Woking Borough Council

Anchor Hill AQMA

Air quality action plan

July 2015

Amec Foster Wheeler Environment
& Infrastructure UK Limited

Report for

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Document revisions

No.	Details	Date
1	Draft Report	18/05/2015
2	Final Report	16/07/2015

Executive summary

Amec Foster Wheeler Environment & Infrastructure UK Limited ('Amec Foster Wheeler') has been commissioned by Woking Borough Council (WBC) to produce this Air Quality Action Plan (AQAP) detailing how WBC will work with other organisations in pursuit of compliance with the Air Quality Objectives (AQOs) within the Anchor Hill Air Quality Management Area (AQMA).

WBC declared an AQMA at Anchor Hill in 2014 as a result of exceedences of the annual mean nitrogen dioxide (NO_2) AQO of 40 µg m^{-3}. In 2013, the maximum recorded NO_2 concentration in the Anchor Hill AQMA was 41.5 µgm^{-3} and the AQMA was declared on this basis. The AQMA incorporates the top of Anchor Hill at the junction with the High Street, Highclere Road and Lower Guildford Road in Knaphill, Woking. Movement across the junction is controlled by traffic lights and traffic queues occur at peak times, resulting in emissions that are higher than would be the case for free-flowing traffic. Emissions from queuing and slow moving vehicles are increased by the gradient of Anchor Hill, which puts greater demand on the engines travelling southwards up the hill.

Following the declaration of the AQMA, a Further Assessment was carried out in 2015. This found that the greatest contributor to NO_2 concentrations within the AQMA was local traffic. The contribution of diesel cars and LGVs was found to have a significant influence on total concentrations. It was estimated that NO_X emission reductions of up to 17% were required to reduce NO_2 concentrations to below the AQO. This corresponds to a reduction of road-NOx concentration of around 11 µg m^{-3}. It was predicted that the annual mean NO_2 AQO will be achieved by 2017 assuming that predicted reductions in roadside NO_2 concentration as a result of national fleet renewal actually occur.

The conclusions of the 2015 Further Assessment were used to inform discussions between WBC and Surrey County Council (SCC), in order to identify practical options which could be taken to reduce pollution levels within the AQMA. The initial option proposed was to modify the pedestrian crossing phasing to improve traffic flow, however, further detailed consideration of this proposal lead to the conclusion that the potential benefit to air quality would be so negligible as to not warrant the expenditure.

In order to improve air quality around the junction, Surrey Highways Officers sought to prioritise the junction within the county-wide Traffic Systems Capital Refurbishment programme. This would release funding to upgrade the junction to Microprocessor Optimised Vehicle Actuation (MOVA) operation thereby giving a far greater degree of confidence in improving air quality, without any funds needing to be directly provided by other departments/stakeholders.

In February 2015, it was confirmed that the Anchor Hill junction has been included in the 2015/16 Capital Refurbishment Programme, with a view to the junction being refurbished and upgraded to MOVA operation as early as possible within that financial year, subject to coordination with other works activities.

MOVA uses microprocessors to assess the best signal timings, given the physical layout of the junction, the signal stages available and the traffic conditions at the time. Heavily loaded, congested junctions, such as the Anchor Hill junction, offer the best return on the costs of installing MOVA. Studies have shown that MOVA reduces delays by around 13% compared to earlier junction control systems. Dispersion modelling carried out to support this AQAP indicates that upgrading the signals at the junction to MOVA operation would be likely to reduce NO_2 concentrations by a sufficient magnitude so that they are below the annual mean AQO of 40 µg m^{-3} in 2015. Furthermore, NO_2 concentrations are expected to decrease over the forthcoming years as newer, lower emitting vehicles replace older vehicles. The available monitoring data shows that roadside NO_2 concentrations have decreased significantly over the long-term, suggesting that 2015 concentrations may be below the AQO even without the proposed MOVA system.

It is concluded that the reduced emissions associated with the replacement of older vehicles with newer, lower emitting models and the upgrade of the signals at the Anchor Hill junction are likely to reduce NO_2 concentrations so that the annual mean AQO will no longer exceeded in the AQMA from 2015. The progress towards compliance will be tracked using the monitoring data collected by WBC and reported in the Annual Progress Reports and Updating and Screening Assessments produced by the Council. The AQMA will be revoked when monitoring results from three consecutive years show no exceedence of the AQO, so that a permanent improvement in air quality can be demonstrated.

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Appendix A AQMA order for Anchor Hill

1. Introduction

1.1 Background

Amec Foster Wheeler Environment & Infrastructure UK Limited ('Amec Foster Wheeler') has been commissioned by Woking Borough Council (WBC) to produce this Air Quality Action Plan (AQAP) detailing how WBC will work with other organisations in pursuit of compliance with the Air Quality Objectives (AQOs) within the Anchor Hill Air Quality Management Area (AQMA).

WBC declared an AQMA at Anchor Hill in 2014 as a result of monitored and modelled exceedences of the annual mean nitrogen dioxide (NO_2) AQO of 40 µg m^{-3}. A map of the AQMA is given in Appendix A. In 2013, the maximum recorded NO_2 concentration in the Anchor Hill AQMA was 41.5 $µgm^{-3}$.

Having identified the area where the AQO was likely to be exceeded, and subsequently declared an AQMA, the Council commissioned a Further Assessment to:

- confirm the original assessment of air quality;
- calculate more accurately how much of an improvement in air quality would be needed to deliver the AQOs;
- refine knowledge of the sources of pollution so that air quality action plan measures can be properly targeted; and
- provide quantification of air quality impacts on introducing particular air quality action plan measures through scenario testing.

The detailed conclusions of the 2015 Further Assessment report, which are discussed later in this document, were used to inform discussions between WBC and Surrey County Council (SCC), in order to identify practical options which could be taken to reduce pollution levels within the AQMA. This AQAP details the process followed and the measures chosen to reduce NO_2 concentrations.

1.2 Anchor Hill AQMA

The AQMA incorporates the top of Anchor Hill at the junction with the High Street, Highclere Road and Lower Guildford Road in Knaphill, Woking. Movement across the junction is controlled by traffic lights and traffic queues occur at peak times resulting in emissions that are higher than would be the case for free-flowing traffic. Emissions from queuing and slow moving vehicles are increased by the gradient of Anchor Hill, which puts greater demand on the engines of vehicle travelling southwards up the hill. The AQMA has been declared for Anchor Hill only, and not the other roads, as there is relevant exposure, at residential properties, on this road alone.

