Town and Country Planning Act 1990 - Section 77
Town and Country Planning (Inquiries Procedure) (England) Rules 2000

Site:	Anglia Square including land and buildings to the north and west
Appeal by:	Weston Homes PLC
PINS reference:	APP/G2625/V/19/3225505
LPA reference:	18/00330/F

Norwich Cycling Campaign

Rebuttal of Aether's Proof of Evidence (WH8/1) and Air Quality Assessment V3 (WH8/3)

<u>Air Quality</u>

REBUT-CYC/103

14th January 2020

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Documents are also provided in the Core Document set and noted as such in the footnotes.

1 INTRODUCTION

1 Climate Emergency Planning and Policy (CEPP) have been commissioned by the Norwich Cycling Campaign to provide an independent assessment of air quality in relation to planning for the proposed development by Weston Homes Plc ("the Developer") at Anglia Square in Norwich (Application no 18/00330/F). The relevant Norwich City Council ("the council", and "NCC") application is 18/00330/F.

2 Dr Andrew Boswell is an independent consultant at CEPP, specialising in the interface of science, numerical footprinting, the planning system, policy and law. He has a doctorate in molecular biophysics (Oxford, 1981). He worked in IT and computer science in industry (1984-1994) and academia (University of East Anglia, 1995-2006). He has wide experience of software modelling in scientific and engineering applications from industry and academia. He was elected to serve as a councillor on Norwich City Council for 4 years until 2016 and on Norfolk County Council for 12 years until 2017. He has very considerable experience in local plan making, public inquiries on infrastructure, legal compliance on air quality, carbon emissions and affordable housing.

This rebuttal responds to Aether Ltd's proof of evidence (Ae_PoE)[1] and the Version 3 of its Air Quality Assessment (AQA V3)[2].

2 BACKGROUND: AETHER HAS SUBMITTED A COMPLETELY NEW AIR QUALITY MODEL

3 Aether have produced three Air Quality Assessments (AQA):

1) AQA V1, March 2018
2) AQA V2, August 2018 (addressing NCC comments)
3) AQA V3, December 2019, alongside their Proof of Evidence

4 In AQA V3 Aether introduced a completely new Air Quality model. It is important to understand at outset that AQA V3 is not a simple progression, with a set of well contained incremental adjustments, on the AQA V1/V2 model. Instead, the AQA V3 model introduces a completely new set of assumptions, input data and methods. Achieving legal air quality levels in 2031 in AQA V3 is predicated on several new assumptions. Each assumption introduces optimism which accumulates through the stages of the modelling process. These include:

i. *Substitution of the reference data for the model verification step.* Eight diffusion tube (DT) monitoring points **within the development area**, which formed the basis of verifying the AQA V1/V2 model, are now replaced with three DT monitoring points from the Norwich City Council 2018 data which **lie outside the development area and are less representative of it**.

ii. *Accepting an extremely low, and optimistic, bias factor* on the Norwich City Council 2018 DT data, from which these three DT points are taken as the basis of the model verification step.

[1] 'RE-development of Anglia Square, Norwich. **WH 8/1**: Proof of Evidence of Melanie Hobson MSc, BSc on Air Quality Matters', Aether Ltd, Dec. 2019.

[2] '**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', Aether Ltd, Nov. 2019.

iii. *Relying on a 100% delivery of local and national air quality policy* every year until 2031.

5 As well as this completely new model which accumulates optimism in several dimensions, Aether have reached a completely different set of conclusions from that made in the Weston Homes Statement of Case (WH_SoC) of August 2019[3]. For example, the WH_SoC states at bullet 518:

> "*the modelling predicts that in all locations (with the exception of location C) the development (2028) will to lead to an increase in NO_2 concentrations … the annual NO_2 target is predicted to be exceeded in both the 'with' and 'without' 2028 development scenarios*"

and acknowledges that public health risks are associated (bullet 521):

> *"In locations where exceedance of the hourly NO_2 level is predicted, there is the risk that the development could give rise to a wider detrimental public health impact."*

6 In summary, very late in the process, the developer has presented completely new information on air quality which profoundly contradicts their own Statement of Case. Such fundamentally new material should have been provided to all appeal parties well in advance of the Proof of Evidence stage, so it could have been reviewed in our Proofs of Evidence. Regrettably, the very late delivery, and very considerable changes, in AQA V3 have required that we produce a very significant rebuttal.

7 Our conclusions remain, as per our Proof of Evidence (PoE-CYC/101) that the development is detrimental to air quality (AQ) and contributes negatively to the current AQ public health crisis.

2.1 Scope of Rebuttal

8 Norwich Cycling Campaign have commissioned Professor Stephen Peckham and Dr Ashley Mills of the Centre for Health Services Studies (CHSS), University of Kent, to provide an independent assessment of air quality. This rebuttal **(REBUT-CYC/103)** and their rebuttal **(REBUT-CYC/002)** are mutually complementary and should be read together.

3 SUMMARY

9 This rebuttal goes through the logical steps that have been taken to produce the completely new model in AQA V3. At every stage, we find that assumptions are made that make the modelling exercise optimistic and unrealistic. These accumulate through the entire logical process, leading to model outputs that are extremely misleading and cannot be trusted.

[3] **CD11.2**: "Statement of Case Weston Homes /Columbia Threadneedle", August 2019

10 Further due to anomalies in the ADMS model, we recommend that a peer review of the entire model is performed by an expert in ADMS modelling.

4 LESS RELIABLE REFERENCE DATA SUBSTITUTED FOR MODEL VERIFICATION

11 Bullets 8 -11 in Ae_PoE provide a history of the air quality modelling. The original methodology (the "agreed approach") was approved between NCC and Aether before 2017 and included agreement on the location of eight suitable DT sites. Both parties have now thrown away this valuable reference data.

4.1 DT site review: Norwich City Council did not follow their own advice

12 At the beginning of 2018, Norwich City Council removed 13 NO_2 diffusion tube monitoring sites and added nine new locations. A key rational for the additional sites, given by NCC in the 2019 ASR (page 5), is "*where new significant development is planned or approved*".

