WORTHING BOROUGH COUNCIL

Air Quality Action Plan 2024-2029

In fulfilment of Part IV of the Environment Act 1995, as amended by the Environment Act 2021

Local Air Quality Management

December 2024

Worthing Borough Council

Air Quality Action Plan 2024

Bureau Veritas

July 2024

BUREAU VERITAS 1828

BUREAU VERITAS

Move Forward with Confidence

Document Control Sheet

Identification	
Client	Worthing Borough Council
Document Title	Air Quality Action Plan – 2024
Bureau Veritas Ref No.	AIR18434846

Contact Details		
Company Name	Bureau Veritas UK Limited	Worthing Borough Council
Contact Name	Hannah Broomfield-Payne	Nadeem Shad
Position	Principal Consultant	Team Leader Environmental Protection, Public Health & Regulation
Address	2nd Floor, Atlantic House Atlas Business Park Simonsway Manchester M22 5PR	Town Hall, Chapel Road, Worthing, West Sussex, BN11 1HA

Configuration				
Version	**Date**	**Author**	**Reason for Issue/Summary of Changes**	**Status**
v1.0	27/03/24	S Garrington	Draft for comment	Draft
V2.0	18/07/2024	N. Shad	Draft Updated following Defra Draft Consultation	Draft
V3.0	31/07/2024	S Garrington	Updated following Defra Draft Consultation	Finalised
V4.0	27/12/2024	N Shad	Version submitted to Defra following Public Consultation	Finalised
Final Version	21/02/2025	N Shad	Updated following Defra approval	Finalised

	Name	Job Title	Signature
Prepared By	S Garrington	Consultant	S Garrington
Reviewed By	D Clampin	Senior Consultant	

Bureau Veritas UK Limited, Registered in England & Wales, Company Number: 01758622
Registered Office: Suite 206 Fort Dunlop, Fort Parkway, Birmingham B24 9FD

Information	Worthing Council Details
Local Authority Officer	Nadeem Shad/Tessa Denny
Department	Public Health & Regulation
Address	Worthing Town Hall, Chapel Road, Worthing, West Sussex, BN11 1HA
Telephone	01273 263331
E-mail	publichealth.regulation@adur-worthing.gov.uk
Report Reference Number	18434846
Date	December 2024

Executive Summary

This Air Quality Action Plan (AQAP) has been produced as part of our statutory duties required by the Local Air Quality Management framework. It outlines the actions we will take to improve air quality in Worthing Borough Council between 2024 – 2029. The AQAP sets out how the local authority will exercise its functions in order to secure the achievement of the air quality objectives.

Implementation of the outlined measures will result in the relevant objectives being attained by 2029.

Air pollution is associated with a number of adverse health impacts. It is recognised as a contributing factor in the onset of heart disease and cancer. Additionally, air pollution particularly affects the most vulnerable in society: children and older people, and those with heart and lung conditions. There is also often a strong correlation with equalities issues because areas with poor air quality are also often the less affluent areas[1,2].

The annual health cost to society of the impacts of particulate matter alone in the UK is estimated to be around £16 billion[3]. Worthing Borough Council is committed to reducing the exposure of people in Worthing to poor air quality in order to improve health.

We have developed actions that can be considered under four broad topics:

- Priority 1: Reduce the impact of traffic on air quality and congestion.
- Priority 2: Reduction in the Council’s air quality impacts
- Priority 3: Public engagement, participation and awareness to support healthier lifestyles for residents
- Priority 4: Planning and guidance for future growth impacts

---

[1] Environmental equity, air quality, socioeconomic status and respiratory health, 2010

[2] Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006

[3] Defra. Abatement cost guidance for valuing changes in air quality, May 2013

The priorities within this action plan intend to target transport emissions within the AQMA through working with local communities and businesses to aid a behavioural shift within the population to promote more sustainable and less polluting methods of transport. This should help to reduce dangerous pollutant concentrations and reduce the risk of detrimental impact on health and wellbeing within the district. In addition, where transport remains a major source of air pollution, traffic measures will be implemented to reduce congestion, aiming to reduce source emissions in areas of relevant exposure. The Borough Council intends to implement measures which set a positive example for others through measures to control emissions from their own fleet, particularly the waste fleet. The Council will also look to use citizen science projects with local schools to measure air quality and help educate and raise awareness of air pollution.

In this AQAP, we outline the plan to effectively tackle air quality issues within our control. However, we recognise that there are a large number of air quality policy areas that are outside of our influence (such as vehicle emissions standards agreed in Europe), but for which we may have useful evidence, and so we will continue to work with regional and central government on policies and issues beyond Worthing Borough Council's direct influence.

Responsibilities and Commitment

This AQAP was prepared by Bureau Veritas and the Public Health & Regulation Department of Worthing Borough Council with the support and agreement of the following departments:

- Sustainability
- Taxi Licensing
- Car Parking
- Economic Development
- Planning
- WSCC Transport Planning & Policy

This AQAP has been approved by Cllr Vicki Wells, the Cabinet Member for the Environment.

The following Air Quality Partners / stakeholders have contributed to the development of the AQAP and will be committed to delivery of actions:

- National Highways
- West Sussex County Council
- Internal Local Authority Representatives e.g. Sustainability/Economic Development/Planning

This AQAP will be subject to an annual review and appraisal of progress. Progress each year will be reported in the Annual Status Reports (ASRs) produced by Worthing Borough Council as part of our statutory Local Air Quality Management duties.

If you have any comments on this AQAP please contact us using our online form at https://www.adur-worthing.gov.uk/eforms/aw-ext-environmental-health.ofml.

Table of Contents

List of Tables

List of Figures

1. Introduction

This report outlines the actions that Worthing Borough Council will deliver between 2024-2029 in order to reduce concentrations of air pollutants and exposure to air pollution; thereby positively impacting on the health and quality of life of residents and visitors to Worthing. The purpose of the report is to set out how the local authority will exercise its functions in order to achieve the relevant air quality objectives. This action plan is a draft version and will be adopted subject to consultation.

It has been developed in recognition of the legal requirement on the local authority to work towards Air Quality Strategy (AQS) objectives under Part IV of the Environment Act 1995, as amended by the Environment Act (2021), and relevant regulations made under that part and to meet the requirements of the Local Air Quality Management (LAQM) statutory process.

This Plan will be reviewed every five years at the latest and progress on measures set out within this Plan will be reported on annually within Worthing Borough Council's air quality ASR.

2. Summary of Current Air Quality in WorthingBorough Council

2.1 Air Quality Management Areas

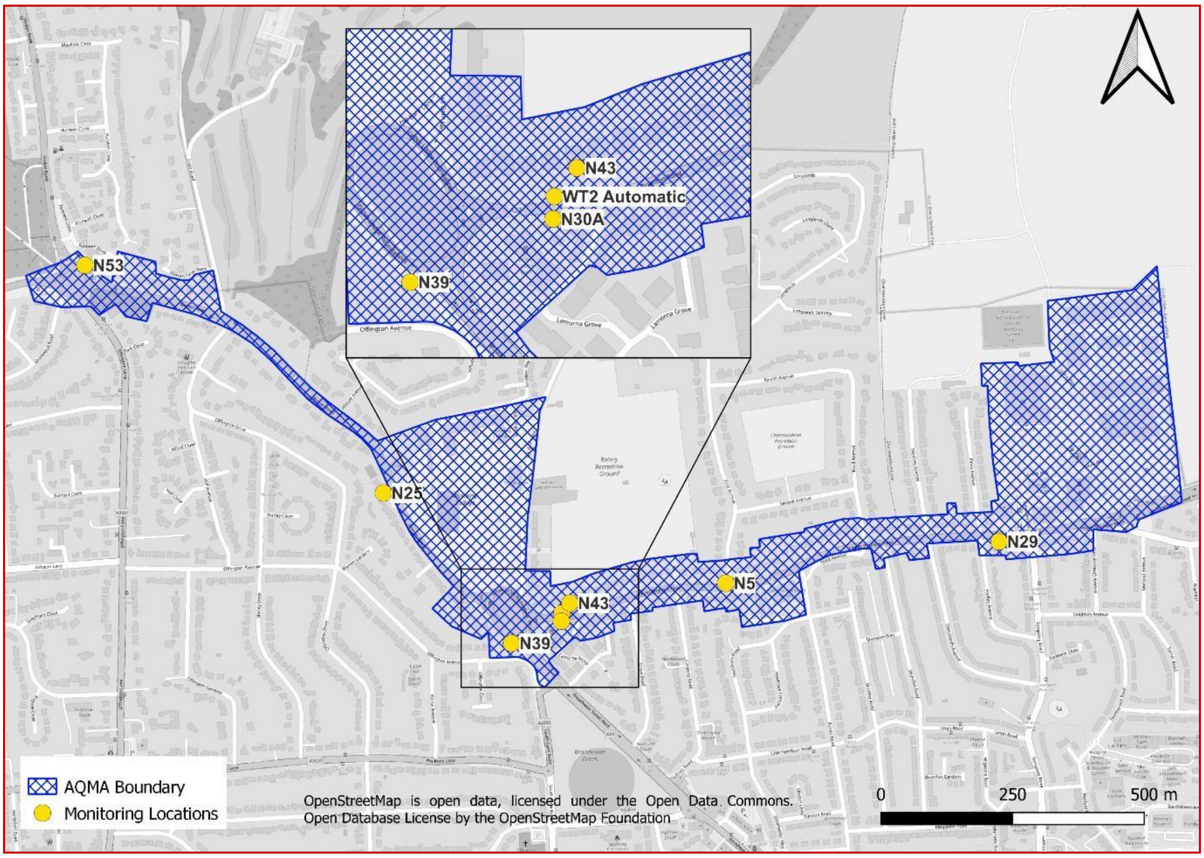
The relevant Air Quality Management Area (AQMA) addressed by this AQAP is outlined below.

