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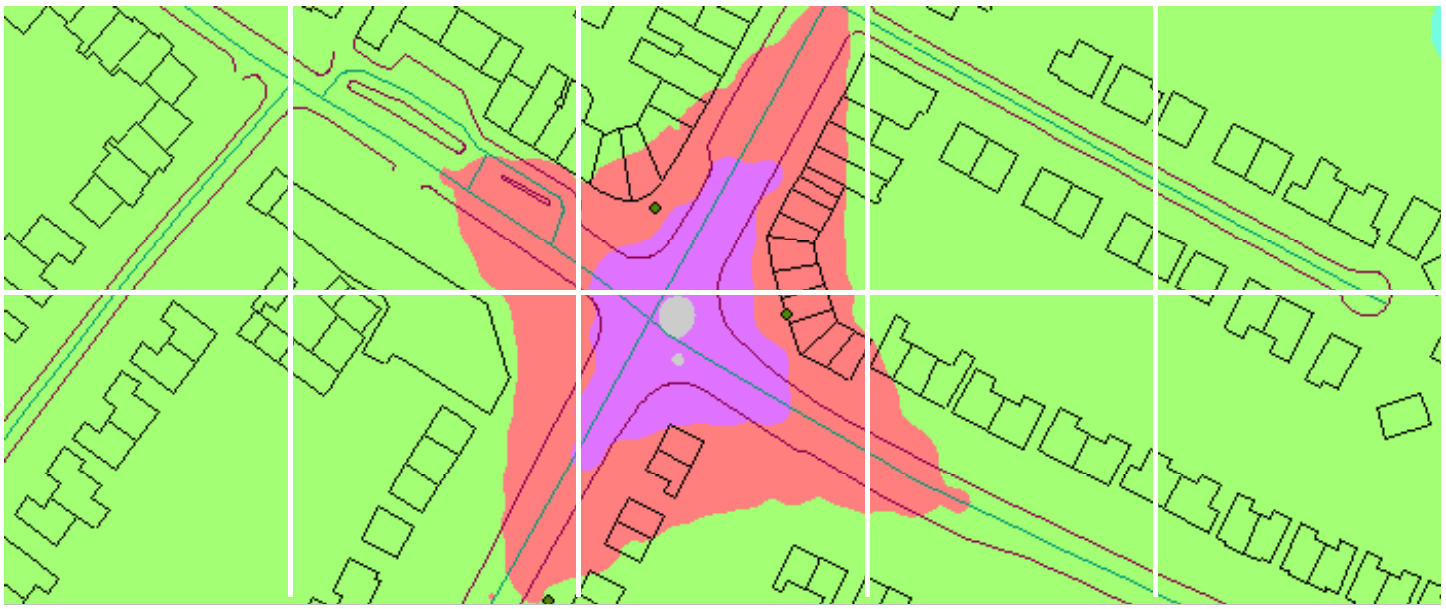

Detailed Assessment for The Broadway, Potters Bar

Report to Hertsmere BoroughCouncil

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Executive summary

The UK Government published its strategic policy framework for air quality management in 1995 establishing national strategies and policies on air quality, which culminated in the Environment Act, 1995. The Air Quality Strategy[1] provides a framework for air quality control through air quality management and air quality standards. These and other air quality standards[1] and their objectives have been enacted through the Air Quality Regulations in 1997, 2000 and 2002[2]. The Environment Act 1995 requires Local Authorities to undertake air quality reviews. In areas where an air quality objective is not anticipated to be met, Local Authorities are required to establish Air Quality Management Areas and implement action plans to improve air quality.

The first round of air quality review and assessments was completed by Hertsmere Borough Council Council in 2002. The Council proceeded to the second round of review and assessment in which sources of emissions to air are reassessed to identify whether the situation has changed since the first round, and if so, what impact this may have on predicted exceedences of the air quality objectives.

The second round of review and assessment was undertaken in two steps. The first step was an Updating and Screening Assessment, which updated the Stage 1 and 2 review and assessments previously undertaken for all pollutants identified in the Air Quality Regulations. Where a significant risk of exceedence was identified outside the AQMA for a pollutant it was necessary for the local authority to proceed to a Detailed Assessment, equivalent to the previous Stage 3 assessments. Where a local authority does not need to undertake a Detailed Assessment, a Progress Report is required instead.

Hertsmere Borough Council carried out an Updating and Screening Assessment (USA) in 2003 and concluded that a Detailed Assessment was required for nitrogen dioxide on the basis of diffusion tube measurements at Stirling Corner (Borehamwood), Shenley Road (Borehamwood), the Broadway (Potters Bar) and the High Street bus garage (Potters Bar). The USA also recommended that a Detailed Assessment be carried out for various busy junctions because screening modelling suggested that there was a possibility that the air quality objectives would not be met at these junctions. These junctions were Elstree crossroads, Junctions 23 and 24 on the M25, the junction of Watling Street and Aldenham road in Radlett, and the junction of Heathbourne Road and Elstree Road in Bushey.

A Detailed Assessment for all the areas recommended for assessment was therefore carried out in 2004. The Detailed Assessment recommended that small areas close to Elstree crossroads and on High Street, Potters Bar be designated as Air Quality Management Areas. Hertsmere Borough Council AQMAs No. 5 and 6 were declared after consideration of potential residential exposure in these areas. The modelling study of the B556 Mutton Lane past the Broadway carried out for the Detailed Assessment indicated that the air quality strategy objective for nitrogen dioxide would be met at the Broadway.

However, subsequent diffusion tube measurements at the Broadway have shown that the air quality strategy objective limit for nitrogen dioxide has been exceeded. Substantial changes have been made to the layout of the junction between Mutton Lane and the Broadway. New traffic data has been obtained for B556 Mutton Lane and Darkes Lane (the Broadway) and Baker Street, which are unclassified roads. This report is a Detailed Assessment for Hertsmere Borough Council of the Broadway as outlined in the Government's published guidance: it takes account of the revised layout of the junction and new traffic data.

[1] Refers to standards recommended by the Expert Panel on Air Quality Standards. Recommended standards are set purely with regard to scientific and medical evidence on the effects of the particular pollutants on health, at levels at which risks to public health, including vulnerable groups, are very small or regarded as negligible.

The general approach taken to this Detailed Assessment was to:

- Collect and interpret additional data to support the detailed assessment, including detailed traffic flow data around potential hotspots;
- Consider recent continuous monitoring and diffusion tube measurements;
- Use monitoring data from the continuous monitors located in neighbouring boroughs to assess the ambient concentrations produced by the road traffic and to calibrate the output of modelling studies;
- Model the concentrations of NO_2 around the potential hotspot, concentrating on the locations (receptors) where people might be exposed over the relevant averaging times of the air quality objectives;
- Present the concentrations as contour plots and assess the uncertainty in the predicted concentrations;
- Consider whether the authority should declare an Air Quality Management Area and provide recommendations on the scope and extent of any proposed Air Quality Management Area.

The assessment confirms that it is likely that the air quality objectives for nitrogen dioxide will not be met close to the Mutton Lane / the Broadway junction. The area of potential exceedence is described below. It is recommended that Hertsmere Borough Council consider declaring this area as an Air Quality Management Area.