1.3 Relevant legislation

The legislative framework for air quality consists of legally enforceable EU Limit Values that are transposed into UK legislation as Air Quality Standards (AQS) that must be at least as challenging as the EU Limit Values. Action in the UK is then driven by the UK's Air Quality Strategy[1].

[1] Defra in partnership with the Scottish Executive, Welsh Assembly Government and Department of the Environment Northern Ireland (2007) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland.

The EU Limit Values are set by the European directive on air quality and cleaner air for Europe (2008/50/EC)[2] and the European directive relating to arsenic, cadmium, mercury, nickel, and polycyclic aromatic hydrocarbons in ambient air (2004/107/EC)[3], as the principal instruments governing outdoor ambient air quality policy in the EU. The Limit Values are legally binding levels for concentrations of pollutants for outdoor air quality.

The two European directives, as well as the Council's decision on exchange of information were transposed into UK Law via the Air Quality Standards Regulations 2010[4], which came into force in the UK on 11th June 2010, replacing the Air Quality Standards Regulations 2007[5]. Air Quality Standards are concentrations recorded over a given time period, which are considered to be acceptable in terms of what is scientifically known about the effects of each pollutant on health and on the environment.

The Air Quality Strategy sets the AQOs, which give target dates and some interim target dates to help the UK move towards achievement of the EU Limit Values. The AQOs are a statement of policy intentions or policy targets and as such, there is no legal requirement to meet these objectives except in as far as they mirror any equivalent legally binding Limit Values in EU legislation. The most recent UK Air Quality Strategy for England, Scotland, Wales and Northern Ireland was published in July 2007.

Table 1.1 sets out the air quality objectives that are relevant to this AQAP, and the dates by which they are to be achieved. The latest LAQM Technical Guidance (LAQM TG (09))[6] suggests that the relationship between monitored hourly and annual NO_2 concentrations is such that if the monitored annual mean of NO_2 is less than 60µg m^{-3}, exceedences of the hourly mean objective are unlikely.

Table 1.1 NO_2 Air Quality objectives included in regulations for the purpose of LAQM in England

Pollutant	Concentration	Measured as	Date by which to be achieved
Nitrogen dioxide	200 µg m^{-3} not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 µg m^{-3}	Annual mean	31.12.2005

1.4 Local air quality management

Part IV of the Environment Act 1995[7] places a statutory duty on local authorities to review and assess air quality in their areas under the Local Air Quality Management (LAQM) regime, and to determine whether or not the AQOs are likely to be achieved.

[2] Official Journal of the European Union, (2008) Directive 2008/50/EC of the European Parliament and of The Council of 21 May 2008 on ambient air quality and cleaner air in Europe.

[3] Official Journal of the European Union, (2004) Directive 2004/107/EC of the European Parliament and of The Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.

[4] The Stationery Office Limited (2010) Statutory Instrument 2010 No. 1001 Environmental Protection – The Air Quality Standards Regulation 2010.

[5] The Stationery Office Limited (2007) Statutory Instrument 2010 No. 64 Environmental Protection – The Air Quality Standards Regulation 2007.

[6] Defra (2009). *Local Air Quality Management: Technical Guidance*. London: Defra Publications. (LAQM.TG(09))

[7] HMSO (1995) Environment Act 1995

The Review and Assessment process is undertaken every three years. Local authorities undertake an Updating and Screening Assessment (USA) at the start of each round of Review and Assessment to identify any significant changes that may have occurred since the last round. To ensure continuity in the LAQM process, Review and Assessment Progress Reports are prepared in the years between each Review and Assessment round.

Where exceedences for a certain pollutant are considered likely at a relevant location, the local authority is required to proceed to a Detailed Assessment for that pollutant. If the results of the Detailed Assessment confirm that an AQO is unlikely to be met, the local authority is required to declare AQMA.

Once a local authority has declared an AQMA, a remedial AQAP must be prepared and implemented to improve air quality within that area. Within 12 months of the AQMA declaration, a Further Assessment is required to provide local authorities with an opportunity to supplement the information they have already gathered from their earlier Review and Assessment work. The findings of the Further Assessment can be used to improve air quality and feed into the local authority's AQAP.

A local authority is also required to submit a Detailed Assessment in order to revoke an AQMA. The Detailed Assessment should outline the evidence for changes in the likelihood of exceedence of objectives occurring and demonstrate the cause of these changes.

1.5 Anchor Hill LAQM

The following LAQM actions have taken place in relation to NO_2 concentrations at Anchor Hill:

- Detailed Assessment (2007) – A detailed dispersion modelling assessment was undertaken due to an exceedence of the annual mean AQO for NO_2 identified by diffusion tube monitoring at Anchor Hill, Knaphill. The modelling predicted that the highest levels of NO_2 were close to facades of houses on the north side of Anchor Hill with concentrations there just below the annual mean AQO (by less than 1µg m^{-3}). Predictions for the then future year of 2010 indicated that concentrations at all facades and at the diffusion tube site would not exceed the objective. As a result it was concluded that an AQMA did not need to be designated in the area. The diffusion tube monitoring in this area was subsequently extended to include two additional locations.
- Updating Screening and Assessment (2012) – Additional monitoring at Anchor Hill identified exceedences of the annual mean objective for NO_2 at sites of relevant exposure. It was recommended that the Council proceed to a new Detailed Assessment for this junction.
- Detailed Assessment (2012) – Due to monitored and modelled exceedences of the annual mean AQO for NO_2 at the Anchor Hill junction, WBC decided to declare an AQMA and undertake further monitoring in the area. WBC declared the Anchor Hill AQMA in January 2014.
- Further Assessment (2015) – The Further Assessment was carried out to assess whether the declaration of the AQMA was justified and whether the appropriate geographical area had been included; to ascertain the sources contributing to the exceedence; and to calculate the magnitude of reduction in emissions required to achieve the objective.

2. Anchor Hill AQMA

2.1 Monitoring data

WBC carry out monitoring of NO_2 concentrations at twenty-eight locations across the borough using diffusion tubes. Seven of these diffusion tube sites are within the assessment area. All seven of the diffusion tubes are roadside sites. Table 2.1 presents the details of these NO_2 diffusion tube monitoring sites. Figure 2.1 shows the locations of the diffusion tubes.