Table 2-1 – Relevant Declared Air Quality Management Areas

AQMA Name	Date of Declaration	Pollutants and Air Quality Objectives	One Line Description	Is air quality in the AQMA influenced by roads controlled by National Highways?	Level of Exceedance: Declaration (μg/m^3)	Level of Exceedance: Current Year (μg/m^3)	Number of Years Compliant with Air Quality Objective
Worthing Borough Council AQMA No.2	Declared 13/07/2010, Amended 15/12/2014	NO_2 Annual Mean	An area encompassing Crockhurst Hill, Offington Corner Roundabout, Warren Road, Grove Lodge Roundabout, Upper Brighton Road up to and including the Downlands Retail Centre and Lyons Way	YES	76.5	4.7	0

The location of the AQMA and monitoring therein is shown in figure 2.1.

Figure 2.1 –WBC Monitoring Locations



2.2 Review of Air Quality Monitoring

2.2.1 Local Automatic Air Quality Monitoring

WBC undertakes automatic (continuous) monitoring at one location.

The details of the automatic monitoring within Worthing AQMA for 2017 - 2023 are shown in Table 2-2.

Table 2-2 WBC Automatic Monitoring

Site ID	Site Location	In AQMA	Annual Mean NO_2 Concentration (µg/m^3)						
			2017	2018	2019	2020	2021	2022	2023
WT2	Grove Lodge	Yes	35.8	36.8	32.9	26.0	27.6	25.4	23.4

Note: Exceedances of the annual mean AQS objective of 40 µg/m^3 marked in bold

2.2.2 Local Non-Automatic Air Quality Monitoring

WBC's non-automatic monitoring programme consists of recording NO_2 concentrations using a network of 30 sites[1].

The details of 8 diffusion tubes within the Worthing AQMA for 2018 - 2023 are shown in Table 2-3.

Table 2-3 WBC Passive Monitoring

Site ID	Site Location	In AQMA	Annual Mean NO_2 Concentration (µg/m^3)					
			2018	2019	2020	2021	2022	2023
N39	SW of Roundabout, Grove lodge	Yes	32.7	28.5	24.1	23.7	24.4	20.9
N44	AQMS O/S 21 Upper Brighton Road	Yes	**40.7**	*36.1*	31.1	29.8	27.8	26.1
N30A	Grove Lodge Cottages	Yes	**<u>60.1</u>**	**56.6**	**45.1**	**44.4**	**44.7**	**41.0**
N43	23 Upper Brighton Road	Yes	22.3	19.9	17.6	17.2	16.6	16.0
N25	Warren Court	Yes	20.3	17.8	14.8	15.4	15.4	14.2
N5	First Avenue	Yes	25.6	28.3	24.5	23.0	21.5	21.2
N29	Downlands Parade	Yes	23.6	29.9	25.6	24.2	26.0	22.7
N53	Offington Corner	Yes	33.9	30.7	30.2	23.7	24.4	24.0

Note: Exceedances of the annual mean Air Quality Objective (AQO) of 40 µg/m^3 marked in bold, those within 10% marked in italics. Reported concentrations are those at the location of the monitoring site (bias

[1] in 2023

adjusted and annualised, as required), i.e. prior to any fall-off with distance correction.

Monitoring location N30A exceeded the annual mean AQO for NO_2 in all monitoring years between 2018-2023. N30A is also situated on a brick wall façade, which is influenced by reduced air flow and thus presents a higher concentration. When considering fall off with distance to the closest receptor the estimated concentration of NO_2 is 50.1 µg/m^3 for 2019. When considering 2022 data (post COVID-19), N30A was exceeding at value of 44.7 µg/m^3, indicating that air quality has improved. That trend continued in 2023 with the measured level decreasing to 41.0µg/m^3. When predicted back to the receptor this value is 40.4µg/m^3.

Monitoring location N44 was exceeding the AQO during 2018 but has since decreased substantially. When considering fall off with distance, N44 is well below 10% of the exceedance value at 18.4 µg/m^3.

The empirical relationship given in LAQM.TG(22) states that exceedances of the 1-hour mean objective for NO_2 is only likely to occur where annual mean concentrations are 60µg/m^3 or above at a location of relevant exposure. This indicates that an exceedance of the 1-hour mean objective was likely to have occurred at N30A in 2018.

The decline of concentrations in 2020 and 2021 within the AQMA indicates the impact of lockdown during the COVID-19 pandemic. An average decline in mean NO_2 concentration of 16.6% was observed in the Worthing AQMA from 2019 to 2020. While 2022 is not considered a year affected by the COVID-19 pandemic, concentrations remained similar to 2020 and 2021 with a mixture of the monitoring siteswithin the AQMA showing marginal increases and decreases. 2022 and 2023 concentrations are substantially lower than those observed in 2019. Therefore, the traffic data and monitoring data prior to 2020 are used to represent a normalised circumstance with no interference from COVID-19 in combination with a worst-case scenario in the AQMA.

2.3 Public Exposure

To understand the number of the population exposed to poor air quality, a review of the estimated population of the AQMA has been undertaken. This has been completed using the Office for National Statistics ‘Lower Super Output Area’ (LSOA) information. Information from the Indices of Multiple Deprivation (IMD) are also included.

The number for the IMD are based on deciles of multiple factors of deprivation. The larger the score, the more deprived the area.

Table 2-4 - Population Exposure within Worthing AQMA

AQMA	Estimated Population in AQMA	Average IMD within AQMA	Median Age
Worthing Borough Council AQMA No.2	451	9	49

The Worthing Borough AQMA is in the 9th Decile (out of 10), indicating that the area is in a relatively affluent area. However, the median age for the borough of Worthing is 49 which is slightly higher than the England average of 42. As a consequence, those living within the AQMA are more likely to be susceptible to poor health associated with air quality. In total, the AQMA has an estimated population of 451.

3. Worthing Borough Council's Air Quality Priorities

3.1 Public Health Context

Mounting scientific evidence shows the scale of the impact of poor ambient air quality on health. In December 2020, the first case of air pollution being ruled as the cause of death was recorded for nine-year old, Ella Kissi-Debrah as a result of failure to reduce pollution levels to legal limits within the London Borough of Lewisham. Poor air quality is considered to be a significant contributory factor to the loss of life, shortening lives by an average of 5 months. The Committee on the Medical Effects of Air Pollution (COMEAP)[4] provides advice to Government on the setting of air quality standards, and increasingly has sought to consolidate evidence on the health burden and impacts of various pollutants, both in single occurrence and pollutants in combination. The current range of estimate for annual mortality burden for man-made air pollution in the UK is estimated to be between 28,000 – 36,000 deaths.

Local authorities have a range of powers which can effectively help to improve air quality. However, the involvement of public health officials is crucial in playing a role to assess the public health impacts and providing advice and guidance on taking appropriate action to reduce exposure and protect the health of people in Worthing Borough Council.

