Air Quality
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Air Quality Assessment: Land to the West of Bridgend

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Document Control

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Executive Summary

The air quality impacts associated with the proposed residential development of land to the west of Bridgend have been assessed.

The assessment has demonstrated that future residents of the proposed development site will experience acceptable air quality, with pollutant concentrations below the air quality objectives.

Worst-case modelling carried out for the year 2022 suggested a risk of adverse impacts at 6-8 properties along Park Street, in Bridgend's air quality management area, as a result of development-generated traffic emissions. However, it is now considered unlikely that any new homes within the development will be occupied before 2024, and the development is unlikely to be complete and thus generating its full traffic volumes until the 2030s. Given these factors, and applying professional judgement, it is considered most likely that the actual impact of the development at these 8 homes will actually be negligible in all years from the first occupation in 2024, and that concentrations at these properties will be below the objective in those years. Impacts elsewhere were all negligible even in the worst-case 2022 scenario.

Overall, the operational air quality effects of the proposed development are judged to be 'not significant'.

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1 Introduction

1.1 This report describes the potential air quality impacts associated with the proposed residential development of open land 2 km to the west of Bridgend town centre, north of the A473 (hereafter described as the 'Site'). The assessment has been carried out by Air Quality Consultants Ltd on behalf of Llanmoor Development Co Limited.

1.2 The proposed development will consist of up to 850 residential dwellings (hereafter referred as the 'proposed development'). The Site lies approximately 2 km west of an Air Quality Management Area (AQMA) declared by Bridgend County Borough Council (BCBC) for exceedances of the annual mean nitrogen dioxide (NO_2) objective. The development will lead to changes in vehicle flows on local roads, which may impact on air quality at existing residential properties, including those within the AQMA. The new residential properties will also be subject to the impacts of road traffic emissions from the adjacent road network. The main air pollutants of concern related to road traffic emissions are nitrogen dioxide (NO_2) and fine particulate matter (PM_{10} and $PM_{2.5}$).

1.3 This report describes existing local air quality conditions (for the base year 2018 to be consistent with the latest year of monitoring data from BCBC), and the predicted air quality in the future assuming that the proposed development does, or does not proceed. The assessment of traffic-related impacts focuses on 2022, which was the original anticipated year of first occupation of any of the new homes (this is now unlikely to be prior to 2024).

1.4 This report has been prepared taking into account all relevant local and national guidance and regulations.

2 Policy Context and Assessment Criteria

2.1 The United Kingdom formally left the European Union (EU) on 31 January 2020; until the end of 2020 there will be a transition period while the UK and EU negotiate additional arrangements. During this period EU rules and regulations will continue to apply to the UK. All European legislation referred to in this report is written into UK law and will remain in place beyond 2020, unless amended, although there is uncertainty at this point in time as to who will enforce the requirements of some of this legislation.

Air Quality Strategy

2.2 The Air Quality Strategy (Defra, 2007) published by the Department for Environment, Food, and Rural Affairs (Defra) and Devolved Administrations, provides the policy framework for air quality management and assessment in the UK. It provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the objectives.

Clean Air Strategy 2019

2.3 The Clean Air Strategy (Defra, 2019a) sets out a wide range of actions by which the UK Government, in partnership with the Governments of Scotland, Wales and Northern Ireland, will seek to reduce pollutant emissions and improve air quality. Actions are targeted at four main sources of emissions: Transport, Domestic, Farming and Industry. At this stage, there is no straightforward way to take account of the expected future benefits to air quality within this assessment.

The Clean Air Plan for Wales

2.4 The consultation draft of the Clean Air Plan for Wales was published in December 2019 (Welsh Government, 2019). This sets out interventions to improve air quality and how they align with other Welsh plans and policies, and includes a priority to develop a Clean Air Act for Wales. In addition, it includes plans to consult on new targets for particulate matter, carry out a review of the LAQM and Smoke Control regimes, publish a Clean Air Zone (CAZ) Framework, and increase awareness of the influence of both indoor and outdoor air quality on public health.

Reducing Emissions from Road Transport: Road to Zero Strategy

2.5 The Office for Low Emission Vehicles (OLEV) and Department for Transport (DfT) published a Policy Paper (DfT, 2018) in July 2018 outlining how the government will support the transition to zero tailpipe emission road transport and reduce tailpipe emissions from conventional vehicles during the transition. This paper affirms the Government's pledge to end the sale of new conventional petrol and diesel cars and vans by 2040, and states that the Government expects the majority of new cars and vans sold to be 100% zero tailpipe emission and all new cars and vans to have significant zero tailpipe emission capability by this year, and that by 2050 almost every car and van should have zero tailpipe emissions. It states that the Government wants to see at least 50%, and as many as 70%, of new car sales, and up to 40% of new van sales, being ultra-low emission by 2030.

2.6 The paper sets out a number of measures by which Government will support this transition, but is clear that Government expects this transition to be industry and consumer led. The Government has since announced *"plans to bring forward an end to the sale of new petrol and diesel cars and vans to 2035, or earlier if a faster transition is feasible, subject to consultation, as well as including hybrids for the first time"*. If these ambitions are realised then road traffic-related NOx emissions can be expected to reduce significantly over the coming decades, likely beyond the scale of reductions forecast in the tools utilised in carrying out this air quality assessment.

Planning Policy

National Policies

2.7 Land-use planning policy in Wales is established within the policy document Planning Policy Wales (PPW) (Welsh Government, 2018a), which provides the strategic policy framework for the effective preparation of local planning authority development plans. With regard to pollution and health effects, it states:

"Planning authorities have a role to play in the prevention of physical and mental illnesses caused, or exacerbated, by pollution, disconnection of people from social activities (which contributes to loneliness) as well as the promotion of travel patterns which facilitate active lifestyles. The planning system must consider the impacts of new development on existing communities and maximise health protection and well-being and safeguard amenity. This will include considering the provision of, and access to, community and health assets, such as community halls, libraries, doctor's surgeries and hospitals. Health impacts should be minimised in all instances, and particularly where new development could have an adverse impact on health, amenity and well-being. In such circumstances, where health or amenity impacts cannot be overcome satisfactorily, development should be refused".

"Planning authorities should develop and maintain places that support healthy, active lifestyles across all age and socio-economic groups, recognising that investment in walking and cycling

infrastructure can be an effective preventative measure which reduces financial pressures on public services in the longer term. The way a development is laid out and arranged can influence people's behaviours and decisions and can provide effective mitigation against air and noise pollution. Effective planning can provide calming, tranquil surroundings as well as stimulating and sensory environments, both of these make an important contribution to successful places"

"Green infrastructure can be an effective means of enhancing health and well-being, through linking dwellings, workplaces and community facilities and providing high quality, accessible green spaces. In all development and in public spaces especially, there should be sensitive management of light, and exposure to airborne pollution should be kept as low as reasonably practicable. The compatibility of land uses will be a key factor in addressing air quality and creating appropriate soundscapes which are conducive to, and reflective of, particular social and cultural activities and experiences, particularly in busy central areas of towns and cities. Equally, the provision of quiet, tranquil areas which provide peaceful sanctuaries in otherwise noisy environments can help to reduce general levels of pollution and promote both mental and physical well-being".

2.8 PPW places a general presumption in favour of sustainable development, stressing the importance of local development plans, and states that the planning system should perform an environmental role to minimise pollution. Local development plans should enable consideration of the effects that the proposed development may have on air quality, as well as the effect that air quality may have on the proposed development. To prevent unacceptable risks from air pollution, planning decisions should ensure that new development is appropriate for its location.

2.9 PPW also places considerable emphasis on the Well-being of Future Generations Act (Welsh Government, 2015) with the intention to improve the social, economic, environmental and cultural well-being of Wales, and outlines how this can be achieved through the concept of 'Placemaking'.

2.10 PPW is supported by a series of Technical Advice Notes (TANs) and National Assembly for Wales Circulars. Local planning authorities have to take PPW, TANs and Circulars into account when preparing Development Plans.

2.11 With respect to planning policy guidance, TAN 18 on transport (Welsh Government, 2007) makes reference to local air quality and the need for Air Quality Action Plans to be prepared for any Air Quality Management Areas declared.

2.12 The need for compliance with any statutory air quality limit values and objectives is stressed, and the presence of AQMAs must be accounted for in terms of the cumulative impacts on air quality from individual sites in local areas. New developments in AQMAs should be consistent with local air quality action plans.

Local Transport Plan

2.13 The Bridgend County Borough Council Local Transport Plan (LTP) 2015 – 2030 was published in 2015 (BCBC, 2015). It sets out priorities for transport over the 15-year period. With relevance to air quality, Key Priority (KP) 4 sets out to:

"Encourage safer, healthier and sustainable travel to achieve:

- *Increased take up of active and sustainable travel;*
- *Reduced number of personal injury accidents;*
- *Reduction in the negative impact of transport emissions on health and the environment;*
- *Increased number of journeys to tourism destinations being made by sustainable and active travel modes."*

2.14 Additionally, in specific relation to nitrogen dioxide and PM_{10}, the LTP states:

"*Consistent exposure over long periods to these pollutants affects the health of residents, especially those who live closely adjacent to sensitive sites. It is therefore necessary that the LTP identifies measures that would help reduce the level of pollution."*

2.15 These measures include: the promotion and improvements to sustainable and active travel alternatives; improvements to public transport infrastructure and services; improvements to key junctions; and the implementation of strategic highways proposal.

Local Policies

2.16 The Bridgend Local Development Plan 2006-2021 (BCBC, 2013) was adopted in September 2013 and contains Strategic Policy SP2 relating to *Design and Sustainable Place Making*, which states:

"All development should contribute to creating high quality, attractive, sustainable places which enhance the community in which they are located, whilst having full regard to the natural, historic and built environment by…

8) Avoiding or minimising noise, air, soil and water pollution…"

2.17 In addition to Strategic Policy SP2, the Local Development Plan contains Policy ENV7 relating to *Natural Resource Protection and Public Health*, and states:

"Development proposals will only be permitted where it can be demonstrated that they would not cause a new, or exacerbate an existing, unacceptable risk of harm to health, biodiversity and/or local amenity due to:

1) Air pollution…

Development in areas currently subject to the above will need to demonstrate mitigation measures to reduce the risk of harm to public health, biodiversity and/or local amenity to an acceptable level."

Air Quality Action Plans

National Air Quality Plan

2.18 Defra has produced an Air Quality Plan to tackle roadside nitrogen dioxide concentrations in the UK (Defra, 2017); a supplement to the 2017 Plan (Defra, 2018a) was published in October 2018 and sets out the steps Government is taking in relation to a further 33 local authorities where shorter-term exceedances of the limit value were identified.

Welsh Government Supplemental Air Quality Plan

2.19 The Welsh Government has produced a supplemental plan to the 2017 UK plan for tackling roadside nitrogen dioxide concentrations (Welsh Government, 2018b). The document sets out the work done to date to identify how the Welsh Government will reduce concentrations of nitrogen dioxide around roads where levels are above legal limits. The plan expands on Section 7.6 (Additional Actions in Wales) of the 2017 UK plan for tackling roadside nitrogen dioxide concentrations, and sets out how the Welsh Government will comply within the shortest possible time with the limit values for nitrogen dioxide.

Local Air Quality Action Plan

2.20 BCBC declared an AQMA for nitrogen dioxide on January 1st 2019. This covers the area between 39 and 105 Park Street, incorporating all north facing properties, including open space areas, and open space areas that front the south facing properties encapsulating the public access pathway. This declared AQMA is located approximately 2 km east of the Site. The Council is in the process of preparing an Air Quality Action Plan, outlining proposed measures to improve air quality within the AQMA. At the time of writing, the Air Quality Action Plan had not been published.