Table 2.1 Diffusion Tube Locations

Site ID	Site Name	X (m)	Y (m)	In AQMA?
AH	Anchor Hill 1	496618	158699	Yes
AH2	Anchor Hill 2	496615	158696	Yes
AH3	Anchor Hill 3	496646	158750	No
AH4	Anchor Hill 4	496679	158767	No
AH5	Anchor Hill 5	496594	158698	Yes
AH6	Anchor Hill 6	496587	158689	Yes
LGR	Lower Guildford Road	496601	158668	Yes

Table 2.2 displays the results of the diffusion tube monitoring for 2008 to 2013. The National Diffusion Tube Bias Adjustment Factor Spreadsheet (version 03/15) gives a bias adjustment factor of 0.80 for diffusion tubes supplied and analysed in 2014 by Lambeth Scientific Services and prepared using 50% TEA/Acetone. This factor is, however, based on one co-location study so consideration of the range of factors is not possible. For the purposes of this AQAP it has been decided to apply the 2013 factor of 0.87. If the 2014 factor is applied, there would be no recorded exceedences of the AQO; the highest NO_2 concentration recorded would be 37.1 µg m^{-3}.

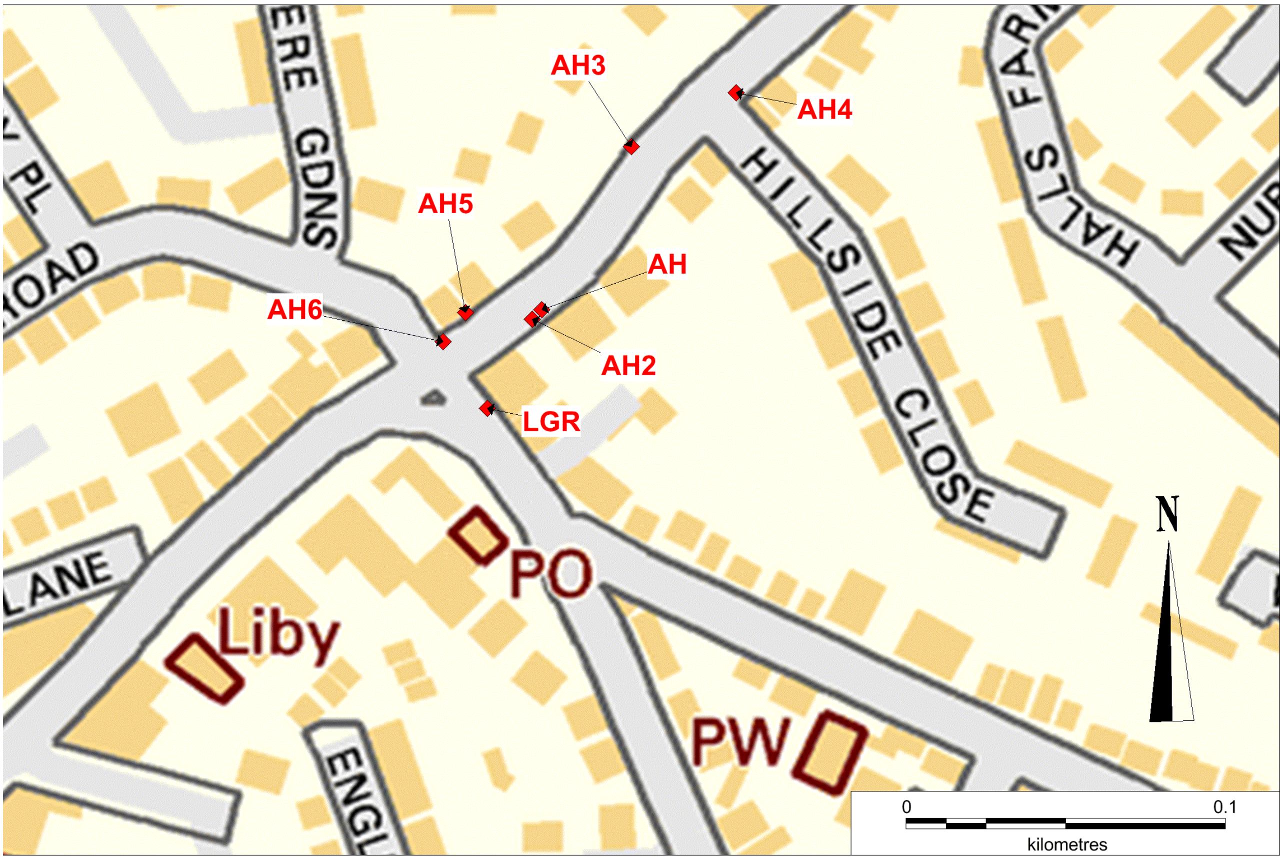
Table 2.2 Bias adjusted diffusion tube monitoring results for 2011-2013

		Annual Mean Concentrations (µg m-3)						
Site ID	Site Name	2008 (bias factor = 0.98)	2009 (1.02)	2010 (1.08)	2011 (1.06)	2012 (0.91)	2013 (0.87)	2014 (0.87)
AH	Anchor Hill 1	**51.5**	**43.9**	**47.5**	**47.7**	35.1	**41.5**	**40.4**
AH2	Anchor Hill 2	36.9	34.9	**43.3**	37.6	42.8	36.5	31.6
AH3	Anchor Hill 3	36.6	34.1	36.4	28.0	30.4	30.7	22.5
AH4	Anchor Hill 4	-	-	-	-	33.3	32.0	26.7
AH5	Anchor Hill 5	-	-	-	-	15.5a	32.0	28.6
AH6	Anchor Hill 6	-	-	-	-	-	38.0	36.4
LGR	Lower Guildford Road	-	-	-	-	-	32.3	27.4

Notes: [a] Limited amount of data available

Figures in bold indicate a value above the annual mean AQO of 40 µg m^{-3}

Figure 2.1 Diffusion tube monitoring locations



2.2 LAQM further assessment 2015

Modelled concentrations

In the 2015 Further Assessment, annual average NO_2 concentrations were predicted at relevant receptors using ADMS-Roads modelling software. Full details of the modelling process can be found in the Further Assessment. The modelled results were verified against 2013 monitoring data, which was the most recent data available at the time of the report.