Potential Air Quality Management Area

Street	Numbers
The Broadway	Even numbers 14-40 and odd numbers 7-33
Mutton Lane	Odd numbers 213-225
Baker Street	Even numbers 2-10

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Acronyms and definitions used in this report

AADTF	Annual Average Daily Traffic Flow
ADMS	an atmospheric dispersion model
AQDD	an EU directive (part of EU law) - Common Position on Air Quality Daughter Directives, commonly referred to as the Air Quality Daughter Directive
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
AURN	Automatic Urban and Rural Network (Defra funded network)
base case	In the context of this report, the emissions or concentrations predicted at the date of the relevant air quality objective (2005 for nitrogen dioxide)
CO	Carbon monoxide
d.f.	degrees of freedom (in statistical analysis of data)
DETR	Department of the Environment Transport and the Regions (now defra)
Defra	Department of the Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges
EA	Environment Agency
EPA	Environmental Protection Act
EPAQS	Expert Panel on Air Quality Standards (UK panel)
EU	European Union
GIS	Geographical Information System
kerbside	0 to 1 m from the kerb
Limit Value	An EU definition for an air quality standard of a pollutant listed in the air quality directives
n	number of pairs of data
NAEI	National Atmospheric Emission Inventory
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NRTF	National Road Traffic Forecast
ppb	parts per billion (1 ppb is 1 volume of pollutant in 10^9 volumes of air
r	the correlation coefficient (between two variables)
receptor	In the context of this study, the relevant location where air quality is assessed or predicted (for example, houses, hospitals and schools)
roadside	1 to 5 m from the kerb
SD	standard deviation (of a range of data)
TEA	Triethanolamine
TEMPRO	A piece of software produced by the defra used to forecast traffic flow increases
TEOM	Tapered Element Oscillating Microbalance
TEOM (Grav.)	TEOM Measurements expressed as the equivalent value from a gravimetric monitor
V/V	Volume ratio

1 Introduction

This section outlines the purpose of this Detailed Assessment for Hertsmere Borough Council, and the scope of the assessment.

1.1 Purpose of the Detailed Assessment

The first round of air quality review and assessments is now complete and all local authorities should have completed all necessary stages. Where the likelihood of exceedences of air quality objectives has been identified in areas of significant public exposure, an air quality management area (AQMA) should have been declared. Hertsmere Borough Council's Stage 4 reports (2002) confirmed that the air quality objectives would not be met at a small number of residential properties close to the motorways and so four separate AQMAs were declared.

Local authorities were required to proceed to the second round of review and assessment in which sources of emissions to air are reassessed to identify whether the situation has changed since the first round of review and assessment, and if so, what impact this may have on predicted exceedences of the air quality objectives. Such changes might include significant traffic growth on a major road, which had not been foreseen, construction of a new industrial plant with emissions to air, or significant changes in the emissions of an existing plant.

The second round of review and assessment was undertaken in two steps. The first step was an Updating and Screening Assessment, which updates the Stage 1 and 2 review and assessments previously undertaken for all pollutants identified in the Air Quality Regulations. Where a significant risk of exceedence was identified for a pollutant it was necessary for the local authority to proceed to a Detailed Assessment, equivalent to the previous Stage 3 assessments. Where a local authority did not need to undertake a Detailed Assessment, a Progress Report was required instead.

Hertsmere Borough Council carried out an Updating and Screening Assessment (USA) in 2003 and concluded that a Detailed Assessment was required for nitrogen dioxide on the basis of diffusion tube measurements at Stirling Corner (Borehamwood), Shenley Road (Borehamwood), the Broadway (Potters Bar) and the High Street bus garage (Potters Bar). The USA also recommended that a Detailed Assessment be carried out for various busy junctions because screening modelling suggested that there was a possibility that the air quality objectives would not be met at these junctions. These junctions were Elstree crossroads, Junctions 23 and 24 on the M25, the junction of Watling Street and Aldenham road in Radlett, and the junction of Heathbourne Road and Elstree Road in Bushey.

A Detailed Assessment for all the areas recommended for assessment was therefore carried out in 2004. The Detailed Assessment recommended that small areas close to Elstree crossroads and on High Street, Potters Bar be designated as Air Quality Management Areas. Hertsmere Borough Council AQMAs No. 5 and 6 were declared after consideration of potential residential exposure in these areas. The modelling study of the B556 Mutton Lane past the Broadway carried out for the Detailed Assessment indicated that the air quality strategy objective for nitrogen dioxide would be met at the Broadway.

However, subsequent diffusion tube measurements at the Broadway have shown that the air quality strategy objective limit for nitrogen dioxide has been exceeded. Substantial changes have been made to the layout of the junction between Mutton Lane and the Broadway. New traffic data has been obtained for B556 Mutton Lane and Darkes Lane (which becomes the Broadway near to the junction) and Baker Street, which are unclassified roads. This report is a Detailed Assessment for Hertsmere Borough Council of the Broadway as outlined in the Government's published guidance: it takes account of the revised layout of the junction and new traffic data.

The purpose of the detailed assessment is to provide an accurate assessment of the likelihood of an air quality objective being exceeded at locations with relevant exposure. This should be sufficiently detailed to allow the designation of any necessary AQMAs. This report is a Detailed Assessment for Hertsmere Borough Council as outlined in the Government's published guidance.

1.2 Overview of approach taken

The general approach taken to this Detailed Assessment was to:

- Collect and interpret additional data to support the detailed assessment, including detailed traffic flow data around potential hotspots;
- Consider recent continuous monitoring and diffusion tube measurements;
- Use monitoring data from the continuous monitors located in neighbouring boroughs to assess the ambient concentrations produced by the road traffic and to calibrate the output of modelling studies;
- Model the concentrations of NO_2 around the potential hotspot, concentrating on the locations (receptors) where people might be exposed over the relevant averaging times of the air quality objectives;
- Present the concentrations as contour plots and assess the uncertainty in the predicted concentrations;
- Consider whether the authority should declare an Air Quality Management Area and provide recommendations on the scope and extent of any proposed Air Quality Management Area.

1.3 Relevant DEFRA documentation used

Technical Guidance has been issued in 'Review and Assessment: Technical Guidance' LAQM.TG (03) to enable air quality to be monitored, modelled, reviewed and assessed in an appropriate and consistent fashion. Further guidance is provided in a series of Frequently Asked Question on the Review and Assessment website hosted by the University of the West of England. This detailed assessment has considered the procedures set out in this technical guidance.

1.4 Pollutants considered in this report

Table 1.1 lists the pollutants included in the Air Quality Regulations for the purposes of Review and Assessment. Nitrogen dioxide is considered in this report. The Updating and Screening Assessment concluded that detailed assessment of other pollutants was not required.