Assessment Criteria

2.21 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality (Wales) Regulations (2000) and the Air Quality (Amendment) (Wales) Regulations (2002).

2.22 The UK-wide objectives for nitrogen dioxide and PM_{10} were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. The $PM_{2.5}$ objective is to be achieved by 2020. Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded at roadside locations where the annual mean concentration is below 60 µg/m^3 (Defra, 2018b). Therefore, 1-hour nitrogen dioxide concentrations will only be considered if the annual mean concentration is above this level. Measurements have also shown that the 24-hour mean PM_{10} objective could be exceeded at roadside locations where the annual mean concentration is above 32 µg/m^3 (Defra, 2018b). The predicted annual mean PM_{10} concentrations are thus used as a proxy to determine the likelihood of an exceedance of the 24-hour mean PM_{10} objective. Where predicted annual mean concentrations are below 32 µg/m^3 it is unlikely that the 24-hour mean objective will be exceeded.

2.23 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2018b). The annual mean objectives for nitrogen dioxide and PM_{10} are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 24-hour mean objective for PM_{10} is considered to apply at the same locations as the annual mean objective, as well as in gardens of residential properties and at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.

2.24 EU Directive 2008/50/EC (The European Parliament and the Council of the European Union, 2008) sets limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$, and is implemented in UK law through the Air Quality Standards Regulations (2010). The limit values for nitrogen dioxide are the same numerical concentrations as the UK objectives, but achievement of these values is a national obligation rather than a local one. In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values. Central Government does not normally recognise local authority monitoring or local modelling studies when determining the likelihood of the limit values being exceeded, unless such studies have been audited and approved by Defra and DfT's Joint Air Quality Unit (JAQU).

2.25 The relevant air quality criteria for this assessment are provided in Table 1.

Table 1: Air Quality Criteria for Nitrogen Dioxide, PM_{10} and $PM_{2.5}$

Pollutant	Time Period	Objective
Nitrogen Dioxide	1-hour Mean	200 µg/m^3 not to be exceeded more than 18 times a year
	Annual Mean	40 µg/m^3
Fine Particles (PM_{10})	24-hour Mean	50 µg/m^3 not to be exceeded more than 35 times a year
	Annual Mean	40 µg/m^3 [a]
Fine Particles ($PM_{2.5}$) [b]	Annual Mean	25 µg/m^3

[a] A proxy value of 32 µg/m^3 as an annual mean is used in this assessment to assess the likelihood of the 24-hour mean PM_{10} objective being exceeded. Measurements have shown that, above this concentration, exceedances of the 24-hour mean PM_{10} objective are possible (Defra, 2018b).

[b] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Descriptors for Air Quality Impacts and Assessment of Significance

2.26 There is no official guidance in the UK in relation to development control on how to describe air quality impacts, nor how to assess their significance. The approach developed jointly by Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)[1] (Moorcroft and Barrowcliffe et al, 2017) This includes defining descriptors of the impacts at individual receptors, which take account of the percentage change in concentrations relative to the relevant air quality objective, rounded to the nearest whole number, and the absolute concentration relative to the objective. The overall significance of the air quality impacts is determined using professional judgement, taking account of the impact descriptors. Full details of the EPUK/IAQM approach are provided in Appendix A1. The approach includes elements of professional judgement, and the experience of the consultants preparing the report is set out in Appendix A2.

[1] The IAQM is the professional body for air quality practitioners in the UK.

3 Assessment Approach

Existing Conditions

3.1 Existing sources of emissions within the study area have been defined using a number of approaches. Industrial and waste management sources that may affect the area have been identified using Defra's Pollutant Release and Transfer Register (Defra, 2020a). Local sources have also been identified through examination of the Council's Air Quality Review and Assessment reports.

3.2 Information on existing air quality has been obtained by collating the results of monitoring carried out by the local authority. Background concentrations have been defined using the 2017-based national pollution maps published by Defra (2020b). These cover the whole of the UK on a 1x1 km grid.

3.3 Whether or not there are any exceedances of the annual mean EU limit value for nitrogen dioxide in the study area has been identified using the maps of roadside concentrations published by Defra (2019b) (2020c). These maps are used by the UK Government, together with the results from national Automatic Urban and Rural Network (AURN) monitoring sites that operate to EU data quality standards to report exceedances of the limit value to the EU. The national maps of roadside PM_{10} and $PM_{2.5}$ concentrations (Defra, 2020c), which are available for the years 2009 to 2018, show no exceedances of the limit values anywhere in the UK in 2018.

Road Traffic Impacts

Sensitive Locations

3.4 Concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been predicted at a number of locations both within, and close to, the proposed development. Receptors have been identified to represent a range of exposure, including worst-case locations. When selecting receptors, particular attention has been paid to assessing impacts close to junctions, where traffic may become congested and where there is a combined effect of several road links, and close to those roads where the traffic increases as a result of the proposed development will be greatest.

3.5 Thirty-five existing residential properties have been identified as receptors for the assessment. Four additional receptors have been identified within the proposed development, representing worst-case potential exposure close to the A473. The modelled receptors are shown in Figure 1.

3.6 In addition, predicted concentrations have been modelled at diffusion tube monitoring sites at Ewenny Cross Roundabout, 41 and 49 Park street, and 19 and 43 Tondu Road, south and north of the roundabout respectively, in order to verify the model outputs and apply an adjustment where necessary (see Appendix A3 for verification method).

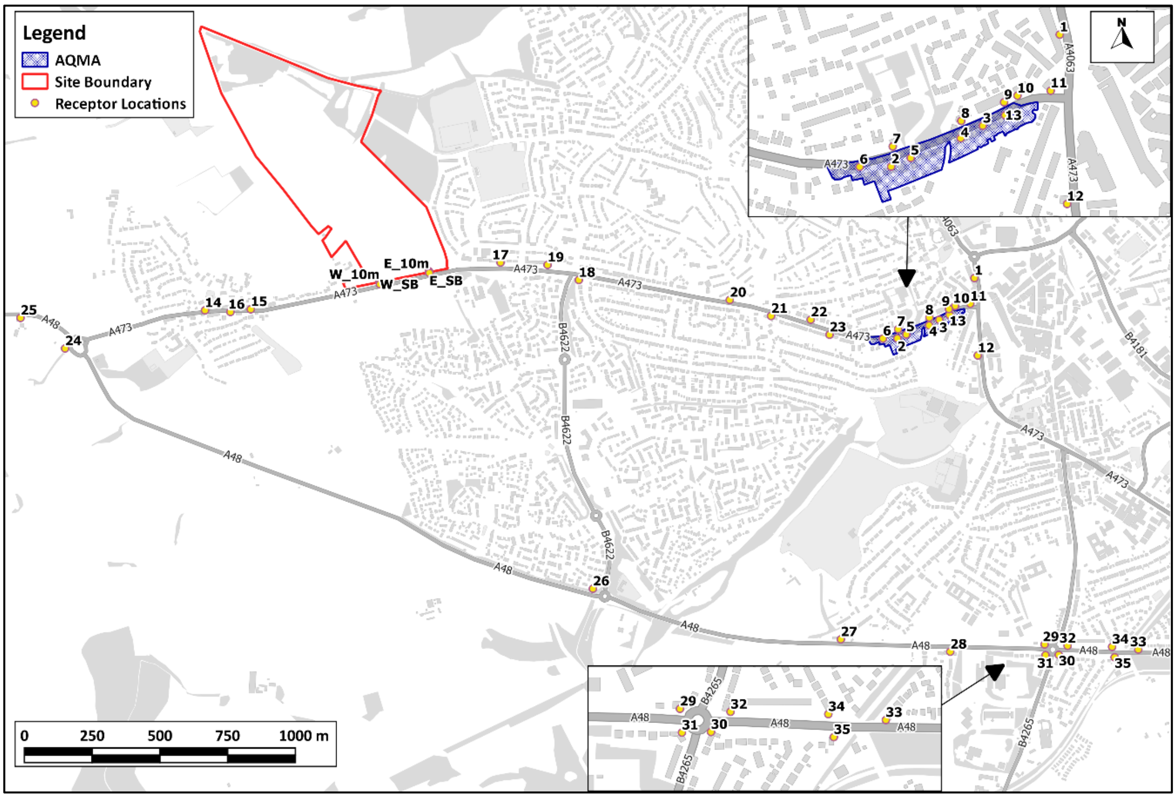

Figure 1: Receptor Locations

Modelling Methodology

3.7 Concentrations have been predicted using the ADMS-Roads dispersion model, with vehicle emissions derived using Defra's Emission Factor Toolkit (EFT) (v9.0) (Defra, 2020b). Details of the model inputs, assumptions and the verification are provided in Appendix A3, together with the method used to derive base and future year background concentrations. Where assumptions have been made, a realistic worst-case approach has been adopted.

Assessment Scenarios

3.8 Nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations have been predicted for a base year (2018 to be consistent with the latest year of monitoring data from BCBC) and the first year of occupation within the proposed development (2022). For 2022, predictions have been made assuming both that the development does proceed (With Scheme), and does not proceed (Without Scheme).

Traffic Data

3.9 Baseline traffic data for the assessment have been determined from the interactive web-based map provided by DfT (2020). Development trip generation and routing information has been provided by Vectos. Further details of the traffic data used in this assessment are provided in Appendix A3.

Uncertainty

3.10 There are many components that contribute to the uncertainty of modelling predictions. The road traffic emissions dispersion model used in this assessment is dependent upon the traffic data that have been input, which will have inherent uncertainties associated with them. There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms.

3.11 An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix A3). This can only be done for the road traffic model. The level of confidence in the verification process is necessarily enhanced when data from an automatic analyser have been used, as has been the case for this assessment (see Appendix A3). Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of base year (2018) concentrations.

3.12 Predicting pollutant concentrations in a future year will always be subject to greater uncertainty. For obvious reasons, the model cannot be verified in the future, and it is necessary to rely on a series of projections provided by DfT and Defra as to what will happen to traffic volumes, background pollutant concentrations and vehicle emissions.

3.13 European type approval (‘Euro’) standards for vehicle emissions apply to all new vehicles manufactured for sale in Europe. These standards have, over many years, become progressively more stringent and this is one of the factors that has driven reductions in both predicted and measured pollutant concentrations over time.

3.14 Historically, the emissions tests used for type approval were carried out within laboratories and were quite simplistic. They were thus insufficiently representative of emissions when driving in the real world. For a time, this resulted in a discrepancy, whereby nitrogen oxides emissions from new diesel vehicles reduced over time when measured within the laboratory, but did not fall in the real world. This, in turn, led to a discrepancy between models (which predicted improvements in nitrogen dioxide concentrations over time) and measurements (which very often showed no improvements year-on-year).

3.15 Recognition of these discrepancies has led to changes to the type approval process. Vehicles are now tested using a more complex laboratory drive cycle and also through ‘Real Driving Emissions’ (RDE) testing, which involves driving on real roads while measuring exhaust emissions. For Heavy Duty Vehicles (HDVs), the new testing regime has worked very well and NOx emissions from the latest vehicles (Euro VI[2]) are now very low when compared with those from older models (ICCT, 2017).

3.16 For Light Duty Vehicles (LDVs), while the latest (Euro 6) emission standard has been in place since 2015, the new type-approval testing regime only came into force in 2017. Despite this delay, earlier work by AQC (2016) showed that Euro 6 diesel cars manufactured prior to 2017 tend to emit significantly less NOx than previous (Euro 5 and earlier) models.