The Air Quality Indicator in the Public Health Outcomes Framework (England) provides further impetus to join up action between the various local authority departments which can impact on the delivery of air quality improvements. The "Air Quality – A Briefing for Directions of Public Health[5]" document published in March 2017 provides a one-stop guide to the latest evidence on air pollution, guiding local authorities to use existing tools to appraise the scale of the air pollution issue in its

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

[5] https://laqm.defra.gov.uk/mwg-internal/de5fs23hu73ds/progress?id=J-TIiE-srpwXrbZr9rPkC5cmncdLvHWZY0qt_Gytj0E,

area. It also advises local authorities how to appropriately prioritise air quality alongside other public health priorities to ensure it is on the local agenda.

The document comprises the following key guides:

- Getting to grips with air pollution – the latest evidence and techniques
- Understanding air pollution in your area
- Engaging local decision-makers about air pollution
- Communicating with the public during air pollution episodes
- Communicating with the public on the long-term impacts of air pollution
- Air Pollution: an emerging public health issue: Briefing for elected members

Besides NO_2, there is an increasing focus on fine particulate matter. $PM_{2.5}$ is a pollutant of concern meaning particulate matter which is 2.5 microns or less in diameter. The AQMA has not been declared for $PM_{2.5}$ and the modelling as part of the detailed assessment has shown predicted levels below the annual mean objective of 20µg/m³.

The Public Health Outcomes Framework data tool compiled by Public Health England quantifies the mortality burden of $PM_{2.5}$ within England on a county and local authority scale. The 2021 fraction of mortality attributable to $PM_{2.5}$ pollution, i.e. the percentage of total deaths as a result of air pollution, in Worthing is 5.3%, which is below the national average of 5.5%, and lower than the regional average (South East) of 5.4%[6]. It should be noted that this figure only accounts for one pollutant ($PM_{2.5}$) for which stronger scientific evidence on links with mortality exist, and not NO_2, for which the AQMA is declared. This means that the true mortality burden as a result of air pollution could be higher.

Furthermore, following a review of research into the mortality burden associated with the air pollution mixture rather than single pollutants acting independently, the Committee on the Medical Effects of Air Pollutants (COMEAP) are reviewing the

[6] https://fingertips.phe.org.uk/search/pollution#page/1/gid/1/pat/6/ati/401/are/E07000242/iid/30101/age/230/sex/4/cat/-1/ctp/-1/yrr/1/cid/4/tbm/1

legitimacy of linking deaths to one specific pollutant.

The West Sussex County Council Breathing Better document (2023)[7] is an action-oriented summary of the partnership approach to improving air quality in West Sussex. The Breathing Better document focusses on sources of outdoor air pollution.

3.2 Planning and Policy Context

This Action Plan outlines the Council's plan to effectively tackle air quality issues within its control; however, it is recognised there are numerous existing and impending policies and strategies adopted at local, regional, and national level that can exert significant effects, both positive and negative, on air quality across Worthing Borough. It is important that these plans and strategies are identified and taken into consideration at an early stage in the development of the plan. These will aid the establishment of the context in which specific options for improving air quality can be implemented.

Whilst certain policies and / or strategies may be outside of the influence of Worthing Borough Council, there are a number of related policies and strategies at local and regional levels that can be tied directly with the aims of this AQAP. Some of these are directly focused on air quality improvements within Worthing Borough Council, whilst others relate to transportation issues and therefore have the added benefit of contributing to overall improvements in air quality across the borough.

Reviewing these strategies and policies can help to prevent duplication of work within the AQAP, enabling a focus on any additional measures that can be taken, that contribute to the overall aims of the AQAP (and potentially other strategic objectives), This section outlines the strategies and policies that have the most significant potential to impact on pollutant concentrations within Worthing Borough. Given their importance, the majority of measures listed below have also been included as action measures within this Action Plan.

[7] https://www.westsussex.gov.uk/media/19667/air_quality_plan.pdf

The most relevant policies and strategic documents are detailed below.

3.2.1 Environmental Improvement Plan 2023

The Environmental Improvement Plan[8] had its first revision in 2023 since being published as the 25 Year Environment Plan in 2018. The document sets out the UKs vision of action for the natural world for the next quarter century. To achieve this the document sets 10 goals to help direct and measure progress. Goal 2: Clean air is relevant to this AQAP.

The following text has been pulled from the document and highlights the targets the UK has proposed for achieving reduced emissions and subsequently ‘clean’ air:

…”A legal target to reduce population exposure to PM2.5 by 35% in 2040 compared to 2018 levels, with a new interim target to reduce by 22% by the end of January 2028.

- *Legal concentration limits for a number of other key pollutants. We already meet the majority of these limits including for sulphur dioxide and coarse particulate matter. We are working towards meeting compliance with a 40µg/m3 limit for nitrogen dioxide.*
- *A legal target to require a maximum annual mean concentration of 10 micrograms of PM2.5 per cubic metre (µg/m3) by 2040, with a new interim target of 12 µg/m3 by the end of January 2028.*
- *Legal emission reduction targets for five damaging pollutants by 2030 relative to 2005 levels:*
    - *Reduce emissions of nitrogen oxides by 73%.*
    - *Reduce emissions of sulphur dioxide by 88%.*
    - *Reduce emission of PM2.5 by 46%.*
    - *Reduce emissions of ammonia by 16%.*

[8] https://assets.publishing.service.gov.uk/media/64a6d9c1c531eb000c64fffa/environmental-improvement-plan-2023.pdf

- *Reduce emissions of non-methane volatile organic compounds by 39%."…*

3.2.2 Clean Air Strategy 2019

The Clean Air Strategy[9] sets out the case for action at a national level, identifying a number of sources of air pollution within the UK including road transportation (relevant in terms of the AQMA currently present within WBC). It also sets out the actions required to reduce the impact upon air quality from these sources. It has been developed in conjunction with three other UK Government Strategies; the Industrial Strategy, the Clean Growth Strategy, and the 25 Year Environment Plan.

Key actions that are detailed within the strategy aimed at reducing emissions from transportation sources include the following:

- The publication of the Road to Zero strategy, which sets out plans to end the sale of new conventional petrol and diesel cars and vans by 2035[10]
- New legislation to compel vehicle manufacturers to recall vehicles and non-road mobile machinery for any failures in emission control systems, and to take effective action against tampering with vehicle emissions control systems
- Develop new standards for tyres and brakes to reduce toxic non-exhaust particulate emissions from vehicles. [NB: This action would not necessarily target reductions in NO_2 for which the AQMAs have been declared].
- The encouragement of the cleanest modes of transport for freight and passengers
- Permitting approaches for the reduction of emissions from non-road mobile machinery, especially in urban areas

[9] Department for Environment, Food and Rural Affairs (2019), Clean Air Strategy

[10] https://www.gov.uk/government/publications/transitioning-to-zero-emission-cars-and-vans-2035-delivery-plan

3.2.3 Air Quality Strategy 2023

In August 2023, the Air Quality Strategy[11] superseded the previous Air Quality Strategy (2008).

The strategy plans to set out a framework to enable local authorities to deliver for their communities and contribute to the governments long term air quality goals, this includes the new targets for $PM_{2.5}$.

The Air Quality Strategy is designed for local authorities in England with the focus on three main pollutants, $PM_{2.5}$, NO_x and NH_3.

Section 3 of the strategy identifies clear requirements for local authorities to accompany declared AQMA's with an AQAP to provide measures and dates by which they will be carried out. The Air Quality Strategy focuses on air quality as a public health issue, with Directors of Public Health to be involved and collaborate with action plans and strategies. The expectation is that local authorities and their partners deliver air quality improvements within reasonable timeframes. Local authorities should consider prevention and reduction of polluting activities in preference to only taking steps to improve air quality once exceedances have been identified.

3.2.4 UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations

Published in July 2017, the UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations (Detailed Plan)[12] is the UK governments plan for bringing concentrations of NO_2 within statutory limits within the shortest possible time. It identifies that the most immediate air quality challenge within the UK is tackling the issue of NO_2 concentrations close to roads, especially within towns and cities. The plan identifies a number of local authorities that were required to complete feasibility studies to define NO_2 concentrations on road links which were identified by the

[11] https://www.gov.uk/government/publications/the-air-quality-strategy-for-england/air-quality-strategy-framework-for-local-authority-delivery

[12] Department for Environment, Food and Rural Affairs, Department for Transport (2017), UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations (Detailed Plan)

national Pollutant Climate Mapping (PCM) model as exceeding the NO_2 annual mean AQS objective.

