WH 8 / 3: Air Quality Assessment for the proposed re-development at Anglia Square, Norwich

Report to Weston Homes Plc

Version 3 – Updated timeline and additional scenario modelling

November 2019

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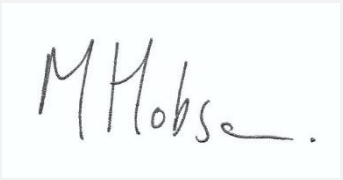
Signature	
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1 Introduction

A hybrid planning application has been made by Weston Homes and Columbia Threadneedle, (the Applicant), to comprehensively redevelop Anglia Square, Norwich (the Site), with up to 1,250 dwellings (predominantly apartments), retail and commercial premises, cinema, chapel, hotel, public and residential/commercial car parking and public amenity space (the Development). This was submitted to Norwich City Council, (NCC), on 2nd March 2018, (LPA ref: 18/00330/F). This is an "EIA application" which comprised a full set of technical documents to assess the potential impacts of the proposals, including an Environmental Statement, (ES), which covered a number of topics, including Air Quality. Please refer to the original application documents for further details.

Following submission of the application, and the statutory consultation exercise, a number of changes to the originally submitted scheme were proposed, including the reduction in height of the proposed marker building (within Block E) by 5 storeys; reduction of part of Block D from 5 to 4 storeys, amendments to the elevation design of Block A; the inclusion of public conveniences in Block A, resultant amendments to the proposed dwelling mix between the outline and detailed phases; a reduction in residential parking spaces from a maximum of 950 to a maximum of 940, the provision of additional electric vehicle (EV) charging points within the residential car parks, changes to the landscape strategy; additional highways improvements; and greater flexibility for B1 use within the proposed commercial floorspace. The application continues to seek consent for up to 1,250 dwellings, although the detailed and outline illustrative drawings show a reduction from 1,234 to 1,209 dwellings.

The additional highways work included further enhancements to Edward Street to facilitate the operation of a 7 vehicle car club and home deliveries, whilst not blocking through traffic. Also included was the improvement of the pedestrian and cycle crossing at the west end of Edward Street, linking to the enhancement of the cycle network on Edward Street immediately north of the Site and to a new segregated pedestrian / cycle route along New Botolph Street / Pitt Street. All of these actions were intended to encourage walking, cycling and reduced use of the private car.

These changes comprise the Amended Scheme submitted in August 2018.

Aether was originally commissioned by Stansted Environmental Services Ltd on behalf of Weston Homes Plc to undertake an Air Quality Assessment to support the hybrid planning application submitted in March 2018. The February 2018 Air Quality Assessment Version 1, which comprised one of the original technical documents, formed Technical Appendix 10.1 to the ES, although it was not specifically referenced in Chapter 10 on Air Quality. Version 2 (August 2018) formed part of the Supplementary Environmental Information (SEI) document, as Appendix SEI 10.2. It provided a review of Version 1 to reflect the changes in the Amended Scheme, setting out where necessary a response to the relevant comments received from NCC on the originally submitted application proposals. Other comments on matters related to air quality were listed and addressed in a separate document titled "Response to Consultation Comments – Overview and Planning Summary". A subsequent note of clarification was produced in October 2018 in response to a set of queries from the planning officer on the traffic modelling used for the air quality assessment.

Since the Note of Clarification was produced, the Secretary of State has 'called in' the Application for a Public Inquiry. This has led to the delay in the effective start and completion date of the Development. Whilst the original completion date for the Development was expected to be 2028, the delay in proceedings has adjusted the final completion of the Development to early 2031. As a result, Aether have been commissioned by the Applicant to update the air quality modelling in line with the new dates. It is worth noting that only the impact of the additional traffic generated as a result of the development has been assessed. The Energy Strategy has yet to be finalised, but it is likely to consist of individual low NOx gas fired boilers (although these will become illegal to install from 2025) and air source heat pumps. This will result in negligible emissions and have therefore not been considered further. As part of this updated assessment, several other factors have been taken into consideration:

- **The impact of the Development on the surrounding area has been further factored into the model.** Modelling receptors have been added at the two diffusion tube monitoring locations on St Augustines Street and the monitoring location on Magdalen Street administered by NCC.
- **The predicted impacts of the UK's road to zero strategy and air quality improvements to the conventional fossil fuelled road vehicle fleet have been factored in as a sensitivity test.** With the predicted introduction of more electrical vehicles (EVs) as part of the UK's strategy for low carbon road transport[1] and expected air quality improvements with conventional fossil fuelled vehicles with increasingly stringent Euro standards , some improvement to road traffic fleet emission factors and background pollutant concentrations are expected by 2030. The Department for Transport's long-term ambitions include for all new cars and vans to be effectively zero emission by 2040. In addition, in 2030, approximately 99% of conventional fuelled cars are expected to meet Euro 6 standards, compared to approximately 60% in 2019. Therefore, for each future year scenario modelled in this assessment, both a 'Policy Applied' and a 'No policy Applied' scenario has been assessed to provide an indication of model sensitivity. This has been factored in through projections in road transport fleet emission factors and background concentrations. In May 2019, Defra published an updated version of the road transport emission factor toolkit (EFT)[2]. The latest version takes into account updated fleet assumptions and Euro Class compositions projected to 2030 in line with DfT and the National Atmospheric Emissions Inventory (NAEI) projections. Euro standards refer to the increasingly stringent vehicle emission exhaust standards that manufacturers have to meet. In the context of recent uncertainty over whether vehicles are complying with emissions standards, 'Real World' driving standard tests[3], provide more confidence that vehicles are now confirming to the required standards. Therefore, the emission factors from the EFT for 2030 have been incorporated into the 'Policy Applied' scenarios given that there are no projections currently beyond that date. This will take into account that cleaner vehicles that will have entered the fleet by this year. The alternative 'No Policy Applied' scenarios assume no improvement in the road transport fleet

[1] 'The Road to Zero', Department for Transport, July 2018, available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf
[2] https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html
[3] https://ec.europa.eu/commission/presscorner/detail/en/MEMO_18_3646

between 2018 and future years. This is a conservative estimate and therefore an extreme worst-case. The latest Defra estimated background concentration predictions for the Anglia Square area for 2030 have also been factored in for the Policy Applied scenarios, whereas 2018 baseline background concentrations are used for the No Policy Applied scenarios (See Section 2.3 Model input data).

- **A 'Proxy' Scenario has been modelled for benchmarking.** The current underusage of the brownfield Site suppresses the level of traffic activity in the surrounding area artificially. Therefore, an alternative scenario has been modelled **as a proxy** for the level of traffic activity at the Site should it be restored according to existing planning conditions. This provides an amended baseline against which the predicted impact of the Development on road traffic levels in the surrounding area, and therefore, on air pollutant concentrations can be compared.
- **A 'completion date + five years' scenario has been qualitatively assessed based on projected traffic flows and expected improvements to fleet emission factors and background pollutant concentrations.** To indicate expected trends in air quality over a period of five years beyond the completion date of the Development, a qualitative assessment of the road traffic projections and expected improvements to fleet emission factors has been included in this version of the assessment.

The following scenarios have therefore been modelled:

- **2018 Baseline**: to enable model verification to be undertaken
- **2031 Without Development No Policy Applied**: modelled with predicted traffic levels for local roads without the impact of the Development, as estimated in the traffic assessment, and without the predicted impact of improvements to the fleet emission factors and background concentrations as a result of the UK's road to zero strategy and expected air quality improvements in the road transport fleet.
- **2031 With Development No Policy Applied:** modelled with the impact of predicted traffic levels for local roads from the Development, as estimated in the traffic assessment, but without the predicted impact of improvements to the fleet emission factors and background concentrations as a result of UK air quality strategy.
- **2031 Proxy No Policy Applied:** modelled with the impact of existing traffic flows associated with Anglia Square obtained from the traffic surveys, in addition to traffic flows for the units within Anglia Square that were vacant at the time of the traffic surveys (based on trip rates used for the proposed Development). The multi-storey car park (MSCP) currently on Site is also assumed to be reopened (with the existing number of spaces), the surveyed average usage of the other car parks on Site has then been used to determine the usage and demand for the existing MSCP on Site, if it were to be reopened. Also, without the predicted impact of improvements to the fleet emission factors and background concentrations as a result of UK air quality strategy.
- **2031 Without Development Policy Applied**: modelled with predicted traffic levels for local roads without the impact of the Development, as estimated in the traffic assessment, and with the predicted impact of improvements to the fleet emission factors, applied using the ETF, and background concentrations, applied using Defra background pollutant concentration maps, as a result of UK air quality strategy.

- **2031 With Development Policy Applied:** modelled with the impact of predicted traffic levels for local roads from the Development, as estimated in the traffic assessment, and with the predicted impact of improvements to the fleet emission factors and background concentrations as a result of the UK's road to zero strategy and expected air quality improvements in the road transport fleet.
- **2031 Proxy Policy Applied:** modelled with the impact of existing traffic flows associated with Anglia Square obtained from the traffic surveys, in addition to traffic flows for the units within Anglia Square that were vacant at the time of the traffic surveys (based on trip rates used for the proposed Development). The multi-storey car park (MSCP) currently on Site is also assumed to be reopened (with the existing number of spaces), the surveyed average usage of the other car parks on Site has then been used to determine the usage and demand for the existing MSCP on Site, if it were to be reopened. Also, with the predicted impact of improvements to the fleet emission factors and background concentrations as a result of the UK's road to zero strategy and expected improvements in the road transport fleet

1.1 The Location of the Development

As noted in Version 2, the Development is located in the central Norwich area, north of St Crispins Road (**Figure 1**). The location of each block referred to in the assessment is shown in **Figure 2**.

