m}^3$ contours of predicted pollution levels produced in the Detailed Assessment (AQC, 2008b). However these straight contour lines cut through residential gardens and buildings which does not conform to best practice guidance from EPUK (NSCA, 2001b & 2004) as recommended by Defra guidance (LAQM.TG(09) and PG(09)) thus the AQMA boundary requires amendment.

3.6.1 Prevailing Conditions

AM and PM peak traffic time site observations of the Lowesmoor/Rainbow Hill AQMA were undertaken in 2012 to characterise existing conditions and identify issues in order to inform the focus of potential measures within the action plan. Photos from the site walkover are included at the end of this section.

The AQMA can be divided into two distinctly different areas: Rainbow Hill is predominately a residential area with a few shops, pubs and food bars whilst Lowesmoor is predominately retail, service providers, restaurants and other food outlets on the ground floor with residential dwellings above.

A large volume of traffic passes through the two areas of the AQMA and is made up of a mixture of vehicle types and users including commuters, buses, delivery vehicles and school traffic. In Lowesmoor the proportion of buses and delivery vehicles is higher whilst in the Rainbow Hill area the school traffic, commuters and local residences are the dominant

vehicles. Speed limit is 30mph but this is not possible in many parts during the peak traffic times.

There are a number of schools in the area although none within the AQMA itself: the closest being St Barnabas Primary School and Bishop Perone High School both on Green Lane. Gorse Hill primary School is accessible via Tunnel Hill halfway along Rainbow Hill and there is a Technology College and Perdiswell Primary School along Bilford Road. Traffic to these various education institutions likely contributes significantly to the AM peak traffic volumes.

The majority of the AQMA is narrow, leading to a street canyon effect in most parts, particularly evident in Lowesmoor. The majority of buildings are only two or three storey residential houses but some taller dwellings and commercial properties are also present. This effect is exacerbated by queuing traffic unable to pass buses at stops, illegally parked delivery vehicles and cars dropping off passengers.

Despite the presence of double yellow lines in most parts of the AQMA delivery vehicles have been observed obstructing the flow of traffic on numerous occasions in the AQMA, particularly in the Lowesmoor area.

There are no taxi ranks within the AQMA but there are a number of bus routes and stops into the City Centre from Warndon, Blackpole and Perdiswell. There are no pull-ins bus stops and therefore traffic queues form behind buses at stops as the street is too narrow to overtake.

There are few traffic light signals within the AQMA. There is a pedestrian crossing near a small row of shops in the centre of Rainbow Hill area near Tunnel Hill turning. Pedestrian traffic increases in this area due to the presence of the shops and clearly the crossing potentially causes queuing traffic. The only other set other signals is at the exit from Lowesmoor onto Lowesmoor Terrace. It has been noted the lights here do cause traffic to build up at the traffic lights, backing up along the street canyon in Lowesmoor, and is especially apparent at peak times. Comment provided by WCC June 2013 indicates this traffic is caused by contravention of Traffic Regulation Orders at Trinity Gate Junction which limit access into Lowesmoor during the afternoon peak westbound.

Pedestrian traffic was not observed to be particularly significant within the Astwood Road end of the AQMA with the exception of the small shopping area. In contrast Lowesmoor is a bustling shopping and restaurant community with footpaths linking to recent St Martins Gate development. The whole AQMA does not therefore meet the criterion of the Technical Guidance LAQM.TG(09) requiring consideration of the 1 hour objective. However the Lowesmoor area would potentially be a consideration under that objective if emission levels were sufficiently elevated.

Photo 1: Astwood Road Looking S to Green Lane junction and Rainbow Hill beyond



Photo 2: Rainbow Hill Looking N along Astwood Road from location of monitoring position Astwood 3



Photo 3: Corner of Lowesmoor Looking N to Lowesmoor Terrace and along Rainbow Hill in centre right of picture.



Photo 4: Looking SW along Lowesmoor to legitimate parking bays outside Elim Pentecostal Church



Photo 5: Looking W along Lowesmoor to traffic waiting for traffic lights to change.