3.17 AQC has analysed trends in measured NOx concentrations against trends in Defra's EFT model predictions for the period 2013 to 2019 (AQC, 2020). This has demonstrated that, while the EFT typically over-stated the improvements over the period 2013 to 2016, it has tended to under-state the improvements since 2016. Wider consideration of the assumptions built into the EFT suggests that, on balance, the EFT is unlikely to over-state the rate at which NOx emissions decline in the future at an 'average' site in the UK. In practice, the balance of evidence thus suggests that NOx concentrations are most likely to decline more quickly in the future, on average, than predicted by the EFT, especially against a base year of 2016 or later. Using EFT v9.0 for future-year forecasts in this report thus provides a robust assessment, given that the model has been verified against measurements made in 2018.

3.18 It must also be borne in mind that the predictions in 2022 are based on the worst-case assumption that the proposed development is complete and fully occupied in this year, which is entirely unrealistic; it is now considered unlikely that that any of the new homes will be occupied before 2024, and the development is unlikely to be complete, and thus generating its full volume of traffic, until beyond 2030. Development-generated traffic emissions in 2022, and hence the 2022 "With Scheme" concentrations will, therefore, have been greatly over-estimated.

2 Euro VI refers to HDVs while Euro 6 refers to LDVs.

4 Site Description and Baseline Conditions

4.1 The proposed development site is located approximately 2 km to the west of Bridgend town centre. The site is bounded by the A473 to the south of the site, residential properties to the east and farmland to the north and west. It currently consists of farmland.

Industrial sources

4.2 A search of the UK Pollutant Release and Transfer Register (Defra, 2020a) has not identified any significant industrial or waste management sources that are likely to affect the proposed development, in terms of air quality.

Air Quality Management Areas

4.3 BCBC has investigated air quality within its area as part of its responsibilities under the LAQM regime. BCBC declared an AQMA for nitrogen dioxide on 1st January 2019; this AQMA is located approximately 2 km east of the proposed development site and is shown in Figure 2.

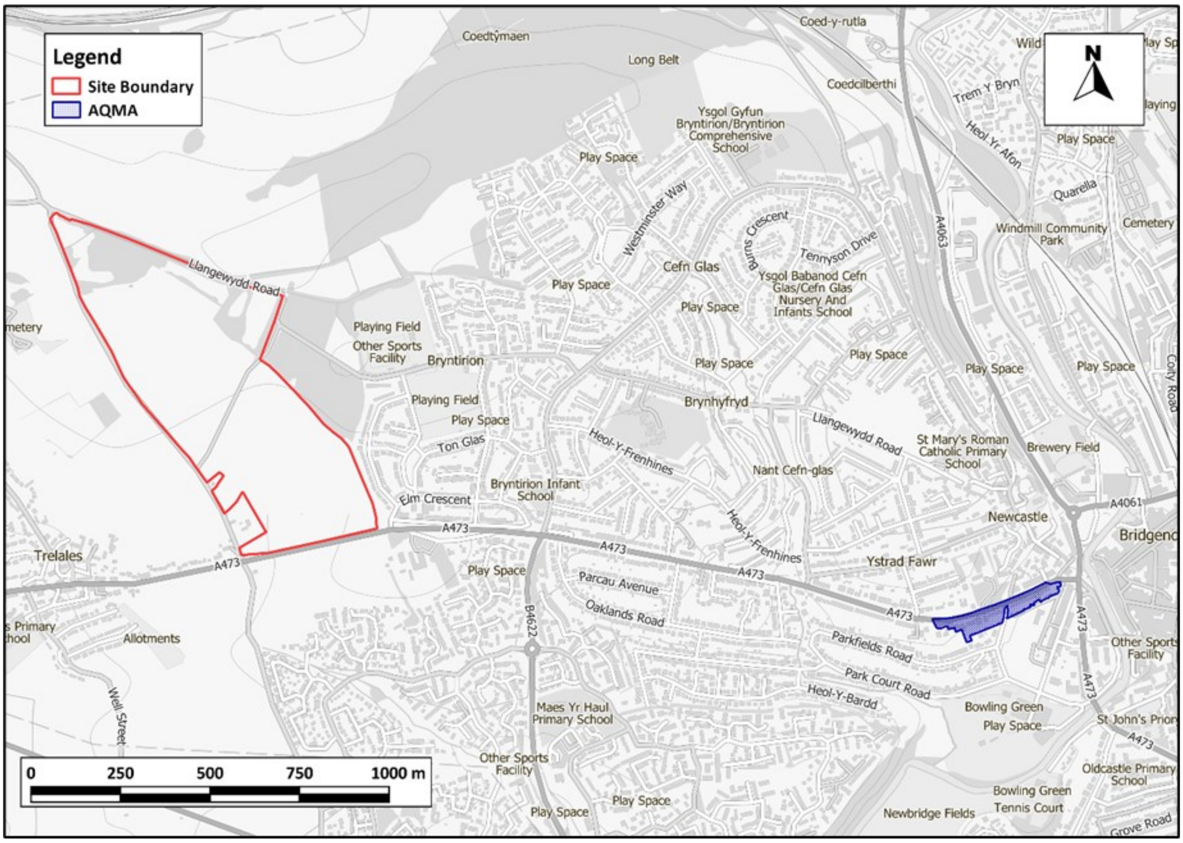

Figure 2: Declared AQMA

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Local Air Quality Monitoring

Nitrogen Dioxide

4.4 BCBC operates one automatic monitoring station within its area that measures nitrogen dioxide, which is located at Ewenny Cross Roundabout. This monitor is not in close proximity to the Site, located approximately 3 km to the south east. The Council also operates a number of nitrogen dioxide monitoring sites using diffusion tubes prepared and analysed by Socotec UK Ltd (using the 50% TEA in water method). These include four deployed within the AQMA on Park Street (A473). Tubes are also positioned to the north of the Park Street junction after the AQMA on Tondu Road, and south of the junction on the A473, and around the Ewenny Cross Roundabout. There is no monitoring in close proximity to the Site. Results for the years 2013 to 2018 are summarised in Table 2 and the monitoring locations are shown in Figure 3. Data have been taken from the BCBC 2018 ASR (BCBC, 2018) and 2019 ASR (BCBC, 2019). An assessment of the diffusion tube network was undertaken in 2017, leading to expansion and amendment, thus the majority of locations only have one or two years of presentable data (BCBC, 2018).

Table 2: Summary of Nitrogen Dioxide (NO_2) Monitoring (2013-2018) [a]

Site No.	Site Type	Location	2013	2014	2015	2016	2017	2018
Automatic Monitor - Annual Mean (µg/m³) [a b]								
CM1	Roadside	Ewenny Cross Roundabout	**42**	-	30.5 [c]	32.37	25.7 [c]	17.8 [c]
Objective			**40**					
Automatic Monitor - No. of Hours > 200 µg/m³ [b d]								
CM1	Roadside	Ewenny Cross Roundabout	0	-	0 (30.4)	0	0 (131.3)	0 (66.4)
Objective			**18 (200)**					
Diffusion Tubes - Annual Mean (µg/m³)								
OBC102	Roadside	Sunnyside Street	-	-	-	-	23.7	23.5
OBC103	Roadside	Park Street	-	-	-	-	37.6	35.6
OBC104	Roadside	Park Street	-	-	-	-	**41.5**	37.1
OBC068	Roadside	Bridgend United Club	32	28	26	27	25.9	-
OBC107	Roadside	Tondu Road	-	-	-	-	-	31.7
OBC108	Kerbside	Tondu Road	-	-	-	-	-	38.5
OBC109	Roadside	Park Street	-	-	-	-	-	20.6
OBC110	Kerbside	Park Street	-	-	-	-	-	**58.7**
OBC105	Roadside	Cowbridge Road	-	-	-	-	24.6	22.6
OBC115	Roadside	Ewenny Road	-	-	-	-	-	22.3
OBC085	Roadside	A48 Bypass, Bridgend	27	21	23	21	19.9	19.3
OBC087	Roadside	A48 Bypass, Bridgend	19	21	22	20	20	18.9
OBC090	Roadside	A48 Bypass, Bridgend	24	23	23	21	19.5	20.9
OBC091	Roadside	A48 Bypass, Bridgend	28	25	23	24	22	22.4
Objective			**40**					

[a] Exceedances of the objectives are shown in bold.

[b] No result available for 2014 due to a technical fault with the Automatic Monitoring Station.

[c] Data have been "annualised" by the Council where valid data capture for the full calendar year is less than 75%.

[d] If the period of valid data is less than 85%, the 99.8th percentile of 1-hour means is provided in brackets.

4.5 The automatic monitor located at Ewenny Cross Roundabout appears to show a downward trend in annual mean nitrogen dioxide concentrations after recording an exceedance in 2013, and is now measuring concentrations well below the objective. The diffusion tube sites 'OBC085', 'OBC087', 'OBC090', 'OBC091' and 'OBC115' located on the A48 close to Ewenny Cross Roundabout also show a trend for reduction in concentrations, all of which are well below the objective.

4.6 'OBC103', 'OBC104', 'OBC109' and 'OBC110' are within the AQMA and adjacent to Park Street (A473) – the road along which the proposed development is located. 'OBC102' is located just outside of the AQMA, at the Park Street and A473 junction. Concentrations have exceeded the objective at two of these sites; at 'OBC104' in 2017 and at 'OBC110' in 2018. Although 'OBC110' is a kerbside site and does not best represent relevant exposure at all properties within the AQMA, the six residential properties close to this monitoring location are situated approximately 1 m from the road, and it is representative of exposure at them, and perhaps at the two properties just to the west of this terrace, which are set back slightly further from the kerb.

4.7 The monitoring sites are not generally representative of the proposed development location, with the monitoring being either located in more urban and congested areas, or along busier roads. Annual mean nitrogen dioxide concentrations at the Site can reasonably be expected to be lower than those measured at any of the monitoring sites described in Table 2, and thus well below the objective level.