Figure 1: Location of the Development Site

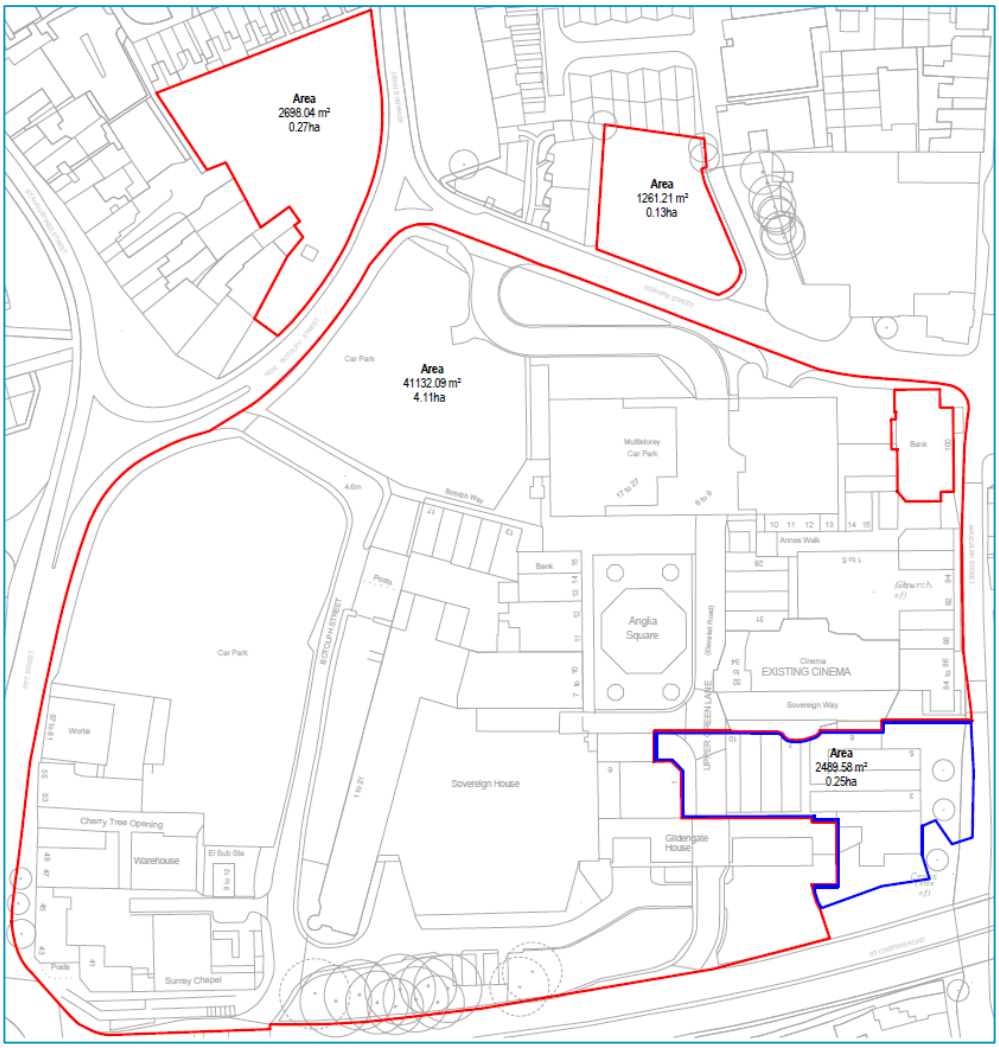


Image source: Broadway Malyan architectural plans

1.2 Assessment Criteria

A summary of the air quality objectives relevant to the Development, as set out in the UK Air Quality Strategy[4], is presented in **Table 1** below.

Table 1: UK Air Quality Objectives for NO_2 and PM_{10}

Pollutant	Concentration	Measured as
Nitrogen Dioxide (NO_2)	40 µg/m^3	Annual mean
	200 µg/m^3	Hourly mean not to be exceeded more than 18 times per year (99.8th percentile)
Particulate Matter (PM_{10})	40 µg/m^3	Annual mean
	50 µg/m^3	24 hour mean not to be exceeded more than 35 times a year (90.4th percentile)

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

The oxides of nitrogen (NO_x) comprise principally of nitric oxide (NO) and nitrogen dioxide (NO_2). NO_2 is a reddish brown gas (at sufficiently high concentrations) and occurs as a result of the oxidation of NO, which in turn originates from the combination of atmospheric nitrogen and oxygen during combustion processes. NO_2 can also form in the atmosphere due to a chemical reaction between NO and ozone (O_3). Health based standards for NO_x generally relate to NO_2, where acute and long-term exposure may adversely affect the respiratory system.

Particulate matter is a term used to describe all suspended solid matter, sometimes referred to as Total Suspended Particulate matter (TSP). Sources of particles in the air include road transport, power stations, quarrying, mining and agriculture. Chemical processes in the atmosphere can also lead to the formation of particles. Particulate matter with an aerodynamic diameter of less than 10 µm is the subject of health concerns because of its ability to penetrate deep within the lungs and is known in its abbreviated form as PM_{10}.

Further information on the health effects of air pollution can be found in the reports produced by the Committee on the Medical Effects of Air Pollutants[5].

As defined by the regulations, the air quality objectives for the protection of human health are applicable:

- Outside of buildings or other natural or man-made structures above or below ground
- Where members of the public are regularly present.

Using these definitions, the annual mean objectives will apply at locations where members of the public might be regularly exposed such as building façades of residential properties, schools and hospitals and will not apply at the building façades of offices or other places of work, where members of the public do not have regular access. The 24 hour objective will apply at all locations where the annual mean objective would apply together with hotels. Therefore, in this assessment, different objectives will apply at different locations on different floor levels around the Development. Please see **Figure 2** for block labelling. As noted, there is no proposed ground floor residential accommodation, except those units in Block B.

On the ground floor level, the annual mean and 24 hour mean objectives will apply at all locations around Block B only.

On the first floor, the annual mean and 24 hour mean objectives will apply at all first floor locations of the Development except for the north eastern corner of Block E, the south western corner of Block A (all of which are double height commercial spaces), the north western corner of Block H, and Block C, which is a chapel.

[5] https://www.gov.uk/government/collections/comeap-reports

On the second floor and above, the annual mean and 24 hour mean objectives will apply at all locations around the Development except for Block C, the chapel.

The hourly objective will apply at all locations where members of the public could reasonably be expected to spend that amount of time. Therefore, in this assessment the hourly objective will apply at all levels of the Development.

Figure 2. Labelled blocks for the Development at Anglia Square

Image source: Broadway Malyan architectural plans

1.3 Local Air Quality Management

Local authorities are required to periodically review and assess the current and future quality of air in their areas. Where it is determined that an air quality objective is not likely to be met, the authority must designate an Air Quality Management Area (AQMA) and produce an Air Quality Action Plan (AQAP).

Norwich City Council has declared one AQMA[6] covering the centre of the city, broadly covering an area within the inner link road. This AQMA was declared in 2012 due to exceedances of the annual mean NO_2 objective. An AQAP[7] was published in 2015. The proposed development site is located within this AQMA.

[6] https://www.norwich.gov.uk/info/20212/pollution/1491/air_pollution
[7] https://www.norwich.gov.uk/downloads/file/3020/2015_air_quailty_action_plan

2 Methodology

2.1 Local Pollutant Concentrations

It is good practice to include up-to-date local background pollutant concentrations in the assessment model, and also to verify modelled outputs against local monitoring data where available. This section provides an overview of the local data available for use in the assessment.

2.1.1 Local monitoring data

Norwich City Council has two automatic monitoring sites which monitor nitrogen dioxide (NO_2) and particulate matter (PM_{10}), however neither of these are located within close proximity of the Site. NO_2 concentrations are also measured passively at diffusion tube sites across the Borough. For this update assessment, three nearby diffusion tube sites have been selected for modelling and verification. Details of these sites are provided in **Table 2**.

Monitoring results for 2018 have been provided by NCC, however it must be noted that at the time of publication of this update assessment, the results for 2018 have been submitted to, but not yet been ratified by, Defra and so, whilst unlikely, may be subject to change. Results for the years prior to 2017 have been taken from the Council's Annual Status Report (ASR) published in 2018[8].

Table 2: Nearby monitoring sites to the Anglia Square Site

Site Name	Site Type	Pollutants	Grid Reference	Distance to Kerb (m)	Approx. distance to centre of Site (m)
DT6 130 Magdalen St	R	NO_2	623160.89, 309550.43	4	190
DT9 13 St Augustines St	K	NO_2	622905.81, 309496.11	1	200
DT11 52 St Augustines St	K	NO_2	622825.87, 309573.17	1	310

Note: R = roadside, K = kerbside

The diffusion tubes were analysed by Gradko International Ltd, who participate in the Proficiency scheme[9]. Whilst diffusion tubes provide an indicative estimate of pollutant concentrations, they tend to under or over read. The data is therefore corrected using a bias adjustment factor. There are two types of bias adjustment factor – local and national. The local factor is derived from co-locating diffusion tubes (usually in triplicate) with automatic monitors, whereas the national factor is obtained from the average bias from all local authorities using the same laboratory. NCC has applied a local bias adjustment factor (0.86) to their 2018 diffusion tube results.

[8]https://www.norwich.gov.uk/downloads/download/1917/air_quality_monitoring_reports_and_assessments

[9] This is a national QA/QC scheme.

Monitoring results are presented in **Table 3**. The data shows that the annual mean NO_2 objective was exceeded at the DT11 52 St Augustines St monitoring location in 2016, 2017 and 2018. However, at the other two sites, the objective was met in all years shown. Diffusion tubes do not provide information on hourly exceedances, but research[10] identified a relationship between the annual and 1 hour mean objective, such that exceedances of the latter were considered unlikely where the annual mean was below 60 µg/m^3. Therefore no exceedances of the 1 hour mean objective are expected.

Table 3: Monitoring results for sites close to the proposed development site, 2016-2018

Objective	Site Name	2016	2017	2018
Annual mean NO_2 (µg/m^3)	DT6 130 Magdalen St	30	31	27
	DT9 13 St Augustines St	40	42	37
	DT11 52 St Augustines St	**51**	**54**	**44**

Note: Values exceeding the 40 µg/m^3 annual mean objective are shown in bold

2.1.2 Background mapped data

Background pollutant concentration maps are available from the Defra LAQM website[11] and data has been extracted for Norwich City Council for this assessment. These 2017 baseline, 1 kilometre grid resolution maps are derived from a complex modelling exercise that takes into account emissions inventories and measurements of ambient air pollution from both automated and non-automated sites.

The estimated mapped background NO_x, NO_2 and PM_{10} concentrations around the development site are 25.9 µg/m³, 17.8 µg/m³ and 15.1 µg/m³ respectively in 2018. For 2030 (latest year for which mapped background concentrations are available), the concentrations obtained for the same pollutants are 18.3 µg/m³, 13.1 µg/m³ and 13.9 µg/m³ respectively.

Due to the lack of a nearby urban background monitoring site, the 2018 mapped background concentrations have been used for the 'No policy applied' scenarios in this assessment. This provides a worst-case scenario as it does not take into account predicted improvements to the background pollutant concentrations. These predicted improvements to background concentrations have been factored in for the 'Policy applied' scenarios by using the 2030 values. This could potentially be a conservative estimate as pollutant concentrations would be expected to decrease further for 2031, the Development year.

2.2 Traffic data

Information on traffic data collection and modelling is set out in Version 2. The method and values have been updated to reflect the updated baseline year (now 2018) and year of completion (now 2031). The values are shown in Appendix B. In the previous modelling, the projected AADT data for minor roads was calculated using an average of change predicted on the major roads derived from the monitoring data provided by WSP Traffic consultants. However, following discussions with WSP it was decided that this

[10] As described in Box 5.2 of LAQM Technical Guidance (TG16).
[11] http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

data should be projected using the RTF Automated Traffic Growth Calculator[12]. As this growth calculator only provides projections up to 2030, the trend has been extrapolated for 2031.