Table 1.1: Objectives included in the Air Quality Regulations 2000 and (Amendment) Regulations 2002 for the purpose of Local Air Quality Management

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene			
All authorities	16.25 μg/m^3	running annual mean	31.12.2003
Authorities in England and Wales only	5.00 μg/m^3	annual mean	31.12.2010
Scotland and Northern Ireland only	3.25 μg/m^3	running annual mean	31.12.2010
1,3-Butadiene	2.25 μg/m^3	running annual mean	31.12.2003
Carbon monoxide Authorities in England, Wales and Northern Ireland only	10.0 mg/m^3	maximum daily running 8-hour mean	31.12.2003
Authorities in Scotland only	10.0 mg/m^3	running 8-hour mean	31.12.2003
Lead	0.5 μg/m^3 0.25 μg/m^3	annual mean annual mean	31.12.2004 31.12.2008
Nitrogen dioxide[b]	200 μg/m^3 not to be exceeded more than 18 times a year 40 μg/m^3	1 hour mean annual mean	31.12.2005 31.12.2005
Particles (PM_{10}) (gravimetric)[c] All authorities	50 μg/m^3 not to be exceeded more than 35 times a year 40 μg/m^3	24 hour mean annual mean	31.12.2004 31.12.2004
Authorities in Scotland only[d]	50 μg/m^3 not to be exceeded more than 7 times a year 18 μg/m^3	24 hour mean annual mean	31.12.2010 31.12.2010
Sulphur dioxide	350 μg/m^3 not to be exceeded more than 24 times a year 125 μg/m^3 not to be exceeded more than 3 times a year 266 μg/m^3 not to be exceeded more than 35 times a year	1 hour mean 24 hour mean 15 minute mean	31.12.2004 31.12.2004 31.12.2005

b. The objectives for nitrogen dioxide are provisional.
c. Measured using the European gravimetric transfer standard sampler or equivalent.
d. These 2010 Air Quality Objectives for PM10 apply in Scotland only, as set out in the Air Quality (Scotland) Amendment Regulations 2002.

In addition, the Air Quality Strategy, 2007 provides new objectives for particles ($PM_{2.5}$). These are an annual mean of 25 μg m^{-3} (12 μg m^{-3} in Scotland) to be achieved by 2020 and a target of 15% reduction in concentrations at urban background. These objectives for England, Wales and Greater London are not currently included in Regulations for the purpose of LAQM.

1.5 Locations that the Review and Assessment must concentrate on

For the purpose of review and assessment, the authority should focus their work on locations where members of the public are likely to be exposed over the averaging period of the objective. Table 1.2 summarises the locations where the objectives should and should not apply.

Table 1.2 Typical locations where the objectives should and should not apply

Averaging Period	Pollutants	Objectives *should* apply at …	Objectives should *not* generally apply at …
Annual mean	• 1,3 Butadiene • Benzene • Lead • Nitrogen dioxide • Particulate Matter (PM_{10})	• All background locations where members of the public might be regularly exposed.	• Building facades of offices or other places of work where members of the public do not have regular access.
		• Building facades of residential properties, schools, hospitals, libraries etc.	• Gardens of residential properties.
			• Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term
24 hour mean and 8-hour mean	• Carbon monoxide • Particulate Matter (PM_{10}) • Sulphur dioxide	• All locations where the annual mean objective would apply.	• Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term.
		• Gardens of residential properties.	
1 hour mean	Nitrogen dioxide Sulphur dioxide	All locations where the annual mean and 24 and 8-hour mean objectives apply.	Kerbside sites where the public would not be expected to have regular access.
		Kerbside sites (e.g. pavements of busy shopping streets).	
		Those parts of car parks and railway stations etc. which are not fully enclosed.	
		Any outdoor locations to which the public might reasonably be expected to have access.	
15 minute mean	Sulphur dioxide	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer.	

2 Information used to support this assessment

This section lists the key information used in this review and assessment.

2.1 Review and assessment reports

This report draws upon earlier Review and Assessment reports published by Hertsmere Borough Council. These include:

- Air Quality Review and Assessment – Stage 4, September 2002
- Updating and Screening Assessment, June 2003
- Detailed Assessment, August 2004
- Further Assessment, August 2005

2.2 Maps and distances of receptors from roads

Hertsmere Borough Council provided electronic OS LandLine™ data which were used in the Geographical Information System (GIS) in this assessment. The maps were used to provide details of the location of road centrelines and road widths. Individual buildings or groups of buildings (receptors) were also identified. The distances of these receptors from the road were accurately determined from the maps.

2.3 Road traffic data

Hertfordshire County Council provided traffic data for the roads and junctions assessed. The data included 24-hour automatic counts for the period Wednesday 20th September 2006 to Tuesday 26th September 2006 for:

- Mutton Lane, east of the Broadway
- Mutton Lane, west of the Broadway
- Darkes Lane
- Baker Street

The road traffic data is shown in Appendix 1.

In addition, traffic data from the 2004 National Atmospheric Emissions Inventory was used to model traffic flows past the roadside monitoring station on Rickmansworth Road in neighbouring Watford Borough Council

A diurnal variation in traffic flow was assumed, typical of urban roads in the south-east.

The base year for the traffic flows was 2006 for the Hertsmere data and 2004 for the NAEI data. Traffic flows were projected for future years using TEMPRO/NRTF scaling factors for the appropriate year.

Some congestion occurs at the junction throughout the day, particularly during peak hours. Substantial modifications were made to the junction during 2005, including the provision of defined filter lanes. Queues were assumed to extend the length of the filter lanes for 50% of the time during the day.

It was assumed that heavy-duty vehicles make up 4% of the traffic flow based on 2001 data for B556 Cecil Road taken from the 2004 Detailed Assessment report. Cecil Road extends B556 Mutton Lane to the west.

2.4 Ambient monitoring

The assessment has considered continuous automatic monitoring data from monitoring stations in Hertsmere and neighbouring local authorities for nitrogen dioxide and ozone. The continuous monitors form part of the Hertfordshire and Bedfordshire Network, HBNet operated and are maintained by Kings College, London on behalf of the local authorities. Nitrogen dioxide concentrations are measured by ozone chemiluminescence. HBNet quality control and assurance procedures are employed at the Hertsmere site.

The Hertsmere 2 site has operated since July 2006, replacing the Hertsmere 1 site.

Table 2.1 shows the locations of urban background sites in neighbouring local authority areas.

Table 2.1: Monitoring sites in neighbouring local authorities

Local authority area	Site	OS Grid reference
Three Rivers background	Rectory Road, Rickmansworth	505450, 194460
St Albans background	Fleetville Community Centre, Royal Road, St Albans	516550, 207360
Watford Roadside	Town Hall, Rickmansworth Road, Watford	334850, 390680

Hertsmere Borough Council operates a network of nitrogen dioxide diffusion tubes across the District. The diffusion tubes are prepared with 20% triethylamine in water and are analysed by Gradko. Three of the diffusion tube sites are located close to the areas to be investigated in the detailed assessment. Triplicate diffusion tubes are collocated with the Hertsmere continuous monitor. The locations of the diffusion tubes are listed in Table 2.2.

Table 2.2: Diffusion tube locations.

Site no.	Site Location	Easting, m	Northing, n	Site type
HM45	Air Quality Monitoring Station	520147	197357	Background
HM46				
HM47				
HM62	The Broadway Potters Bar	524945	201163	Kerbside
HM77				
HM78				
HM79	11 The Broadway Potters Bar	524973	201140	Roadside
HM80				
HM81				
HM82	10 Baker Street Potters Bar	524922	201079	Roadside
HM83				
HM84				

2.5 Emission factors

The vehicle emission factors used for national mapping were revised by defra and the devolved administrations[2] in 2001. The most recent emission factors have been used in this detailed assessment.

[2] The new set of emission factors on the NAEI website (www.naei.org.uk/emissions/index.php) approved by DEFRA and DTLR for use in emissions and air quality modelling, following consultation of the TRL Report "Exhaust Emission Factors 2001: Database and Emission Factors" by TJ Barlow, AJ Hickman and P Boulter, TRL, September 2001

Emissions from stationary traffic in queues were estimated using the emission factor for vehicles moving at 5 km h^{-1} and taking account of the proportion of time stationary vehicles are present and the length of road over which emissions take place. The average length of a queuing vehicle was assumed to be 5 m. Vehicles queuing at junctions were assumed to wait for 30 seconds in each minute during the peak period 0700-1800.