13 This should have provided a good opportunity both to enhance the monitoring within the Anglia Square development area (one of the most significant planned developments in Norwich for decades) and to resolve some issues from the previous monitoring and modelling in AQA V1/V2.

However, NCC both removed DT sites that were very relevant to Anglia Square, and failed to add any new DT sites that were relevant. This has resulted in an AQ model in AQA V3 which is less trustworthy and introduces optimism which cumulates through every subsequent step.

4.2 DT site review: Removal of important reference DTs

14 5 of the 13 removed sites are shown below:

		2013	2014	2015	2016	2017	2018
DT3	St Stephens	**55.4**	**59.6**	**42.9**	**41.1**	**46.4**	REMOVED
DT10	32 St Augustines	42.8	39.4	37.5	35.7	38.9	REMOVED
DT12	65 St Augustines	33.2	31.9	31.4	30.8	34.7	REMOVED
DT14	Castle Meadow 2	**52.4**	**50.5**	**48.1**	**41.1**	**45.4**	REMOVED
DT18	Upper King Street	35.6	33.1	32.2	28.8	36.9	REMOVED

St Augustines is a busy gyratory close to the development that was modelled to have an additional 16% AADT movements with the development (15,165 "without development", 17,599 "with development") in the Traffic Data[4] that was current when the decision to remove the DTs was made. There is still a 9% increase in AADT movements in AQA V3[5].

Removal of DT10 and DT12 is completely counter to Norwich CC's rational to add new DTs where significant development is planned. Removal of all five of the DTs listed

[4] ***CD7.81 SEI (v):*** AQA_V2, page 32, "Appendix B – Traffic Data"

[5] ***CD7.81 SEI (v):*** AQA_V3, page 36, "Appendix B – Traffic Data" - 15309 "without development", 16,657 "with development"

above is complacent when they are all registering close to the annual NO_2 objective in streets where there have been historic issues with air quality.

4.3 DT site review: Lost opportunities to resolve issues from AQA V1/V2

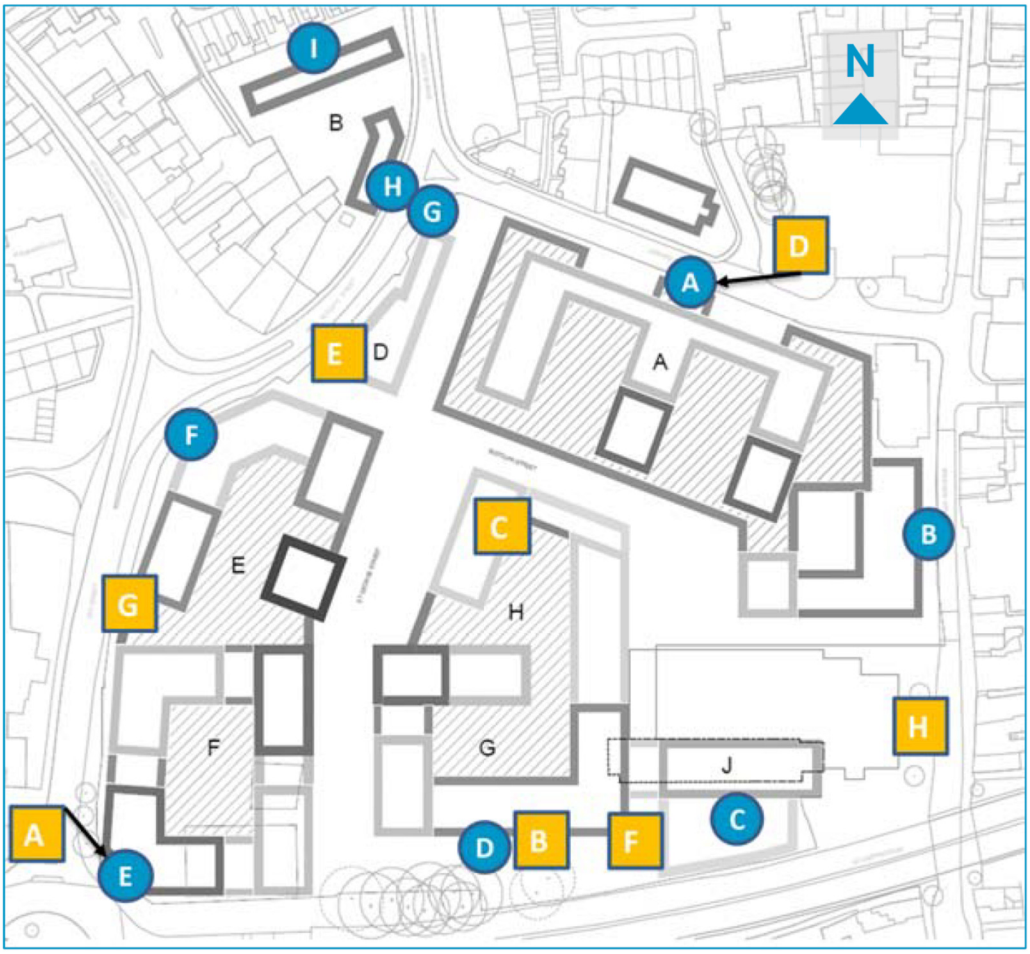
15 These are discussed and related to the figure extracted from AQA V2, Figure 4, where:

i. Blue circles are the ADMS model points (which remain the same between AQA V1/V2 and AQA V3).

ii. The eight yellow squares are the eight DT sites agreed from “comprehensive discussion” (Ae_PoE, bullet 8). They are distributed around the development.

iii. The building blocks are also labelled.

Figure 4: The location of the receptors used in the modelling



16 The NCC review of DT locations could have added new tubes to resolve issues in the air quality assessment, as follows:

i. Aether DT D (yellow box D) recorded **60.74** μg/m^3 NO_2 in Aether’s 2017 survey: this is over the hourly objective limit.