As with the previous modelling, average speeds for the above-mentioned roads have been supplied in the traffic assessment. In the absence of any other data being available, average speeds on local minor roads have been assumed based on the speed limit.

2.2.1 Street Canyons

Sections of Magdalen Street, St Augustines Street, Cowgate, Bull Close and Calvert Street have been modelled as street canyons. These can generally be defined as narrow streets where the heights of the buildings on both sides of the road are greater than the road width. This can restrict the dispersion and dilution of emissions. The section of Magdalen Street, north of the junction with Edward Street, has been modelled with a 8.5m high street canyon, representing approximately three storeys. The southern section of Magdalen Street, south of the junction with Cowgate, has been modelled with a 6.5m high street canyon. However, the Development involves setting back the new building line along the Magdalen Street frontage of the Site to create a wider pavement. This would lessen the street canyon immediately east of the Site. St Augustines Street has been modelled with a 8.5m high street canyon; Cowgate and Bull Close have both been modelled with 6.5m high street canyons. Calvert Street has been modelled with a 10m high street canyon.

2.2.2 Queuing Traffic

Special consideration has been given to junctions modelled in this assessment. Junctions on the following roads qualified for traffic queue modelling as based on expert judgment: Pitt Street, Edward Street (South), Edward Street (North), Magdalen Street, Magpie Road, St Augustines Street, St Crispins Road, St Crispins Road (West), Duke Street and on the intersection between Calvert St and St Crispins Road. CERC note 60[13] has been used for estimating emissions from queuing traffic. This defines a representative AADT for queuing traffic to be 30,000 at 5 kph, assuming an average vehicle length of 4 m. These figures, along with the traffic composition of the corresponding roads were then input into the Emission Factor Toolkit (EFT)[14] to calculate emission rates. The emission rates were then used within the dispersion model as separate road sources of pre-defined length, representing each queue with time-varying emission profiles applied to represent busy periods.

2.3 Model input data

Hourly meteorological data from Norwich for 2018 has been used in the model. The wind-rose diagram (**Figure 3**) presents this below.

[12] http://laqm.defra.gov.uk/documents/RTF-Automated-Traffic-Growth-Calculator-v3-1.xls
[13] Cambridge Environmental Research Consultants Ltd, Modelling Queuing Traffic – note 60, 20th August 2004
[14] Latest version 9.0, http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

Figure 3: Wind-rose diagram for Norwich meteorological data, 2018

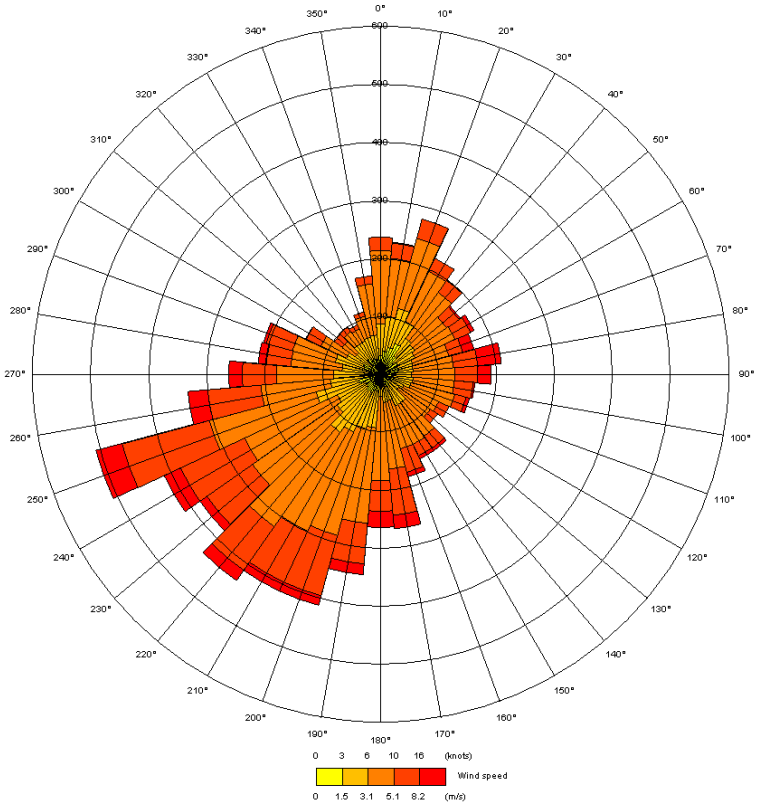
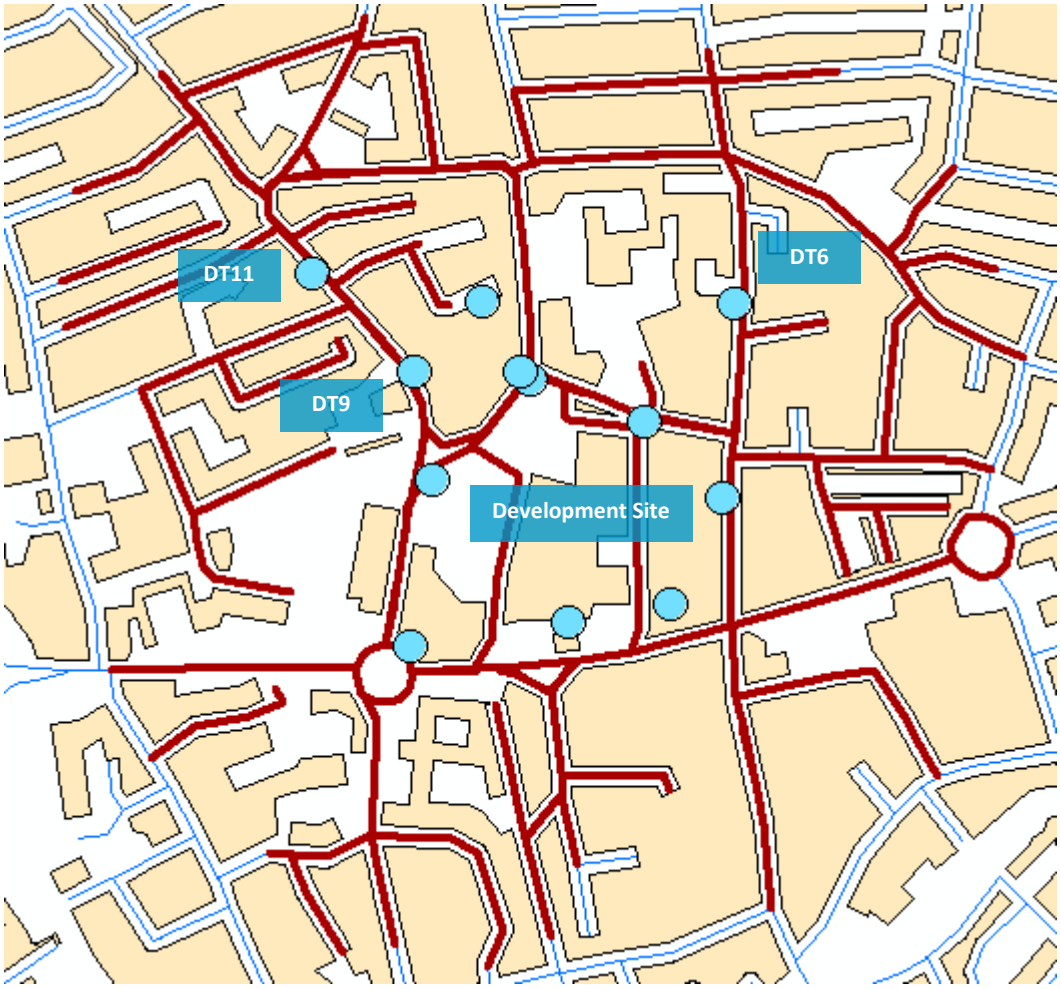


Figure 4: Road sources and receptors



Contains Ordnance Survey data © Crown copyright and database right [2018]

ArcMap software has been used to model the road source locations (red lines) that are within 200 metres of the receptor locations (blue circles). This data can then be automatically uploaded to ADMS-Roads. This generates an accurate representation of the surrounding area to be assessed in the model in terms of the length of roads and distances between sources and receptors. This is shown in **Figure 4** above. The emission factors calculated by the EFT, which accounts for AADT, road type, % HDV and average speed along specified roads, can be found in Appendix C. It is assumed that the contribution of other sources to NO_2 and PM_{10} is included in the background concentrations.

12 sensitive receptor locations have been selected for the assessment:

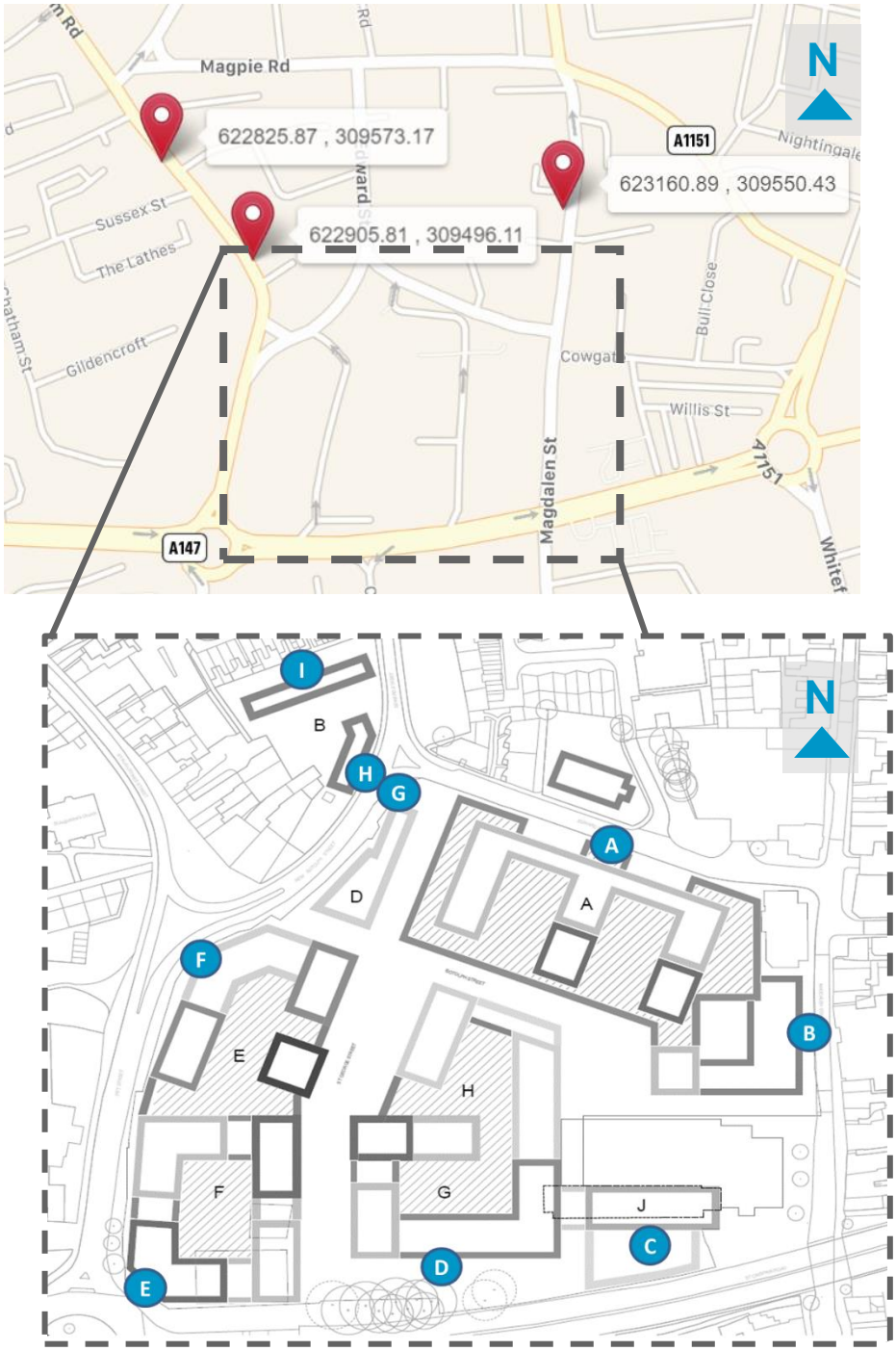
- DT6 130 Magdalen St – NCC diffusion tube monitoring location illustrating the impact of the Development on the surrounding area
- DT9 13 St Augustines St - NCC diffusion tube monitoring location illustrating the impact of the Development on the surrounding area
- DT11 52 St Augustines St - NCC diffusion tube monitoring location illustrating the impact of the Development on the surrounding area
- A - North facing façade of Block A, residential use from the first floor.
- B – East facing façade of Block A, residential use from the first floor, close to Magdalen Street.

- C – South facing façade of Block J, residential use from the first floor, close to St Crispins Road.
- D – South facing façade of Block G, residential use from the first floor, close to St Crispins Road.
- E – South east corner of Block F, hotel use from the ground floor, close to the intersection between Pitt Street and St Crispins Road.
- F – North east corner of Block E, residential use from the first floor, close to the intersection of New Botolph Street and Pitt Street.
- G – North corner of Block D, residential use from the first floor, close to the intersection between Edward Street and New Botolph Street.
- H – East facing façade of one of the buildings labelled Block B, residential use from the ground floor, close to Edward Street.
- I – North facing façade of one of the buildings labelled Block B, residential use from the ground floor.

These sites have been chosen to reflect the extremities of the site and their proximity to road traffic sources. The architect's plans (**Figure 5**) show the development site in more detail with receptor locations highlighted (blue circles) and the location of the diffusion tube monitoring sites in more detail above (red markers). An assessment is made for the receptors at varying heights to assess likely concentrations across floor levels. It has been assumed that background concentrations remain constant at all heights of the development based on the 2017 City Air Quality at Height report[15]. Exposure has been assumed to be represented at the mid-point of each floor.

[15] http://www.wsp-pb.com/PageFilesn/80156/WSPPB%20City%20Air%20Quality%20at%20Height.pdf

Figure 5: The location of the receptors around the Site used in the modelling, the top picture illustrates the diffusion tube monitoring location receptors in the surrounding area, the bottom picture highlights the receptors around the Site.



2.4 Conversion of NO_x to NO_2

Recent evidence shows that the proportion of primary NO_2 in vehicle exhaust has increased[16]. This means that the relationship between NO_x and NO_2 at the roadside has changed from that currently used in the ADMS model. A NO_x to NO_2 calculator (Published in October 2017)[17] has therefore been developed and has been used in conjunction with the ADMS model to obtain a more accurate picture of NO_2 concentrations.

2.5 Model Verification

Model verification refers to checks that are carried out on model performance at a local level. This involves the comparison of predicted versus measured concentrations. Where there is a disparity, the first step is to check the input data and the model parameters in order to minimise the errors. If required, the second step will be to determine an appropriate adjustment factor that can be applied.

In the case of NO_2, the model should be verified for NO_x as the initial step and should be carried out separately for the background contribution and the source (i.e. road traffic). Once the NO_x has been verified and adjusted as necessary, a final check should be made against the measured NO_2 concentration.

For this project, modelled annual mean road-NO_x estimates have been verified against the concentrations measured at the three diffusion tube sites (see **Appendix A**).

The adjustment factor determined for annual mean NO_x concentrations was also applied to the modelled annual mean PM_{10} concentrations. This was done as no PM_{10} monitoring data that is representative of the development site is available from NCC, and this approach was considered more appropriate than not applying any adjustment[18].

[16] http://uk-air.defra.gov.uk/assets/documents/reports/aqeg/primary-no-trends.pdf
[17] https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOXNO2calc
[18] Paragraph 7.529 of LAQM TG(16)

3 Results

3.1 Results of the Dispersion Modelling

Table 5 below provides the estimated NO_2 concentrations in the base year (2018) and the development year (2031), without and with[19] Development, and a proxy use case, in a No Policy Applied scenario. **Table 6** below provides the estimated NO_2 concentrations in the base year (2018) and the development year (2031), without and with[20] Development, and a proxy use case, in a Policy Applied scenario. **Tables 7 and 8** below provides the estimated PM_{10} concentrations for the same respective scenarios.

[19] 'With' development includes the impact of the additional traffic that will be generated with the development.

Table 5: Estimated NO_2 concentrations ($\mu g/m^3$) in a No Policy Applied scenario

		Annual mean NO_2 concentration ($\mu g /m^3$)					
			No Policy Applied				
Floor level	Receptor	2018 Baseline	2031 Without development	2031 With development	2031 Proxy	Change between with and without Development	Change between Proxy and with Development
	DT6 130 Magdalen St	25.9	25.0	25.3	25.4	0.3	-0.1
	DT9 13 St Augustines St	39.4	39.2	**40.3**	40.0	1.1	0.4
	DT11 52 St Augustines St	**42.4**	**40.3**	**41.6**	**40.8**	1.3	0.7
Ground	A	**56.7**	**56.8**	**58.9**	**59.5**	2.1	-0.7
	B	**54.2**	**53.9**	**54.2**	**54.2**	0.2	-0.1
	C	27.1	26.6	27.1	27.2	0.5	-0.1
	D	26.8	25.6	25.9	26.0	0.3	-0.1
	E	39.8	35.8	36.1	36.2	0.4	<0.1
	F	38.4	38.1	39.0	39.3	0.8	-0.4
	G	**54.1**	**54.1**	**55.3**	**55.8**	1.2	-0.5
	H	**44.4**	**44.4**	**45.5**	**45.9**	1.1	-0.5
	I	26.6	26.2	26.7	26.7	0.5	<0.1
First	A	27.7	27.5	28.1	28.3	0.7	-0.2
	B	29.1	28.7	29.0	29.1	0.3	-0.1
	C	25.7	25.0	25.3	25.4	0.3	-0.1
	D	25.0	24.1	24.3	24.4	0.2	<0.1
	E	28.2	26.9	27.1	27.1	0.2	<0.1
	F	27.5	27.2	27.6	27.6	0.4	-0.1

	G	28.0	27.8	28.3	28.4	0.5	-0.1
	H	27.7	27.5	28.0	28.1	0.5	-0.1
	I	25.2	24.9	25.2	25.3	0.4	<0.1
Second	A	23.9	23.7	24.0	24.1	0.3	-0.1
	B	24.2	23.9	24.1	24.2	0.2	-0.1
	C	24.3	23.6	23.8	23.8	0.2	<0.1
	D	23.5	22.8	23.0	23.0	0.2	<0.1
	E	23.8	23.2	23.4	23.4	0.2	<0.1
	F	23.8	23.5	23.7	23.8	0.2	<0.1
	G	23.8	23.6	23.9	24.0	0.3	-0.1
	H	23.9	23.7	24.0	24.1	0.3	-0.1
	I	23.8	23.5	23.7	23.8	0.3	<0.1
Third	A	22.1	21.9	22.1	22.1	0.2	<0.1
	B	22.0	21.7	21.9	21.9	0.2	<0.1
	C	22.9	22.2	22.4	22.4	0.1	<0.1
	D	22.2	21.7	21.9	21.9	0.1	<0.1
	E	21.6	21.3	21.5	21.5	0.1	<0.1
	F	22.0	21.7	21.9	21.9	0.2	<0.1
	G	22.1	21.9	22.1	22.1	0.2	<0.1
	H	22.2	22.0	22.2	22.2	0.2	<0.1
	I	22.4	22.1	22.3	22.3	0.2	<0.1
Fourth	A	21.0	20.8	20.9	20.9	0.1	<0.1
	B	20.8	20.5	20.6	20.7	0.1	<0.1
	C	21.5	21.1	21.1	21.2	<0.1	<0.1
	D	21.1	20.8	20.9	20.9	0.1	<0.1
	E	20.5	20.3	20.4	20.4	<0.1	<0.1
	F	20.9	20.7	20.8	20.8	0.1	<0.1

	G	21.0	20.8	21.0	21.0	0.1	<0.1
	H	21.1	20.9	21.0	21.0	0.1	<0.1
	I	21.2	21.0	21.1	21.2	0.2	<0.1

Note 1: Exceedances of the annual mean objectives are highlighted.

Note 2: The "change due to the development" may not exactly equal the difference between the two previous columns due to rounding, differences less than 0.1 but larger than 0 have been recorded as <0.1.