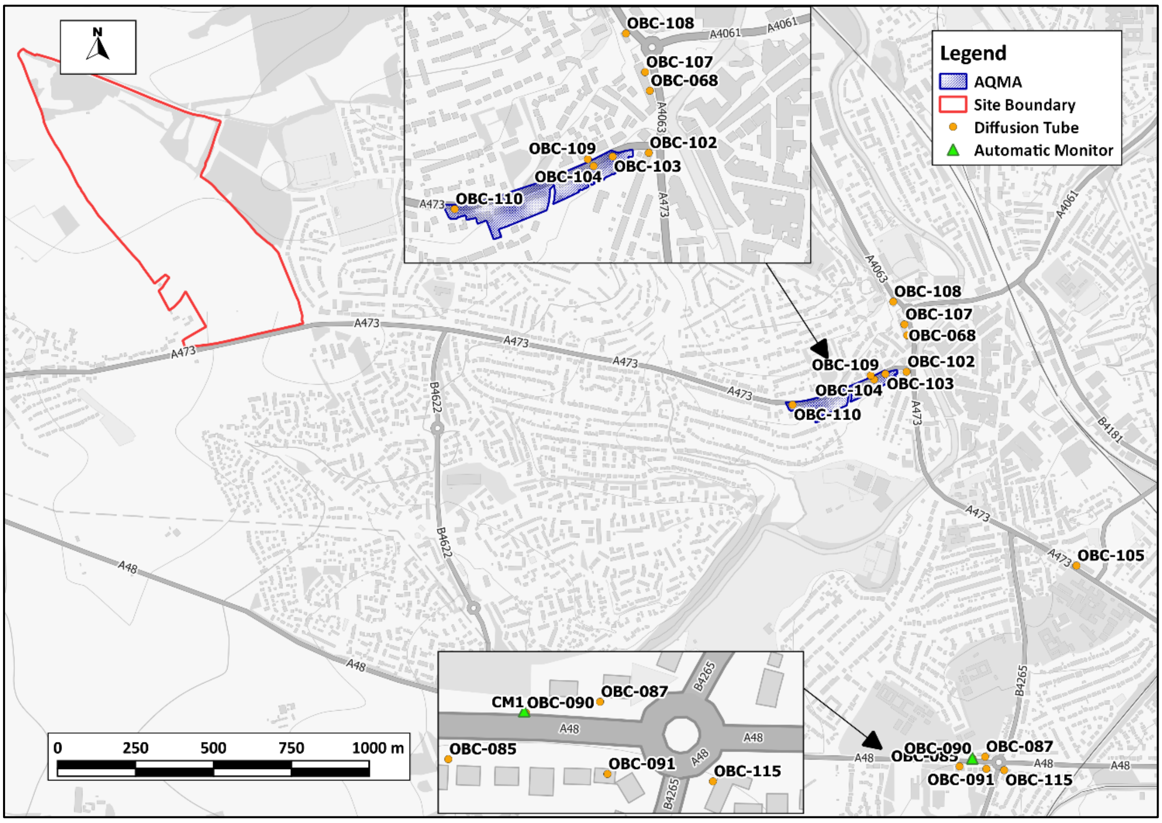

Figure 3: Monitoring Locations

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Particulate Matter

4.8 The 'CM1' automatic monitoring station, located adjacent to Ewenny Cross Roundabout approximately 3 km south east of the Site, is the closest station that measures PM_{10} concentrations. Results for the years 2013 to 2018 are summarised in Table 3 and show concentrations (including the 90.4th percentile of daily means) well below the objectives. There have been frequent technical faults with this Automatic Monitoring Station and data capture rates were low for presented years.

Table 3: Summary of PM_{10} Automatic Monitoring (2013-2018) [a]

Site No.	Site Type	Location	2013	2014	2015	2016	2017	2018
PM_{10} Annual Mean (µg/m^3) [b]								
CM1	Roadside	Ewenny Cross Roundabout	14.3	-	-	15.18	-	10.13
Objective			**40**					
PM_{10} No. Days >50 µg/m^3 [c]								
CM1	Roadside	Ewenny Cross Roundabout	0	-	-	2 (24.66)	-	1 (19.17)
Objective			**35 (50) [b]**					

[a] No result available for 2014, 2015 and 2017 due to technical faults with the Automatic Monitoring Station.

[b] Data have been "annualised" by the Council where valid data capture for the full calendar year is less than 75%.

[c] If the period of valid data is less than 85%, the 90.4th percentile of 24-hour means is provided in brackets.

4.9 There are no monitors measuring $PM_{2.5}$ concentrations in Bridgend.

Exceedances of EU Limit Value

4.10 There are no AURN monitoring sites within the study area with which to identify exceedances of the annual mean nitrogen dioxide limit value. Defra's roadside annual mean nitrogen dioxide concentrations (Defra, 2020c), which are used to report exceedances of the limit value to the EU, do not identify any exceedances within the study area in 2018. As such, there is considered to be no risk of a limit value exceedance in the vicinity of the proposed development by the time that it is operational (noting that limit value exceedances are assessed differently to objective exceedances).

Background Concentrations

4.11 Estimated background concentrations at the proposed development and at existing receptors have been determined for 2018 and 2022 using Defra's 2017-based background maps (Defra, 2020b). The background concentrations are set out in Table 4 and have been derived as described in Appendix A3. The background concentrations are all well below the objectives.

Table 4: **Estimated Annual Mean Background Pollutant Concentrations in 2018 and 2022 (µg/m³)**

Year	NO_2	PM_{10}	$PM_{2.5}$
Background Concentrations at proposed development site			
2018	9.0	10.9	7.0
2022 [a]	7.5	10.5	6.6
Background concentrations at existing receptors			
2018	6.7 – 13.5	9.8 – 11.3	6.4 – 7.5
2022 [a]	5.6 – 11.5	9.3 – 10.9	6.1 – 7.1
Objectives	**40**	**40**	**25** [a]

The range of values for existing receptors is for the different 1x1 km grid squares covering the study area.

[a] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Baseline Dispersion Model Results

4.12 Baseline concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been modelled at each of the existing receptor locations (see Figure 1). The results, which cover both the existing (2018) and future year (2022) baseline (Without Scheme), are set out in Table 5 and Table 6. The modelled road components of nitrogen oxides, PM_{10} and $PM_{2.5}$ have been increased from those predicted by the model based on a comparison with local measurements (see Appendix A3 for the verification methodology).

Table 5: **Modelled Annual Mean Baseline Concentrations of Nitrogen Dioxide (µg/m³) at Existing Receptors** [a b]

Receptor	2018	2022 Without Scheme
Receptor 1	30.1	24.2
Receptor 2	21.7	17.8
Receptor 3	34.2	27.7
Receptor 4	24.6	20.1
Receptor 5	27.1	22.1
Receptor 6	**52.4**	**42.5**
Receptor 7	20.4	16.8
Receptor 8	27.9	22.7
Receptor 9	27.7	22.4
Receptor 10	21.8	17.8
Receptor 11	30.1	24.2
Receptor 12	23.5	19.3
Receptor 13	38.3	31.0
Receptor 14	16.8	13.5

Receptor	2018	2022 Without Scheme
Receptor 15	16.9	13.5
Receptor 16	17.2	13.8
Receptor 17	12.2	10.0
Receptor 18	16.7	13.4
Receptor 19	12.9	10.5
Receptor 20	18.8	15.2
Receptor 21	19.9	15.9
Receptor 22	16.5	13.4
Receptor 23	17.3	14.0
Receptor 24	16.4	13.0
Receptor 25	30.6	24.4
Receptor 26	14.7	11.7
Receptor 27	17.1	13.8
Receptor 28	18.9	15.3
Receptor 29	22.1	17.6
Receptor 30	25.2	20.1
Receptor 31	22.9	18.3
Receptor 32	22.9	18.3
Receptor 33	20.0	16.1
Receptor 34	17.3	14.0
Receptor 35	18.9	15.3
Objective	40	

[a] Exceedances of the objective are shown in bold.

[b] Underlined receptors are within the AQMA.

Table 6: Modelled Annual Mean Baseline Concentrations of PM_{10} and $PM_{2.5}$ at Existing Receptors (µg/m^3)

Receptor [a]	PM_{10} [b]		$PM_{2.5}$	
	2018	2022 Without Scheme	2018	2022 Without Scheme
Receptor 1	14.0	13.6	9.1	8.7
Receptor 2	12.7	12.3	8.3	7.9
Receptor 3	15.1	14.7	9.7	9.3
Receptor 4	13.3	12.8	8.6	8.2
Receptor 5	13.7	13.3	8.9	8.5
Receptor 6	19.2	18.7	12.2	11.6
Receptor 7	12.5	12.0	8.2	7.8
Receptor 8	13.9	13.4	9.0	8.6

Receptor [a]	PM_{10} [b]		$PM_{2.5}$	
	2018	2022 Without Scheme	2018	2022 Without Scheme
Receptor 9	13.8	13.3	9.0	8.5
Receptor 10	12.6	12.2	8.3	7.9
Receptor 11	13.7	13.3	9.0	8.5
Receptor 12	13.1	12.7	8.6	8.1
Receptor 13	15.9	15.5	10.2	9.7
Receptor 14	11.6	11.2	7.5	7.1
Receptor 15	11.6	11.2	7.5	7.1
Receptor 16	11.7	11.3	7.5	7.1
Receptor 17	11.4	11.0	7.3	6.9
Receptor 18	12.0	11.5	7.6	7.2
Receptor 19	11.5	11.1	7.3	7.0
Receptor 20	12.3	11.9	8.1	7.7
Receptor 21	12.3	11.8	8.1	7.7
Receptor 22	11.9	11.5	7.9	7.5
Receptor 23	12.1	11.7	8.0	7.6
Receptor 24	11.3	10.8	7.3	6.9
Receptor 25	14.4	13.9	8.8	8.3
Receptor 26	11.0	10.5	7.1	6.7
Receptor 27	12.6	12.2	7.9	7.5
Receptor 28	12.7	12.3	8.1	7.7
Receptor 29	12.7	12.2	8.1	7.7
Receptor 30	13.2	12.7	8.4	8.0
Receptor 31	12.8	12.4	8.2	7.8
Receptor 32	12.9	12.4	8.2	7.8
Receptor 33	12.9	12.5	8.2	7.8
Receptor 34	12.3	11.9	7.9	7.5
Receptor 35	12.7	12.3	8.1	7.7
Objective / Criterion	**32** [b]		**25** [c]	

[a] Underlined receptors are within the AQMA.

[b] While the annual mean PM_{10} objective is 40 µg/m^3, 32 µg/m^3 is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG16 (Defra, 2018b). A value of 32 µg/m^3 is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

[c] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

2018 Baseline

4.13 The predicted annual mean concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ are below objective levels in 2018 at all receptors, apart for Receptor 6 where the annual mean nitrogen dioxide objective is exceeded.

4.14 Receptor 6 is located in the BCBC AQMA and represents a terrace of six properties that are situated within a metre of kerbside, adjacent to which diffusion tube monitoring site OBC110, which measured an exceedance of the objective in 2018, is located. Consequently, the results are consistent with the conclusions of BCBC in the outcome of its air quality review and assessment work.

4.15 The annual mean PM_{10} concentrations are below 32 µg/m^3 and it is, therefore, unlikely that the 24-hour mean PM_{10} objective will be exceeded. The annual mean nitrogen dioxide concentrations are below 60 µg/m^3 at every receptor; it is, therefore, also unlikely that the 1-hour mean nitrogen dioxide objective will be exceeded (see Paragraph 2.22).

2022 Baseline

4.16 Concentrations of all pollutants are predicted to be below the objectives at all receptors in 2022, again with the exception of Receptor 6, where an exceedance of the annual mean nitrogen dioxide is predicted to remain. The extent of the exceedance is, however, greatly reduced, with the annual mean concentration predicted to reduce from 52.5 µg/m^3 in 2018 to 42.5 µg/m^3 in 2022. Considering this reduction over time, it is unlikely that the objective would continue to be exceeded at receptor 6 by the time that the development begins to be occupied (now anticipated to be from 2024 onwards)

5 Impact Assessment

Impacts at Existing Receptors

5.1 Predicted annual mean concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ in 2022 for existing receptors are set out in Table 7 and Table 8 for both the "Without Scheme" and "With Scheme" scenarios. These tables also describe the impacts at each receptor using the impact descriptors given in Appendix A1.