The modelled results are given in Table 2.3. The predicted annual mean concentrations of NO_2 at Receptor 6, on the corner of Highclere Road and Anchor Hill was 43.4 µg m^{-3}. All other modelled receptors and monitoring locations in the vicinity of the junction between Anchor Hill, Lower Guildford Road and Highclere Road met the AQO of 40 µg m^{-3}. As all modelled annual mean concentrations were less than 60 µg m^{-3}, exceedences of the hourly mean at relevant receptors in this area are unlikely.

Table 2.3 Modelled baseline NO_2 concentrations

Receptor ID	Receptor Location	X (m)	Y (m)	Z (m)	Total Modelled NO_2 (µg m^{-3})
R1	Cleve Court	496644	158713	1.5	24.4
R2	Residential	496623	158721	1.5	26.9
R3	Aragon Court	496628	158700	1.5	27.3
R4	Residential	496606	158701	1.5	37.2
R5	Tudor Court (north-side)	496609	158685	1.5	31.4
R6	Highclere Dental Practice	496593	158693	1.5	**43.4**
R7	Tudor Court (south-side)	496607	158668	1.5	29.3
R8	Residential	496527	158648	1.5	33.9
R9	The Anchor Pub (east-side)	496594	158642	1.5	25.9
R10	Pets Kingdom Shop	496567	158681	1.5	31.1
R11	The Anchor Pub (north-side)	496580	158658	1.5	33.7
R12	Knaphill Food & Wine Convenience Store	496550	158668	1.5	35.3

Figures in bold indicate a value above the annual mean AQO of 40 µg m^{-3}

Source apportionment

In order to develop an appropriate AQAP it is necessary to identify the sources contributing to the objective exceedences at locations within AQMAs. NO_X sources were broken down into the regional and local background contribution as well as the local traffic contribution. Whilst NO_X chemistry is non-linear, so changes to NO_X emissions do not relate directly to changes in NO_2 concentrations, this approach provides a useful approximation of the changes required. Local traffic contributions were derived by apportioning the road-NO_X contribution at the free-flowing sections of High Street, Anchor Hill and Lower Guildford Road in accordance with the contributions from each vehicle class in the Emissions Factor Toolkit.

Table 2.4 sets out the source contributions to the total ambient concentration at representative receptors for each road (High Street – Receptor 8, Anchor Hill - Receptor 2, and Lower Guildford Road – Receptor 9) as actual NO_2 concentrations and as percentages. The regional and local background concentrations used the gridded data for 2013 supplied by Defra. The source apportionment at each site if shown in Figure 2.2, Figure 2.3 and Figure 2.4 respectively.

The results showed that local traffic sources were generally the predominant source of NO_2 concentrations within the AQMA, contributing between 50% and 65%. Diesel cars and Light Goods Vehicles (LGVs) were a key source of emissions; combined they contributed 46% to NO_2 concentrations on the High Street and 37% on Anchor Hill and on Lower Guildford Road.

Table 2.4 Source apportionment results

	High Street		**Anchor Hill**		**Lower Guildford Road**	
	Concentration ($\mu g\ m^{-3}$)	%	Concentration ($\mu g\ m^{-3}$)	%	Concentration ($\mu g\ m^{-3}$)	%
Regional Background	9.5	15.5	9.5	21.0	9.5	22.2
Local Background	12.0	19.5	12.0	26.4	12.0	27.8
Local	40.0	65.1	23.8	52.6	21.5	50.0
- Petrol Cars	2.2	3.6	2.2	4.9	1.3	3.0
- Diesel Cars	8.3	13.5	8.1	17.8	4.7	10.9
- Petrol LGV	0.3	0.6	0.2	0.4	0.2	0.5
- Diesel LGV	20.2	32.8	8.9	19.6	11.1	25.8
- Rigid HGV	6.9	11.3	3.6	7.9	3.7	8.7
- Artic HGV	0.8	1.3	0.7	1.6	0.3	0.7
- Buses/Coaches	1.1	1.8	0.1	0.3	0.2	0.4
- Motorcycles	0.1	0.1	0.0	0.1	0.0	0.1