Table 6: Estimated NO_2 concentrations ($\mu g/m^3$) in a Policy Applied scenario

		Annual mean NO_2 concentration (µg /m^3)					
			Policy Applied				
Floor level	**Receptor**	**2018 Baseline**	**2031 Without development**	**2031 With development**	**2031 Proxy**	**Change between with and without Development**	**Change between Proxy and with Development**
	DT6 130 Magdalen St	25.9	16.6	16.6	16.7	<0.1	<0.1
	DT9 13 St Augustines St	39.4	23.0	23.1	23.2	0.2	-0.1
	DT11 52 St Augustines St	**42.4**	23.8	23.9	24.0	0.2	<0.1
Ground	A	**56.7**	36.3	36.9	37.2	0.6	-0.2
	B	**54.2**	34.9	35.0	35.0	<0.1	<0.1
	C	27.1	17.4	17.5	17.6	0.1	<0.1
	D	26.8	16.5	16.6	16.6	<0.1	<0.1
	E	39.8	20.6	20.7	20.7	0.1	<0.1
	F	38.4	22.3	22.6	22.8	0.3	-0.2
	G	**54.1**	33.9	34.3	34.5	0.3	-0.3

	H	**44.4**	27.1	27.3	27.6	0.2	-0.3
	I	26.6	16.9	17.0	17.1	<0.1	-0.1
First	A	27.7	18.1	18.2	18.3	0.2	-0.1
	B	29.1	19.1	19.1	19.2	<0.1	<0.1
	C	25.7	16.6	16.7	16.7	<0.1	<0.1
	D	25.0	15.9	16.0	16.0	<0.1	<0.1
	E	28.2	16.9	16.9	16.9	<0.1	<0.1
	F	27.5	17.4	17.5	17.5	0.1	-0.1
	G	28.0	18.1	18.2	18.3	0.1	-0.1
	H	27.7	17.8	17.9	18.0	0.1	-0.1
	I	25.2	16.3	16.4	16.5	<0.1	-0.1
Second	A	23.9	16.0	16.1	16.1	<0.1	<0.1
	B	24.2	16.2	16.3	16.3	<0.1	<0.1
	C	24.3	15.9	15.9	15.9	<0.1	<0.1
	D	23.5	15.3	15.4	15.4	<0.1	<0.1
	E	23.8	15.4	15.4	15.4	<0.1	<0.1
	F	23.8	15.7	15.7	15.8	<0.1	<0.1
	G	23.8	15.8	15.9	15.9	<0.1	<0.1
	H	23.9	15.9	16.0	16.0	<0.1	<0.1
	I	23.8	15.7	15.8	15.8	<0.1	<0.1
Third	A	22.1	15.1	15.1	15.1	<0.1	<0.1
	B	22.0	15.0	15.0	15.1	<0.1	<0.1
	C	22.9	15.2	15.2	15.2	<0.1	<0.1
	D	22.2	14.9	14.9	14.9	<0.1	<0.1
	E	21.6	14.6	14.6	14.6	<0.1	<0.1
	F	22.0	14.9	14.9	14.9	<0.1	<0.1
	G	22.1	15.0	15.0	15.0	<0.1	<0.1

	H	22.2	15.0	15.1	15.1	<0.1	<0.1
	I	22.4	15.1	15.1	15.2	<0.1	<0.1
Fourth	A	21.0	14.5	14.5	14.5	<0.1	<0.1
	B	20.8	14.4	14.4	14.4	<0.1	<0.1
	C	21.5	14.6	14.6	14.6	<0.1	<0.1
	D	21.1	14.5	14.5	14.5	<0.1	<0.1
	E	20.5	14.2	14.2	14.2	<0.1	<0.1
	F	20.9	14.4	14.4	14.4	<0.1	<0.1
	G	21.0	14.5	14.5	14.5	<0.1	<0.1
	H	21.1	14.5	14.5	14.5	<0.1	<0.1
	I	21.2	14.6	14.6	14.6	<0.1	<0.1

Note 1: Exceedances of the annual mean objectives are highlighted.

Note 2: The "change due to the development" may not exactly equal the difference between the two previous columns due to rounding, differences less than 0.1 but larger than 0 have been recorded as <0.1.

Table 7: Estimated PM_{10} concentrations ($\mu g/m^3$) in a No Policy Applied scenario

		Annual mean PM_{10} concentration (µg /m^3)					
			No Policy Applied				
Floor level	Receptor	2018 Baseline	2031 Without development	2031 With development	2031 Proxy	Change between with and without Development	Change between Proxy and with Development
	DT6 130 Magdalen St	15.8	15.7	15.7	15.7	<0.1	-0.1
	DT9 13 St Augustines St	16.8	17.1	17.4	17.2	0.3	0.1
	DT11 52 St Augustines St	17.0	17.1	17.4	17.2	0.3	0.1
Ground	A	17.6	17.7	18.0	18.2	0.4	-0.2
	B	17.3	17.2	17.3	17.3	<0.1	<0.1
	C	15.9	15.8	15.8	15.9	<0.1	<0.1
	D	16.2	16.0	16.0	16.0	<0.1	<0.1
	E	18.5	17.6	17.6	17.7	<0.1	<0.1
	F	17.6	17.6	17.7	17.8	<0.1	-0.2
	G	18.0	18.1	18.3	18.5	0.1	-0.2
	H	17.5	17.6	17.7	17.9	<0.1	-0.2
	I	15.9	16.2	15.9	16.3	<0.1	-0.3
First	A	15.8	15.8	15.9	15.9	<0.1	-0.1
	B	15.8	15.8	15.8	15.8	<0.1	<0.1
	C	15.8	15.7	15.7	15.8	<0.1	<0.1
	D	15.9	15.8	15.8	15.8	<0.1	<0.1
	E	16.4	16.2	16.2	16.2	<0.1	<0.1
	F	16.1	16.2	16.1	16.2	<0.1	-0.1
	G	16.0	16.0	16.0	16.1	<0.1	-0.1

	H	16.0	16.0	16.0	16.1	<0.1	-0.1
	I	15.8	16.0	15.8	16.1	<0.1	-0.3
Second	A	15.6	15.6	15.6	15.6	<0.1	-0.1
	B	15.6	15.5	15.5	15.6	<0.1	<0.1
	C	15.7	15.6	15.6	15.7	<0.1	<0.1
	D	15.7	15.6	15.6	15.6	<0.1	<0.1
	E	15.8	15.7	15.7	15.7	<0.1	<0.1
	F	15.7	15.7	15.7	15.8	<0.1	-0.1
	G	15.6	15.7	15.6	15.7	<0.1	-0.1
	H	15.6	15.7	15.7	15.8	<0.1	-0.1
	I	15.6	15.8	15.6	15.9	<0.1	-0.2
Third	A	15.4	15.4	15.4	15.5	<0.1	<0.1
	B	15.4	15.4	15.4	15.4	<0.1	<0.1
	C	15.6	15.5	15.5	15.5	<0.1	<0.1
	D	15.5	15.5	15.5	15.5	<0.1	<0.1
	E	15.5	15.5	15.5	15.5	<0.1	<0.1
	F	15.5	15.5	15.5	15.5	<0.1	-0.1
	G	15.5	15.5	15.5	15.6	<0.1	-0.1
	H	15.5	15.5	15.5	15.6	<0.1	-0.1
	I	15.5	15.6	15.5	15.7	<0.1	-0.2
Fourth	A	15.4	15.4	15.3	15.4	<0.1	<0.1
	B	15.4	15.3	15.3	15.4	<0.1	<0.1
	C	15.5	15.4	15.4	15.4	<0.1	<0.1
	D	15.4	15.4	15.4	15.4	<0.1	<0.1
	E	15.4	15.4	15.3	15.4	<0.1	<0.1
	F	15.4	15.4	15.4	15.4	<0.1	-0.1
	G	15.4	15.4	15.4	15.4	<0.1	-0.1

	H	15.4	15.4	15.4	15.4	<0.1	-0.1
	I	15.4	15.5	15.4	15.5	<0.1	-0.1

Note: The "change due to the development" may not exactly equal the difference between the two previous columns due to rounding, differences less than 0.1 but larger than 0 have been recorded as <0.1.

Table 8: Estimated PM_{10} concentrations ($\mu g/m^3$) in a Policy Applied scenario

		Annual mean PM_{10} concentration (µg /m^3)					
			Policy Applied				
Floor level	Receptor	2018 Baseline	2031 Without development	2031 With development	2031 Proxy	Change between with and without Development	Change between Proxy and with Development
	DT6 130 Magdalen St	15.8	14.4	14.4	14.4	<0.1	<0.1
	DT9 13 St Augustines St	16.8	15.4	15.5	15.5	<0.1	<0.1
	DT11 52 St Augustines St	17.0	15.4	15.4	15.5	<0.1	<0.1
Ground	A	17.6	16.0	16.4	16.3	0.4	<0.1
	B	17.3	15.7	15.7	15.7	<0.1	<0.1
	C	15.9	14.5	14.6	14.5	<0.1	<0.1
	D	16.2	14.7	14.7	14.7	<0.1	<0.1
	E	18.5	16.1	16.2	16.2	<0.1	<0.1
	F	17.6	16.1	16.2	16.3	0.1	-0.1
	G	18.0	16.5	16.7	16.8	0.2	-0.1
	H	17.5	16.0	16.2	16.3	0.2	-0.1
	I	15.9	14.6	14.6	14.7	<0.1	<0.1
First	A	15.8	14.5	14.6	14.5	<0.1	<0.1
	B	15.8	14.5	14.5	14.5	<0.1	<0.1

	C	15.8	14.4	14.5	14.4	<0.1	<0.1
	D	15.9	14.5	14.5	14.5	<0.1	<0.1
	E	16.4	14.9	14.9	14.9	<0.1	<0.1
	F	16.1	14.8	14.8	14.8	<0.1	<0.1
	G	16.0	14.7	14.7	14.7	<0.1	<0.1
	H	16.0	14.6	14.7	14.7	<0.1	<0.1
	I	15.8	14.5	14.5	14.5	<0.1	<0.1
Second	A	15.6	14.3	14.3	14.3	<0.1	<0.1
	B	15.6	14.3	14.3	14.3	<0.1	<0.1
	C	15.7	14.4	14.4	14.4	<0.1	<0.1
	D	15.7	14.3	14.4	14.4	<0.1	<0.1
	E	15.8	14.4	14.5	14.5	<0.1	<0.1
	F	15.7	14.4	14.4	14.4	<0.1	<0.1
	G	15.6	14.4	14.4	14.4	<0.1	<0.1
	H	15.6	14.4	14.4	14.4	<0.1	<0.1
	I	15.6	14.3	14.4	14.4	<0.1	<0.1
Third	A	15.4	14.2	14.2	14.2	<0.1	<0.1
	B	15.4	14.2	14.2	14.2	<0.1	<0.1
	C	15.6	14.3	14.3	14.3	<0.1	<0.1
	D	15.5	14.2	14.2	14.2	<0.1	<0.1
	E	15.5	14.2	14.2	14.2	<0.1	<0.1
	F	15.5	14.2	14.2	14.2	<0.1	<0.1
	G	15.5	14.2	14.2	14.2	<0.1	<0.1
	H	15.5	14.2	14.3	14.3	<0.1	<0.1
	I	15.5	14.2	14.3	14.3	<0.1	<0.1
Fourth	A	15.4	14.1	14.1	14.1	<0.1	<0.1
	B	15.4	14.1	14.1	14.1	<0.1	<0.1

	C	15.5	14.2	14.2	14.2	<0.1	<0.1
	D	15.4	14.1	14.2	14.2	<0.1	<0.1
	E	15.4	14.1	14.1	14.1	<0.1	<0.1
	F	15.4	14.1	14.1	14.1	<0.1	<0.1
	G	15.4	14.1	14.2	14.2	<0.1	<0.1
	H	15.4	14.1	14.2	14.2	<0.1	<0.1
	I	15.4	14.1	14.2	14.2	<0.1	<0.1

Note: The "change due to the development" may not exactly equal the difference between the two previous columns due to rounding, differences less than 0.1 but larger than 0 have been recorded as <0.1.