Photo 6: Delivery van parked on double yellow lines in Lowesmoor



Photo 7: Bus at stop causes congestion for vehicles behind



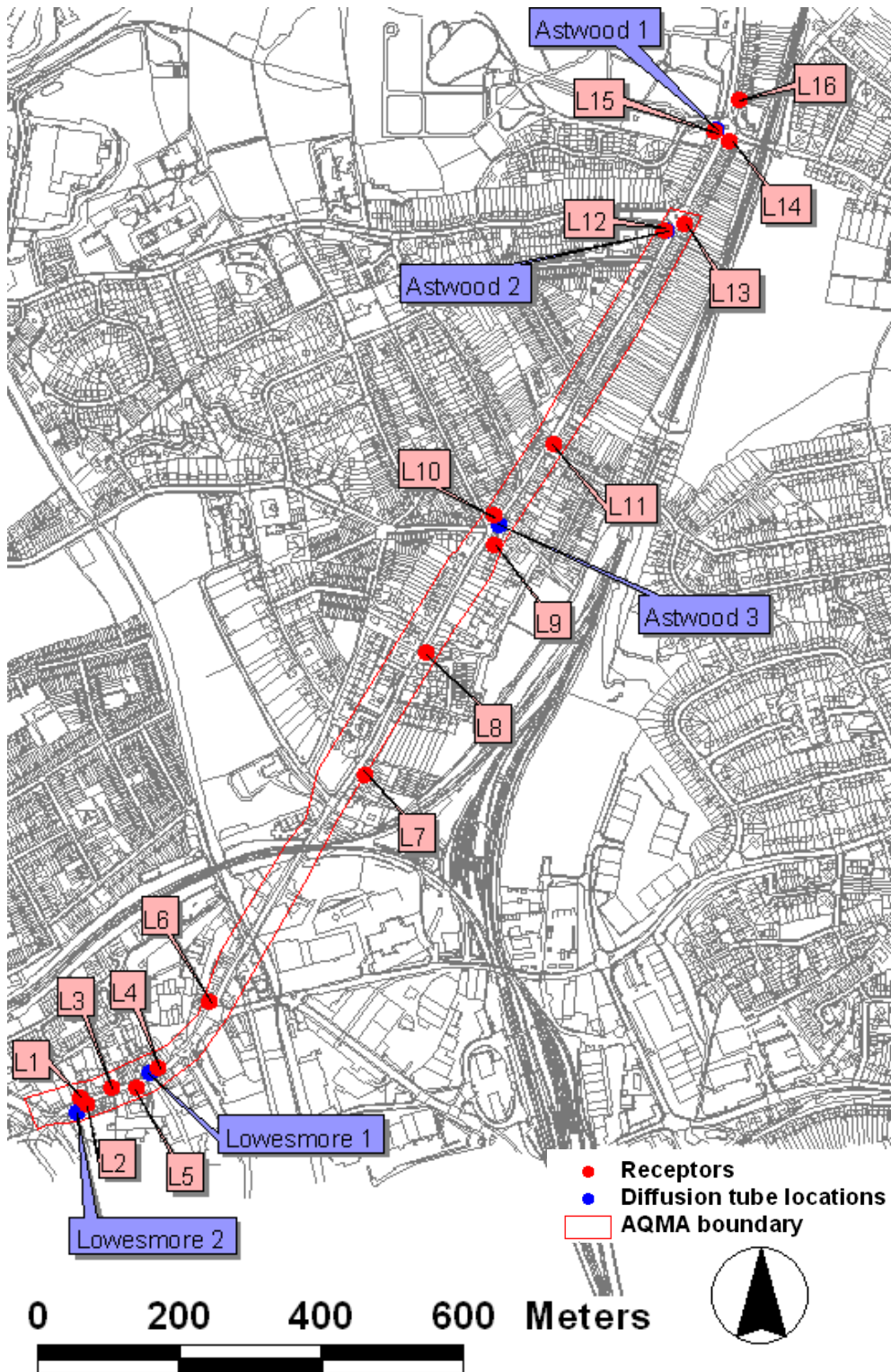
3.6.2 Summary of any Further Assessment report

A Further Assessment to confirm the requirement for an AQMA in Lowesmoor/ Rainbow Hill, Worcester and undertake modelling to inform potential solutions was completed by independent consultants AQC (Air Quality Consultants) on behalf of WC in July 2010. A summary of the findings of the Further Assessment are outlined below.