Figure 2.2 Source apportionment – High Street

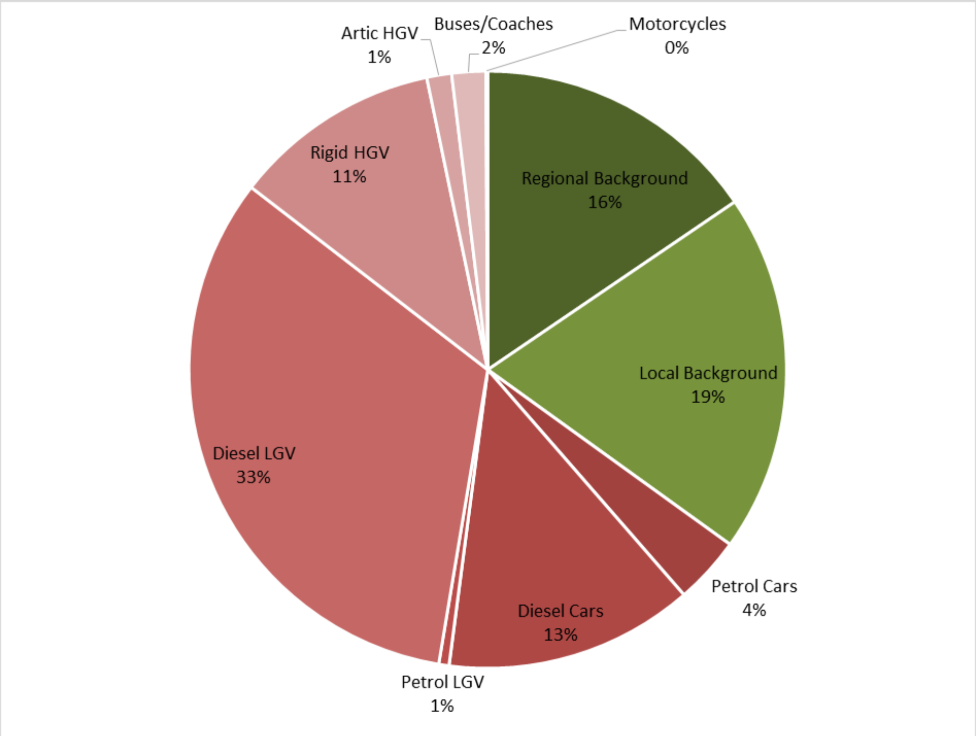


Figure 2.3 Source apportionment – Anchor Hill

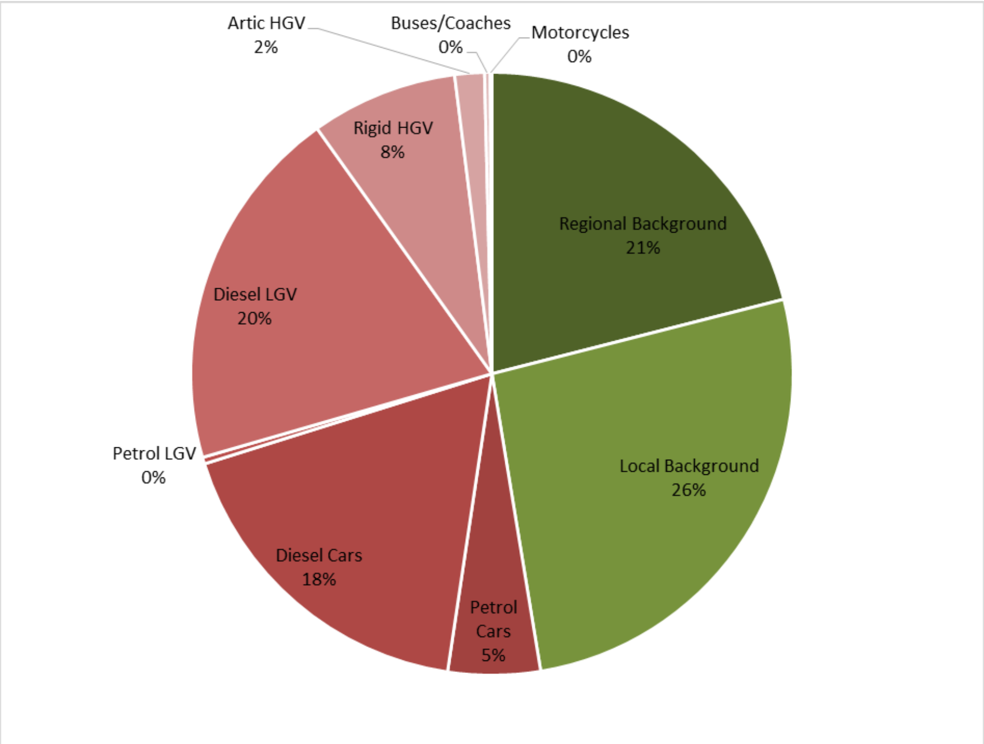
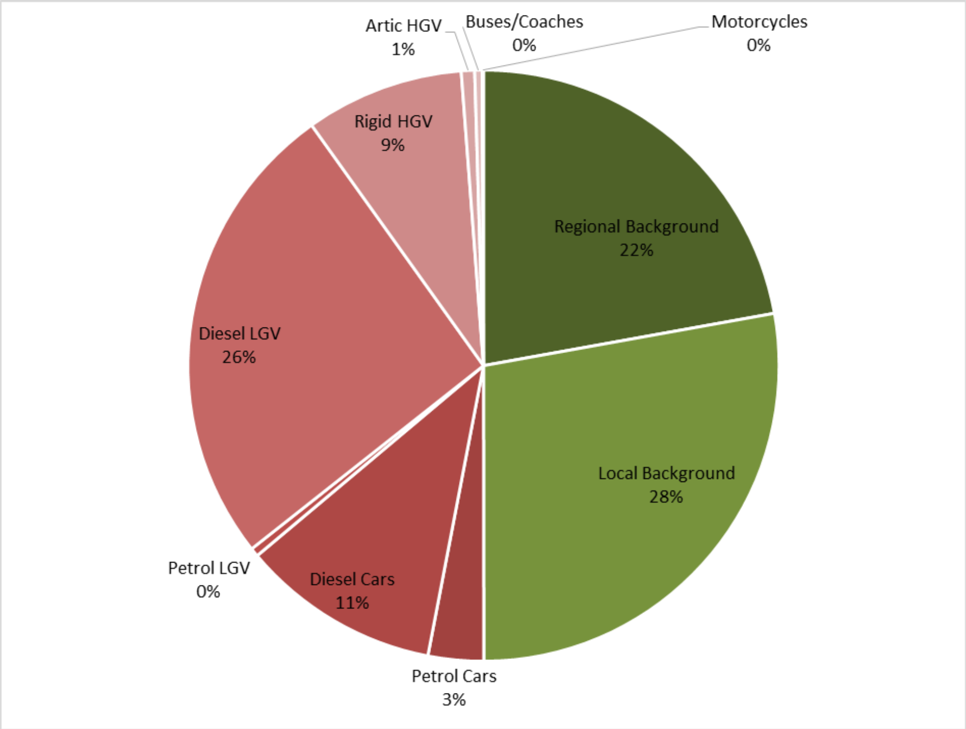


Figure 2.4 Source apportionment – Lower Guildford Road



Required reductions

The issue of NO_2 reduction is complex as a certain reduction in NO_X emissions does not necessarily deliver an equivalent improvement in air quality (reduction in NO_2 concentration) since non-linear chemical transformations take place between the emitted NO_X and the background NO_X and atmospheric ozone. The non-linear chemistry is taken into account when estimating the amount of emission reduction necessary to achieve the AQOs.

The calculated emissions reduction required at the modelled receptor with the highest NO_2 concentration (Receptor 6) is given in Table 2.5. This shows the reductions required to achieve the annual mean NO_2 AQO as both road-NO_X concentrations and the percentage reductions required in road-NO_X emissions. The reductions were calculated using the methodology in LAQM.TG (09).

Table 2.5 Estimates of emissions reductions required to achieve the annual NO_2 AQO.

Receptor	Modelled NO_2 concentration ($\mu g\ m^{-3}$)	Road-NO_X concentration ($\mu g\ m^{-3}$)	Road-NO_X concentration required for NO_2 concentration of 40 $\mu g\ m^{-3}$ ($\mu g\ m^{-3}$)	% Road-NO_X emissions reduction required (%)
Receptor 6	43.4	66.4	55.4	16.6%

The results showed that a reduction in road-NO_X emissions and, therefore, road-NO_X concentrations of around 17% was required to achieve compliance within the AQMA.

A prediction of when the annual mean AQO for NO_2 will be met at the receptor locations was also undertaken using the guidance in LAQM TG (09), paragraphs 2.10 to 2.14. This method uses the ratio of adjustment factors for the future year and the year in which data is available, to predict the NO_2 concentrations in future years. The adjustment factors were taken from the Defra website which provides the most up to date factors. The 2013 to 2016 adjustment factor is 0.927 (0.906/0.977)[8].