3.1.1 No Policy Applied scenarios

In the scenarios modelled without the predicted impact of UK air quality and climate change policy, in the 'Without Development' scenario, the model predicts annual mean NO_2 concentrations to be:

- Above (by 32 %) the annual mean objective at the worst-case location (ground floor receptor A - on the north facing façade of Block A, on Edward Street). However, the annual mean objective will not apply at this location as there will be no residential use at ground floor level.
- Similarly, exceedances of the NO_2 annual mean objective are also predicted at receptor locations B and G at the ground floor) However, the annual mean objective for NO_2 does not apply at these locations.
- Exceedances of the NO_2 annual mean objective are also predicted at receptor locations H (at the ground floor) and DT11 52 St Augustines' St. Concentrations modelled at DT9 13 St Augustines St in the 'Without Development' scenario are very close to the annual mean objective level. These are residential locations and **therefore the annual mean objective will apply**.

The receptor locations that have been identified as exceeding the annual mean objective are all roadside locations where roadside concentrations will be maximised. Receptors C, D are located close to a main road, St Crispins Road, however this road is elevated (by approximately 8m) at this location, and so ground floor elevations are not expected to be as high.

The model has also been run for a 'Proxy' scenario taking into account the level of traffic activity at the Site, should it be restored according to existing planning conditions, in contrast to the 'Without Development' scenario which emulates current conditions in which traffic activity is artificially suppressed. In this scenario, the model also predicts annual mean NO_2 concentrations to be:

- Above (by 33 %) the annual mean objective at the worst-case location (ground floor receptor A - on the north facing façade of Block A, on Edward Street). However, the annual mean objective will not apply at this location as there will be no residential use at ground floor level.
- Similarly, exceedances of the NO_2 annual mean objective are also predicted at receptor locations B and G at the ground floor) However, the annual mean objective for NO_2 does not apply at these locations.
- Exceedances of the NO_2 annual mean objective are also predicted at receptor locations H (at the ground floor) and DT11 52 St Augustines' St.. These are residential locations and **therefore the annual mean objective will apply**.
- Annual mean NO_2 concentrations are estimated to be 40µg/m^3 and are therefore borderline on the exceedance threshold at DT9 13 St Augustines Street.

The model has also been run for a 'With development' scenario taking into account predicted increases to traffic levels due to the Development. The results indicate that between the without and with Development scenarios, annual mean NO_2 concentrations would increase by a maximum of 2.1 µg/m^3 with greatest impact felt on the ground floor locations (specifically receptor locations A, G, H, DT9 13 St Augustines St and DT11 52 St Augustines St). Increases in NO_2 concentrations due to the Development decrease with floor height. Between the Proxy and with Development scenarios, annual mean NO_2 concentrations would increase by a maximum of 0.7 µg/m^3 with the greatest impact felt

at receptors DT9 13 St Augustines St and DT11 52 St Augustines St. However, at all other receptor locations the impact of the Development compared to the Proxy scenario is <0.1 μg/m^3 or negative, i.e. indicates a reduction in NO_2 concentrations.

The estimated annual mean NO_2 concentrations at the Site show some variance when compared to the data collected at the diffusion tube monitoring sites. However, this is a result of the different road layouts and traffic estimations around the Site compared to the diffusion tube locations. For example, receptor B, located on the southern section of Magdalen St, predicts significantly higher concentrations than those recorded at DT6 130 Magdalen St, located further north along a one-way section of Magdalen St. Along the southern section of this road (north of the overpass) there are several bus stops and sets of traffic lights which are likely to cause traffic queues and idling vehicles. Receptor location A is located on Edward Street, where traffic queues are expected at either end as a result of the traffic lights, as such these have been modelled and contribute to the high NO_2 concentrations predicted along this street. Receptor locations G and H are both located near the roadside at a busy junction between Edward Street and New Botolph Street and so it is not unexpected that predicted results are higher than those of the monitoring locations. The results predicted at the NCC's DT6 and DT9 diffusion tube monitoring sites in the 2018 baseline are very similar to those recorded at the monitoring stations, and the increases in pollutant concentrations for 2031 reflect a predicted increase to traffic flows on St Augustines Street (by 4%) for the 2031 Without Development scenario.

The Guidance states that authorities may assume exceedances of the NO_2 hourly mean objective are only likely to occur where annual mean concentrations are 60 μg/m^3 or above. Therefore, it is considered unlikely that this objective will be exceeded at any receptor locations.

The model estimates no exceedance against the annual mean PM_{10} objective. Potential exceedances of the daily mean PM_{10} objective can be estimated based on the annual mean[21], such that:

$$No.\,24-hour\ mean\ exceedances = -18.5 + 0.00145 \times Annual\ Mean^3 + \left(\frac{206}{Annual\ Mean}\right)$$

On this basis, it is estimated that in 2031 there will be two exceedances of the daily mean PM_{10} limit value, regardless of whether the development takes place or not. Therefore, the daily mean PM_{10} objective would be met as 35 exceedances of limit value are allowed per year.

3.1.2 Policy Applied scenarios

This assessment has also considered the UK's commitment to improving air quality as a result of improving transport fleet emission factors through the promotion of electric vehicles (EVs) (primarily driven by climate change concerns and the commitment for all new cars and vans to be effectively zero emission by 2040[22]) and the increasingly stringent Euro standards that vehicles need to meet. The predicted improvements to air

[21] Paragraph 7.92 of LAQM TG(16)
[22] Set out in 'The Road to Zero', Department for Transport, published July 2018, available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf

quality have been incorporated into the model through improvements to the fleet emission factors (projected in the latest version of DfT's EFT) and background concentrations (projected in Defra's background concentration maps). It is worth noting that these are potentially conservative estimates of improvements as projections are only available up to 2030, and improvements are expected to continue post this year.

In the scenarios modelled with the predicted impact of UK air quality and climate change policy, the model predicts annual mean NO_2 concentrations to be below (by 9 %) the annual mean objective at the worst-case location (ground floor receptor A) in the 'Without development' scenario. The 'Proxy' scenario results predict annual mean NO_2 concentrations to be below (by 7 %) the annual mean objective at the worst-case location (ground floor receptor A).

The 'With Development' scenario results indicate that annual mean NO_2 concentrations would increase by a maximum of 0.6 $\mu g/m^3$ as between the 'Without Development' and 'With Development' scenarios. Increases in NO_2 concentrations due to the Development decrease with floor height. Therefore, annual mean NO_2 concentrations are also predicted to be below (by 8 %) the annual mean objective at the worst-case location in the 'With Development' scenario. Compared to the 'Proxy' scenario, annual mean NO_2 concentrations are modelled to either increase by <0.1 $\mu g/m^3$ or to decrease in the 'With Development' scenario. No exceedances of the hourly mean objective are expected in any scenario with policy applied.

With regards to PM_{10}, no exceedances of the annual mean objective are predicted in the Policy Applied scenarios, and based on the equation above for daily mean PM_{10} limit values, it is expected that in 2031 there will be one exceedances of the daily mean PM_{10} limit value, regardless of whether the development takes place or not. Therefore, the daily mean PM_{10} objective would also be met.

3.1.3 Qualitative assessment of air quality five years after the Development year (2036)

Road traffic projections have also been provided for 2036 to provide a longer-term assessment of the impact of the Development on local air quality. A qualitative assessment of air pollutant concentrations in 2036 has been carried out based on these estimates as well as trends in fleet emission factors and background pollutant concentrations. Road traffic projections estimate decreases in traffic flows localised to Magdalen Street, Edward Street (South), Bull Close Lane, Aylsham Road, St Crispins Road, New Botolph Street, Whitefrairs and Duke Street between 2031 and 2036. Therefore, estimates of air pollutant concentrations in these locations are expected to decrease regardless of improvements to vehicle fleet emission factors or background pollutant concentrations. However, increases to road traffic flows are predicted for Pitt Street, western sections of St Crispins Road, Magpie Road, St Augustines Street, and Esdelle Street. Therefore, a conservative estimate of air pollutant concentrations, in which none of the expected improvements to vehicle fleet emission factors and background air pollution materialise, would suggest an increase in pollutant concentrations at these locations.

However, this is contrary to predicted trends to vehicle fleet emission factors and background concentrations, which would suggest significant improvements to air pollutant concentrations, in line with trajectories from DfT and Defra projected values. Based on the modelled Policy Applied scenarios, continued improvements to these

factors would decrease pollutant concentrations further beyond the improvements modelled between 2018 and 2031.

3.2 Significance

Professional judgement is an important part of the assessment of significance. However, there are various documents available that attempt to qualitatively or quantitatively provide ways of assessing the significance of a development on air quality. The most commonly applied is Environmental Protection UK's Air Quality Guidance Document[23] which outlines how impacts may be assessed quantitatively. The assessment is made up of two steps – firstly to assess the magnitude of change in concentration (e.g. between with and without development) relative to the objective level, and secondly the percentage above/below the objective based upon the total modelled concentration at a given location or receptor. By combining these two values, you can obtain the impact descriptor. This method is presented in **Table 9** below.

Table 9: Significance of change description

Long term average concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75 % or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94 % of AQAL	Negligible	Slight	Moderate	Moderate
95-102 % of AQAL	Slight	Moderate	Moderate	Substantial
103-109 % of AQAL	Moderate	Moderate	Substantial	Substantial
110 % of more of AQAL	Moderate	Substantial	Substantial	Substantial

In addition to the criteria provided above, the Guidance document states that the table is intended to be used by rounding the change in percentage pollutant concentrations to whole numbers. Changes of 0 % i.e. less than 0.5 % are described as negligible.

Table 10 below outlines the significance of the Development compared against the Without Development and Proxy scenarios at receptor locations, where the NO_2 annual mean objective applies for both No Policy Applied and Policy Applied scenarios.