3 Detailed Assessment for Nitrogen Dioxide

3.1 The national perspective

The principal source of NOx emissions is road transport, which accounted for about 37% of total UK emissions in 2004. 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 is considerably more demanding than achieving the 1-hour objective. National studies have indicated that the annual mean objective is likely to be achieved at all urban background locations outside of London by 2005, but that the objective may be 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 London, and at roadside locations in other cities.

3.2 Standards and objectives for nitrogen dioxide

The Government and the Devolved Administrations have adopted two Air Quality Objectives for nitrogen dioxide, as an annual mean concentration of 40 μgm^{-3}, and a 1-hour mean concentration of 200 μgm^{-3} not to be exceeded more than 18 times per year. The objectives are to be achieved by the end of 2005 and in subsequent years. The Air Quality Strategy 2007 confirmed these two objectives.

3.3 Conclusions of the first and second round of review and assessments for nitrogen dioxide

The first round Stage 4 Review and Assessment of NO_2 confirmed that concentrations of NO_2 at certain locations close to some major roads in the Borough were likely to exceed the annual mean air quality objective limit. Hertsmere Borough Council retain four AQMAs from the first round of review and assessment covering isolated properties close to the M25 and M1 motorways. The Council have prepared an air quality action plan for these AQMAs. Following the preparation of a detailed assessment as part of the second round of review and assessment, the Council declared two new AQMAs in 2004. These cover parts of Potters Bar High Street and the Elstree crossroads. The 2005 Further Assessment confirmed the need for these two AQMAs. Detailed maps of the AQMAs are provided in Appendix 2.

3.4 Background concentrations for nitrogen dioxide

The estimated annual average background nitrogen dioxide (NO_2) concentration provided by the UK background maps for 2005 was 21.1 μgm^{-3} averaged across Hertsmere Borough with a maximum concentration of 24.7 μgm^{-3}.

The estimated annual average background oxides of nitrogen (NO_x) concentration provided by the UK background maps for 2005 was 33.0 μgm^{-3} averaged across Hertsmere Borough with a maximum concentration of 41.4 μgm^{-3}.

3.5 Assessment of monitoring data

Table 3.1 summarises the measurements of nitrogen dioxide concentrations at continuous monitoring stations in Hertsmere and nearby districts for relevant periods.

Table 3.1: Continuous monitoring data

Site	Period	Data capture, %	NO_x, concentration, $\mu g\ m^{-3}$ as NO_2	NO_2 Concentration, $\mu g\ m^{-3}$	
			Period average	Period average	99.8^{th} percentile hourly
Watford	2005	97	75	38.0	111.0
	1/11/06-30/6/07	92	68.9	37.3	
	2006	92	66.9	37.3	145.9
Three Rivers	2005	90	71.8	30.2	
	1/11/06-30/6/07	91	76.3	30.6	
	2006	85	71	32.7	121.3
St Albans	2005	90	47.8	26.5	96.6
	1/11/06-30/6/07	94	46.0	23.1	
	2006	93	47	25.3	103
Hertsmere	1/11/06-30/6/07	92	44.3	24.2	
	2006	44	43.3	24.6	83.3

The concentrations measured at the background site in Hertsmere, Borehamwood were well below the objectives for nitrogen dioxide during the measurement period.

Table 3.2 shows the concentrations measured by diffusion tube at relevant locations in Borehamwood. The 2006 measurements have been corrected for diffusion tube bias using a national bias adjustment factor of 0.98 taken from the Review and Assessment Helpdesk Frequently Asked Questions for Gradko 20% TEA in water tubes. A local bias adjustment factor of 0.71 was also determined from the measurements at the Hertsmere monitoring site for the period 1 November 2006 to 30 June 2007. The diffusion tube measurements for this period have also been scaled to provide an estimate of the 2006 concentrations using a scaling factor of 1.055 determined from the measurements at St Albans, Three Rivers and Watford.

The diffusion tube measurements at the Broadway, adjusted according to both the national bias adjustment factor and the local bias adjustment factor, exceed the air quality objective of 40 $\mu g\ m^{-3}$. The measurements at 10 Baker Street, when adjusted for local diffusion tube bias, indicate that the air quality objective will be met at this location.

Table 3.2: Summary of diffusion tube data

Site No.	Site	2006		November 2006-June 2007		2006
		Average, μg m^{-3}	Number of samples	Average, μg m^{-3}	Number of samples	Bias adjusted average, μg m^{-3}
HM45	Automatic monitoring site	29.8	12	34.0	8	29.2
HM46		29.0	12	33.9	8	28.4
HM47		30.1	12	34.4	8	29.5
HM62	The Broadway Potters Bar	49.7	10	53.4	8	48.7 (40.0)*
HM77		54.0	2	55.6	8	52.9 (41.7)
HM78		54.0	2	56.3	8	52.9 (42.1)
HM79	11 The Broadway Potters Bar				0	
HM80				45.0	1	
HM81					0	
HM82	10 Baker Street Potters Bar	42.0	2	47.4	7	(35.5)
HM83		44.0	2	45.9	8	(34.4)
HM84		48.0	2	48.6	8	(36.4)

* Figures in brackets adjusted for local bias adjustment

3.6 Overview of the air quality modelling

3.6.1 Summary of the models used

The air quality impact from roads has been assessed using our proprietary urban model (LADS Urban). There are two parts to this model:

- The *Local Area Dispersion System (LADS) model*. This model calculates background concentrations of oxides of nitrogen on a 1 km x 1 km grid. The estimates of emissions of oxides of nitrogen for each 1 km x 1 km area grid square were obtained from the 2004 National Atmospheric Emissions Inventory.
- The *DISP model*. This model is a tool for calculating atmospheric dispersion using a 10 m x 10 m x 3 m volume-source kernel derived from ADMS3.3 to represent elements of the road. The volume source depth takes account of the initial mixing caused by the turbulence induced by the vehicles. Estimates of emissions from vehicles have been calculated using the latest (and finalised for this round of Review and Assessment) vehicle emission factors.

Particular attention was paid to the avoidance of "double counting" of the contribution from major roads in the modelled areas. Thus the emissions from sections of roads modelled using DISP were removed from the LADS inventory.

Hourly sequential meteorological data for 2005 from London Heathrow, approximately 30 km south-west of Hertsmere was used. A surface roughness of 1 m was used in the modelling to represent the urban conditions corresponding to the most exposed sites.

A regional background oxides of nitrogen concentration of 16.2 μg m, measured at Harwell for 2006 was added to the modelled oxides of nitrogen concentrations.

The netcen primary NO_2 model (AQEG 2006) was used to calculate nitrogen dioxide concentrations from the oxides of nitrogen concentrations predicted by LADS Urban. The model takes into account the background ozone, nitrogen dioxide and nitric oxide concentrations, the proportion of the oxides of nitrogen released from vehicles as nitrogen dioxide and the exposure of the site to sunlight. The model was used first to analyse the monitoring data from the Watford roadside site to estimate the proportion

of oxides of nitrogen (7.9%) released as nitrogen dioxide. The analysis took account of background measurements of ozone, oxides of nitrogen and nitrogen dioxide concentrations at the Fleetville, St Albans site.

3.6.2 Validation and verification of the model

In simple terms, model validation is where the model is tested at a range of locations and is judged suitable to use for a given application. The modelling approach used in this assessment has been validated, and used in numerous **netcen** air quality review and assessments.