- The results indicate that the annual mean nitrogen dioxide objective is being exceeded at a number of properties along Astwood Road up to the brow of Rainbow Hill and in Lowesmoor and therefore the AQMA should be retained.
- Concentrations are predicted at both ground-floor and first-floor levels; however ground-floor concentrations are discussed as these are worst case.
- The highest predicted concentration in 2009 is $51.6 \mu\text{g}/\text{m}^3$, at receptor L2 in Lowesmoor area and $56.2 \mu\text{g}/\text{m}^3$ at receptor L10 in the Rainbow Hill area. Concentrations are predicted to exceed the annual mean objective at 12/16 receptor locations.
- There are no predicted annual mean concentrations greater than $60 \mu\text{g}/\text{m}^3$ and therefore it is unlikely that the 1-hour nitrogen dioxide objective is being exceeded at these locations.
- Receptors L14, L15 and L16 are located outside of the AQMA boundary. Modelled concentrations at receptors L14 and L15 exceed the objective, with concentrations of $48.8 \mu\text{g}/\text{m}^3$ and $42.5 \mu\text{g}/\text{m}^3$, whereas the modelled concentration at receptor L16 is below the objective. Although modelled concentrations could be slightly over predicting in this area, it is considered appropriate to adopt a precautionary approach.

- On this basis AQC recommend that the AQMA boundary needs to be extended to the north to encompass residential properties on Astwood Road extending to the roundabout which forms a junction with Brickfields Road and Tintern Avenue.

Figure 3-18 shows location of 16 worst case receptors, monitoring locations and AQMA boundary



3.6.3 Source Apportionment Data

Sources contributing to the objective exceedences within the AQMA have been identified within the Further Assessment. The data presented below have been calculated in line with guidance provided in LAQM.TG(09) (Defra, 2009).

Table 3-19 and Figure 3-19 (AQC, 2010) set out the relative contributions of traffic emissions to the total predicted nitrogen dioxide concentration at sixteen worst case receptor locations.

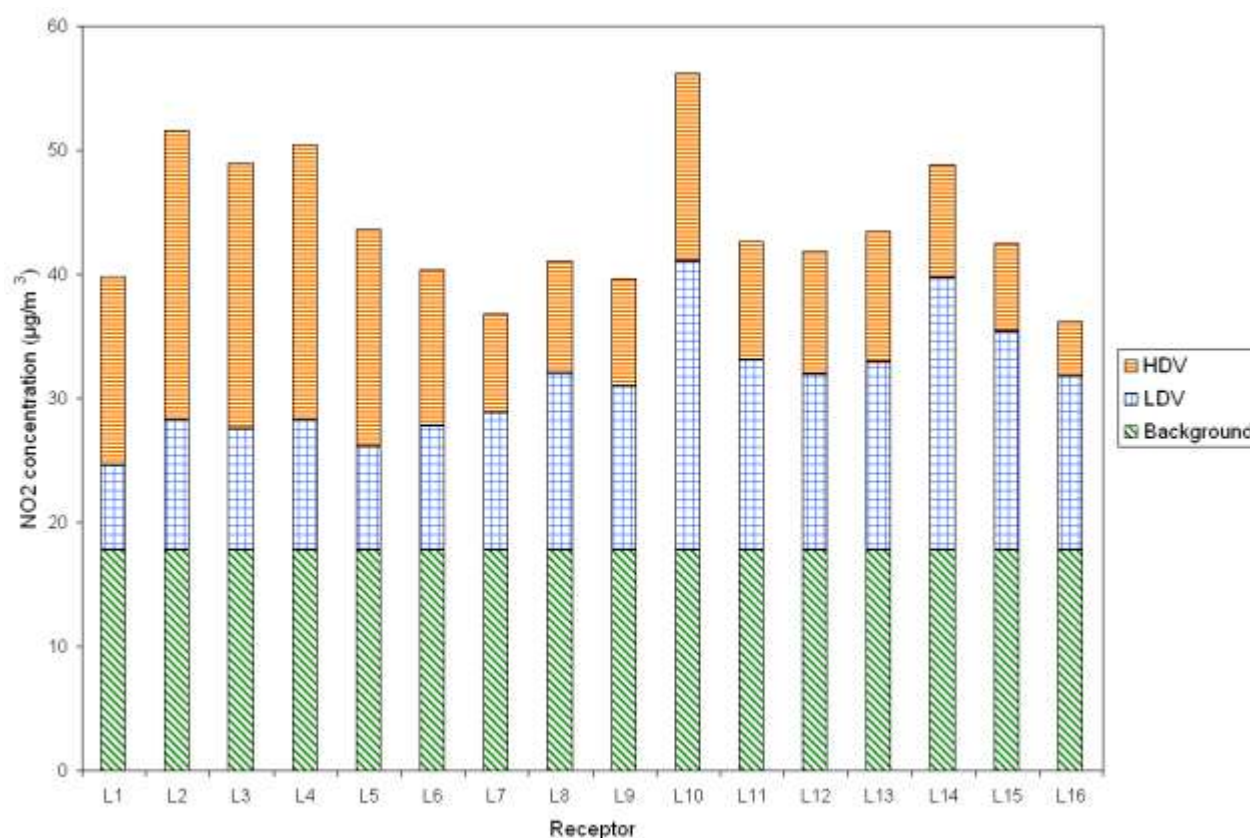
Table 3-19 Predicted Annual Mean (2009) Nitrogen Dioxide Concentrations and the Contribution of Each Source Type to the Total