The guidance was used to predict when the annual mean AQO for NO_2 was likely to be met at the modelled location with the highest concentration (43.4 $\mu g\ m^{-3}$ at Receptor 6). The calculations showed that the annual mean NO_2 AQO was likely to be achieved due to the modernisation of the national fleet by 2016. Actual monitored concentrations (maximum of 41.5 $\mu g\ m^{-3}$) were lower than the maximum modelled concentration, so it was considered possible that the AQO may be achieved due to this national trend earlier.

[8] Defra (2009). *Local Air Quality Management: Technical Guidance*. London: Defra Publications. (LAQM.TG(09)) – web update http://laqm.defra.gov.uk/technical-guidance/

3. Existing policies

3.1 European policies

Traffic emissions are predicted to decline each year as new vehicles replace older ones. Following the introduction of European emission standards for road vehicles in 1992, emissions from the overall road vehicle fleet have been decreasing due to the penetration of new vehicles and trucks meeting the emission regulations. Future emissions (per vehicle) are therefore likely to continue to decrease as new vehicles, meeting the increasingly stringent emission regulations, replace older vehicles and form a greater part of the UK fleet. Market demand and future UK and European policies are likely to achieve further reductions in vehicle emissions. As the exceedence of the NO_2 annual mean AQO is only marginal at worst (0.4 µg m^{-3}), existing European policies alone are likely to result in reduction in NO_2 concentration so that the AQO will no longer be exceeded within two years.

Table 3.1 shows the background NO_X and NO_2 concentrations from the Defra concentration maps for the AQMA. NO_2 concentrations are expected to decrease by between 0.3 µg m^{-3} and 0.5 µg m^{-3} per year between 2013 and 2017. The monitoring data presented in Table 2.2 showed that roadside NO_2 concentrations have decreased significantly over the long-term. 2014 concentrations at the three diffusion tubes where a long-term data set is available (Anchor Hill 1, 2 and 3) are 14-39 % lower than they were in 2008. This represents an average decrease of between 0.9 µg m^{-3} and 2.4 µg m^{-3} per year. This suggests that if 2015 concentrations followed the long-term trend, are likely to be below the AQO.

Table 3.1 Annual mean background Concentrations used in the further assessment (496500, 158500)

Year	NO_X	NO_2
2013	21.5	15.4
2014	21.0	15.1
2015	20.5	14.9
2016	19.8	14.4
2017	19.1	14.0

3.2 Local development framework

Woking 2027[9] is the name of the WBC Local Development Framework (LDF). This is a statutory planning policy framework to guide future development in the borough between 2015 and 2027. Woking 2027 was adopted by WBC in October 2012. Core Strategy Objective 7 is of particular relevance to air quality. The objective is "*To maintain and improve air and water quality and manage effectively the impacts of noise and light pollution*." The following policies in the Core Strategy are related to air quality:

- CS1: A spatial strategy for Woking Borough
  - *"The Core Strategy will make provision for the delivery of the following scale of uses between 2010 and 2027. 4,964 net additional dwellings, with an overall affordable housing provision target of 35% 28,000 sq.m of additional office floorspace and 20,000 sq.m of warehousing floorspace. 93,900 sq.m of additional retail floorspace."*

[9] http://www.woking2027.info/ - Accessed April 2015

- *"The impact of development will be fully assessed to ensure it does not adversely impact on sensitive environmental designations"*
- CS18: Transport and accessibility
  - *"Locating most new development in the main urban areas, served by a range of sustainable transport modes, such as public transport, walking and cycling to minimise the need to travel and distance travelled. "*
  - *"Ensuring development proposals provide appropriate infrastructure measures to mitigate the adverse effects of development traffic and other environmental and safety impacts (direct or cumulative). Transport Assessments will be required for development proposals, where relevant, to fully assess the impacts of development and identify appropriate mitigation measures. Developer contributions13 will be secured to implement transport mitigation schemes."*
  - *"Supporting proposals that deliver improvements and increased accessibility to cycle, pedestrian and public transport networks and interchange facilities. In particular, proposals to improve easy access between Woking Rail Station and the town centre will be encouraged."*

3.3 Local transport plan

The Surrey Transport Plan[10] is the third Local Transport Plan (LTP) for the county. It is a statutory plan (required by the Local Transport Act 2008 and Transport Act 2000), which replaced the second LTP on 1 April 2011. In common with the previous Plans, the Surrey Transport Plan is partly an aspirational document. The strategies look forward to 2026 and will be reviewed every three to five years as necessary. The Local Transport Strategies and Implementation Programmes will cover a three year cycle and will be updated and rolled forward annually. The accompanying strategic environmental assessment used a set of criteria to evaluate the likely environmental performance of the Plan, specifically including air quality. Air quality and climate change were found to represent a significant opportunity for impact, due to the accessibility and congestion measures planned. The assessment based solely on the vision and objectives for the Plan suggested that emissions of transport related air pollutants would be expected to fall over the lifetime of the Plan, although there would be potential for localised adverse impacts as a consequence of construction works associated with the maintenance and improvement of the transport network.

The Surrey Transport Plan Air Quality Strategy (2011) contains the following aims and objectives:

- *Aim: To improve air quality in AQMAs on the county road network such that Surrey's borough and districts are able to undeclare (sic) these areas as soon as possible, with regard to other strategies and funding constraints.*
- Objectives:
  - *1. Working with the accountable borough or district council for each designated AQMA, to incorporate physical transport measures in the borough or district council's Infrastructure Delivery Plan, agree options for the enforcement of existing regulations and agree options for supporting smarter travel choices, for future implementation as and when funding becomes available, in order to reduce air pollution from road traffic sources;*
  - *2. To provide assistance to the borough and district councils in producing their review and assessment reports, and Action Plan progress reports; and,*
  - *3. To consider air quality impacts when identifying and assessing transport measures in Surrey.*

In addition, it is stated that:

[10] http://new.surreycc.gov.uk/roads-and-transport/surrey-transport-plan-ltp3 - Accessed April 2015

"Option appraisal of potential physical transport measures will be carried out. The county council, working in partnership with the borough or district council, will incorporate agreed physical transport measures and in the appropriate borough/district Infrastructure Delivery Plan. These will subsequently be brought forward as and when funding becomes available."