WBC were not one of the authorities identified. However, the UK Plan details a range of possible solutions to reduce NO_x emissions from vehicles, and therefore lower NO_2 concentrations. The actions detailed within the UK Plan include:

- Implementation of Clean Air Zones (CAZs)
- New real world driving emissions requirements for light passenger and commercial vehicles
- Additional funding to accelerate the uptake of low emissions buses and also for the retrofitting of older buses
- Additional funding to accelerate the uptake of hydrogen vehicles and associated infrastructure
- New mandatory emissions standards for non-road mobile machinery
- Local cycling and walking investment plans

3.2.5 Worthing Borough Council Local Plan

The Council adopted the Local Plan on the 28th of March 2023[13]. The Local Plan sets out the planning framework for the Borough for the period of 2020-2036 and will deliver sustainable development.

Specific Air Quality policies are included within the plan, specifically the following:

Policy S020

"Provide an integrated, safe and sustainable transport system to improve air quality, reduce congestion and promote active travel."

Policy SP3 Healthy Communities

"…v) improve environmental sustainability resilience and reduce contributors to poor health and mitigating their risks, such as those associated with climate change,

[13] https://www.adur-worthing.gov.uk/media/Media,169486,smxx.pdf

flooding, hazardous uses, crime, noise and poor air quality to reduce inequalities and address climate justice;…"

Policy DM15 Sustainable Transport

"…vii) ensure new development contributes to the mitigation of air pollution, particularly in Air Quality Management Areas. New development should be located and designed to incorporate facilities for electric vehicle charging points, thereby extending the current network;…"

Policy DM22 Pollution

"…d) Where appropriate, air quality and/or noise assessments and lighting assessments will be required to support planning applications. These should be undertaken in accordance with the most up to date guidance and have regard to any relevant action plans. Any new development in the Worthing Air Quality Management Area must be consistent with the Air Quality Action Plan. Where any identified harm to any of these factors cannot be adequately mitigated, planning permission will be refused…"

3.2.6 Air Quality and Emissions Mitigation Guidance for Sussex Guidance

Sussex Air have developed a Supplementary Guidance Document[14]. This guidance deals with the pollutants from transport which are regulated under the Local Air Quality Management (LAQM) regime, and the assessment and control of dust during demolition and construction.

Air quality is a material consideration in deciding a planning application. The purpose of this document is to:

1) provide clarity to how authorities intend interpreting relevant Local Plan policies.

2) provide advice for developers and their consultants on how to assess and mitigate the impact that new developments may have on local air quality.

3) detail a consistent approach by developers and Local Planning Authorities (LPAs)

---

[14] https://www.adur-worthing.gov.uk/media/Media,165958,smxx.pdf

to:

- address impacts on local air quality
- ensure optimum scheme design to reduce emissions and/or exposure and
- avoid unnecessary delays in the planning process.

3.2.7 West Sussex County Council Transport Plan 2022-2036

The West Sussex Transport Plan 2022 – 2036 (WSTP)[15] is the County Council's main policy on transport and sets out how key challenges including improving, maintaining and managing the transport network will be addressed in the period up to 2036. The WSTP identifies the theme of public health and wellbeing, and AQMAs around the county in particular, as one of the key issues for the plan. The plan's objectives cover the following themes:

- Prosperous West Sussex
- Healthy West Sussex
- Protected West Sussex
- Connected West Sussex

The plan recognises the traffic-related air quality management area on the A27 between Grove Lodge and Lyons Farm as a key issue and identifies a range of measures including on-street electric vehicle charging infrastructure, active travel route improvements and wider improvements to the A27 to address traffic congestion and emissions.

3.2.8 Road Investment Strategy 3 - 2025-2030

National Highways is currently developing the Road Investment Strategy 3 document and states that it is planning for and improving its Strategic Road Network (SRN) where there is poor air quality.

[15] https://www.westsussex.gov.uk/media/17428/wstp.pdf

The Transport Decarbonisation Plan set a credible and ambitious pathway to deliver transport's contribution to the five-year carbon budgets and meeting net zero by 2050, amplified for the SRN by National Highways' own net zero highways plan. Action on the SRN will, for example, support the use of a decarbonised vehicle fleet and make active travel and public transport easier and more attractive to use. The way the SRN is maintained and enhanced will continue to adapt to reduce carbon use and help improve air quality.

On air quality, work to identify and implement measures to address NO_2 exceedances on the SRN and supporting the work of local authorities to develop and implement their clean air plans, where there are interactions with the SRN.

3.2.9 West Sussex Cycling and Walking Strategy

This strategy states WSCC's aims and objectives for cycling and walking between 2016 and 2026. The strategy guides the Council's approach to maintaining, managing, and investing in transport, and meeting their main objective of improving quality of life for West Sussex residents. At the time of writing the County Council is developing a new West Sussex Active Travel Strategy which it consulted on during 2023.

3.3 Source Apportionment

The AQAP measures presented in this report are intended to be targeted towards the predominant sources of emissions within Worthing Borough Council's area with particular emphasis on the AQMA.

A source apportionment exercise was carried out for Worthing Borough Council based on the detailed modelling which was completed for a 2019 (pre-Covid) baseline year. Full details are provided within the technical report in **Appendix C** including a breakdown of polluting vehicles and pollution from background sources.

A source apportionment exercise was undertaken using an air dispersion model to assess the overall emissions profile of vehicles moving through the AQMA. It should be noted that emission sources of NO_2 are dominated by a combination of direct NO_2 (f-NO_2) and oxides of nitrogen (NOx), the latter of which is chemically unstable and rapidly oxidised upon release to form NO_2. Reducing levels of NO_x emissions therefore reduces levels of NO_2.

The NO_2 Source Apportionment exercise has been completed at the Max Receptor in line with the guidance contained within Box 7-5 of LAQM TG(22).

Table 3-1 NO_2 Source Apportionment Calculations at Max Receptor in AQMA

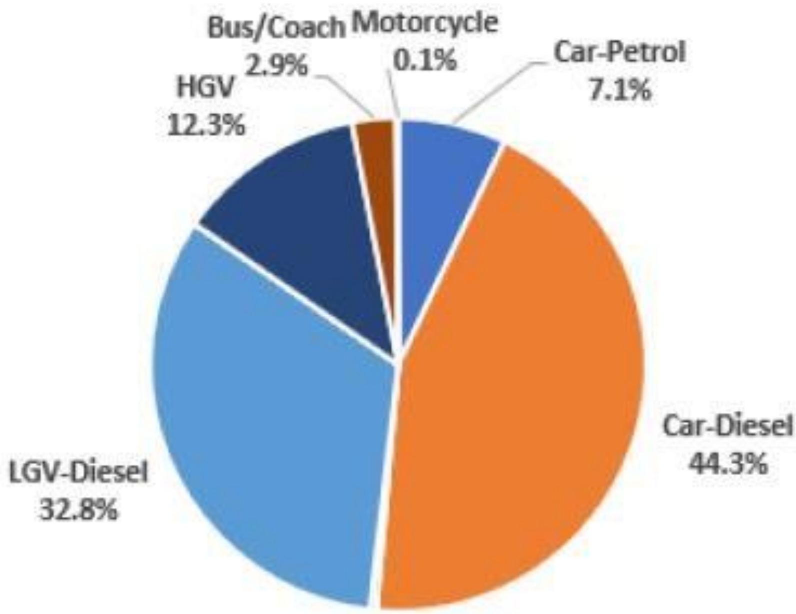
Calculation	Concentration (µg/m³)
Total Background NO_2 [TB-NO_2]	12.1
Total Background NO_x [TB-NO_x]	17.3
Regional Background NO_x [RB-NO_x]	6.9
Local Background NO_x [LB-NO_x]	10.4
Local Background NO_2 [LB-NO_2]	11.8
Total Max Modelled NO_2 [T-NO_2]	47.2
Local NO_2 Contribution [L-NO_2]	35.4

Using the above calculations, the NO_2 apportionment for vehicles is set out below.

Table 3-2- NO_2 Source Apportionment from Vehicles at Max Receptor in AQMA

Vehicle	NO_2 Contribution (µg/m³)
Petrol Cars	5.1
Diesel Cars	32.3
Petrol LGV	<0.1
Diesel LGV	23.9
HGV	9.0
Buses	2.1
Motorcycle	0.1
Car Alternative (Electric/Hybrid)	0.3

Figure 3.1 NO_2 Source Apportionment percentage from Vehicles at Max Receptor in AQMA



The source apportionment exercise demonstrates a largely consistent ranking of contributing vehicle classes exhibited (Diesel Cars, Diesel LGVs, HGVs, Petrol Cars, and Buses), where Diesel Cars are found to be the main contributors to total road NO_2 concentrations across the AQMA.