	Annual Mean Concentration ($\mu\text{g}/\text{m}^3$) ^a			
	Background	LDV	HDV	Total
L1	17.8	6.8	15.2	39.8
L2	17.8	10.4	23.4	51.6
L3	17.8	9.7	21.5	49.0
L4	17.8	10.4	22.3	50.5
L5	17.8	8.3	17.5	43.6
L6	17.8	10.0	12.5	40.3
L7	17.8	11.1	8.0	36.8
L8	17.8	14.2	9.1	41.1
L9	17.8	13.2	8.6	39.7
L10	17.8	23.2	15.2	56.2
L11	17.8	15.3	9.5	42.6
L12	17.8	14.1	9.9	41.8
L13	17.8	15.1	10.5	43.4
L14	17.8	21.9	9.1	48.8
L15	17.8	17.6	7.1	42.5
L16	17.8	13.9	4.5	36.2
	% Contribution to Total			
	Background	LDV	HDV	Total
L1	44.8	17.1	38.2	100
L2	34.5	20.1	45.3	100
L3	36.4	19.8	43.8	100
L4	35.3	20.6	44.1	100
L5	40.8	19.1	40.1	100
L6	44.2	24.9	31.0	100
L7	48.3	30.0	21.7	100
L8	43.4	34.6	22.1	100
L9	44.9	33.3	21.8	100
L10	31.7	41.4	27.0	100
L11	41.8	35.8	22.4	100

L12	42.6	33.8	23.6	100
L13	41.0	34.7	24.3	100
L14	36.5	44.8	18.7	100
L15	41.9	41.4	16.7	100
L16	49.2	38.4	12.4	100

The sixteen worst case receptor locations identified within the Further Assessment have been used to provide an overview of source contributions. Table 3-19 and Figure 3-19 show that in most cases, the most significant component is the background concentration. In the Lowesmoor area (receptors L1-L6), emissions from HDVs (HGVs and Buses) contribute significantly to the overall concentration (30%-45%), despite making up a relatively small proportion to the total traffic volume (9%). In the Rainbow Hill area (receptors L7-L16), emissions from LDVs (Cars and LGVs) contribute a significant proportion (30-45%) to the overall concentration.

Figure 3-19 Relative Contribution of Each Source Type to the Total Annual Mean Nitrogen Dioxide Concentration ($\mu\text{g}/\text{m}^3$) at Receptor Locations where exceedences of the Annual Mean Objective are predicted (AQC, 2010)



3.6.4 Air Quality Improvement Required.

The degree of improvement, identified in the Further Assessment, required in order for the mean objective for nitrogen dioxide to be achieved is defined by the difference between the highest measured or predicted concentration and the objective level ($40 \mu\text{g}/\text{m}^3$). The highest predicted nitrogen dioxide concentration is $56.2 \mu\text{g}/\text{m}^3$ (at L10), requiring a reduction of $16.24 \mu\text{g}/\text{m}^3$ in order for the objective to be achieved.

However the Further Assessment explains that in terms of describing reductions in emissions required it is more useful to consider nitrogen oxides (NO_x) which has been calculated in line with guidance presented in LAQM.TG(09) (Defra, 2009). Table 3-20 below sets out the required reduction in local emissions of NO_x in Lowesmoor/Rainbow Hill AQMA to achieve the annual mean objective where an exceedence was predicted in 2009. At Receptor L10, local emissions would need to have been 52.2% lower in order to meet the objective.