Table 7: Predicted Impacts on Annual Mean Nitrogen Dioxide Concentrations in 2022 (µg/m³) [a]

Receptor [b]	Without Scheme	With Scheme	% Change [c]	Impact Descriptor
Receptor 1	24.2	24.4	0	Negligible
Receptor 2	17.8	18.0	0	Negligible
Receptor 3	27.7	28.1	1	Negligible
Receptor 4	20.1	20.3	1	Negligible
Receptor 5	22.1	22.4	1	Negligible
Receptor 6	**42.5**	**43.2**	2	Moderate Adverse
Receptor 7	16.8	16.9	0	Negligible
Receptor 8	22.7	23.0	1	Negligible
Receptor 9	22.4	22.7	1	Negligible
Receptor 10	17.8	18.0	0	Negligible
Receptor 11	24.2	24.4	1	Negligible
Receptor 12	19.3	19.3	0	Negligible
Receptor 13	31.0	31.5	1	Negligible
Receptor 14	13.5	14.4	2	Negligible
Receptor 15	13.5	14.4	2	Negligible
Receptor 16	13.8	14.7	2	Negligible
Receptor 17	10.0	10.5	1	Negligible
Receptor 18	13.4	13.8	1	Negligible
Receptor 19	10.5	11.1	1	Negligible
Receptor 20	15.2	15.4	1	Negligible
Receptor 21	15.9	16.1	1	Negligible
Receptor 22	13.4	13.6	0	Negligible
Receptor 23	14.0	14.2	0	Negligible
Receptor 24	13.0	13.3	1	Negligible
Receptor 25	24.4	24.8	1	Negligible
Receptor 26	11.7	11.8	0	Negligible
Receptor 27	13.8	14.4	1	Negligible

Receptor [b]	Without Scheme	With Scheme	% Change [c]	Impact Descriptor
Receptor 28	15.3	15.8	1	Negligible
Receptor 29	17.6	18.4	2	Negligible
Receptor 30	20.1	21.1	2	Negligible
Receptor 31	18.3	19.1	2	Negligible
Receptor 32	18.3	19.1	2	Negligible
Receptor 33	16.1	16.8	2	Negligible
Receptor 34	14.0	14.5	1	Negligible
Receptor 35	15.3	15.9	2	Negligible
Objective	40		-	-

[a] Exceedances of the objective are shown in bold.

[b] Underlined receptors are within the AQMA

[c] % changes are relative to the objective and have been rounded to the nearest whole number.

Table 8: Predicted Impacts on Annual Mean PM_{10} and $PM_{2.5}$ Concentrations in 2022 (µg/m^3)

Receptor [a]	Annual Mean PM_{10} (µg/m^3)				Annual Mean $PM_{2.5}$ (µg/m^3)			
	Without Scheme	With Scheme	% Change [b]	Impact Descriptor	Without Scheme	With Scheme	% Change [b]	Impact Descriptor
Receptor 1	13.6	13.6	0	Negligible	8.7	8.7	0	Negligible
Receptor 2	12.3	12.3	0	Negligible	7.9	7.9	0	Negligible
Receptor 3	14.7	14.8	0	Negligible	9.3	9.3	0	Negligible
Receptor 4	12.8	12.9	0	Negligible	8.2	8.2	0	Negligible
Receptor 5	13.3	13.4	0	Negligible	8.5	8.5	0	Negligible
Receptor 6	18.7	19.0	1	Negligible	11.6	11.7	1	Negligible
Receptor 7	12.0	12.1	0	Negligible	7.8	7.8	0	Negligible
Receptor 8	13.4	13.5	0	Negligible	8.6	8.6	0	Negligible
Receptor 9	13.3	13.4	0	Negligible	8.5	8.6	0	Negligible
Receptor 10	12.2	12.2	0	Negligible	7.9	7.9	0	Negligible
Receptor 11	13.3	13.3	0	Negligible	8.5	8.5	0	Negligible
Receptor 12	12.7	12.7	0	Negligible	8.1	8.2	0	Negligible
Receptor 13	15.5	15.6	0	Negligible	9.7	9.8	0	Negligible
Receptor 14	11.2	11.4	1	Negligible	7.1	7.2	1	Negligible
Receptor 15	11.2	11.4	1	Negligible	7.1	7.2	1	Negligible
Receptor 16	11.3	11.5	1	Negligible	7.1	7.3	1	Negligible
Receptor 17	11.0	11.2	0	Negligible	6.9	7.0	0	Negligible
Receptor 18	11.5	11.6	0	Negligible	7.2	7.3	0	Negligible

Receptor [a]	Annual Mean PM_{10} (µg/m³)				Annual Mean $PM_{2.5}$ (µg/m³)			
	Without Scheme	With Scheme	% Change [b]	Impact Descriptor	Without Scheme	With Scheme	% Change [b]	Impact Descriptor
Receptor 19	11.1	11.2	0	Negligible	7.0	7.1	0	Negligible
Receptor 20	11.9	12.0	0	Negligible	7.7	7.8	0	Negligible
Receptor 21	11.8	11.8	0	Negligible	7.7	7.7	0	Negligible
Receptor 22	11.5	11.5	0	Negligible	7.5	7.5	0	Negligible
Receptor 23	11.7	11.7	0	Negligible	7.6	7.6	0	Negligible
Receptor 24	10.8	10.9	0	Negligible	6.9	6.9	0	Negligible
Receptor 25	13.9	14.0	0	Negligible	8.3	8.3	0	Negligible
Receptor 26	10.5	10.6	0	Negligible	6.7	6.8	0	Negligible
Receptor 27	12.2	12.4	1	Negligible	7.5	7.6	0	Negligible
Receptor 28	12.3	12.5	1	Negligible	7.7	7.8	0	Negligible
Receptor 29	12.2	12.4	1	Negligible	7.7	7.8	0	Negligible
Receptor 30	12.7	12.9	1	Negligible	8.0	8.1	0	Negligible
Receptor 31	12.4	12.5	1	Negligible	7.8	7.9	0	Negligible
Receptor 32	12.4	12.6	1	Negligible	7.8	7.9	0	Negligible
Receptor 33	12.5	12.7	1	Negligible	7.8	7.9	0	Negligible
Receptor 34	11.9	12.1	0	Negligible	7.5	7.6	0	Negligible
Receptor 35	12.3	12.5	1	Negligible	7.7	7.8	0	Negligible
Criterion	32 [c]		-	-	25 [d]		-	-

[a] Underlined receptors are within the AQMA

[b] % changes are relative to the criterion and have been rounded to the nearest whole number.

[c] While the annual mean PM_{10} objective is 40 µg/m³, 32 µg/m³ is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG16 (Defra, 2018b). A value of 32 µg/m³ is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

[d] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Nitrogen Dioxide

5.2 The annual mean nitrogen dioxide concentrations are below the objective with or without the proposed development at all receptors, apart from Receptor 6, where the objective will be exceeded with or without the proposed development. This receptor is within the AQMA in a location with previously identified exceedances. The percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be 0% at 8 of the receptors, 1% at 17 of the receptors and 2% at 10 of the receptors (including Receptor 6). Using the matrix in Table A1.1

(Appendix A1), these impacts are described as *negligible* for all receptors other than Receptor 6, where the impact is *moderate adverse*.

5.3 It is worth re-iterating that the modelling for this assessment is worst-case, assuming the full development traffic will be on the roads in 2022, when in reality it is reasonably likely that concentrations at these properties will be below the objective before any development traffic is on the roads, and the full development traffic won't be on the roads until the 2030s.

5.4 Applying professional judgement, and considering the worst-case nature of the assessment, it is considered most likely that all impacts will be *negligible*, even at the terrace of properties represented by Receptor 6.

PM_{10} and $PM_{2.5}$

5.5 The annual mean PM_{10} and $PM_{2.5}$ concentrations are well below the relevant criteria at all receptors, with or without the proposed development. The percentage changes in both PM_{10} and $PM_{2.5}$ concentrations, relative to the applied annual mean criteria (when rounded), are predicted to be between 0-1% at all of the receptors. Using the matrix in Table A1.1 (Appendix A1), these impacts are all described as *negligible.*

Impacts of Existing Sources on Future Residents of the Development

5.6 Predicted air quality conditions for future residents of the proposed development, taking account of emissions from the adjacent road network, are set out in Table 9. Concentrations have been predicted at the site boundary (Receptors labelled SB) at 10 m from the kerb (Receptors labelled 10m) (see Figure 1 for receptor locations), to provide an indication of worst-case possible exposure within the Site alongside a more realistic indication of where new homes within the Site will be located (likely at least 10 m from the kerb of the A473). Predicted concentrations are well below the objectives for all pollutants. Air quality for future residents within the development will thus be acceptable

Table 9: Predicted Concentrations of Nitrogen Dioxide (NO_2), PM_{10} and $PM_{2.5}$ in 2022 for New Receptors in the Development Site (μg/m^3)

Receptor	Annual Mean NO_2	Annual Mean PM_{10}	Annual Mean $PM_{2.5}$
Receptor E_SB	14	12	7.5
Receptor E_10m	11.8	11.5	7.2
Receptor W_SB	14.4	12.1	7.6
Receptor W_10m	11.7	11.4	7.2
Objective / Criterion	**40**	**32** [a]	**25** [b]

[a] While the annual mean PM_{10} objective is 40 μg/m^3, 32 μg/m^3 is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG16 (Defra, 2018b). A value of 32 μg/m^3 is thus used as a proxy to determine the likelihood of exceedance of the 24-

hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

[b] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Significance of Operational Air Quality Effects

5.7 The assessment has demonstrated that the proposed development will not cause new exceedances of the air quality objectives. The modelling has suggested the potential for *moderate adverse* annual mean nitrogen dioxide impacts at 6-8 properties on Park Street in the year 2022, but only if the full development traffic were on the roads in this year. It is now considered unlikely that any new homes within the development will be occupied before 2024, and the development is unlikely to be complete and fully occupied, and thus generating its full traffic volumes, until the 2030s. As a result, it is considered most likely that, by the time any significant level of development traffic is using Park Street, annual mean nitrogen dioxide concentrations at these 6-8 properties will be below the objective, and any resultant impacts will be *negligible*. There is no realistic prospect of any *moderate adverse* impacts.

5.8 The assessment has also demonstrated that all future residents of the proposed development will experience acceptable air quality, with pollutant concentrations well below the objectives.

5.9 On the basis of the above, the operational air quality effects without mitigation are judged to be 'not significant'. This professional judgement is made in accordance with the methodology set out in Appendix A1.

6 Mitigation

6.1 The assessment has demonstrated that the overall effect of the proposed development will be 'not significant'. It is, therefore, not considered appropriate to propose further mitigation measures for this development.

6.2 Mitigation measures to reduce pollutant emissions from road traffic are principally being delivered in the longer term by the introduction of more stringent emissions standards, largely via European legislation (which is written into UK law). The Council's Air Quality Action Plan will also be helping to deliver improved air quality.

6.3 While it is not considered necessary to recommend specific mitigation, the EPUK/IAQM guidance advises that good design and best practice measures should be considered, whether or not more specific mitigation is required. As the proposed development is only at the local plan promotion stage, it is not yet supported by detailed design documents. However, it is anticipated that the following design measures will be implemented:

- coherent walking and cycling neighbourhood design and good access to local networks;
- network of green spaces and infrastructure incorporating existing and new hedgerows and trees, promoting walking routes and with appropriate design acting as a buffer from traffic emissions;
- inclusion of Travel Plan and Travel Packs to promote sustainable modes of transport, such as the bus stop the site is located next to;
- provision of Electric vehicle charge points; and
- ensuring gas-fired boilers will meet a minimum emission standard of <40mg NOx/kWh.

7 Conclusions

7.1 The operational impacts of increased traffic emissions arising from the additional traffic on local roads, due to the development, have been assessed. Concentrations have been modelled for a number of worst-case receptors, representing existing properties where impacts are expected to be greatest. In addition, the impacts of traffic emissions from local roads on the air quality for future residents on the proposed development have been assessed.

7.2 The assessment has demonstrated that concentrations of PM_{10} and $PM_{2.5}$ will remain below the objectives at all existing receptors in 2022, with or without the proposed development, and that all impacts for these pollutants will be *negligible*.