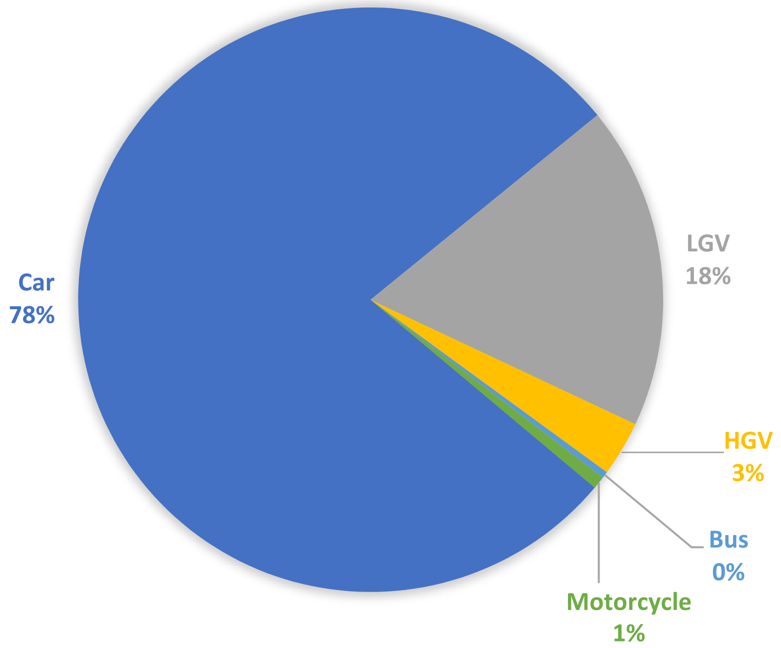
Whilst comparing modelled contributions at identified receptor locations within the AQMA against the max receptor within the AQMA, Diesel Cars were observed to have a very similar influence on total road NOx concentrations within the AQMA. For all the other vehicle types at the max receptors, they have either a similar or slightly higher influence, excluding Diesel LGVs, on total road NOx concentrations within the AQMA when compared the average across the AQMA.

Overall, the volume of traffic and congestion in the AQMA is considered to be the key contributor to elevated levels of NO_2 annual mean concentrations within the AQMA. The key location in the AQMA where elevated levels of NO_2 are observed are the where the A27 Upper Brighton Road meets the Grove Lodge Roundabout.

This is explored in detail in Appendix C.

Figure 3.2 presents the traffic split percentage per vehicle class within the AQMA. It shows that while HGV's account for only 3% of the traffic volume they account for 12.3% of the emissions. There is not sufficient detail available to present the volume percentage of Petrol Cars and Diesel Cars however it can be assumed that petrol vehicles account for a higher percentage of the traffic volume but resulting in a smaller contribution to road NO_2 emissions.

Figure 3.2 Proportion of Vehicles in the AQMA



3.4 Required Reduction in Emissions

Full details of the required reductions and methodology are contained within the Technical Report in Appendix C.

Table 3-3 below also illustrates the required reduction in NO_x emissions for annual mean NO_2 concentrations to fall below the AQO of 40µg/m^3 at the worst-case modelled receptor during the year 2019 as used for the detailed modelling assessment. As shown, a 22.4% reduction in road NO_x is required to meet the AQO for annual mean NO_2 at the worst-case receptor within the AQMA for 2019.

The highest annual mean NO_2 concentration was recorded at Receptor 28A with a concentration of 47.2 µg/m^3, Receptor 28A is located along a façade of a residential property which immediately fronts onto a stretch of the A27 Upper Brighton Road, which is considered to be susceptible to congestion due to the convergence of high capacity around the Grove Lodge Roundabout and subsequent junctions. Receptor 28A is the ground level representative point of exposure for local authority monitoring location N30A which measured the highest concentration of 56.5µg/m^3 in Worthing AQMA in 2019. Receptor 28A is modelling a lower concentration than the monitoring station due to being modelled at the location of a ground floor window which is set back several metres from the road. N30A is also situated on a brick wall façade, which is influenced by reduced air flow and thus presents a higher concentration.

Table 3-3– Required Reduction in NOx emissions to meet AQO for Annual Mean NO_2

Metric	Value (Concentrations as µg/m^3)
Worst-Case Relevant Exposure NO_2 Concentration	47.2
Equivalent NO_x Concentration	90.2
Background NO_x	17.3
Background NO_2	12.9
Road NO_x - Current	72.8
Road NO_x - Required (to achieve NO_2 concentration of 39.9µg/m^3)	56.6
Required Road NO_x Reduction	16.3
Required % Reduction	22.4%

3.5 Key Priorities

3.5.1 Priority 1 - Reduce the impact of traffic on air quality and congestion.

The main source of air pollution leading to the declaration of the AQMA is road transport emissions, specifically from diesel vehicles. Therefore, reducing transport emissions is the key priority. Our approach focuses on areas where WBC has direct control (e.g. planning and procurement of outsourced functions) and areas where measures can be implemented via a partnership with National Highways, West Sussex County Council (WSCC), or others.

As the roads contributing to pollutant concentrations which result in exceedance of the annual average NO_2 objective are managed by National Highways, this Relevant Public Authority has been engaged with for the purpose of preparing this AQAP. And

National Highways have confirmed that the criteria for a formal “Air Quality Partner” relationship have been met.

There are currently plans to reduce levels of NO_2 within the AQMA through strategic highway improvements to the A27. This includes junction capacity, access management and variable message sign measures, as well as improvements to active travel infrastructure and bus stop facilities, to reduce congestion and provide improvements for non-car modes. Where appropriate, National Highways will work to support these plans.

Further detail on the 3 options consulted on are available here:

https://nationalhighways.co.uk/our-roads/south-east/a27-worthing-and-lancing-improvements/

While there is still ongoing review of project options with the support of the Department for Transport, National Highways will continue to engage with WBC to present improvements through annual status reporting.

This is used in conjunction with measures such as ‘Cut Engine, Cut pollution’ signs along the A27 to help encourage anti-idling behaviours.

This includes junction capacity, access management and variable message sign measures, as well as improvements to active travel infrastructure and bus stop facilities, to reduce congestion and provide improvements for non-car modes."
Further detail on the 3 options consulted on are available here:
https://nationalhighways.co.uk/our-roads/south-east/a27-worthing-and-lancing-improvements/

Across the local authority, there are multiple efforts in place to improve uptake in cleaner vehicles. This includes provision of additional electrical vehicle charging through the formation of the West Sussex Chargepoint Network. The Worthing Car Club scheme has also been an ongoing success continuing to expand with new developments across the borough.

WSCC and WBC interchange improvements at Worthing Station Railway Approach are expected to benefit pedestrians, cyclists, and train, bus and taxi users. WSCC has committed funding to develop detailed designs for Worthing Railway Approach public realm and access improvements with the scheme programmed to be delivered in 2024. This includes plans to provide real time bus information for passengers at various locations across the borough.

Adur and Worthing Local Cycling & Walking Infrastructure Plan will contribute to achieving and improving on the targets of the Government's Cycling & Walking Investment Strategy, which aims to double levels of cycling by 2025 (from 2013 base levels).

3.5.2 Priority 2 – Reduction in the council's air quality impact

We will continue to make steps towards greening our own fleet including that of our contractors, especially a move away from diesel vehicles after being identified as the largest contributor to NO_2 emissions as identified by the source apportionment study. Procurement processes are key to this next step, greening of our own fleet sets a good example for other fleet operators, but seeking higher environmental standards from council suppliers and contractors would accelerate this move significantly.

The WBC Staff Travel Plan was updated in 2021 and has led to the adoption of a hybrid mixed home/office model as well as funding for hybrid pool cars. It is anticipated that this plan will be updated in the near future to further mitigate WBC's impact.

3.5.3 Priority 3 - Public information access to support healthier lifestyles for residents

As detailed in Section 3.1, air pollution has a detrimental impact on public health. Therefore, improving air quality within the borough is a key priority. The main sources of air pollution in areas of public exposure in WBC are from vehicle emissions, predominantly diesel vehicles. The application of a Clean Air Zone or Low Emission Zone along the A27 through Worthing is considered unlikely to be deliverable in particular because of the potential unintended consequences on other local roads away from the A27. Therefore, the most effective way to achieve a reduction in vehicle numbers is to change the attitudes and behaviour of the population towards travel. WBC will encourage and facilitate these changes through implementing a suite of interventions to affect travel behaviour, working with schools, active travel groups, public transport partners, etc.