Verification of the model involves comparison of the modelled results with any local monitoring data at relevant locations. Table 3.3 compares modelled predictions using LADS Urban of oxides of nitrogen with measured values at the Watford, Three Rivers and St Albans continuous monitoring sites.

Bias adjustment is the process where the concentrations of the model are adjusted to agree with local air quality monitoring data. In this case, the model has tended to underestimate the oxides of nitrogen concentrations. An additional 6 μg m^{-3} has been added to the modelled oxides of nitrogen concentrations to take account of emission sources in London outside the modelled domain. Table 3.3 shows the adjusted oxides of nitrogen concentrations.

Table 3.3 shows the modelled and measured nitrogen dioxide concentrations. The agreement is satisfactory and so no further adjustment of the modelled concentrations has been made.

Table 3.3: Comparison of modelled and measured concentrations, 2006

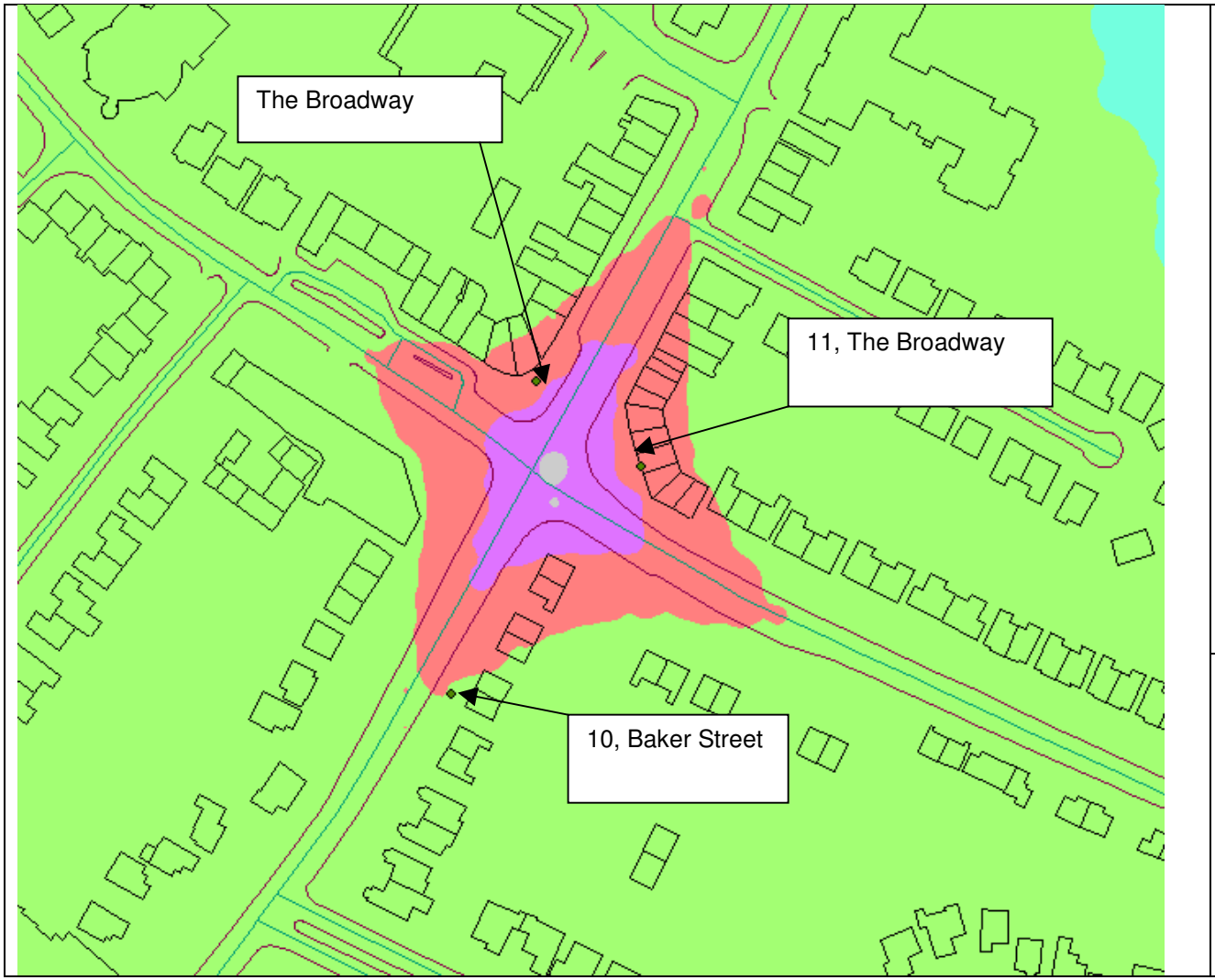
Site	Oxides of nitrogen concentration, μg m^{-3}			Nitrogen dioxide concentration, μg m^{-3}	
	Modelled	Bias adjusted model	Measured	Modelled	Measured
Watford	59.6	65.6	66.9	37.4	37.3
St Albans	37.2	43.2	46	31.8	25.3
Three Rivers	39.9	45.9	71	32.5	32.7

3.7 Detailed modelling results

Fig.3.1 shows the modelled nitrogen dioxide concentrations for 2006 at the Broadway junction. The locations of the diffusion tubes are also shown. The modelled concentrations exceed the air quality objective of 40 μg m^{-3} at distances up to 80 m from the junction. The modelled concentration at the Broadway diffusion tube was 44.7 μg m^{-3} compared with the measured concentration of 41.2 μg m^{-3} (local bias adjustment) to 51.5 μg m^{-3} (national bias adjustment). The modelled concentration at the 10 Baker Street diffusion tube site was 39.8 μg m^{-3} compared with the measured concentration of 35.4 μgm^{-3} (local bias adjustment).

Fig. 3.2 shows the modelled concentrations for 2010. The model predicts that concentrations will continue to exceed the objective of 40 μg m^{-3} on the faces of buildings at the junction.