Table 3-20 Required reduction in Annual Mean Nitrogen Dioxide Concentrations and in Emissions of Nitrogen Oxides at Receptors in the Lowesmoor/Rainbow Hill AQMA in 2009

Receptor	Required reduction in annual mean nitrogen dioxide concentration ($\mu\text{g}/\text{m}^3$)	Required reduction in emissions of oxides of nitrogen from local roads (%)
L2	11.6	42.7
L3	9.0	35.8
L4	10.5	39.9
L5	3.6	17.5
L6	0.3	1.7
L8	1.1	5.7
L10	16.2	56.2
L11	2.6	13.2
L12	1.8	9.4
L13	3.4	16.7
L14	8.8	35.4
L15	2.5	12.6

The results highlight that targeting individual types of vehicle on these local roads in isolation would not lead to the annual mean objective being achieved unless the reductions are very large. This is primarily because the background concentration, which is not influenced significantly by very local emissions, contributes a large proportion of total nitrogen dioxide concentrations. However reducing total vehicle emissions by around 50% would be a potentially effective measure for achieving the objectives at most receptor locations in the AQMA in 2009.

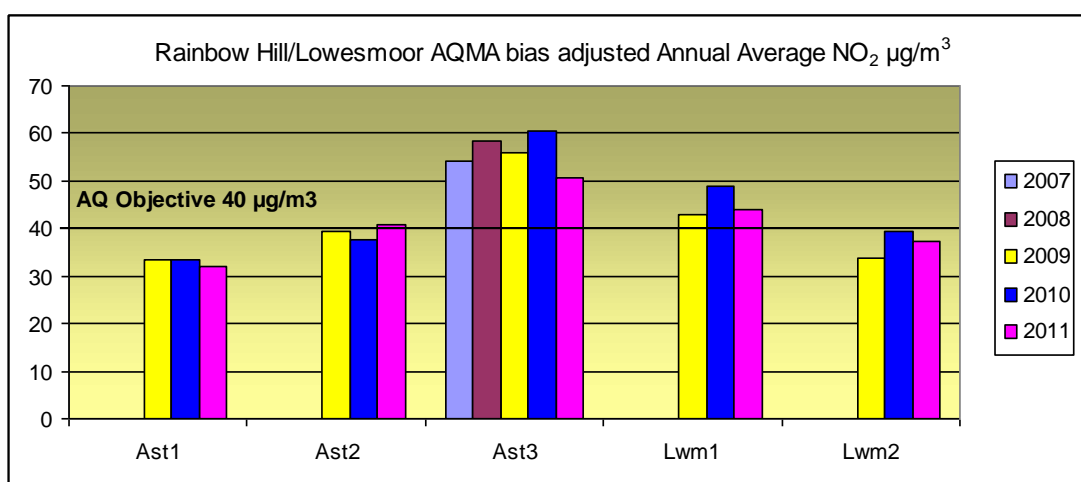
Measures within the Action Plan need to be proportionate to the scale of the exceedence of the objective and the number of people affected. In this case, 100 to 350 people are likely subject to exceedences of the annual mean and the magnitude of the exceedence ranges from relatively small to large (0.3 to $16.2 \mu\text{g}/\text{m}^3$ above the objective).

3.6.5 Long term local trends in NO₂

As part of the AQAP process data has been collated from previous WC yearly progress reports and screening assessments to produce meaningful picture of long term trends in monitoring results of nitrogen dioxide in Lowesmoor/Rainbow Hill.

The graph below depicts these long term trends from bias adjusted annual average results of NO₂ at relevant exposure receptor locations in Lowesmoor, however Astwood Road locations require some adjustment.

Figure 3-20 Bias adjusted Annual Average NO₂ monitoring results 2007 - 2011 Lowesmoor/Rainbow Hill AQMA



Loc Ast 1 – Astwood Road nr opposite New Chequers PH; Loc Ast 2 - Green lane/Church Street; Loc Ast 3 – Brow of Rainbow Hill; Lwm 1 – 61 Lowesmoor; Lwm 2 – 18 Lowesmoor

The Astwood Road monitoring positions do not represent relevant receptor locations. Accordingly the measured data from all the positions should be adjusted back from the roadside position to nearest relevant exposure receptor locations (i.e. residential dwelling) using the calculator tool provided by Defra. The calculation requires an appropriate background level be used within the calculation. As an appropriate local urban background monitoring position is not available for the majority of the years it has not been possible to undertake the necessary calculations satisfactorily prior to the completion of the AQAP. Calculations will be undertaken for future versions of the AQAP utilising available background map data from Defra.

3.6.6 Summary of progress of actions identified or implemented to date

No previous action plans have been produced for the Lowesmoor/Rainbow Hill AQMA.