In the AQA V2 model, corresponding receptor A (blue circle A) outputs high values (2017 Base=**50.4**, 2028 “without development”=**50.4**, 2028 “with development”=**50.6**).

In AQA V3, A outputs even higher values (2018 Base=**56.7**, 2031 “without development”=**56.8**, 2031 “with development”=**58.9**).

This is one of the most important modelling points: as well as high pollution levels, a street canyon is created by the development in Edward Street close to DT D (PoE-CYC/001, bullets 56-62). Aether should monitor this is ADMS, although they appear not to.

NCC should have added a new DT site to their monitoring regime at Aether location D to continue the modelling that had already started at that site in 2017. 2018 monitoring data for this site would have been very useful for assessment.

ii. Aether ADMS modelling receptors G and H, close to the intersection of Edward Street and New Botolph Street, model high NO_2 levels: all levels for G in AQA V2 breach the one-hour NO_2 objective limit (ie: above **60.00** $\mu g/m^3$ NO_2). NCC should have added new DT sites co-located with these model receptor sites; again the 2018 data would have been most useful.

iii. Aether ADMS modelling receptor B on Magdalen Street, models high NO2 levels: all levels in AQA V2 breach the one-hour NO2 objective limit (ie: above **60.00** $\mu g/m^3$ NO_2).

This is also in a street canyon. Slightly further south, Aether DT H recorded **70.4** $\mu g/m^3$ NO_2 in 2017.

The existing NCC DT6 monitor is not placed close enough to assess pollution in the Magdalen Street part of the development, being far to the north, as recognised by Aether who states in AQA V3, page 28:

> “*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.*”

NCC should have added new DT sites at both modelling receptor B and Aether DT H to refine the monitoring on this part of Magdalen Street.

iv. Further NCC should have continued with all the other Aether DT sites, knowing that decisions on the development proposals were in progress.

17 NCC did not follow their own advice to increase monitoring where major development is planned. Instead relevant sites have been removed. The opportunities to resolve issues with AQA V1/V2 by adding new sites and providing continued monitoring of the Aether DT sites was not taken.

18 The result is that reference data provided by DT monitoring is not only inferior, but much less relevant in AQA V3 (three unrepresentative sites) than AQA V2/V3 (eight sites within the development area). It is also much less trustworthy, and introduces optimism that accumulates through subsequent steps, the next being model verification.

19 The additional DT sites identified above would have provided a much more representative reference set for the model verification stage. **It is hardly credible that the accuracy of the air quality modelling has been so compromised by the minor cost to the Council of some additional DT monitoring.**

5 UNTRUSTWORTHY BIAS FACTORS IN NCC DATA ARE TRANSMITTED TO THE MODEL OUTPUTS

20 AQA V3 uses three diffusion tube (DT) measurements from the Norwich City Council 2019 (2018 data) Air Quality Annual Status Report, recently published[6] to verify (calibrate) the ADMS AQ dispersal model. There are two key issues: whether the dataset provides good reference data for the model, and whether the dataset is accurate. The first has been discussed above, and the Centre for Health Services Studies provide rebuttal to it (see REBUT-CYC/002). Now we discuss accuracy of the reference DT data.

21 When the model is verified against the DT data, the accuracy of the model outputs is dependent on the accuracy of NO_2 levels for each input DT. If the DT dataset is optimistic or pessimistic, then this will be transmitted by the verification and calibration step to the model outputs.

Norwich City Council have chosen an unusually low (optimistic) bias factor for their 2018 data, and this introduces, at outset, an optimism in the eventual model outputs. This is now explained.

5.1 Local and national bias factors

22 The reason for bias factor adjustment to DT data is explained on the DEFRA webpage on “LAQM Bias Adjustment factors” where it states[7]:

> “*Diffusion tubes are [a] useful low-cost method for indicative monitoring of ambient nitrogen dioxide (NO_2) concentrations. However, diffusion tubes are affected by several sources of interference which can cause substantial under or overestimation (often referred to as "bias") compared to the chemiluminescent analyser (defined within Europe as the reference method).*”

23 Local authorities may choose either to use locally derived bias factors from a co-location study in which the accuracy of the diffusion tubes is quantified by exposure alongside an automatic chemiluminescence analyser, or using a national bias factor which is an average of local bias factors submitted by local authorities.

[6] **CD15.126**: Norwich City Council 2019 (2018 data) Air Quality Annual Status Report

[7] https://laqm.defra.gov.uk/bias-adjustment-factors/bias-adjustment.html, accessed Jan 11th 2020

24 For Norwich, the local bias factor is calculated using the outputs of a co-location study with the Lakenfields chemiluminescent analyser[8] - the "co-location site" (details are given in the annual ASR reports).

5.2 Norwich's history of bias factors

25 For important context, we summarise Norwich CC's historic practice for bias factors. The council has calculated a local bias factor for many previous years, and, until 2019 (2018 data), **has always decided to choose the national bias factor over their locally derived one**, as shown below. The table shows the historic record from 2013, along with the reasons given for **choosing a national factor over the local factor** in each year[9].

ASR year (data year)	National factor	Local factor	Norwich chosen factor	Factor chosen	Reason for choice
2013 (2012)	1.02	1.04	1.02	National	Local bias factor derived from Lakenfields site which is a "Canyon-like" street.
2014 (2013)	1.01	1.11	1.01	National	"Canyon-like" street, as above
2015 (2014)	0.97	1.07	0.97	National	"Canyon-like" street, as above
2016 (2015)	0.96	1.09	0.96	National	"Canyon-like" street, as above. Poor data produced from automatic analyser
2017 (2016)	1.01	1.14	1.01	National	"Canyon-like" street, as above. National factor considered more accurate, following AEA checking of local data.
2018 (2017)	0.97	1.05	0.97	National	AEA checking showed local DT data imprecise.
2019 (2018)	0.92	0.86	0.86	Local	AEA checking on local tubes satisfactory.