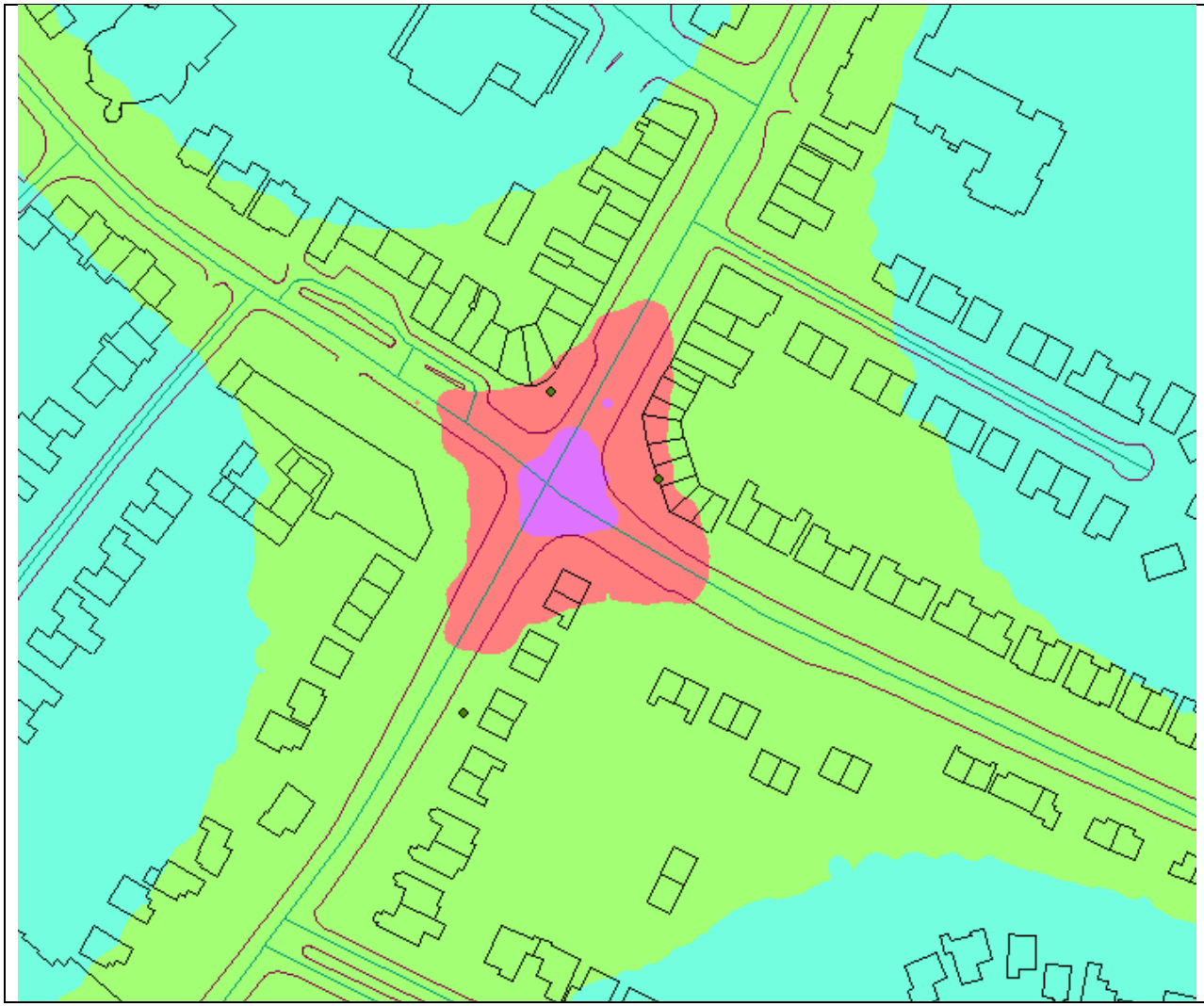
Fig. 3.1: Modelled nitrogen dioxide concentrations, 2006



Nitrogen dioxide, ug/m3

- <28
- 28 - 34
- 34 - 40
- 40 - 46
- 46 - 52
- >52

Fig. 3.2: Modelled nitrogen dioxide concentrations, 2010



Nitrogen dioxide, ug/m3

- <28
- 28 - 34
- 34 - 40
- 40 - 46
- 46 - 52
- >52

3.8 Source apportionment

3.8.1 Source apportionment of 'base case' predictions

Source apportionment is the process whereby the contributions from the sources of a pollutant are determined. In local air quality, the relevant sources could include: traffic; local background; industrial and domestic. Contributions from the different types of vehicles (for example, cars, lorries and buses) can also be considered to highlight which class of vehicle is contributing most to the emissions from traffic. Source apportionment allows the most important source or sources to be identified and options to reduce ambient concentrations of pollutants can then be considered and assessed.

The source apportionment should:

- Confirm that exceedences of NO_2 are due to road traffic
- Determine the extent to which different vehicle types are responsible for the emission contributions to NO_2: this will allow traffic management scenarios to be modelled/tested to reduce the exceedences
- Quantify what proportion of the exceedences of NO_2 is due to background emissions, or local emissions from busy roads in the local area. This will help determine whether local traffic management measures could have a significant impact on reducing emissions in the area of exceedence, or, whether national measures would be a suitable approach to achieving the air quality objectives

3.8.2 What is the 'base case'?

The base case in this assessment is defined as the annual mean concentrations of NO_2 that are predicted in 2006 in the absence of any measures to improve air quality in Hertsmere. They are the concentrations that should be relevant to defining the extent of Air Quality Management Areas.

3.8.3 Receptors considered

The most affected receptors where there is potential relevant public exposure outside have been considered: these are shown in Table 3.4. They are the locations of the diffusion tubes insalled in the area of the junction.

Table 3.4: Most affected receptors exceeding annual average objective

Description	Easting, m	Northing, m
10 Baker Street	524922	201079
The Broadway	524945	201163
11 The Broadway	524973	201140

3.8.4 Sources of pollution considered

We have considered the effect of the following sources in this detailed assessment at the receptors considered:

- Background
- Traffic
- Heavy duty vehicles (buses, coaches and heavy goods)
- Stationary vehicles in queues

The concentrations of oxides of nitrogen concentrations apportioned to each source category and the fractions of the total concentrations are shown in Table 4.8. Table 4.8 shows the contributions from the

background and the modelled local roads contribution. It then shows the breakdown of the local road contribution between heavy and light duty vehicles and between moving and stationary vehicles (in queues approaching the junction).

Table 4.8: Apportionment of oxides of nitrogen concentrations at most affected receptors

Area	Contribution to oxides of nitrogen concentration, µg m^{-3}						
	Total	Background	Local roads	Local LDV	Local HDV	Moving vehicles	Stationary vehicles
10 Baker Street	71.2	47.8	23.4	10.6	12.8	18.7	4.7
The Broadway	97.3	46.5	50.9	19.6	31.3	32.0	18.9
11 The Broadway	90.7	46.5	44.2	17.1	27.1	33.9	10.4

The background concentrations arising largely from traffic throughout this urban area make a relatively large contribution to the total oxides of nitrogen concentrations. Although there is a relatively small heavy-duty traffic flow through this junction, the contribution form heavy-duty vehicles is larger than that from light duty vehicles. There is some queuing of traffic at the junction and this adds significantly to the total concentrations.

4 Conclusion

The assessment has confirmed that it is likely that the air quality objective for nitrogen dioxide will not be achieved at residential properties close to the Broadway at the junction of Darkes Lane, Mutton Lane and Baker Street. The potential area of exceedence of the objective extends approximately 80 m from the junction along each of the road links. The area of potential exceedence is described below. It is recommended that Hertsmere Borough Council consider declaring this area as an Air Quality Management Area.

Potential Air Quality Management Area

Street	Numbers
The Broadway	Even numbers 14-40 and odd numbers 7-33
Mutton Lane	Odd numbers 213-225
Baker Street	Even numbers 2-10

The high concentrations at the junction arise partly as the result of the generally high background concentrations in the area from other traffic sources including the M25 and M1 motorways that pass through the Borough. Road traffic at the junction substantially increases the concentrations above the background, with the largest contribution from cars and light vans. Queuing at the junction adds to the concentrations.