7.3 In the case of annual mean nitrogen dioxide, concentrations will remain below the objective at all but one existing receptor (representative of 6-8 homes) in 2022, with or without the proposed development. However, it is now considered unlikely that any new homes within the development will be occupied before 2024, by which time it would be reasonable to expect concentrations at these 8 homes to be below the objective. The assessment has demonstrated that the impacts in terms of annual mean nitrogen dioxide concentrations of the full development traffic being on the roads in 2022 will be *negligible* everywhere other than at this one receptor, where the impact under this scenario would be *moderate adverse*. However, bearing in mind that no new homes will be occupied before 2024, and the development is unlikely to be complete and thus generating its full traffic volumes until the 2030s, this scenario is unrealistically worst-case. Applying professional judgement, it is considered most likely that the actual impact of the development at these 8 homes will also be *negligible* in all years from the first occupation in 2024.

7.4 The effects of local traffic on the air quality for future residents living in the proposed development have been shown to be acceptable at the worst-case locations assessed, with concentrations being well below the air quality objectives.

7.5 The overall operational air quality effects of the development are judged to be ‘not significant’.

8 References

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9 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
AQC	Air Quality Consultants
AQAL	Air Quality Assessment Level
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
CAZ	Clean Air Zone
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
Exceedance	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
EU	European Union
EV	Electric Vehicle
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HMSO	Her Majesty's Stationery Office
HGV	Heavy Goods Vehicle
IAQM	Institute of Air Quality Management
ICCT	International Council on Clean Transportation
JAQU	Joint Air Quality Unit
kph	Kilometres Per hour
LAQM	Local Air Quality Management
LDV	Light Duty Vehicles (<3.5 tonnes)
LGV	Light Goods Vehicle
$\mu g/m^3$	Microgrammes per cubic metre
NO	Nitric oxide

NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)
NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
OLEV	Office for Low Emission Vehicles
PM_{10}	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
$PM_{2.5}$	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
PPG	Planning Practice Guidance
PPW	Planning Policy Wales
RDE	Real Driving Emissions
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
TAN	Technical Advice Note
TEA	Triethanolamine – used to absorb nitrogen dioxide
TEMPro	Trip End Model Presentation Program

10 Appendices

A1 EPUK & IAQM Planning for Air Quality Guidance

A1.1 The guidance issued by EPUK and IAQM (Moorcroft and Barrowcliffe et al, 2017) is comprehensive in its explanation of the place of air quality in the planning regime. Key sections of the guidance not already mentioned above are set out below.

Air Quality as a Material Consideration

"Any air quality issue that relates to land use and its development is capable of being a material planning consideration. The weight, however, given to air quality in making a planning application decision, in addition to the policies in the local plan, will depend on such factors as:

- *the severity of the impacts on air quality;*
- *the air quality in the area surrounding the proposed development;*
- *the likely use of the development, i.e. the length of time people are likely to be exposed at that location; and*
- *the positive benefits provided through other material considerations".*

Recommended Best Practice

A1.2 The guidance goes into detail on how all development proposals can and should adopt good design principles that reduce emissions and contribute to better air quality management. It states:

"The basic concept is that good practice to reduce emissions and exposure is incorporated into all developments at the outset, at a scale commensurate with the emissions".

A1.3 The guidance sets out a number of good practice principles that should be applied to all developments that:

- include 10 or more dwellings;
- where the number of dwellings is not known, residential development is carried out on a site of more than 0.5 ha;
- provide more than 1,000 m^2 of commercial floorspace;
- are carried out on land of 1 ha or more.

A1.4 The good practice principles are that:

- New developments should not contravene the Council's Air Quality Action Plan, or render any of the measures unworkable;
- Wherever possible, new developments should not create a new "street canyon", as this inhibits pollution dispersion;

- Delivering sustainable development should be the key theme of any application;
- New development should be designed to minimise public exposure to pollution sources, e.g. by locating habitable rooms away from busy roads;
- The provision of at least 1 Electric Vehicle (EV) “rapid charge” point per 10 residential dwellings and/or 1000 m^2 of commercial floorspace. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made available;
- Where development generates significant additional traffic, provision of a detailed travel plan (with provision to measure its implementation and effect) which sets out measures to encourage sustainable means of transport (public, cycling and walking) via subsidised or free-ticketing, improved links to bus stops, improved infrastructure and layouts to improve accessibility and safety;
- All gas-fired boilers to meet a minimum standard of <40 mgNOx/kWh;
- Where emissions are likely to impact on an AQMA, all gas-fired CHP plant to meet a minimum emissions standard of:
  - Spark ignition engine: 250 mgNOx/Nm^3;
  - Compression ignition engine: 400 mgNOx/Nm^3;
  - Gas turbine: 50 mgNOx/Nm^3.
- A presumption should be to use natural gas-fired installations. Where biomass is proposed within an urban area it is to meet minimum emissions standards of 275 mgNOx/Nm^3 and 25 mgPM/Nm^3.

A1.5 The guidance also outlines that offsetting emissions might be used as a mitigation measure for a proposed development. However, it states that:

“It is important that obligations to include offsetting are proportional to the nature and scale of development proposed and the level of concern about air quality; such offsetting can be based on a quantification of the emissions associated with the development. These emissions can be assigned a value, based on the “damage cost approach” used by Defra, and then applied as an indicator of the level of offsetting required, or as a financial obligation on the developer. Unless some form of benchmarking is applied, it is impractical to include building emissions in this approach, but if the boiler and CHP emissions are consistent with the standards as described above then this is not essential”.

A1.6 The guidance offers a widely used approach for quantifying costs associated with pollutant emissions from transport. It also outlines the following typical measures that may be considered to offset emissions, stating that measures to offset emissions may also be applied as post assessment mitigation:

- Support and promotion of car clubs;
- Contributions to low emission vehicle refuelling infrastructure;
- Provision of incentives for the uptake of low emission vehicles;
- Financial support to low emission public transport options; and
- Improvements to cycling and walking infrastructures.

Screening

Impacts of the Local Area on the Development

"There may be a requirement to carry out an air quality assessment for the impacts of the local area's emissions on the proposed development itself, to assess the exposure that residents or users might experience. This will need to be a matter of judgement and should take into account:

- *the background and future baseline air quality and whether this will be likely to approach or exceed the values set by air quality objectives;*
- *the presence and location of Air Quality Management Areas as an indicator of local hotspots where the air quality objectives may be exceeded;*
- *the presence of a heavily trafficked road, with emissions that could give rise to sufficiently high concentrations of pollutants (in particular nitrogen dioxide), that would cause unacceptably high exposure for users of the new development; and*
- *the presence of a source of odour and/or dust that may affect amenity for future occupants of the development".*

Impacts of the Development on the Local Area

A1.7 The guidance sets out two stages of screening criteria that can be used to identify whether a detailed air quality assessment is required, in terms of the impact of the development on the local area. The first stage is that you should proceed to the second stage if any of the following apply:

- 10 or more residential units or a site area of more than 0.5 ha residential use; and/or
- more than 1,000 m^2 of floor space for all other uses or a site area greater than 1 ha.

A1.8 Coupled with any of the following:

- the development has more than 10 parking spaces; and/or
- the development will have a centralised energy facility or other centralised combustion process.

A1.9 If the above do not apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area. If they do apply then you proceed to stage 2, which sets out indicative criteria for requiring an air quality assessment. The stage 2 criteria relating to vehicle emissions are set out below:

- the development will lead to a change in LDV flows of more than 100 AADT within or adjacent to an AQMA or more than 500 AADT elsewhere;
- the development will lead to a change in HDV flows of more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will lead to a realigning of roads (i.e. changing the proximity of receptors to traffic lanes) where the change is 5m or more and the road is within an AQMA;
- the development will introduce a new junction or remove an existing junction near to relevant receptors, and the junction will cause traffic to significantly change vehicle acceleration/deceleration, e.g. traffic lights or roundabouts;
- the development will introduce or change a bus station where bus flows will change by more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere; and
- the development will have an underground car park with more than 100 movements per day (total in and out) with an extraction system that exhausts within 20 m of a relevant receptor.

A1.10 The criteria are more stringent where the traffic impacts may arise on roads where concentrations are close to the objective. The presence of an AQMA is taken to indicate the possibility of being close to the objective, but where whole authority AQMAs are present and it is known that the affected roads have concentrations below 90% of the objective, the less stringent criteria are likely to be more appropriate.

A1.11 On combustion processes (including standby emergency generators and shipping) where there is a risk of impacts at relevant receptors, the guidance states that:

"Typically, any combustion plant where the single or combined NOx emission rate is less than 5 mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion. As a guide, the 5 mg/s criterion equates to a 450 kW ultra-low NOx gas boiler or a 30kW CHP unit operating at <95mg/Nm^3.

In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates.

Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable".

A1.12 Should none of the above apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area, provided that professional judgement is applied; the guidance importantly states the following:

"The criteria provided are precautionary and should be treated as indicative. They are intended to function as a sensitive 'trigger' for initiating an assessment in cases where there is a possibility of significant effects arising on local air quality. This possibility will, self-evidently, not be realised in many cases. The criteria should not be applied rigidly; in some instances, it may be appropriate to amend them on the basis of professional judgement, bearing in mind that the objective is to identify situations where there is a possibility of a significant effect on local air quality".

A1.13 Even if a development cannot be screened out, the guidance is clear that a detailed assessment is not necessarily required:

"The use of a Simple Assessment may be appropriate, where it will clearly suffice for the purposes of reaching a conclusion on the significance of effects on local air quality. The principle underlying this guidance is that any assessment should provide enough evidence that will lead to a sound conclusion on the presence, or otherwise, of a significant effect on local air quality. A Simple Assessment will be appropriate, if it can provide this evidence. Similarly, it may be possible to conduct a quantitative assessment that does not require the use of a dispersion model run on a computer".

A1.14 The guidance also outlines what the content of the air quality assessment should include, and this has been adhered to in the production of this report.

Impact Descriptors and Assessment of Significance

A1.15 There is no official guidance in the UK in relation to development control on how to describe the nature of air quality impacts, nor how to assess their significance. The approach within the EPUK/IAQM guidance has, therefore, been used in this assessment. This approach involves a two stage process:

- a qualitative or quantitative description of the impacts on local air quality arising from the development; and
- a judgement on the overall significance of the effects of any impacts.

Impact Descriptors

A1.16 Impact description involves expressing the magnitude of incremental change as a proportion of a relevant assessment level and then examining this change in the context of the new total concentration and its relationship with the assessment criterion. Table A1.1 sets out the method for determining the impact descriptor for annual mean concentrations at individual receptors, having been adapted from the table presented in the guidance document. For the assessment criterion the term Air Quality Assessment Level or AQAL has been adopted, as it covers all pollutants, i.e. those with and without formal standards. Typically, as is the case for this assessment, the AQAL will be the air quality objective value. Note that impacts may be adverse or beneficial, depending on whether the change in concentration is positive or negative.

Table A1.1: Air Quality Impact Descriptors for Individual Receptors for All Pollutants [a]

Long-Term Average Concentration At Receptor In Assessment Year [b]	Change in concentration relative to AQAL [c]				
	0%	1%	2-5%	6-10%	>10%
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Negligible	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial

[a] Values are rounded to the nearest whole number.

[b] This is the "Without Scheme" concentration where there is a decrease in pollutant concentration and the "With Scheme" concentration where there is an increase.

[c] AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)'.