[23] http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf

Table 10: Significance of Development on air quality at receptor locations, where the NO_2 annual mean objective applies, for both Policy Applied and No Policy Applied scenarios

Floor level	Receptor	No Policy Applied		Policy Applied	
		Compared to without Development	Compared to Proxy	Compared to without Development	Compared to Proxy
	DT6 130 Magdalen St	Negligible	Negligible	Negligible	Negligible
	DT9 13 St Augustines St	Moderate	Slight	Negligible	Negligible
	DT11 52 St Augustines St	Moderate	Moderate	Negligible	Negligible
Ground	H	Substantial	Negligible	Negligible	Negligible
First	A	Negligible	Negligible	Negligible	Negligible
	B	Negligible	Negligible	Negligible	Negligible
	C	Negligible	Negligible	Negligible	Negligible
	D	Negligible	Negligible	Negligible	Negligible
	E	Negligible	Negligible	Negligible	Negligible
	F	Negligible	Negligible	Negligible	Negligible
	G	Negligible	Negligible	Negligible	Negligible
	H	Negligible	Negligible	Negligible	Negligible
	I	Negligible	Negligible	Negligible	Negligible

3.3 Mitigation Measures

Based on the ADMS results, specific mitigation is recommended in the form of mechanical ventilation or individual whole house ventilation systems with NO_x/NO_2 filters, as concentrations are estimated to be above the annual mean NO_2 objective level at ground floor receptor location H, which is designated as residential use. Note, however that is a very conservative estimate as under the 'policy applied' scenario, air pollutant concentrations are predicted to be substantially below the objective level. If the former mitigation is utilised, as a minimum, air inlets should be located at the rear of the building on which receptor H is positioned, furthest from the roadside, at the upper most roof level and air circulated down to the ground floor. This is to address the worst-case scenario in which no improvements to fleet emission factors or background concentrations are seen by 2031.

Where mechanical ventilation is to be installed, i.e. for the air source heat pumps serving the commercial accommodation, (a matter which can be guaranteed by planning condition), then the developer is encouraged to refer to the National House Builders Registration Council's (now NHBC) guidance for installing mechanical ventilation, found

in Chapter 8.3 'Mechanical ventilation with heat recovery'[24]. Some best practice for installing and maintaining mechanical ventilation includes:

- Insulating ductwork and other components from the cold
- Ensuring the appropriate location of inlet and extract to allow for maintenance and change of filters
- Checking filters following construction as they may be blocked with construction dust.

At residential receptors near to 13 St Augustine's Street and 52 St Augustine's Street an exceedance of the annual mean NO_2 objective is predicted with development under the no policy applied scenario. However, this is a very conservative estimate as under the 'policy applied' scenario, pollutant concentrations are predicted to be substantially below the objective level.

In addition, in order to minimise potential cumulative effects from major Developments[25], the Institute of Air Quality Management (IAQM) has provided guidance on the principles of good practice[26] which should be applied to all major developments. Examples of good practice include:

- The provision of Electric Vehicle (EV) "rapid charge" and other charging points where on-site parking is provided for residentials and the public. The Amended Scheme proposes substantially more EV charging within the residential car parks, as set out in the Transport Assessment Addendum. The details of this will be addressed by a planning condition.
- Where the development generates significant additional traffic, a detailed travel plan should be implemented. As noted, the modelled traffic generated for the 'with Development' scenario has taken into account the impacts of a detailed travel plan and the provision of electric vehicles. Full detailed travel plans will be provided in response to a planning condition covering each phase of the development.

3.4 Mitigating the Impacts of the Construction Phase

There are a range of mitigation measures which are appropriate for all sites and are applicable specifically to demolition, earthworks, construction and trackout. Examples of these measures include:

- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site
- Ensure all vehicles switch off engines when stationary – no idling vehicles

[24] http://www.nhbc.co.uk/Builders/ProductsandServices/TechnicalStandards/

[25] Major developments can be defined as developments where:
- The number of dwellings is 10 or above
- The residential Development is carried out on a Site of more than 0.5ha where the number of dwellings is unknown
- The provision of more than 1000 m^2 commercial floor space
- Development carried out on land of 1ha or more
- Developments which introduce new exposure into an area of existing poor air quality (e.g. an AQMA) should also be considered in this context.

[26] http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf

- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable
- Ensure all loads entering and leaving the site are covered
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation

The measures appropriate to the construction of the Development will be set out in the Construction Environmental Management Plan, which will be agreed by NCC as the subject of a planning condition, in respect of each phase of the development. This will also cover the proposed monitoring and the protocol to address any exceedance of agreed targets.

4 Summary and Conclusions

An Air Quality Assessment has been undertaken and presented in the form of a report for the proposed redevelopment of Anglia Square in Norwich. The Development will comprise of up to 1,250 apartments, retail and commercial premises, hotel, chapel, car parking and public and private amenity space. The Amended Scheme in respect of which this Air Quality Assessment Version 3 has been prepared, proposes a number of changes that could reduce the number of dwellings and parking spaces in the final scheme, notwithstanding that the maximum number of units remains unchanged.

Norwich City Council has declared an Air Quality Management Area (AQMA) covering the centre of Norwich due to exceedances of the annual mean nitrogen dioxide (NO_2) objective. The proposed Development lies within this AQMA.

This assessment models the predicted impact of the changes in traffic flows on the local road network. This has been assessed in the context of two distinct policy landscapes. The first, 'No Policy Applied' is a conservative approach where no improvement in the pollutant background concentrations or road transport emission factors has been assumed between the base year (2018) and the first year of occupation (2031). The second, 'Policy Applied', considers expected improvements to road traffic fleet emission factors and background pollutant concentrations as a result of the UK's road to zero transport strategy [27] and the impact of increasingly stringent vehicle emission standards. The predicted improvements to air quality have been incorporated into the model through improvements to the fleet emission factors (projected in the latest version of DfT's Emission Factor Toolkit) and background concentrations (projected in Defra's background concentration maps).

In addition to modelling the impact of the Development on local traffic levels in 'Without' and 'With' Development scenarios, a 'Proxy' scenario has been modelled. The current underusage of the brownfield Site suppresses the level of traffic activity in the surrounding area artificially. Therefore, an alternative scenario has been modelled **as a proxy** for the level of traffic activity at the Site should it be restored according to existing planning conditions. This provides an amended baseline against which the predicted impact of the Development on road traffic levels in the surrounding area, and therefore on air pollutant concentrations, can be compared.

[27] 'The Road to Zero', Department for Transport, July 2018, available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf

An air quality assessment has been carried out using the ADMS-Roads dispersion model to determine the impact of emissions from road traffic on sensitive receptors. Predicted concentrations have been compared with the air quality objectives.

In the **No Policy Applied scenario**, the results of the assessment indicate that annual mean NO_2 concentrations are above the objective in the 'Without Development', 'Proxy' and 'With Development' scenarios at six out of twelve ground floor locations. However, the annual mean NO_2 objective only applies at three of these ground floor receptor locations (north side of New Botolph Street, 13 St Augustines Street and 52 St Augustines St), since all other receptors that exceed the objective represent commercial use. The impact of the Development is significantly reduced when compared to the Proxy scenario. In many locations the impact of the Development compared to the Proxy scenario is negative, indicating a reduction in NO_2 concentrations. Concentrations of particulate matter (PM_{10}) are predicted to be below the annual mean objective in all scenarios. It is unlikely that there will be any exceedances of the short-term objective for NO_2. In addition, no exceedances of the short term PM_{10} objective are expected.

In the **Policy Applied scenario**, the results of the assessment indicate that annual mean NO_2 concentrations are below the objective in the 'with' and 'without' Development scenarios at all of the receptor locations. Concentrations of particulate matter (PM_{10}) are also predicted to be below the annual mean objective in both the 'with' and 'without' Development scenarios and it is unlikely that there will be any exceedances of the short-term objective for NO_2 at any location around the Site. In addition, no exceedances of the short term PM_{10} objective are expected.

Therefore, in addressing the worst-case No Policy Applied scenario, the installation of mechanical ventilation or whole house ventilation with NO_x/NO_2 filters is recommended on elevations corresponding to the monitoring locations adjacent to New Botolph Street, as the air quality objective is predicted to be exceeded. If the former is utilised, it is recommended that air inlets are installed at the rear of the building, furthest from the road, at the main roof level, and circulated to all other floors of the Development. If the latter approach is used, further monitoring may be necessary to establish exactly which units require such arrangements, as those fronting vehicle-free spaces may be subject to lower pollutant concentrations. Other measures, such as installing the number of electric charging points requested by NCC, with scope to double this number in future, and producing detailed travel plans, the promotion of a 7 vehicle car club and the use of renewable energy sources for the commercial areas are also being proposed, to be agreed upon in detail via planning conditions, so as to lower pollutant concentrations and encourage lesser use of private vehicles by residents and employees of the commercial premises. In addition, the developer will refer to the IAQM's 'Guidance on the assessment of dust from demolition and construction' and will use / require of sub-contractors vehicles and plant intended to reduce emissions (i.e. electric plant), in order to minimise the impact of the construction phase on local air quality. This would be addressed in the Construction Environment Management Plan to be agreed with the NCC and Norfolk County Council, via a planning condition. The above measures will also assist in minimising any impact of the scheme on air quality experienced by passing pedestrians.

Appendix A – Model Verification

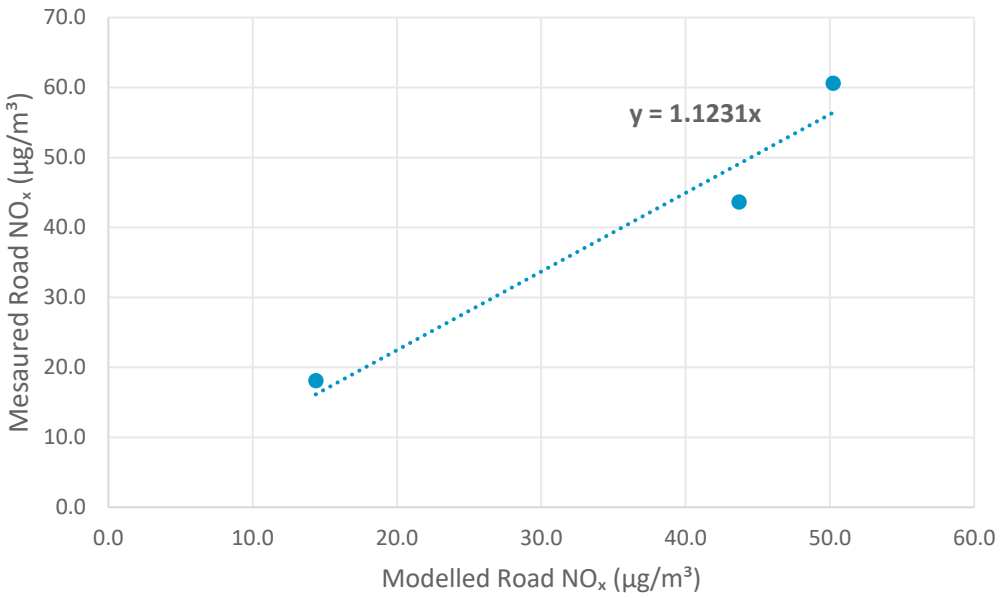
In order to verify modelled pollutant concentrations generated in the assessment, the model has been run to predict the annual mean road-NO_x concentration during 2018 at the three diffusion tube sites described in **Table 2**.