The application of a Clean Air Zone or Low Emission Zone along the A27 through Worthing is considered unlikely to be deliverable in particular because of the potential unintended consequences on other local roads away from the A27. Therefore, the most effective way to achieve a reduction

Air quality monitoring is a useful way to continually assess the extent of air pollution in WBC. It also helps to measure the impact of implementing measures to reduce emissions, and as an evidence base for AQMAs to be revoked. Currently, NO_2 is monitored across WBC using passive diffusion tubes and continuous monitoring stations. Sussex Air also plays an integral role in the availability and public distribution of air quality monitoring. The revamped Sussex-air website launched to provide a smoother more relevant customer experience including Worthing Grove Lodge monitoring results and diffusion tube data.

Measures will include education and awareness raising alongside schemes which incentivise change. Improving air quality to protect public health requires a wide-reaching perspective which is not specific to the AQMA but instead aims to have a wider impact across the borough. Public information initiatives include embedding air quality into the public health plan and the promotion of air alerts through collaboration with WSCC.

3.5.4 Priority 4 – Planning and guidance for future growth impacts

The Local Plan and its policies set out the considerations that will be applied by WBC for all development proposals. The Council will work with developers and partner organisations to ensure the delivery of infrastructure, services, and community facilities necessary to develop and maintain sustainable communities. This will not only apply to air quality but all relevant environmental aspects. Further Section 106 agreements will be sought to secure funding for future mitigation measures as appropriate where development will increase pollutant concentrations.

Existing strategies and policies adopted by WBC and WSCC are key mechanisms for reducing emissions across the borough. Transport is the main source of NO_x emissions, and therefore NO_2 concentrations, within the AQMA.

3.5.5 Delivering Priorities

In order to deliver these priorities, we have focussed our work under these four main themes which we feel would have greatest impact on the reduction of emissions in and around the AQMA based on the emissions sources identified and the powers within our remit;

- Promoting travel alternatives
- Promoting low emission transport
- Providing public information, raising awareness, and education
- Policy guidance and development control

Promoting travel alternatives

This will include measures such as;

- Increasing active travel through progressing implementation of active travel measures identified within Local Cycling and Walking Infrastructure Plans, linked to safe walking and cycle access to schools/colleges in the area
- Supporting improvements to public transport such as improvements at rail station interchanges and bus stops,
- 'Donkey Bikes' bike share scheme
- Promotion of West Sussex Car Share lift share scheme
- Supporting work on school travel plans and trialling of 'school streets'(currently in Arundel, Shoreham and Worthing)
- Encouraging workplace travel plan provision
- Leading by example with council workplace travel plans
- Identify changes that can be made to reduce the number of delivery and servicing vehicles serving council administrative buildings

Promoting low emission transport

- Exploring parking incentives such as free parking for electric vehicles in council car parks,
- Emissions based fees for parking permits
- WSCC Electric Vehicle Strategy

- West Sussex Chargepoint Network partnership installation of large network of electric vehicle charge points across the county

Providing public information, awareness and education

- Promoting anti idling messages at locations where vehicles are stationary for extended periods, such as rail level crossings and schools.
- Delivering behavioural change campaigns
- Promotion of the Sussex Air Quality Alert Service
- Develop communications plan to raise awareness of air pollution effects and measures residents can take to reduce air pollution effects
- Promotion of a revamped, more user friendly and useful Sussex-air website
- Promoting uptake of grant funding to individual households, social and private landlords of energy efficiency retrofitting projects such as replacement of new boilers, loft insulation etc.

Policy guidance and development control

- Reducing emissions from our own activities, particularly the waste fleet
- Explore domestic solid fuel and bonfire policy options to reduce domestic emissions
- Construction code of practice for small developments to be used as an informative on planning consents
- Aim to reduce diesel generators on construction sites wherever possible.
- Promotion and use of the Sussex Air Quality Planning Guidance in the Planning Process
- Explore synergies with Sustainability Policies and join up policies where possible.
- Ensure there are relevant policies relating to Air Quality within the Local Plan.

4. Development and Implementation of Worthing Borough Council AQAP

4.1 Consultation and Stakeholder Engagement

In developing/updating this AQAP, we have worked with other local authorities, agencies, businesses, and the local community to improve local air quality. Schedule 11 of the Environment Act 1995, as amended by the Environment Act (2021), requires local authorities to consult the bodies listed in Table 4-1.

The response to our consultation stakeholder engagement is given in Appendix A. Public consultation responses are summarised in Appendix F. Most comments received were supportive. Many people agreed highway improvements, infrastructure, public transport and safe walking and cycling promotion should be included. Actions such as car clubs and electric vehicles were less popular. Comments will be considered by the steering group when delivering this AQAP.

Table 4-1 – Consultation Undertaken

Consultee	Consultation Undertaken
The Secretary of State	Yes
National Highways	Yes
All neighbouring local authorities	Yes
The County Councils (if a District Council)	Yes
Bodies representing local business interests and other organisations as appropriate	Yes

4.2 Steering Group

A steering group was established as part of the AQAP development process to drive forward the development of the new AQAP. The core aim of the steering group is to identify measures for inclusion within the AQAP that would be effective both in terms of reducing NO_2 concentrations and also feasible in terms of implementation and delivery.

The steering group is composed mainly of WBC Council officers from those services with an interest or potential impact on air quality and who may have an influence on the action measures being considered.

The officers have provided and continue to provide guidance in their respective areas of expertise to ensure selection, and continual evaluation of the most appropriate measures.

An initial steering group meeting took place in February 2023. The steering group included officers from the local authority Public Health & Regulation department alongside West Sussex County Council Transport Planning and Policy.

The steering group sets out an approach to tackling Air Quality within the Borough. While the technical aspects of this AQAP have focussed on concentrations within the declared AQMA, the wider ambitions are included as part of the measures for reducing pollutant concentrations across the whole Borough.

It is the aim for this steering group to continue to communicate at regular intervals following the adoption of the AQAP. This is essential to provide progress reports on individual actions in relation to the AQAP measures, discuss any key lessons learnt from the continual implementation of the measures and to continue to discuss any new ideas in terms of future measures and actions within the Borough.

Having members within the steering group from different areas and departments allows a collaborative approach to improving air quality and provides a wider scope of measures that can be implemented.

5. AQAP Measures

Table 5-1 shows the Worthing Borough Council's AQAP measures. It contains:

- a list of the actions that form part of the plan
- the responsible individual and departments/organisations who will deliver this action
- estimated cost of implementing each action (overall cost and cost to the local authority)
- expected benefit in terms of pollutant emission and/or concentration reduction
- the timescale for implementation
- how progress will be monitored

NB: Please see future ASRs for regular annual updates on implementation of these measures.

Additional information on some measures are set out below inclusive of how they relate to the source apportionment exercise.

5.1.1 Highway Improvements and Transport Infrastructure

The source apportionment study has shown there is an issue with the volume of traffic from cars, especially diesel cars. Within the AQMA, particularly the junctions around the Grove Lodge Roundabout, exceedances of the AQO are observed. Although these exceedances are for the long term AQO, there is potential to strategically implement highway improvement measures to improve vehicle flow and reduce congestion.

National Highways have been working with key stakeholders to identify a package of potential improvements, to improve capacity and flow of traffic on the A27 from Worthing to Lancing, including preparing revised plans for consideration in the Governments Road Investment Strategy 3 (RIS 3): 2025 - 2030.

The Adur and Worthing Local Cycling and Walking Infrastructure Plan (LCWIP) was adopted in summer 2020. This sets out a series of cycling and walking routes intended to be supported by contributions from strategic developments across the

Borough. Department for Transport Active Travel Fund funding was received to deliver the Findon Valley to Findon cycle scheme to connect the cycle route from the A24 Findon village to Worthing through the AQMA, with the scheme completed in early 2023. While there already exists cycle paths segregated from pedestrians in and around the Grove Lodge AQMA, the network could be extended along the full length of the A27.

EV charge points continue to be provided for new major developments. West Sussex County Council, together with each of the local planning authorities across West Sussex including Worthing Borough Council together with Connected Kerb have formed a partnership to provide a new charge point network across West Sussex. The partners are working together to install thousands of charge points across the county within the next ten years, forming the new West Sussex Chargepoint Network.