For the six data years, 2012-2017, the bias factors that were chosen were in the range 0.96 – 1.02, average is 0.99. **For the 2019 (2018 data) ASR, Norwich has chosen a local bias factor of 0.86. This is very significantly below any previously used bias factor**: it is 0.13, or 13% below the average Norwich bias factor in all six preceding years. Such a big reduction in the bias factor against previous year trends is reflected by NCC reporting "significant reductions" in the NO_2 for 2018.

There is no evidence to believe that this represents a real reduction for 2018 (against a spurious numerical reduction) as bias factors are extremely complex, dependent on many factors and subject to considerable uncertainty. This could well be a 'spike in the data' for 2018: overall trends will not be apparent until further years of data are available.

[8] Part of the DEFRA Automatic Urban and Rural Network (AURN) https://uk-air.defra.gov.uk/networks/site-info?site_id=NO12, accessed Jan 11th 2020

[9] This information has been extracted from each ASR submitted to DEFRA for the years in questions. These have been provided to the appeal as the following core documents. 2012 data - **CD15.102**; 2013 - **CD15.103**; 2014 - **CD15.123**; 2015 - **CD15.106**; 2016 - **CD15.107**; 2017 - **CD15.104**; 2018 - **CD15.126**.

5.3 *Recent research on unreliability in bias factors from Scotland*

26 A 2018 paper from Edinburgh University and Air Quality Consultants[10] for the Scottish government reviewed the complex factors that influence local bias factors. It notes that the analyser values which are used as the reference to assess the co-located diffusion tube may themselves be subject be uncertain by up to +/-15%, as set out in the EU Directive for these measurements (ie The reference data used to generate the bias factor is itself uncertain with considerable error bounds).

27 The Norwich bias factor, and the resulting Norwich NO_2 levels, show a sharp reduction between data years 2017 and 2018. **2018 is the first year that a local bias factor has been used**, and its 13% reduction against the average for the six preceding years of bias factors fits within the +/-15% uncertainty for the reference chemiluminescent analyser, as specified in in the EU Directive.

28 A further 2019 report from the same authors[11] was commissioned by the Scottish Government to research if current practice on bias factors might be leading to misleading information on trends in NO_2 concentrations. This report found that bias factors were very dependent on the number of co-location sites contributing to the factor, and to changes in the choice of co-location sites. A recommendation, particularly relevant to this rebuttal, was that "*Uncertainty in trends derived from diffusion tubes will be reduced if bias adjustment factors are not changed from [sic between] local to national factors from year to year.*"

This all suggests that the national bias factor would have been a preferable, and more reliable, choice for the Norwich City Council DT data in 2018.

5.4 *Norwich's choice of local bias factor for 2018 data is unreliable*

29 Norwich City Council and the developers wish to attribute the sharp reduction between 2017 and 2018 data as being the result of a real reduction in NO_2 levels. This assumption then becomes implicit in the ADMS model. However, it is an untrustworthy assumption on several grounds:

i. The reference system is subject to +/- 15% uncertainty, and the low bias factor may equally likely result from errors in the chemiluminescent analyser output.

ii. For five out of six previous years, NCC rejected using local bias as the reference system was in a "canyon like" street; this objection to using a local bias factor has vanished without explanation.

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[10] **CD15.127** "A review of biases in the measurement of ambient nitrogen dioxide (NO_2) by Palmes passive diffusion tube", 2018, Heal, M, Laxen, D & Marner, B,

[11] **CD15.128** "Investigation into Diffusion Tube Bias Adjustment Factors", 2019, Heal, M, Laxen, D et al. From the Executive summary "The Scottish Government commissioned this investigation of bias correction factors used by local authorities to correct nitrogen dioxide (NO_2) passive diffusion tubes. This was in recognition of the important role played by diffusion tubes as a source of data to support the National Modelling Framework for Scotland. However, it had been noted that some bias adjustment factors had been falling year on year and the reason for this was unknown. When the correction factors were applied to diffusion tube monitoring data, they reduced the reported concentrations of NO_2 by greater amounts year on year – resulting in a reported improvement in air quality. This contrasted with an examination of uncorrected passive tube data which showed little change over the years, with an apparent fluctuation in automatic monitoring data year on year. The Scottish Government wished to understand more about the role of bias adjustment applied to diffusion tubes and **whether current practice might be leading to misleading information on trends in NO_2 concentrations.**"

iii. In previous years, the reference system or the local DT data was also rejected due to imprecise, "poor data", or needing checking by AEA consultants.

iv. Recent research in Scotland has shown that switching between local and national bias factors is inadvisable and introduces unreliability.

30 It should also be noted that when the poor choice for a bias factor is solely part of the council's annual reporting procedure to DEFRA, it affects the Council's data for year. The optimistic results generated are undesirable, but their impact is limited, and largely bureaucratic.

In this case, however, the optimistic choice of bias factor is being transmitted into a complex model of air quality for years to come. The impact is significant as it is being used to underwrite a claim that air quality will reach an acceptable level over a decade away, and the choice affects the health impacts on many people in the future.

Further NCC have not followed LAQM guidance in several respects, now laid out.

5.5 Norwich's local bias factor – divergence from LAQM guidance

31 The LAQM Technical Guidance[12] states at bullet 7.195 that:

> *"If the [local and national] factors are significantly different from each other, and/or if it makes a difference as to which sites are greater or less than 40µg/m3, then this should be clearly discussed in the LAQM report."*

Such an analysis is given below of the highest recording DT sites in 2018 where it is clear when the national bias factor is used, there are five sites greater than 40µg/m^3, whilst when the local factor is used only four sites are greater than 40µg/m^3. A further two other sites, marked (α), are extremely close to 40µg/m^3 with the national bias (and would exceed 40 with a bias factor of 0.93).