5 References

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Appendices

Appendix 1: Average daily traffic

Appendix 2: Air Quality Management Areas

Appendix 1

Average daily traffic

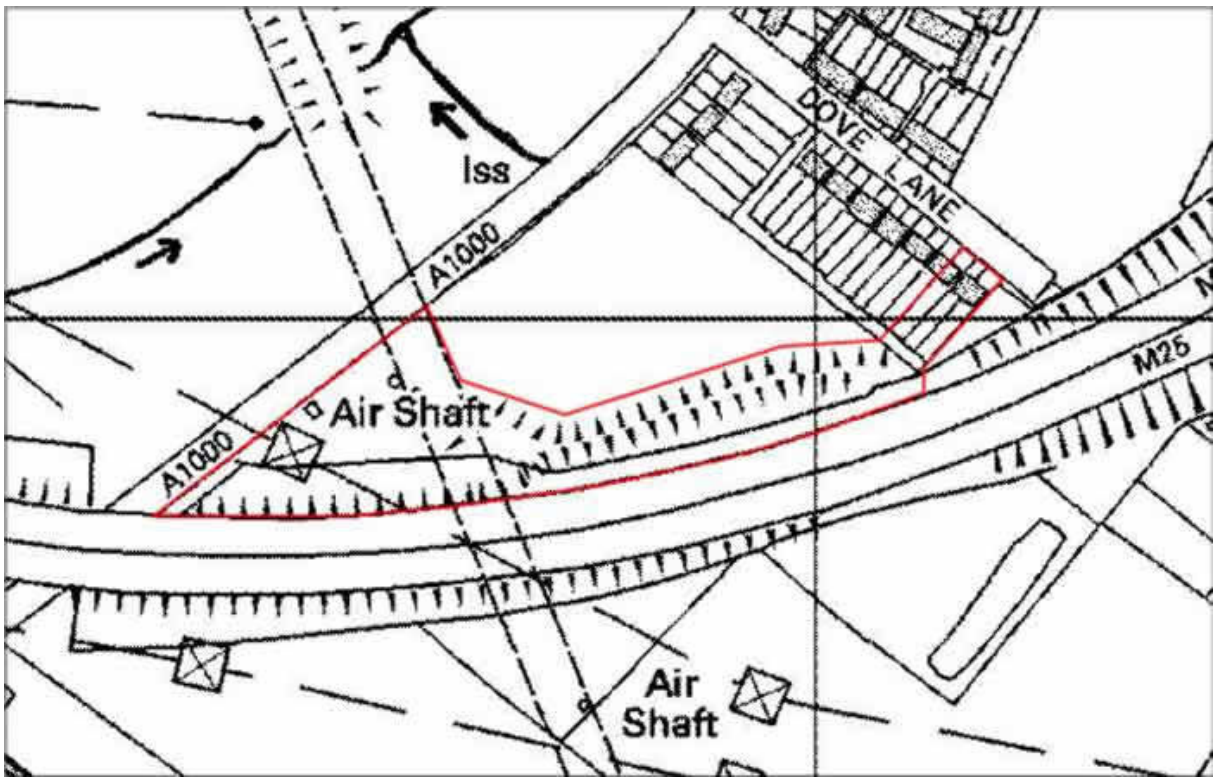
Average daily traffic flows 20-26 September 2006

	Northbound/Eastbound	Southbound/Westbound
Darkes Lane	7232	7352
Mutton Lane West	5217	4302
Baker Street	4914	4498
Mutton lane East	6386	6753

Appendix 2

Air Quality Management Areas

Hertsmere AQMA No.1



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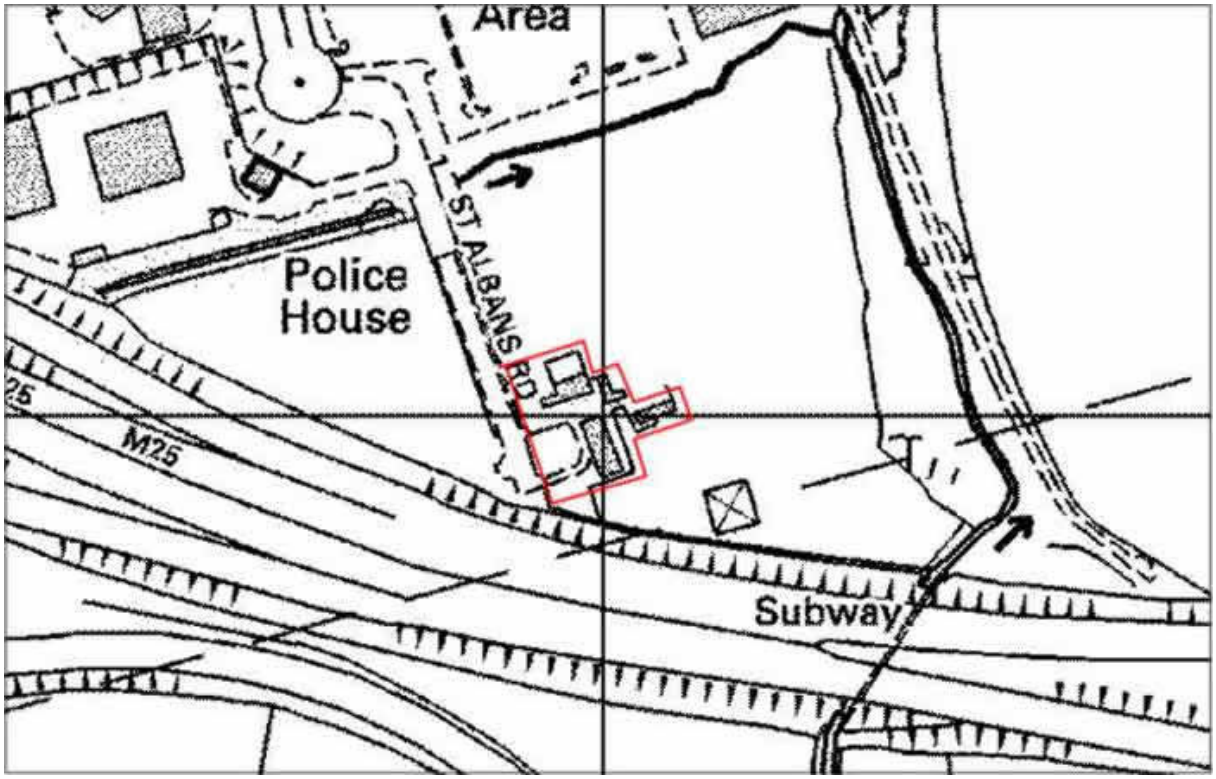