Assessment of Significance

A1.17 The guidance recommends that the assessment of significance should be based on professional judgement, with the overall air quality impact of the development described as either 'significant' or 'not significant'. In drawing this conclusion, the following factors should be taken into account:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts;
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts;
- the potential for cumulative impacts and, in such circumstances, several impacts that are described as '*slight*' individually could, taken together, be regarded as having a significant effect for the purposes of air quality management in an area, especially where it is proving difficult to reduce concentrations of a pollutant. Conversely, a '*moderate*' or '*substantial*' impact may not have a significant effect if it is confined to a very small area and where it is not obviously the cause of harm to human health; and

- the judgement on significance relates to the consequences of the impacts; will they have an effect on human health that could be considered as significant? In the majority of cases, the impacts from an individual development will be insufficiently large to result in measurable changes in health outcomes that could be regarded as significant by health care professionals.

A1.18 The guidance is clear that other factors may be relevant in individual cases. It also states that the effect on the residents of any new development where the air quality is such that an air quality objective is not met will be judged as significant. For people working at new developments in this situation, the same will not be true as occupational exposure standards are different, although any assessment may wish to draw attention to the undesirability of the exposure.

A1.19 A judgement of the significance should be made by a competent professional who is suitably qualified. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix A2.

A2 Professional Experience

Guido Pellizzaro, BSc (Hons) MIAQM MIEnvSc PIEMA

Mr Pellizzaro is an Associate Director with AQC, with more than 14 years' experience in the field of air quality management and assessment. His main experience relates to managing and delivering air quality assessments for major planning applications and EIA development. Guido is a Member of the Institute of Environmental Sciences and of the Institute of Air Quality Management, and a Practitioner of the Institute of Environmental Management and Assessment.

Ricky Gellatly, BSc (Hons) CSci MIEnvSc MIAQM

Mr Gellatly is a Principal Consultant with AQC with over eight years' relevant experience. He has undertaken air quality assessments for a wide range of projects, assessing many different pollution sources using both qualitative and quantitative methodologies, with most assessments having included dispersion modelling (using a variety of models). He has assessed road schemes, airports, energy from waste facilities, anaerobic digesters, poultry farms, urban extensions, rail freight interchanges, energy centres, waste handling sites, sewage works and shopping and sports centres, amongst others. He also has experience in ambient air quality monitoring, the analysis and interpretation of air quality monitoring data, the monitoring and assessment of nuisance odours and the monitoring and assessment of construction dust. He is a Member of the Institute of Air Quality Management and is a Chartered Scientist.

Lauren Armstrong, BSc (Hons) MSc

Mrs Armstrong is an Assistant Consultant with AQC, having joined the company in February 2020. Prior to joining AQC she completed an MSc degree in Climate Change: Environment, Science and Policy at King's College London where her studies explored the physical and social aspects of a changing climate and environment, research methods and environmental monitoring. She is now gaining experience in the field of air quality monitoring and assessment.

A3 Modelling Methodology

Model Inputs

A3.1 Predictions have been carried out using the ADMS-Roads dispersion model (v4.1). The model requires the user to provide various input data, including emissions from each section of road and the road characteristics (including road width, street canyon width, street canyon height and porosity, where applicable). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the EFT (Version 9.0) published by Defra (2020b).

A3.2 Hourly sequential meteorological data from Rhoose for 2018 have been used in the model. The Rhoose meteorological monitoring station is located approximately 20 km to the southeast of the proposed development site and is deemed to be the nearest monitoring station representative of meteorological conditions in the vicinity of the proposed development site; both the development site and the Rhoose meteorological monitoring station are located at near-coastal locations on the south coast of Wales where they will be influenced by the effects of coastal meteorology.::.

A3.3 For the purposes of modelling, it has been assumed that a number of properties along Park Street within the AQMA form a street canyon, along with a section of Tondu Road close to the roundabout on the southern and north western arms (shown in Figure A3.1). These roads display canyon-like features, which reduce dispersion of traffic emissions, and can lead to concentrations of pollutants being higher here than they would be in areas with greater dispersion. These roads have, therefore, been modelled as a street canyons using ADMS-Roads' advanced canyon module, with appropriate input parameters determined from local mapping and photographs. The advanced canyon module has been used along with the urban canopy flow module, the input data for which have been published by Cambridge Environmental Research Consultants (CERC, 2016), who developed the ADMS models.

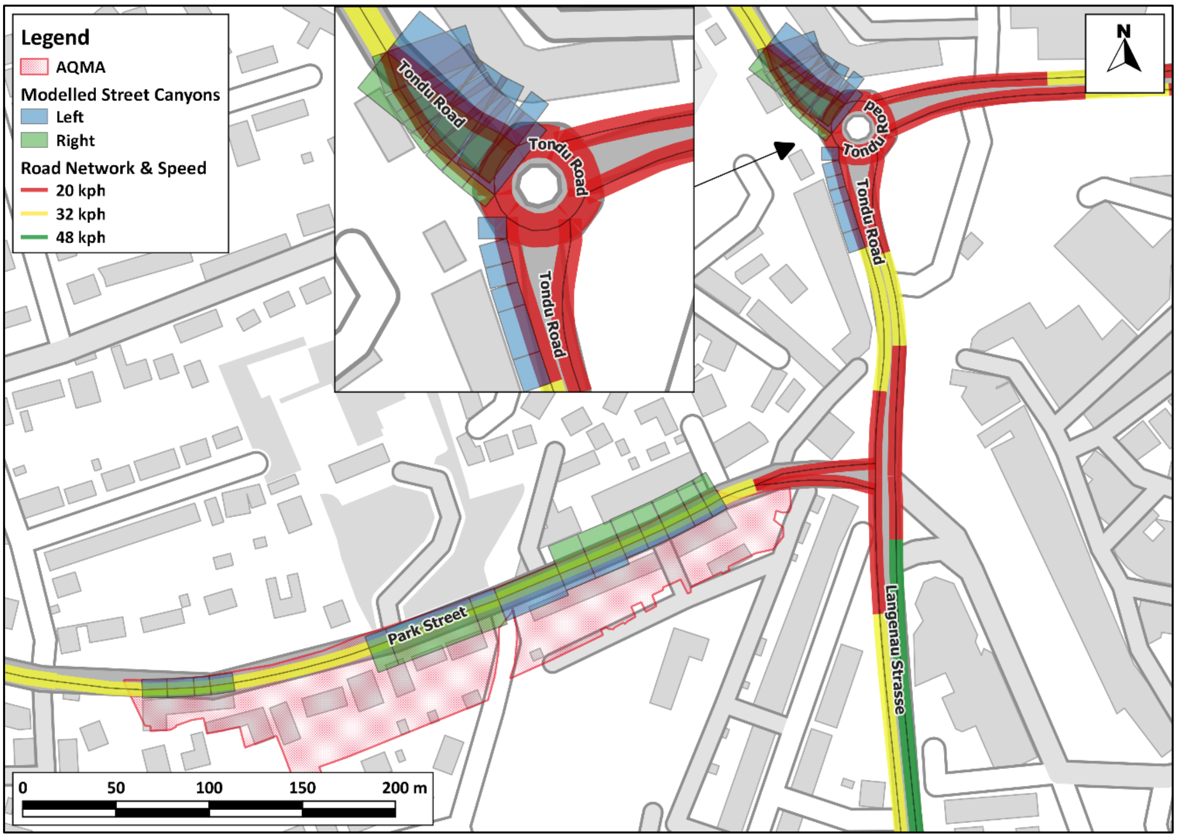

Figure A3.1: Modelled Street Canyon Layouts

A3.4 Baseline traffic flows for local roads have been determined from the interactive web-based map provided by DfT (2019a); it was not possible to carry out robust baseline traffic surveys due to the effects of the Covid-19 social and travel restrictions, thus the DfT data was the only viable resource for baseline traffic flows. The DfT flows do not cover minor roads, such as the B4622, and these have had to be omitted from the model; impacts along these roads are considered highly unlikely and thus their omission will not have affected the conclusions of the assessment.

A3.5 The 2018 AADT flows have been factored forwards to the assessment year of 2022 using growth factors derived using the TEMPro System v7.2 (DfT, 2017). AADT flows for development generated traffic have been provided by Vectos, who have undertaken the transport assessment work for the proposed development, and have been added to the future baseline flows for the 'with development' scenario. Traffic speeds have been estimated based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction. The traffic data used in this assessment are summarised in

A3.6 Table A3.1. Diurnal and monthly flow profiles for the traffic have been derived from the national profiles published by DfT (2019).

Table A3.1: Summary of Traffic Data used in the Assessment (AADT Flows)

Road Link	AADT	% Car	% LGV	% Rigid HGV	% Artic HGV	% Bus/ Coach	% Motor Cycle
2018							
A473 - between site access & A48	9,243	86.9	10.4	0.6	0.0	1.6	0.4
A48 - south of A473	15,841	83.9	12.1	2.2	0.7	0.2	1.0
A48 - between A473 & Bridgend Road	27,728	83.9	12.5	1.4	0.7	0.6	0.8
A473 - between site access & Bright Hill	14,095	87.6	9.8	0.7	0.1	1.4	0.4
A473 Bryntirion Hill - between Bright Hill & Tondu Road	14,095	87.6	9.8	0.7	0.1	1.4	0.4
A473 Langenau Strasse - south of Angel Street	20,664	87.9	9.6	0.7	0.2	0.7	1.0
Tondu Road - between Angel Street & Boulevard De Villenave D'Ornon	25,844	87.2	9.6	0.9	0.1	1.6	0.6
Tondu Road - north of Boulevard De Villenave D'Ornon	13,490	84.7	12.4	1.6	0.1	0.6	0.6
Boulevard De Villenave D'Ornon - between Tondu Road & Coity Road	24,926	87.8	9.9	0.6	0.1	1.4	0.3
A48 Bypass Road - west of B4622	15,841	83.9	12.1	2.2	0.7	0.2	1.0
A48 Bypass Road - between B4622 & B4265 Eweny Road	23,167	86.3	10.7	1.6	0.6	0.2	0.7
A48 Bypass Road - between B4265 Ewenny Road & Bridgend Retail Park	23,167	86.3	10.7	1.6	0.6	0.2	0.7
2022 (Without Scheme)							
A473 - between site access & A48	9,729	86.9	10.4	0.6	0.0	1.6	0.4
A48 - south of A473	16,674	83.9	12.1	2.2	0.7	0.2	1.0
A48 - between A473 & Bridgend Road	29,186	83.9	12.5	1.4	0.7	0.6	0.8
A473 - between site access & Bright Hill	14,836	87.6	9.8	0.7	0.1	1.4	0.4
A473 Bryntirion Hill - between Bright Hill & Tondu Road	14,836	87.6	9.8	0.7	0.1	1.4	0.4
A473 Langenau Strasse - south of Angel Street	21,751	87.9	9.6	0.7	0.2	0.7	1.0
Tondu Road - between Angel Street & Boulevard De Villenave D'Ornon	27,203	87.2	9.6	0.9	0.1	1.6	0.6
Tondu Road - north of Boulevard De Villenave D'Ornon	14,200	84.7	12.4	1.6	0.1	0.6	0.6
Boulevard De Villenave D'Ornon - between Tondu Road & Coity Road	26,237	87.8	9.9	0.6	0.1	1.4	0.3