New*							Local Bias=0.86	National Bias=0.92
		2013	2014	2015	2016	2017	2018	2018
DT6	130 Magdalen Street	32.7	30.9	28.4	29.6	31.2	27.06	28.95
DT9	13 St Augustines	**45.1**	**41.9**	37.6	**40.2**	**41.5**	37.38	39.99$^{\alpha}$
DT11	52 St Augustines	**51.2**	**48.6**	**53.5**	**50.7**	**53.6**	**44.40**	**47.50**
DT13	Castle Meadow	**63.5**	**56.3**	**56.4**	**45.9**	**48.5**	**44.86**	**47.99**
DT16	Zipfel House	**40.9**	39.0	34.8	38.6	39.9	33.41	35.74
DT26	3 Riverside Rd	**52.4**	**51.2**	**47.2**	**46.7**	**44.2**	39.25	**41.99**
DT29	4 Chapelfield North	**60.9**	38.1	**43.0**	**45.8**	37.1	**41.25**	**44.13**
DT31*	Quantrell House, Queens Road						37.24	39.84$^{\alpha}$
DT34*	41 St Stephens Road						**41.22**	**44.10**

NCC have not discussed this in the LAQM report, and therefore have not followed the LAQM guidance in selecting the local bias factor.

[12] **CD11.37:** 'Local Air Quality Management Technical Guidance (TG16)'. Department for Environment Food & Rural Affairs, Feb 2018

32 The Centre for Health Services Studies also note other anomalies[13], relating to Norwich CC's choice of a local bias factor, that have not been made clear by the council including:

i. the average reduction in NO_2 between 2017 and 2018 is only 0.38 µg/m3 when the national bias factor is used, compared to 2.27 µg/m3 when the local bias factor is used

ii. the number of DTs showing an increase in NO_2 level between 2017 and 2018 is greater when the national bias factor is used.

Both these show that claims that substantial NO_2 reductions in the AQMA were made in 2018 (eg: Ae_PoE, bullet 13), do depend upon the choice of bias factor, and therefore are flimsy and depend on the choice of the extremely optimistic, local, bias factor.

33 Box 7.11 of the LAQM Technical Guidance provides guidance on selecting between local and national factors, and states '*the [national] combined bias adjustment factor may be more representative: … for co-location sites with "poor" precision or laboratories with predominately "poor" precision*'.

For DT data between 2012 and 2017, NCC always chose a national bias factor, and based their decision on lack of precise data for several years, and on the analyser being at a "canyon-like" site. For the 2018 data, they have departed from their previous practice. There have been precision issues both with the analyser, and the diffusion tubes, in previous years and, therefore, NCC have not followed the LAQM guidance on poor precision.

34 In summary, the choice of a local bias factor for the 2018 data is extremely optimistic, and this optimism is transmitted into the ADMS model, and will accumulate with further optimistic factors in the modelling.

35 If the national bias factor had been chosen, as all the above suggests would have been more reliable, then **each of the three DT measurements fed into the verifications stage would be 7% higher**.

[13] CHSS Proof of Evidence, **PoE-CYC/001**, bullets 43 – 47.

6 ADMS MODELLING

6.1 ADMS Model Configuration file (.upl)

36 On December 22nd, CEPP requested the .upl control files for the ADMS modelling. Aether finally delivered[14] these on January 8th. We appreciate it was over the Christmas period; however, the 17-day delay and delivery within 6 days of rebuttal deadline has meant the comments below cannot be complete. Despite the short time to review this data, we have found some important issues.

6.2 Incomplete and inaccurate street canyon modelling

37 The CERC ADMS-Roads manual, version 4.1.1, page 29 describes how to set up a basic street canyon model and is reproduced below.

> ***The basic street canyon model***
>
> The basic street canyon model takes account of the additional turbulent flow patterns occurring inside a street with relatively tall buildings on both sides, known as a "street canyon". It only affects results at output points inside the street canyon, at heights below the height of the canyon. For such roads, the appropriate road width to enter is the building edge to building edge distance. Only roads with a canyon height greater than 0.5 m are modelled as basic street canyons, so for roads with canyon height less than 0.5 m, you should enter the actual road (carriageway) width. As mentioned above, the minimum road width allowed is 2 m.

The point that the road width must be building façade to building façade is critical. If this is not the case, then the receptor is not properly positioned, and significantly lower pollution concentrations will be modelled. In the table below, we have extracted the data where street modelling is switched on (by a street height of >0.5m), and Edward Street for which the street canyon modelling is not switched on.

[14] Initial request email, Andrew Boswell to Aether and others, 22 Dec 2019, 23:01; Data delivery email, Melanie Hobson to Andrew Boswell and others, 8 Jan 2020, 09:45.

Receptor (name as in .upl file)	"With Dev", "Policy Applied" file	"With Dev", "Policy Applied" file	Street canyon modelling
	Street width parameter	Street height parameter	
	SrcL1	SrcL2	
MagdelenTraffic1 & MagdelenTraffic2 & MagdelenTraffic3 & MagdelenTraffic4	4m	8.5m	✓
MagdelenRd_S2	5m	6.5m	✓
MagdelenRd_N	5m	8.5m	✓
StAugustinesSt & StAugustineTraffic1	3m	8.5m	✓
StAugustinesTraffic2 & StAugustinesTraffic3 & StAugustinesTraffic4	4m	8.5m	✓
CalvertStMinor	5m	1m	✓
CowgateMinor	5m	6.5m	✓
BullClMinor	4m	6.5m	✓
EdwardStTraffic1 & EdwardTraffic2 & EdwardSt_S &	4m	0m	☒
EdwardSt_N	6m	0m	☒

38 The above table corresponds to AQA V3, section 2.2.1 which states "*sections of Magdalen Street, St Augustines Street, Cowgate, Bull Close and Calvert Street have been modelled as street canyons.*" However, the street width parameters appear to be the road width, not building façade to building façade, and therefore the model will underestimate the NO_2 level.

39 PoE-CYC/001 from CHSS, section 5.3. already noted that Edward Street appeared to not be included in the street canyon modelling. The above confirms that Edward Street was not modelled as a street canyon in Aether's "with development" scenarios. It is particularly important that it should be modelled as Edward Street has the highest NO_2 level, and the NICE guidelines recommend not creating street canyons in new developments.