3.6.7 Actions identified from Local Transport Programme 3 (LTP3):

A number of actions have been identified within the County Councils transport strategy as having a potential impact on Lowesmoor/Rainbow Hill AQMA. The LTP3 scheme code, brief description and current status as provided by WCC Highways in February and updated in June 2013 is shown in Table 3-21.

Table 3-21 LTP3 actions impacting Lowesmoor/Rainbow Hill AQMA.

LTP3 Scheme	Description of Improvements	Current Status
W1 - Worcester Foregate Street Enhancement.	Indirect: Significant improvement to passenger facilities including quality of interchange with other transport modes	Scheme is currently in progress and is due for completion in Autumn 2013.
W2 - Worcester Shrub Hill Station Enhancement	Indirect: Improvements to infrastructure and facilities	Proposals exist within future phases of the Worcester Transport Strategy and also the South Worcestershire Development Plan – Infrastructure Development Plan
W7 - Worcester Shrub Hill and Lowesmoor Area Maintenance & Improvement	Direct: A comprehensive programme of junction and traffic signals enhancements, street furniture decluttering, replacement and enhancement, and improved information systems	Scheme is currently in progress and will be delivered in stages. Lowesmoor completes in Autumn 2013. Lowesmoor Place/Terrace and Shrub Hill Road/Tolladine Road/Lowesmoor Place junctions will be delivered by 2015.
W11 - Worcester – City Secure Cycle parking.	Indirect: Provision of indoor cycle parking facilities in City Centre to make cycling more attractive	Scheme is currently in progress and is due for completion in Autumn 2013. E.g. Foregate Street Station Scheme which includes significant indoor cycle parking provision.
W17 - Worcester – Rail capacity Improvement	Indirect: Upgrading rail signalling and junctions, removal of single track operations, enhance capacity and improve reliability	Not in current Network Rail work scheme. Likely to be 2021-2025.

3.6.8 Summary of key issues identified from review for consideration within actions

Issue LRH1 - The Astwood Road/Rainbow Hill B4550 provides an attractive alternative route into the City centre for commuters via the Warndon, Blackpole and Perdiswell areas from the A449 and A38 and J6 of the M5. It connects to the City centre via Lowesmoor and cut throughs such as Lansdowne Road.

Issue LRH2 – Extension of the current boundary of the AQMA to include further properties along Astwood Road to the north is recommended by AQC within the Further Assessment. Furthermore the current AQMA boundary could be amended to comply with Defra (LAQM.TG(09) and LAQM.PG(09)) and EPUK guidance e.g. along physical or administrative boundaries and exclude rear residential garden areas.

Issue LRH3 – There are a number of schools in the area although none within the AQMA itself. Traffic to these various education institutions likely contributes significantly to the AM peak traffic volumes.

Issue LRH4 – The majority of the AQMA is narrow, leading to a street canyon effect in most parts, particularly evident in Lowesmoor.

Issue LRH5 – Delivery vehicles often observed obstructing the flow of traffic in the Lowesmoor area.

Issue LRH6 – are a number of bus routes and stops into the City Centre from Warndon, Blackpole and Perdiswell. There are a number of bus routes on AQMA and no pull-ins bus stops causing traffic queues behind buses as street is too narrow to overtake.

Issue LRH7 – Set of traffic signals is at the exit from Lowesmoor onto Lowesmoor Terrace cause traffic to back up into street canyon in Lowesmoor. WCC (June 2013) indicates this traffic is caused by contravention of Traffic Regulation Orders at Trinity Gate Junction which limit access into Lowesmoor during the afternoon peak westbound.

Issue LRH8 – Source apportionment in the FA demonstrated that the most significant component is the background concentration. In the Lowesmoor area emissions from HDVs (HGVs and Buses) contribute significantly to the overall concentration (30%-45%) and in the Rainbow Hill area emissions from LDVs (Cars and LGVs) contribute a significant proportion (30-45%) to the overall concentration.

Issue LRH9 – The results of modelling in the Further Assessment indicate greater than 100 people are subject to exceedences of the annual mean and the magnitude of the exceedence ranges from 0.3 to 16.2 $\mu\text{g}/\text{m}^3$ above the objective. Reducing total vehicle emissions by around 50% would be a potentially effective measure for achieving the objectives at most receptor locations.

Issue LRH10 – Recorded data requires working back to facades of residential properties from roadside monitoring locations using available calculator tools and background maps.