Road Link	AADT	% Car	% LGV	% Rigid HGV	% Artic HGV	% Bus/ Coach	% Motor Cycle
A48 Bypass Road - west of B4622	16,674	83.9	12.1	2.2	0.7	0.2	1.0
A48 Bypass Road - between B4622 & B4265 Eweny Road	24,386	86.3	10.7	1.6	0.6	0.2	0.7
A48 Bypass Road - between B4265 Ewenny Road & Bridgend Retail Park	24,386	86.3	10.7	1.6	0.6	0.2	0.7
2022 (With Scheme)							
A473 - between site access & A48	11,345	88.8	8.9	0.5	0.0	1.4	0.3
A48 - south of A473	16,805	84.1	12.0	2.2	0.7	0.2	0.9
A48 - between A473 & Bridgend Road	30,306	84.5	12.1	1.4	0.7	0.6	0.8
A473 - between site access & Bright Hill	18,113	89.9	8.1	0.6	0.1	1.1	0.3
A473 Bryntirion Hill - between Bright Hill & Tondu Road	15,358	88.1	9.5	0.7	0.1	1.3	0.4
A473 Langenau Strasse - south of Angel Street	21,838	87.9	9.5	0.7	0.2	0.7	1.0
Tondu Road - between Angel Street & Boulevard De Villenave D'Ornon	27,580	87.4	9.4	0.8	0.1	1.6	0.6
Tondu Road - north of Boulevard De Villenave D'Ornon	14,257	84.7	12.4	1.6	0.1	0.6	0.6
Boulevard De Villenave D'Ornon - between Tondu Road & Coity Road	26,556	88.0	9.8	0.6	0.1	1.4	0.3
A48 Bypass Road - west of B4622	16,674	83.9	12.1	2.2	0.7	0.2	1.0
A48 Bypass Road - between B4622 & B4265 Eweny Road	26,968	87.6	9.7	1.4	0.6	0.2	0.6
A48 Bypass Road - between B4265 Ewenny Road & Bridgend Retail Park	26,968	87.6	9.7	1.4	0.6	0.2	0.6

A3.7 Figure A3.2 shows the road network included within the model, along with the speed at which each link was modelled, and defines the study area.

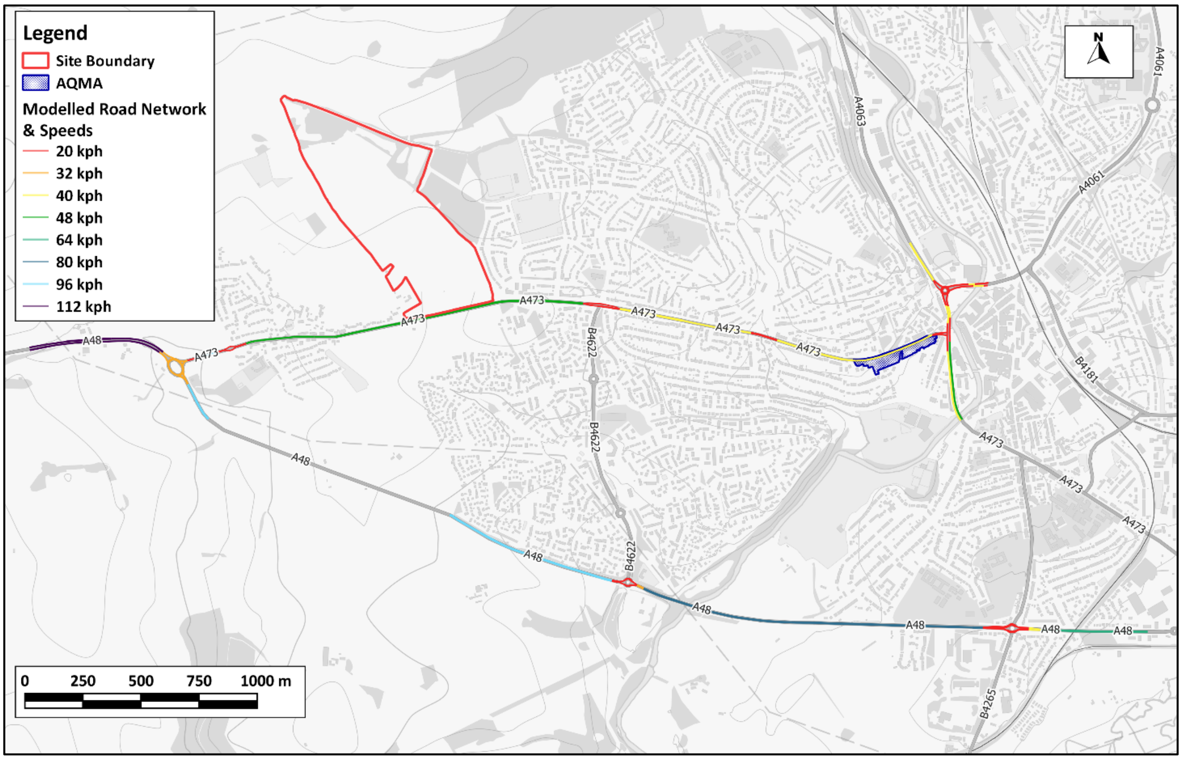

Figure A3.2: Modelled Road Network & Speed

Background Concentrations

A3.8 The background pollutant concentrations across the study area have been defined using the 2017-based national pollution maps published by Defra (2020b). These cover the whole of the UK on a 1x1 km grid and are published for each year from 2017 until 2030. The background annual mean nitrogen oxides and nitrogen dioxide maps for 2018 have been calibrated against concurrent measurements from national monitoring sites (AQC, 2019). The calibration factor calculated has also been applied to future year backgrounds. This has resulted in slightly higher predicted nitrogen oxides and nitrogen dioxide concentrations for the future assessment year than those derived from the Defra maps.

Model Verification

A3.9 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements.

Background Concentrations

A3.10 The 2018 background concentrations for the monitoring sites have been derived from the national maps, having been calculated using the same approach as described in Paragraph A3.8, and are presented in Table A3.2.

Table A3.2: Background Concentrations used in the Verification for 2018

Site	NO_2
OBC-085, OBC-087, OBC-090, OBC-091	9.7
OBC-103, OBC-104, OBC-107, OBC-110	13.5
OBC-108	13.6
Objectives	**40**

Nitrogen Dioxide

A3.11 Most nitrogen dioxide (NO_2) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + NO_2). The model has been run to predict the annual mean NOx concentrations during 2018 at the OBC085, OBC087, OBC090, OBC091, OBC103, OBC104, OBC107, OBC108 and OBC110 diffusion tube monitoring sites. Concentrations have been modelled between 1.5 and 2.5 m, at the heights of the individual monitors.

A3.12 The model output of road-NOx (i.e. the component of total NOx coming from road traffic) has been compared with the 'measured' road-NOx. Measured road-NOx has been calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NOx from NO_2 calculator (Version 7.1) available on the Defra LAQM Support website (Defra, 2020b).

A3.13 The unadjusted model has under predicted the road-NOx contribution; this is a common experience with this and most other road traffic emissions dispersion models. An adjustment factor has been determined as the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure A3.3). The calculated adjustment factor of 3.2213 has been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations.

A3.14 The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx to NO_2 calculator. Figure A3.4 compares final adjusted modelled total NO_2 at each of the monitoring sites to measured total NO_2, and shows a close agreement.

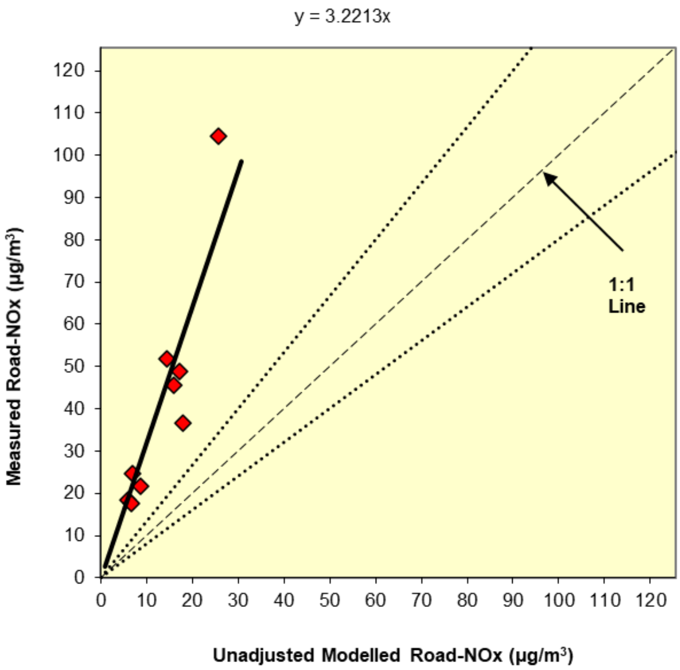

Figure A3.3: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

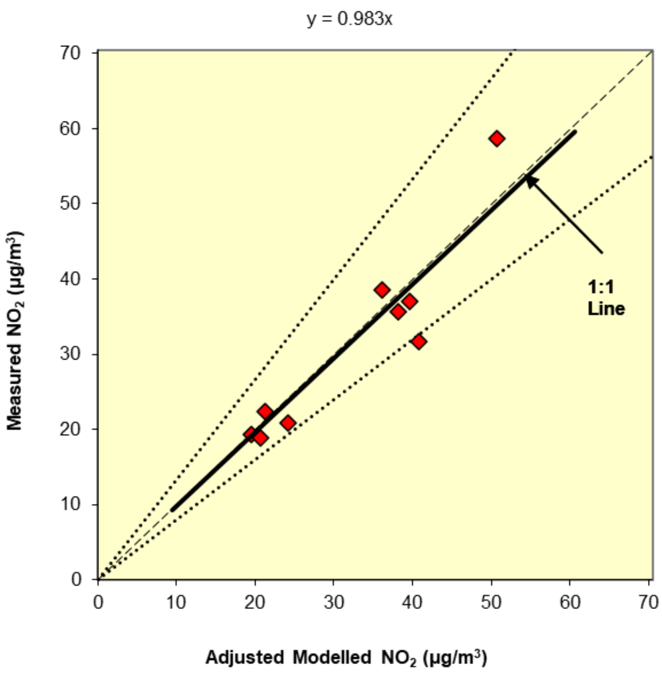

Figure A3.4: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

3.14.1 Table A3.3 shows the statistical parameters relating to the performance of the model, as well as the 'ideal' values (Defra, 2018b).

Table A3.3: Statistical Model Performance

Statistical Parameter	Model-Specific Value	'Ideal' Value
Correlation Coefficient [a]	0.94	**1**
Root Mean Square Error (RMSE) [b]	4.51	**0**
Fractional Bias [c]	- 0.03	**0**

[a] Used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship.

[b] Used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared (i.e. $\mu g/m^3$). TG16 (Defra, 2018b) outlines that, ideally, a RMSE value within 10% of the air quality objective ($4 \mu g/m^3$) would be derived. If RMSE values are higher than 25% of the objective ($10 \mu g/m^3$) it is recommended that the model is revisited.

[c] Used to identify if the model shows a systematic tendency to over or under predict. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.

PM_{10} and $PM_{2.5}$

A3.15 There are no nearby PM_{10} or $PM_{2.5}$ monitors. It has therefore not been possible to verify the model for PM_{10} or $PM_{2.5}$. The model outputs of road-PM_{10} and road-$PM_{2.5}$ have therefore been adjusted by applying the adjustment factor calculated for road NOx.

Model Post-processing

A3.16 The model predicts road-NOx concentrations at each receptor location. These concentrations have been adjusted using the adjustment factor set out above, which, along with the background NO_2, has been processed through the NOx to NO_2 calculator available on the Defra LAQM Support website (Defra, 2020b). The traffic mix within the calculator has been set to "All other urban UK traffic", which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road-NOx and the background NO_2.