6.3 Meteorological data

40 AQA V3, page 10, states "Hourly meteorological data from Norwich for 2018 has been used in the model." The meteorological data to be used is defined as year **2009** for both the base year, and all six 2031 scenario files (parameter "Metsubsetyearstart"). It is not clear that the meteorological data being used is for the correct city or year.

41 The CERC ADMS-Roads manual, version 4.1.1, page 51 describes setting surface roughness in the model, with parameters as below.

Land use	Surface roughness (m)
Large urban areas	1.5
Cities, woodlands	1
Parkland, open suburbia	0.5
Agricultural areas (max)	0.3
Agricultural areas (min)	0.2
Root crops	0.1
Open grassland	0.02
Short grass	0.005
Sea	0.0001

Table 3.9 – The surface roughness for the different land uses available on the **Meteorology** screen.

42 The relevant model parameters "Met_DS_Roughness" and "Met_MS_Roughness" are both set to 0.5: this defines the surface roughness at the Norwich Airport meteorological site to be the same as the modelled development area in the City. The purpose of setting surface roughness is to correctly calibrate wind speed between the meteorological site and the development location. The impact of these settings in the model is that they create higher wind speeds that are likely to disperse pollutants better in the model than in the real world.

7 VERIFICATION STEP – SUBSTITUTED REFERENCED DATA LESS TRUSTWORTHY

43 The key issue with the verification step is that there needs to be at least another 12 existing sensitive receptors in the model, close to where people are currently living and working. The three diffusion tubes, outside the site are totally inadequate.

44 The results from AQA V1/V2 which had more diffusion tubes within the development were thrown away. This was most likely because the results are highly unfavourable to Aether's desired outcome. The suggestion that the Norwich City Council 2018 data is better because it is one year later (more up to date) should not be accepted at face value.

8 UNNECESSARY AND FABRICATED "PROXY" MODELLING SCENARIO

45 The "proxy" modelling scenario introduced in AQA V3 is a fabricated and completely arbitrary configuration. It does not add useful information as the issue of concern for the appeal is the absolute levels of hazardous pollutants, NO_2, PM10 and PM2.5, in the "with development" scenario. It is the absolute levels of these substances which determine the impact of the development on the public health crisis. This proxy model provides no useful information on this key, or any other relevant, issue.

9 POLICY LANDSCAPES: ASSESSING RISK OF POLICY FAILURE

46 In replacing AQA V1/V2 with AQA V3, Aether present two distinct policy scenarios. In the ADMS computer model, these are represented by two distinct and polar configurations of the ADMS computer model:

i. "No Policy Applied" assumes that no air quality policy interventions are applied between now and 2031.

ii. "Policy Applied" assumes a super-set of policy interventions, national and local, each of which is delivered with 100% success.

47 Neither is realistic, as each represents an extreme policy delivery scenario. The IAQM have published a short paper on dealing with such uncertainty[15] in AQAs, and where the DEFRA Emissions Factors Toolkit (EFT) is being used to model policy interventions, as is the case in AQA V3.

Uncertainty can come from main two sources:

i. **technical:** over-estimating the impact of the European diesel vehicle emission standards on NO_x/NO_2 emissions which results in the modelling under-estimating future concentrations. Recent EFT versions have improved, but there remains the uncertainty discussed by IAQM.

ii. **political:** the failure of some policy interventions implicit in the emissions factors to be delivered. Time and time again delivery on environmental policies is delayed at all levels of government; for example, it was the delay, and lack of delivery focus, that led to the successive ClientEarth cases against the UK Governments and its Air Quality plan. In that case, only judicial action compelled the necessary action by policymakers.

Examples, relevant to AQA V3, might be the uptake of electric vehicles being at a slower rate than policy projections, or transport assumptions relevant to how the parking facilities of Anglia Square will be used to underestimate traffic generation.

The reality is that different policy interventions will work with different levels of success, and that there is a spectrum of reality between these two extreme configurations implied in the modelling.

[15] **CD15.YY** Dealing with Uncertainty in Vehicle NOx Emissions within Air Quality Assessments, V1.1', Institute of Air Quality Management, Jul. 2018 [Online]. Available: https://iaqm.co.uk/text/position_statements/uncertainty_vehicle_NOx_emissions.pdf

48 Aether base their entire case on the ADMS model outputs, but they do not address the uncertainty, and risk of policy failure, for the "policy applied" scenario. However, the IAQM state:

> *"It is important that air quality practitioners acknowledge the uncertainty in the EFT emissions factors and future vehicle composition and that they adequately account for this uncertainty when predicting future NO_2 concentrations. There are a number of approaches that could be taken,* ***including applying a sensitivity test that assumes NOx emissions will not reduce as rapidly as shown by the EFT.****"*

49 Aether have only understood a sensitivity test to mean testing the two extreme configurations of their model described above. AQA V3 states on page 2:

> "*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.*
> …
> *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.*"

50 However, this does not test the real-world ground between the extremes in which emissions may not "*reduce as rapidly as shown by the EFT*", either due to technical inaccuracies within the EFT, or failure to deliver policy interventions. By contrast, IAQM propose testing **graduations of EFT reduction** as "sensitivity testing". Aether have not performed this in their modelling.

51 IAQM recommend a "precautionary approach" to AQA modelling based on emission factors, and graduated sensitivity testing is required for a precautionary approach. In the next section, we illustrate what the model outputs would look like in the graduated sensitivity testing that Aether have omitted based on their model outputs.

52 Is it important to note that these risk assessments of policy follow from the issues already raised: bias factor selection in NCC 2018 data, issues with the ADMS model, all of which we have shown to be based on optimistic assumptions that accumulate. So, every conclusion that we reach below, in isolation, will be greater when taken in the round.