The Surrey Transport Plan Congestion Strategy (2014) contains the following aims and objectives:

- *Aim: To improve the reliability of journeys, reduce delays at congestion hotspots and improve the provision of journey planning information for travel in Surrey.*
- *Objectives:*
  - *1. Improve the reliability of journeys in terms of how long they take;*
  - *2. Reduce delays for all modes of transport (car, bus and community transport, freight, pedestrians, cyclists) on key routes within Surrey and at congestion hotspots on Surrey's roads;*
  - *3. Improve the provision of information to allow people to plan their journeys.*

4. Specific measures

4.1 Decision process

WBC and Surrey Highways have discussed options for improving traffic flow at the Anchor Hill junction in order to improve air quality in the AQMA. The initial option proposed was to modify the pedestrian crossing phasing to improve traffic flow, however, further detailed consideration of this proposal led to the conclusion that the potential benefit to air quality would be so negligible as to not warrant the expenditure.

Surrey Highways Officers sought to prioritise the junction within the county-wide Traffic Systems Capital Refurbishment programme. This would release funding to upgrade the junction to Microprocessor Optimised Vehicle Actuation (MOVA) operation thereby giving a far greater degree of confidence in improving air quality, without any funds needing to be directly provided by other departments/stakeholders.

In February 2015, it was confirmed that the Anchor Hill junction has been included in the 2015/16 Capital Refurbishment Programme, with a view to the junction being refurbished and upgraded to MOVA operation as early as possible within that financial year, subject to coordination with other works activities.

4.2 MOVA operation

Traditional Vehicle Actuation (VA) is a simple method for allocating the green times to different traffic movements, between programmed minimum and maximum limits. Vehicles detected during the green phase extend the green period until a gap exceeding a critical value is found or the maximum is reached. The main problem with VA is that it is prone to extend the green phase inefficiently, particularly when there are long queues waiting at red signals and it is difficult to set maximum greens effectively, and this can seriously degrade performance if maximum times are poorly related to the balance of flows in conflicting traffic streams. Thus, if performance is not to deteriorate, it is necessary to measure traffic flows at regular intervals in order to reset maximum greens[11]. It is unlikely that this process has been carried out at the Anchor Hill junction over recent years.

MOVA uses microprocessors to assess the best signal timings, given the physical layout of the junction, the signal stages available and the traffic conditions at the time[12]. MOVA is extremely flexible, and the signal timings can vary widely as the traffic conditions change. Once the site has been set up successfully, the system will generate its own signal timings cycle-by-cycle, varying continuously with traffic conditions, both in the short term (hour to hour, day to day) and in the long term following annual trends and longer term traffic growth[11].

MOVA has two operational modes. MOVA determines which mode is appropriate and which approaches, if any, are overloaded. The two modes operate in the following ways[11]:

- uncongested conditions:
  - MOVA seeks to disperse any queue which has built up on red, and then carries out a delay-and-stops minimising procedure every half second. If there would be a benefit from extending the green, then the green would continue and the calculations repeated. If no benefit is predicted, the signals would change to the next stage.
- congested conditions:
  - MOVA operates a capacity-maximising routine. This routine takes into account which approaches are overloaded, the efficiency of green use, the amount of use made of any local

[11] Department for Transport (2007) The "MOVA" signal control system – Traffic Advisory Leaflet 3/97

[12] Department of Transport (1991) MOVA System of Traffic Control at Signals. DOT Highways Safety and Traffic Departmental Standard ~ TD 35/91

flaring of the carriageway, and determines the signal timings which will maximise the junction throughput under the actual flow conditions prevailing.

Heavily loaded, congested junctions, such as the Anchor Hill junction, offer the best return on the costs of installing MOVA. Transport Research Laboratory trials have shown that MOVA reduces delays by an average of 13% compared to the earlier VA system[11]. Other studies have shown similar reductions in delays[13]. Benefits are likely to be largest when compared with VA signal control that has not been recently validated.

4.3 Expected benefits

The MOVA system can therefore be expected to reduce delays and increase the average speed of vehicles passing through the junction. In order to determine the possible impacts on air quality of this change, the average speed of vehicles crossing the junction in all directions in the Further Assessment dispersion model has been increased from 15 kph by 5%, 10% and 15%. Results of this modelling are shown in Table 4.1.

Table 4.1 Annual mean background concentrations used in the further assessment (496500, 158500)

Receptor ID	Baseline NO_2 (µg m^{-3})	5% speed increase NO_2 (µg m^{-3})	Change in NO_2 (µg m^{-3})	10% speed increase NO_2 (µg m^{-3})	Change in NO_2 (µg m^{-3})	15% speed increase NO_2 (µg m^{-3})	Change in NO_2 (µg m^{-3})
R1	24.4	23.9	-0.5	23.9	-0.5	23.8	-0.6
R2	26.9	26.5	-0.4	26.4	-0.5	26.4	-0.5
R3	27.3	26.9	-0.4	26.8	-0.5	26.8	-0.5
R4	37.2	36.8	-0.4	36.7	-0.5	36.6	-0.6
R5	31.4	31.0	-0.4	30.9	-0.5	30.7	-0.7
R6	43.4	42.8	-0.6	42.4	-1.0	42.1	-1.3
R7	29.3	29.0	-0.4	28.8	-0.5	28.6	-0.7
R8	33.9	33.8	-0.1	33.8	-0.1	33.7	-0.2
R9	25.9	25.6	-0.3	25.5	-0.4	25.4	-0.5
R10	31.1	30.7	-0.4	30.5	-0.6	30.3	-0.8
R11	33.7	33.3	-0.4	33.0	-0.7	32.7	-1.0
R12	35.3	34.9	-0.4	34.7	-0.6	34.4	-0.9

These results show that increases in average speed of 5%, 10% and 15% could lead to reductions in NO_2 concentration of between 0.1 µg m^{-3} and 0.6 µg m^{-3}, between 0.1 µg m^{-3} and 1.0 µg m^{-3} and between 0.2 µg m^{-3} and 1.3 µg m^{-3} respectively. This indicates that upgrading the signals at the junction to MOVA operation would be likely to reduce NO_2 concentrations by a sufficient magnitude so that they are below the annual mean AQO of 40 µg m^{-3}.