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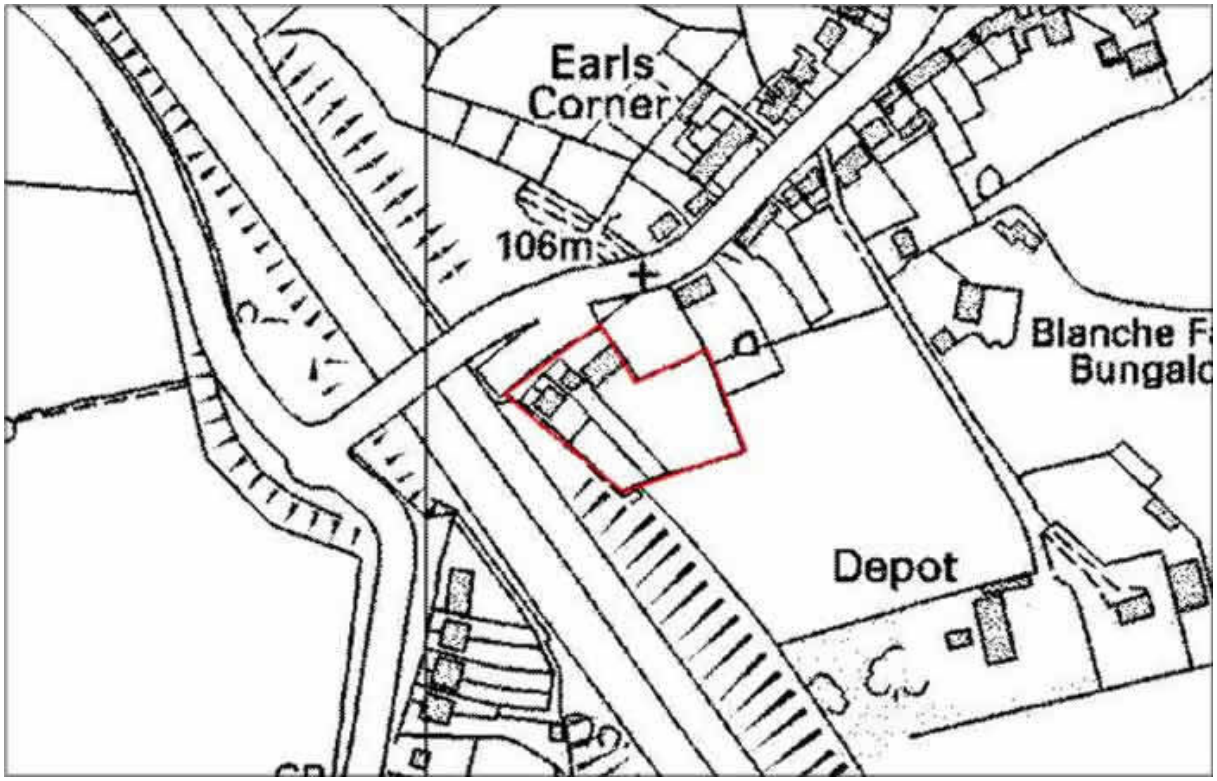
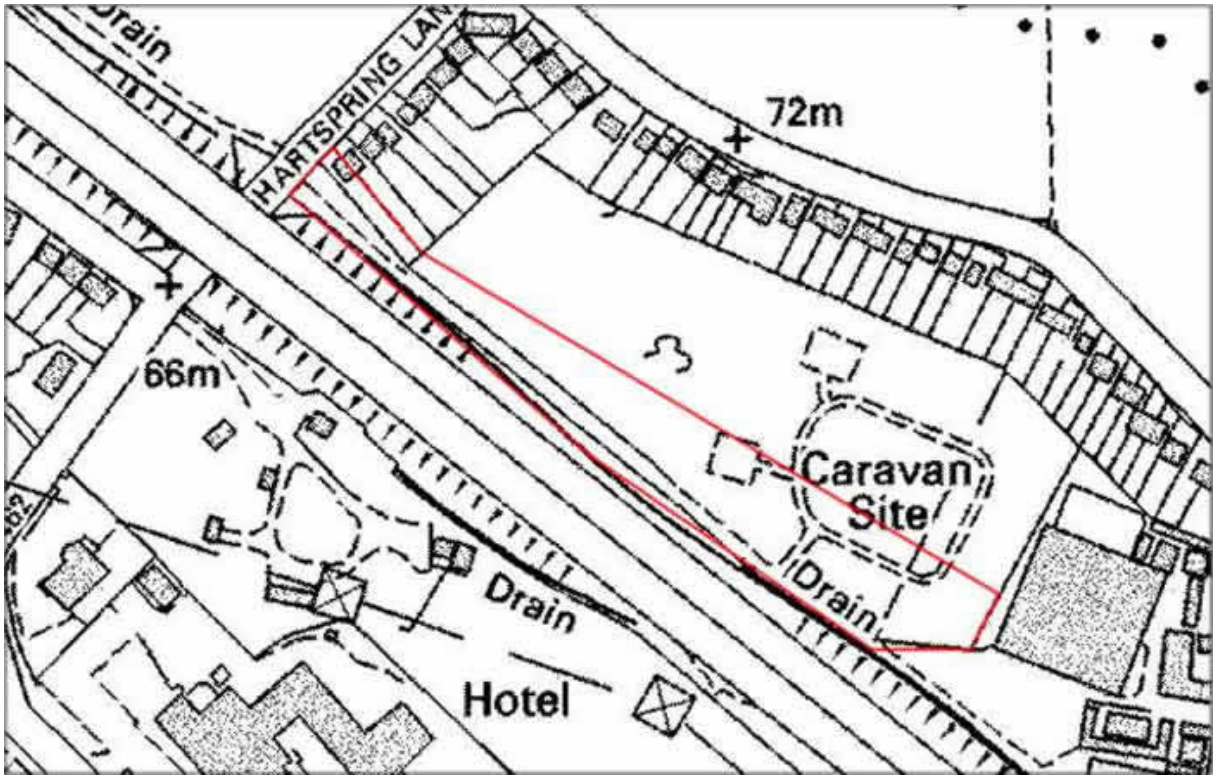
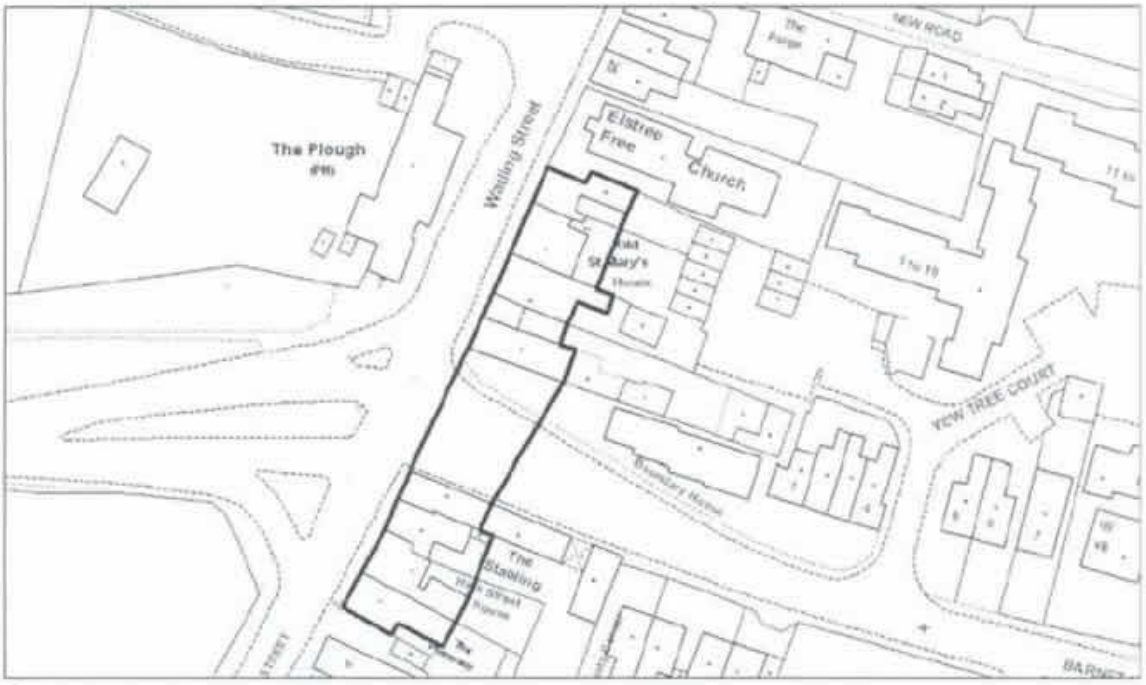


Hertsmere AQMA No.4



Hertsmere AQMA 5



Hertsmere AQMA 6