9.1 Graduated EFT/policy sensitivity testing

53 Using the AQA V3 model outputs and a simple spreadsheet model[16], we have assessed below, the effect on overall NO_2 levels by 20%, 40%, 60% and 80% EFT/policy delivery, for the ground level receptor values for "without development" and "with development". This illustrates NO_2 levels change by a graduated policy delivery between the two extreme polar policy models of 0% and 100% in AQA V3:

	"Without Development", 2031, NO_2 µg/m³						
Floor level	Receptor						
	Policy Extent	**0% "No policy"**	**20%**	**40%**	**60%**	**80%**	**100% "Policy applied"**
	DT6 130 Magdalen Street	25.0	23.3	21.6	20.0	18.3	16.6
	DT9 13 St Augustines	39.2	36.0	32.7	29.5	26.2	23.0
	DT11 52 St Augustines	**40.3**	37.0	33.7	30.4	27.1	23.8
Ground	A	**56.8**	**52.7**	**48.6**	**44.5**	**40.4**	36.3
Ground	B	**53.9**	**50.1**	**46.3**	**42.5**	38.7	34.9
Ground	C	26.6	24.8	22.9	21.1	19.2	17.4
Ground	D	25.6	23.8	22.0	20.1	18.3	16.5
Ground	E	35.8	32.8	29.7	26.7	23.6	20.6
Ground	F	38.1	34.9	31.8	28.6	25.5	22.3
Ground	G	**54.1**	**50.1**	**46.0**	**42.0**	37.9	33.9
Ground	H	**44.4**	**40.9**	37.5	34.0	30.6	27.1
Ground	I	26.2	24.3	22.5	20.6	18.8	16.9

[16] We use a straight-forward linear extrapolation between the two extreme scenarios. So, for example, 60% policy delivery is modelled as 60% of the change to NO_2 level for each receptor.

	“With Development”, 2031, NO_2 µg/m³						
Floor level	Receptor						
	Policy Extent	0% "No policy"	20%	40%	60%	80%	100% "Policy applied"
	DT6 130 Magdalen Street	25.3	23.6	21.8	20.1	18.3	16.6
	DT9 13 St Augustines	**40.3**	36.9	33.4	30.0	26.5	23.1
	DT11 52 St Augustines	**41.6**	38.1	34.5	31.0	27.4	23.9
Ground	A	**58.9**	**54.5**	**50.1**	**45.7**	**41.3**	36.9
Ground	B	**54.2**	**50.4**	**46.5**	**42.7**	38.8	35.0
Ground	C	27.1	25.2	23.3	21.3	19.4	17.5
Ground	D	25.9	24.0	22.2	20.3	18.5	16.6
Ground	E	36.1	33.0	29.9	26.9	23.8	20.7
Ground	F	39.0	35.7	32.4	29.2	25.9	22.6
Ground	G	**55.3**	**51.1**	**46.9**	**42.7**	38.5	34.3
Ground	H	**45.5**	**41.9**	38.2	34.6	30.9	27.3
Ground	I	26.7	24.8	22.8	20.9	18.9	17.0

These results show that, even assuming the NCC bias factors and ADMS model are correct:

i. Over 80% policy delivery is needed to achieve the annual objective level for both “without development” and “with development” for receptor A. 86% policy delivery[17] is required for A to achieve the objective level in the “with development” case.

ii. Over 60% policy delivery is needed to achieve the annual objective level for both “without development” and “with development” for receptors B and G. 74% policy delivery is required for B, and 73% policy delivery is required for G[18], to achieve the objective level in the “with development” case.

9.2 Significance of impacts in graduation policy sensitivity testing

54 Aether calculate “significance” using the Environmental Protection UK’s Air Quality Guidance Document[19]. This procedure may be applied to the receptors for different levels of policy extent. This section should be read with reference to the CHSS Rebuttal (REBUT-CYC/002), bullets 6 to 10. CHSS identify ground floor flats (“Dalymond Court”) in Edward St close to receptor G and same road as receptor A. It is therefore appropriate to calculate significance for AQAL of 40 NO_2 µg/m³.

Below we extend the CHSS Table 1 with linear increments of “Policy Applied” and calculate significance. As we use AQAL of 40 NO_2 µg/m³, our 0% column is the same as CHSS Table 1 “Impact at 40 NO_2 µg/m³” column.

[17] Calculated by linear interpolation in our working spreadsheet from which the table is extracted

[18] Calculated by linear interpolation in our working spreadsheet from which the table is extracted

[19] CD15.108 Environmental Protection Agency, “Land-Use Planning & Development Control: Planning For Air Quality”

	"With Development, 2031"	Significance compared to without development					
Floor	Receptor						
	Policy Extent	0%	20%	40%	60%	80%	100%
	DT6 130 Magdalen Street	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
	DT9 13 St Augustines	Moderate	Slight	Slight	Negligible	Negligible	Negligible
	DT11 52 St Augustines	Moderate	Moderate	Slight	Slight	Negligible	Negligible
Ground	A	Substantial	Substantial	Substantial	Substantial	Moderate	Slight
Ground	B	Moderate	Moderate	Moderate	Moderate	Slight	Negligible
Ground	C	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Ground	D	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Ground	E	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Ground	F	Moderate	Slight	Slight	Negligible	Negligible	Negligible
Ground	G	Substantial	Substantial	Substantial	Moderate	Slight	Negligible
Ground	H	Substantial	Moderate	Moderate	Slight	Negligible	Negligible
Ground	I	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

55 Over 60% policy delivery is required remove "substantial" impacts of the development, and over 80% to remove "moderate" impacts. Over 95% policy delivery is required to remove "moderate" impacts of the development[20]. Our Proof of Evidence (POE-CYC/101), noted at bullet 28 that **Inspector Roger Clews in the Gladman planning appeal related 'moderate adverse' impacts on air quality to a likelihood to have a significant adverse effect on human health**.