The model output of road-NO_x has been compared with the 'measured' road-NO_x. Measured NO_x for the monitoring sites was calculated using the NO_x to NO_2 calculator[17].

A primary adjustment factor was determined to convert between the 'measured' road contribution and the model derived road contribution (**Figure A.1**). This factor was then applied to the modelled road-NO_x concentration for each receptor to provide adjusted modelled road-NO_x concentrations. Total NO_2 concentrations were then determined by combining the adjusted modelled road-NO_x concentrations with the 2018 background NO_2 concentration.

The results imply that the model was under-predicting the road-NO_x contribution. This is a common experience with ADMS and most other models. The results are presented in **Table A.1**.

Figure A.1: Comparison of Measured road-NO_x to unadjusted modelled road-NO_x concentrations



RMSE

The root mean square error (RMSE) is used to define the average error or uncertainty of the model. The following RMSE value has been calculated:

NO_2: 2.88

If the RMSE values are higher than ±25 % of the objective being assessed, it is recommended that the model inputs and verification should be revisited in order to make improvements. In this case the model is being assessed against the annual mean

objective, which is 40 μg/m^3 for NO_2. An RMSE value of less than 10 μg/m^3 is obtained and therefore the model behaviour is acceptable.

Appendix B – Traffic Data

Table B.1: Traffic data for 2018(and prediction for 2031 with and without development

Road links	Annual Average Daily Traffic (AADT) 2018	Annual Average Daily Traffic (AADT) 2031 without Development	Annual Average Daily Traffic (AADT) 2031 with Development	% Heavy Duty Vehicles (HDV)	Speed (kph)
Pitt Street.	20,263	20,150	22,087	4.1	29.3
Edward Street (South).	2,982	3,261	5,009	27.9	33.0
Magdalen Street (North – one way)	4,142	2,214	2,206	13.6	30.2
Magdalen Street (South).	1,580	1,580	1,580	19.7	30.1
Edward Street (North).	12,346	12,800	14,785	8.4	36.3
New Botolph Street	11,357	11,615	12,540	4.1	32.8*
Magpie Road.	11,498	11,334	12,730	7.1	39.4
St Augustines Street.	14,685	15,309	16,657	6.4	28.1
St Crispins Road.	35,050	21,086	21,468	7.3	53.1
Duke Street.	9,416	11,235	11,235	4.6	30.8
St Crispin Road (West).	35,050	33,656	35,390	7.0	43.3
Bull Close Lane.	13,189	7,807	7,807	5.4	35.2
Whitefrairs.	20,263	20,150	22,087	4.1	33.3
Aylsham Road	17,243	16,974	18,006	6.8	44.1
Minor roads	1,500	1,756**	1,914***	2.0	48.3

*Note: % HDV remained constant in all scenarios. *Average speed for this road was derived from the average value of the two adjacent roads, Edward Street (North) and Pitt Street. **The AADT 2031 projection for minor roads was derived by the trend from Defra's Automatic Traffic Growth Calculation v3.1.***The average change due to the development was applied.*

Appendix C – ADMS emission factor inputs

		All Vehicles (g/km/s)						
			No Policy Applied			Policy Applied		
Source name	Pollutant	2018 Base Year	2031 Without Development	2031 With Development	2031 Proxy	2031 Without Development	2031 With Development	2031 Proxy
Aylsham Road	NOx	0.0900	0.0886	0.0940	0.0992	0.0288	0.0306	0.0323
	PM10	0.0081	0.0080	0.0085	0.0090	0.0073	0.0078	0.0082
Aylsham Road Traffic	NOx	0.4921	0.4921	0.4921	0.4921	0.2479	0.2479	0.2479
	PM10	0.0161	0.0161	0.0161	0.0161	0.0137	0.0137	0.0137
Bull Close Lane	NOx	0.0550	0.0459	0.0484	0.0485	0.0153	0.0162	0.0162
	PM10	0.0046	0.0038	0.0040	0.0040	0.0035	0.0037	0.0037
Bull Close Lane Traffic	NOx	0.4260	0.4260	0.4260	0.4260	0.2086	0.2086	0.2086
	PM10	0.0153	0.0153	0.0153	0.0153	0.0132	0.0132	0.0132
Duke Street	NOx	0.0540	0.0644	0.0644	0.0644	0.0216	0.0216	0.0216
	PM10	0.0043	0.0051	0.0051	0.0051	0.0046	0.0046	0.0046
Duke Street. Traffic	NOx	0.4029	0.4029	0.4029	0.4029	0.1948	0.1948	0.1948
	PM10	0.0150	0.0150	0.0150	0.0150	0.0130	0.0130	0.0130
Edward Street (North)	NOx	0.0757	0.0785	0.0907	0.0947	0.0244	0.0282	0.0295
	PM10	0.0062	0.0064	0.0074	0.0077	0.0058	0.0067	0.0070
Edward Street (North) Traffic	NOx	0.5585	0.5585	0.5585	0.5585	0.2874	0.2874	0.2874
	PM10	0.0170	0.0170	0.0170	0.0170	0.0143	0.0143	0.0143
Edward Street (South)	NOx	0.0334	0.0365	0.0560	0.0627	0.0088	0.0135	0.0151
	PM10	0.0023	0.0025	0.0038	0.0042	0.0021	0.0033	0.0037
	NOx	1.3466	1.3466	1.3466	1.3466	0.7561	0.7561	0.7561

		All Vehicles (g/km/s)						
			No Policy Applied			Policy Applied		
Source name	Pollutant	2018 Base Year	2031 Without Development	2031 With Development	2031 Proxy	2031 Without Development	2031 With Development	2031 Proxy
Edward Street (South) Traffic	PM10	0.0267	0.0267	0.0267	0.0267	0.0207	0.0207	0.0207
Magdalen Street N (one way)	NOx	0.0320	0.0171	0.0170	0.0171	0.0049	0.0048	0.0049
	PM10	0.0024	0.0013	0.0013	0.0013	0.0011	0.0011	0.0011
Magdalen Street N (one way) Traffic	NOx	0.7673	0.7673	0.7673	0.7673	0.4116	0.4116	0.4116
	PM10	0.0195	0.0195	0.0195	0.0195	0.0160	0.0160	0.0160
Magdalen Street S	NOx	0.0156	0.0156	0.0156	0.0156	0.0041	0.0041	0.0041
	PM10	0.0010	0.0010	0.0010	0.0010	0.0009	0.0009	0.0009
Magdalen Street S Traffic	NOx	1.0167	1.0167	1.0167	1.0167	0.5599	0.5599	0.5599
	PM10	0.0226	0.0226	0.0226	0.0226	0.0180	0.0180	0.0180
Magpie Road	NOx	0.0644	0.0635	0.0713	0.0751	0.0204	0.0229	0.0242
	PM10	0.0055	0.0054	0.0061	0.0064	0.0049	0.0055	0.0059
Magpie Road Traffic	NOx	0.5058	0.5058	0.5058	0.5058	0.2560	0.2560	0.2560
	PM10	0.0163	0.0163	0.0163	0.0163	0.0138	0.0138	0.0138
Minor roads	NOx	0.0063	0.0074	0.0081	0.0074	0.0027	0.0030	0.0027
	PM10	0.0006	0.0007	0.0008	0.0007	0.0007	0.0007	0.0007
Minor roads Traffic	NOx	0.2967	0.2967	0.2967	0.2967	0.1317	0.1317	0.1317
	PM10	0.0137	0.0137	0.0137	0.0137	0.0121	0.0121	0.0121
New Botolph Street	NOx	0.0617	0.0631	0.0681	0.0736	0.0216	0.0233	0.0251
	PM10	0.0051	0.0052	0.0056	0.0060	0.0047	0.0051	0.0055

		All Vehicles (g/km/s)						
			No Policy Applied			Policy Applied		
Source name	Pollutant	2018 Base Year	2031 Without Development	2031 With Development	2031 Proxy	2031 Without Development	2031 With Development	2031 Proxy
New Botolph Street Traffic	NOx	0.3814	0.3814	0.3814	0.3814	0.1821	0.1821	0.1821
	PM10	0.0148	0.0148	0.0148	0.0148	0.0128	0.0128	0.0128
Pitt Street.	NOx	0.1162	0.1156	0.1267	0.1280	0.0393	0.0430	0.0435
	PM10	0.0091	0.0091	0.0100	0.0100	0.0082	0.0090	0.0091
Pitt Street. Traffic	NOx	0.3814	0.3814	0.3814	0.3814	0.1821	0.1821	0.1821
	PM10	0.0148	0.0148	0.0148	0.0148	0.0128	0.0128	0.0128
St Augustines Street.	NOx	0.0953	0.0993	0.1081	0.1122	0.0319	0.0347	0.0360
	PM10	0.0071	0.0074	0.0080	0.0083	0.0066	0.0072	0.0075
St Augustines Street. Traffic	NOx	0.4740	0.4740	0.4740	0.4740	0.2371	0.2371	0.2371
	PM10	0.0159	0.0159	0.0159	0.0159	0.0136	0.0136	0.0136
St Crispin Road (West).	NOx	0.1859	0.1785	0.1877	0.1866	0.0578	0.0608	0.0604
	PM10	0.0166	0.0160	0.0168	0.0167	0.0146	0.0153	0.0153
St Crispin Road (West). Traffic	NOx	0.5007	0.5007	0.5007	0.5007	0.2530	0.2530	0.2530
	PM10	0.0163	0.0163	0.0163	0.0163	0.0138	0.0138	0.0138
St Crispins Road.	NOx	0.1700	0.1023	0.1041	0.1049	0.0338	0.0344	0.0346
	PM10	0.0166	0.0100	0.0101	0.0102	0.0092	0.0093	0.0094
St Crispins Road. Traffic	NOx	0.5107	0.5107	0.5107	0.5107	0.2590	0.2590	0.2590
	PM10	0.0164	0.0164	0.0164	0.0164	0.0139	0.0139	0.0139
Whitefrairs.	NOx	0.0752	0.0445	0.0445	0.0446	0.0147	0.0147	0.0148
	PM10	0.0061	0.0036	0.0036	0.0036	0.0033	0.0033	0.0033

		All Vehicles (g/km/s)						
			No Policy Applied			Policy Applied		
Source name	Pollutant	2018 Base Year	2031 Without Development	2031 With Development	2031 Proxy	2031 Without Development	2031 With Development	2031 Proxy
Whitefrairs. Traffic	NOx	0.4341	0.4341	0.4341	0.4341	0.2134	0.2134	0.2134
	PM10	0.0154	0.0154	0.0154	0.0154	0.0132	0.0132	0.0132

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