5.1.2 Embed Emissions Mitigation Guidance

While traffic is the main source of emissions within the AQMA, it is also important to consider how WBC can indirectly mitigate traffic emission impacts. WBC have embedded the Air Quality Emissions Mitigation Planning Guidance for Sussex[16] into their respective planning processes. The guidance is signposted within the Worthing Local Plan. This has meant mitigation being flagged at an early stage within the planning procedure, resulting in emissions mitigation assessments being conducted for major developments. To progress this, WBC, as a member of Sussex-air, is planning further revision of this guidance.

5.1.3 Worthing Car Club

This scheme, in collaboration with Co Wheels, provides a pay-as-you-go rental membership for when a private vehicle is really needed. Aimed at those who drive less than 8,000 miles per year, members benefit financially compared to those who own their car outright. This scheme helps reduce the number of private vehicles in

[16] https://sussex-air.net/

the Borough and subsequently reduces congestion and vehicle emissions. To date, this continues to be an ongoing measure with the expansion of new developments.

5.1.4 Public Transport Improvements

Although Buses and Coaches are not a large proportion of the emission observed in the source apportionment assessment, a further measure to reduce congestion from private vehicle usage within the Worthing AQMA and wider borough area is the implementation of public transport improvements. Programmed to be delivered in 2024, WSCC has committed funding to improve the Worthing Railway Approach public realm and subsequent public transport access. Furthermore, bus operators continue to explore low emission technologies within their fleets and the Councils work closely with them over operator plans and funding opportunities. The uptake of low emission buses including electric buses is actively encouraged by the Council. WSCC through its Bus Service Improvement Plan (BSIP) is also working to provide more real time bus information screens at bus stops including within Worthing Borough. WSCC also has a 16-20 Saver scheme allowing child fares for young people where the fares are lower than capped bus fare prices (national scheme £2 single fares until December 2024). This BSIP funded scheme is currently running until March 2025.

5.1.5 WBC Staff Travel and Vehicle Fleet Efficiency

The WBC Staff Travel Plan was updated in 2021 and has led to a move towards a hybrid working model to help reduce the number of private vehicle usage.

WBC is committed to improving emissions from their own vehicle fleet through procurement. All pool cars are now hybrid models with fully electric vehicles being investigated. WBC are actively exploring alternative fuels for larger vehicles such as the fleet of refuse vehicles, as part of the decarbonisation strategy to replace the entire existing diesel fleet by 2027.

5.1.6 Local Plan / Travel Plans

The Submission Draft Worthing Local Plan was submitted for Examination in June 2021. The revised Plan was formally adopted by the Council in March 2023. The document outlines development requirements for future major development proposals stating that:

'…[future major developments are required to] respond to the requirements of the Worthing Air Quality Action Plan and deliver a package of sustainability measures to mitigate the impact of development. This should include a commitment to promote a travel plan to improve the accessibility and sustainability of the site. EV charge points (with a power output of at least 7kW) should be provided for all residential units, fitted ready for first occupation;…'

The local plan also states that applicants for development within or adjacent to an AQMA should discuss requirements with the Council's Environmental Health Team before a planning application is submitted. This will help to determine whether a proposed development could impact upon the AQMA and what potential mitigation measures may be required.

School Travel Plans are also integral to promoting sustainable travel amongst young people and reducing peak time car traffic within the AQMA. Funded through various sources, WSCC Bikeability has been engaging with primary and secondary schools across Worthing to offer cycle training.

Table 5-1 – Air Quality Action Plan Measures

Measure No.	Measure	Category	Classification	Estimated Year Measure to be Introduced	Estimated / Actual Completion Date	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Target Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Potential Barriers to Implementation
1	A27 Highway Improvements	Traffic Management	Strategic highway improvements	2024	2026	National Highways (NH)	NH	NO	Partially Funded	> £10 million	Planning	High	Reduction in levels of NO2	National Highways have been working with key stakeholders to identify a package of potential improvements to meet the revised objectives in the Governments Road Investment Strategy 3 (RIS 3): 2025 - 2030, to improve capacity and flow of traffic on the A27 from Worthing to Lancing. A public consultation was held in 2023. No outcomes yet.	
2	Cut Engine, Cut Pollution Signs	Traffic Management	Anti-idling enforcement	2024	2025	NH/WSCC	Worthing BC/NH/WSCC	NO	Partially Funded	< £10k	Implementation	Low	Local AQ monitoring/reduction in NO2	'Cut Engine, Cut pollution' signs along the A27 to help encourage anti-idling behaviours.	Funded by Worthing BC. Sussex-air funded additional signs at level crossings. For A27 and feeder roads Highway 'clutter' is a concern.
3	Embed Air Quality Emissions Mitigation Planning Guidance for Sussex into the planning process/planning policies	Policy Guidance and Development Control	Air Quality Planning and Policy Guidance	2024	2025	Worthing BC/WSCC	Worthing BC/WSCC	NO	Funded	< £10k	Implementation	Low	LE mitigation secured in developments	Revised Guidance published April 2021. The guidance is signposted within the Worthing Local Plan. Guidance and appropriate mitigation is flagged as a requirement at an early stage. Emission mitigation assessments required from major developments to ensure meaningful mitigation.	Consider developing the Guidance into a Supplementary Planning Document if deemed necessary.
4	EV vehicles and infrastructure	Promoting Low Emission Transport	Procuring alternative Refuelling infrastructure to promote Low Emission Vehicles, EV recharging,	2016	2025	Worthing BC/WSCC	Worthing BC/WSCC/NH	NO	Partially Funded		Implementation	Low/Medium	Number of charge points provided	EV charge points continue to be provided for new 'major' developments aided by new Building Regulations Approved Documents ; West Sussex County Council, Adur and Worthing	Focus is to increase the number of eV's. Discussions continue successfully with developers as part of AQ mitigation packages, aided by

Measure No.	Measure	Category	Classification	Estimated Year Measure to be Introduced	Estimated / Actual Completion Date	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Target Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Potential Barriers to Implementation
			Gas fuel recharging											Councils, and all other West Sussex local planning authorities together with Connected Kerb have formed a partnership to provide a new chargepoint network across West Sussex. The partners are working together to install thousands of chargepoints across the county within the next ten years, forming the new West Sussex Chargepoint Network. West Sussex County Council currently installing electric vehicle chargingpoints on the highway atvarious locations in Worthing. WSCC parking standards sets increasing year on year targets for ev charge points at new developments.	new Building Regulations Approved Document. Promoting an accelerated move to more EV vehicles in the local fleet will help to target the key source of emissions in the AQMA, namely older diesel vehicles.
5	Worthing Car Club	Alternatives to private vehicle use	Car Clubs	2015	2029	Worthing BC/ADC	Worthing BC/Developer Contributions	NO	Partially Funded	£50k - £100k	Implementation	Low	Number of people using the service/ Number of vehicles	There are two dedicated bays in High Street surface car park Worthing. Discussions with car club providers continue. Car club providers continue discussions with developers regarding specific development sites.	V. small reduction in AQMA, however larger reductions anticipated elsewhere (e.g. town centre where new developments are more likely to be car free). Car clubs embedded in planned new developments.
6	Public transport improvement	Transport Planning and Infrastructure	Public transport improvements-interchanges stations and services	2010	2025	WSCC	WSCC/DFT/OLEV	NO	Partially Funded		Implementation	Low	Journey time and passenger number improvements	WSCC and WBC improvements at Worthing Station Railway Approach are to benefit pedestrians, cyclists, and train, bus and taxi users. WSCC is delivering Worthing Railway	Subject to appropriate funding being made available.