9.3 What does "policy applied" mean?

56 This section clarifies what is meant by the "policy applied" scenario. The Aether description is confusing; and it also conflates data, or data sets, with policy. Three different descriptions are given at Ae_PoE, pages 3 and 4, where seven different model scenarios are described:

- "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*"

- "the predicted impact of improvements to the fleet emission factors and background concentrations as a result of *UK air quality strategy*"

- "the predicted impact of improvements to the fleet emission factors, *applied using the Defra EFT*, and background concentrations, *applied using Defra background pollutant concentration maps*, as a result of UK air quality strategy"

[20] Calculated by linear interpolation in our working spreadsheet from which the table is extracted

Further, at bullet 15, Ae_PoE states:

"*The national government policy will be enhanced by NCC's commitment to their air quality action plan.*"

57 Five distinct entities contribute, therefore, to the "Policy Applied" concept:

(A) fleet emission factors numerically applied by the Defra EFT.

(B) background concentrations, applied in ADMS by using Defra background pollutant concentration maps

(C) the UK's road to zero strategy

(D) the UK air quality strategy. (Aether don't specify it, but we believe this is a reference to the 2019 air quality strategy that is called the "Clean Air Strategy 2019").

(E) the local air quality action plan

(A) and (B) are data whilst (C), (D) and (E) are policies and documents.

Aether imply that full 100% delivery of policies (C), (D) and (E) result in "predicted improvements" that are captured, or defined, numerically in data sets (A) and (B).

58 However, for (A), the user manual of EFT v9.0 which is the latest version suggests the EFT, rather than being a definitive, and predictive, description of Government policy as implied by Aether, it is a much more experimental system for exploring policies at the local level. It states:

"*The EFT is published by Defra and the Devolved Administrations to assist local authorities in carrying out Review and Assessment of local air quality as part of their duties under the Environment Act 1995. It is of particular interest for use in the assessment of measures implemented as part of LAQM Air Quality Action Plans (AQAPs), and policy interventions on road traffic emissions, such as the Clean Air Zones (CAZs) and other measures, that form part of the UK national plan on compliance with EU Limit Values. It is a tool that allows users to calculate road vehicle pollutant emission rates for oxides of nitrogen (NOx) and Particulate Matter (PM - PM10 and PM2.5), for a specified year, road type, vehicle speed and vehicle fleet composition. Carbon dioxide (CO2) emission rates can also be calculated for petrol, diesel and alternative fuelled vehicles.*"

59 At the end of the day, the numbers in the EFT are only as reliable as the delivery of Government policy in an extremely technical and socially challenging area of transport. Government policy to tackle carbon emissions in transport has serially failed (emissions rising), air quality policy has serially failed (Government has been in Court three times): there is no reason to believe that air quality objectives will be met over the next decade.

9.4 The national policies invoked are only qualitative and susceptible to failure

60 The national policy statements referenced by Aether – the 2018 "The Road to Zero" and the "Clean Air Strategy 2019" - are documents that are qualitative. They do encompass the Government's best aspiration, but they comprise a set of grand statements, largely without targets. They operate largely, as do much government policies, through incentives, subsidies and encouragements, rather than legally binding targets. They do enshrine the long-term aspiration to reduce air pollution from transport, but they are susceptible to policy failure, especially in terms of the degree of policy delivered.

For example, it has recently been widely reported that policies to reduce vehicle emissions have been undermined by the massive growth in SUV vehicles which was not expected by policymakers[21]. Despite government policies to reduce average CO2 emissions of vehicles, they have increased in the UK for three years running.

61 Furthermore, it is not clear for many policies in these documents whether they extend as far as 2030 and 2031.

9.5 The legal implications for "Policy Applied" scenario

62 In our Proof of Evidence (PoE-CYC/101), we discussed the ClientEarth cases, and the Gladman case. The Gladman High Court judgement upheld (later upheld in the Appeal Court) that "*the Inspector could not reach any view as to whether the measures in the new National Air Quality Plan would be likely to be effective in securing compliance by any particular date"* (PoE-CYC/101, bullet 29 (A))

63 So, development consent cannot rely on presuming "UK will become compliant" with the Air Quality Directive, or that "UK Policy will be delivered 100%" by a certain date. The clear implications are that consent for Anglia Square cannot depend upon "plan and/or policy" measures being effective by any particular date.

Here, "plan and/or policy" include both datasets, that purport to represent policy, and policy itself: ie all the elements of the (A) – (E) elements of the "Policy Applied" scenario described above.

[21] See, "Average CO2 emissions of cars sold in UK up for third year in row", Guardian, 6th January 2020, https://www.theguardian.com/business/2020/jan/06/uk-car-sales-brexit-diesel-electric-vehicles-emissions

10 CONCLUSIONS

64 If there is any doubt that AQA V3 can deliver what it claims (legal air quality in 2031 in Anglia Square and surroundings), then the AQA V3 cannot be relied upon to meet the requirement of current UK legislation (formerly European) that the UK must move to "*compliance within the shortest possible time*", which has been serially enforced by the UK High and Supreme courts without any reservation of judicial opinion.

65 There are many reasons to doubt that AQA V3 shows that legal air quality can be delivered in 2031, these include:

i. For verification, the modelling uses NCC data from 2018 which has had an optimistic and untrustworthy bias factor applied.

ii. For verification, the modelling uses three data points that do not represent the area. This is also an extremely small sample and does not capture the complexity of the Anglia Square area.

iii. A street canyon created by the development at the point of highest NO_2 has not been modelled. Street canyons that have been modelled, have not been modelled correctly.

iv. The "Policy Applied" scenario is an extreme scenario. There has been no sensitivity testing of scenarios where NO_2 emissions do not reduce as rapidly as the EFT predicts, despite this being recommended practice.

v. There is no reason to believe that "Policy Applied" is a realistic proposition that can be fully delivered.

11 POSTSCRIPT: NOTIFICATION OF ERROR

66 The text above Table 3 on AQA V3, page 9, says "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."

67 However, Table 3 shows that DT9 exceeded the annual mean NO_2 objective in 2016 and 2017.

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