[13] Simmonite, H (2008) Fixed Time v Single Stream MOVA Control on a signalled roundabout. Traffic Engineering and Control Magazine, November 2008

5. Progress monitoring

The research undertaken for this AQAP indicates that the reduction in emissions associated with the national replacement of older vehicles with newer, lower emitting models and the upgrade of the signals at the Anchor Hill junction are likely to reduce NO_2 concentrations so that the annual mean AQO is no longer exceeded in the AQMA. The progress towards compliance will be tracked using the monitoring data collected by WBC and reported in the Annual Progress Reports and Updating and Screening Assessments produced by the Council.

In accordance with Defra guidance[14] the AQMA will be revoked when monitoring results from three consecutive years show no exceedence of the AQO, so that a permanent improvement in air quality can be demonstrated.

[14] Defra LAQM Support Website. Revoking an AQMA http://laqm.defra.gov.uk/review-and-assessment/declare-or-revoke-aqmas/revoking-aqma.html - Accessed April 2015

6. Consultation and stakeholder engagement

This AQAP was prepared by Amec Foster Wheeler on behalf by the Neighbourhood Service department of Woking Borough Council. The confirmed measure to improve air quality in the AQMA has been developed by Matthew Jezzard, Traffic Manager in the Traffic and Streetworks Team of Surrey Highways.

This AQAP will be subject to an annual review, appraisal of progress and reporting to the relevant Council Panel. Progress will be reported in the Annual Progress Reports produced by the Council.

Any comments should be addressed to:

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Appendix A
AQMA order for Anchor Hill

Environment Act 1995 Part IV Section 83(1)

Woking Borough Council

Air Quality Management Area Order 1

Woking Borough Council of Civic Offices, Gloucester Square, Woking, Surrey GU21 6YL in exercise of the powers conferred upon it by Section 83(1) of the Environment Act 1995 hereby makes the following Order:-

This Order may be cited/referred to as the Woking Borough Council Air Quality Management Area 1 and shall come into effect on 1st February 2014.

The area shown on the attached plan in red is to be designated as an air quality management area (the designated area). The designated area incorporates the top of Anchor Hill Knaphill Woking at the junction with Lower Guildford Road, Highclere Road and High Street, Knaphill.

This area is designated in relation to a likely breach of the nitrogen dioxide (annual mean) objective as specified in the Air Quality Regulations 2000.

This Order shall remain in force until it is varied or revoked by a subsequent order.

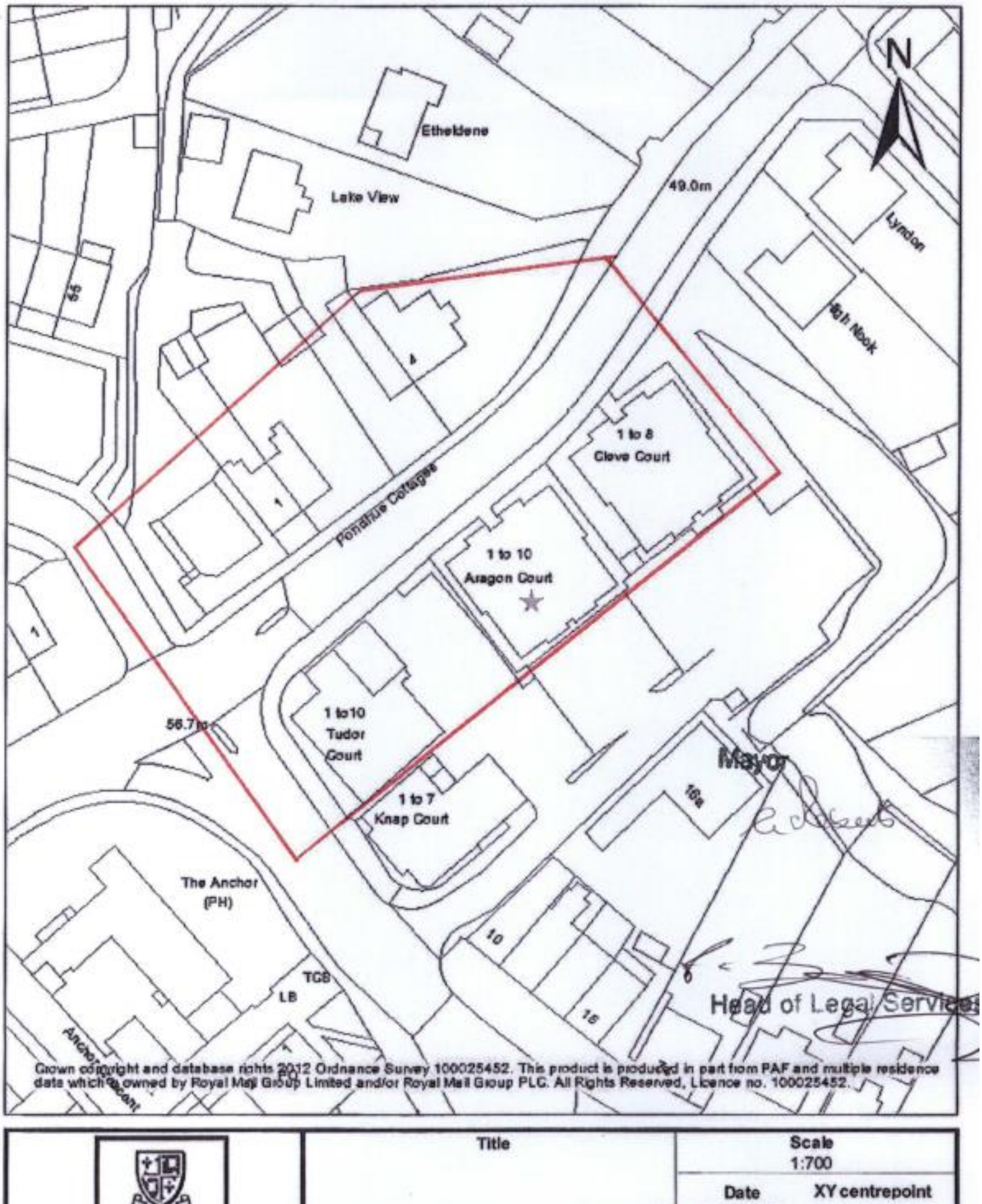
Dated 24 January 2014

The COMMON Seal of Woking Borough Council
Was hereto affixed and signed in the presence of

Mayor

Head of Democratic and Legal Services

19,302



WOKING BOROUGH COUNCIL	Title	Scale 1:700	
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	Project / Details	Drawn by / Department	
Woking Borough Council		Drawing / Reference Number	