Measure No.	Measure	Category	Classification	Estimated Year Measure to be Introduced	Estimated / Actual Completion Date	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Target Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Potential Barriers to Implementation
														Approach public realm and access improvements. Bus operators in West Sussex continue to explore low emission fuel technologies in their fleets and local authorities are in dialogue with operators as plans develop, including consideration of any funding opportunities as they arise. Work with Brighton & Hove City Council continued to reduce emissions on routes through Worthing and into the Brighton LEZ.	
7	WBC and WSCC Staff Travel Planning	Promoting Travel Alternatives	Workplace Travel Planning	2021		Worthing BC/ ADC/ WSCC	Worthing BC/ ADC/ WSCC	NO	Partially Funded		Implementation	Low	Staff travel surveys reduced commuting and business travel by car	WBC Staff Travel Plan updated in 2021. Hybrid models for mixed working from home/office is the business model now. Adur & Worthing & WSCC EASIT scheme for staff and local businesses continues.	
8	Improve Emissions from Council's Vehicle fleet	Promoting Low Emission Transport	Company Vehicle Procurement - Prioritising uptake of low emission vehicles	2024	2030	Worthing BC/ADC/ WSCC	Worthing BC/ADC/WSCC	NO	Partially Funded	£1 million - £10 million	Planning	Low	No. of vehicles replaced with better Euro standard models	Programme of fleet replacement with low emission vehicles, as and when vehicles are due for replacement. All A&WC pool cars hybrids. Exploring alternative fuels for larger vehicles including the fleet of refuse vehicles as part of the decarbonisation strategy to replace the entire, existing diesel entire fleet by 2027. EV's now part of WSCC pool car fleet.	Barrier: Suitable vehicles are both available and affordable (e.g. HGV's/refuse vehicles).
9	Increase availability of AQ information in relation to	Public Information	Via the Internet	2023	2026	Worthing BC	Worthing BC	NO	Funded	< £10k	Implementation	Low	Reduction in levels of NO2/No. of hits on AQ pages	Worthing AURN Grove Lodge Monitoring Station cabinet replaced in early 2023. New AURN urban background site added at Ten Acres. AQ information available via	Measure success of AQAP/levels in AQMA. Assist with PM2.5 strategy

														UK Air and the Sussex-	

Measure No.	Measure	Category	Classification	Estimated Year Measure to be Introduced	Estimated / Actual Completion Date	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Target Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Potential Barriers to Implementation
	impacts on Public Health													air website, links on Council website.	
10	Promotion of Sussex Air Quality Alert Service	Public Information	Via the Internet	2014	2026	Worthing BC	Worthing BC/ WSCC	NO	Partially Funded	£10k - 50k	Implementation	Low	Annual increase in subscriber numbers	Liaison with WSCC Public Health Team who have supported the promotion of alert services. Sussex-air website provides a smoother more relevant customer experience including Worthing Grove Lodge monitoring results and Diffusion tube data.	Attempt to reduce car journeys and increase walking and cycling through the AQMA, promotion of alert service.
11	Re-assess traffic light sequencing in AQMA	Traffic Management	UTC, Congestion management, traffic reduction	2010		NH/WSCC	HE/WSCC	NO	Funded		Implementation	Low	Reduction in levels of NO2	Ongoing optimisation by NH/WSCC.	
12	Safe Cycling and Walking Routes	Transport Planning and Infrastructure	Cycle network	2010	2030	NH/WSCC	NH/WSCC	NO	Funded	£1 million - £10 million	Implementation	Low	Length of new cycle routes provided	The Adur and Working Local Cycling and Walking Infrastructure Plan (LCWIP) was adopted in summer 2020. This sets out a series of cycling and walking routes intended to be supported by government funding or contributions from strategic developments across the Borough. Throughout 2022, construction of the Findon Valley to Findon village cycle path took place, to connect cycle route from the A24 Findon village to Worthing through the AQMA (see entry 25).	There already exist cycle paths segregated from pedestrians in and around the Grove Lodge AQMA.
13	Travel plans for significant /major developments	Promoting Travel Alternatives	Other	2023	2026	Worthing BC/WSCC	Developer Contribution	NO	Partially Funded	£500k - £1 million	Planning/ Implementation	Low	Number of plans delivered	Plans continue to be secured as and when developments come forward. The Local Plan adds weight to the requirement for travel plans.	

Measure No.	Measure	Category	Classification	Estimated Year Measure to be Introduced	Estimated / Actual Completion Date	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Target Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Potential Barriers to Implementation
														The Worthing Local Plan was formally adopted by the Council in 2023.	
14	Car Sharing	Alternatives to private vehicle use	Car & lift sharing schemes	2015		WSCC	WSCC	NO	Funded		Implementation	Low	Website hits/ journeys planned/Number of registrants/take-up of initiatives	Car share website www.westsussexcarshare.com	Focus on promoting sustainable travel/car. Link on Worthing website.
15	Cycling & Walking promotion	Promoting Travel Alternatives	Promotion of cycling	2015		Worthing BC/WSCC	WSCC/Developer Contributions	NO	Partially Funded		Implementation	Low	Automatic cycle counters and travel surveys	WSCC Bikeability has been engaging with primary and secondary schools across Worthing to offer cycle training. In addition Sustrans have been working with schools through a Sussex-air engagement programme.	Focus on reducing traffic congestion and promoting sustainable travel for trips to and from work. Subject to available funding.
16	Increase and improve availability of WBC Air Quality Monitoring results	Public Information	Via the Internet	2015	2026	Worthing BC	Worthing BC	NO	Funded	£10k - 50k	Implementation	Low	Reduction in levels of NO2/No. of hits on AQ pages	Council's webpages updated. Linked Worthing webpage to UK Air and Sussex-air for Grove Lodge AURN monitoring.	Revision of Worthing BC and Sussex-air webpages ongoing

5.2 Timescales of the AQAP Measures

Some of the measures set out in Table 5-1 are at the planning stage. These measures are in their infancy and, while there is every ambition to implement these to achieve reductions in pollutant concentrations within Worthing, they will require investigation and planning before a realistic timescale can be set.

5.3 Air Quality Partners

National Highways have responsibility for the A27 which passes through the AQMA. They have been engaged with and we continue to work with them as part of the steering group and wider Air Quality objectives across the borough.

5.4 Future Measures to Maintain the Objective

It is recognised that improving air quality is an ongoing challenge which must be weighed against business interests and political will. There are a number of measures within this AQAP which look to make behavioural changes by improving active travel and moving away from single occupancy vehicles. With these measures, we look to make sustainable, long-term changes in patterns of behaviour which will aid in reducing pollution in years and decades to come. Air quality within the AQMA is showing substantial improvement, in particular in relation to improving vehicle fleets, and is forecasted to continue improving with further fleet improvements and supporting AQAP measures. Once the improvements outlined in this AQAP have been completed and the Worthing AQMA revoked, an Air Quality Strategy will be developed to maintain good air quality.

6. Quantification of Measures

6.1 Assumptions

Many of the measures set out in Table 5-1 are very difficult to quantify. No detailed studies have been completed for any measure to reliably inform the likely effect in terms of change in traffic or fleet composition as a result of the measures. Some measures do allow for a high-level analysis of reductions in emissions. Consideration of the measures and whether they can be quantified is contained in Table 6-1 below.

Table 6-1 - Assumptions around Quantification of Measures

Measure no.	Measure	Assumptions for Quantification	Quantifiable?	Assumed Reduction in AQMA
1	A27 Highway Improvements	Through the highway improvements it is assumed that there may be an increase in average speed across the AQMA as congestion is reduced. The model was run with an assumed increase of speeds of 5kph across all road links. This resulted in a reduced average concentration in NO_2 of 1.6ug/m^3. It is likely that the reduction will not be this high due to there still being queuing of traffic at slowdown junction however it does show how the effectiveness of easing congestion throughout the AQMA.	Y	0.5-1.5µg/m^3
2	Cut Engine, Cut Pollution Signs	Measure is an awareness raising tool. However, it is also a useful measure to prevent vehicles idling and causing congestion in specific locations, which is a significant cause of emissions.	N	<0.5µg/m^3
3	Embed Air Quality Emissions Mitigation Planning Guidance for Sussex into the planning process/planning policies	It is not possible to quantify any measure from this document at this stage	N	<0.5µg/m^3
4	EV vehicles and infrastructure	Encourages enhanced uptake of Electric Vehicles. Expected 0.006% reduction in road emissions of NOx per EV rather than combustion engine vehicle using latest Emissions Factors Toolkit. It is assumed there will be an uptake of 5% from Diesel/Petrol to EV meaning an average of 1011 AADT change across the AQMA, resulting in a 6% reduction in emissions across the AQMA. The model was run with a reduction of 6% across all road link emissions resulting in an average NO_2 reduction of 0.1ug/m^3 across the AQMA. Effectiveness of measure in isolation is likely to be negligible, but it will help to push the drive towards normalising EV use.	Y	<0.5µg/m^3
5	Worthing Car Club	Possible to quantify emissions once known uptake of users in the borough known. Insufficient detail available to quantify at this stage. Change in Concentrations is based on professional judgement	N	<0.5µg/m^3

Measure no.	Measure	Assumptions for Quantification	Quantifiable?	Assumed Reduction in AQMA
6	Public transport improvement	It has been identified that this measure is unlikely to have a large impact within the AQMA as opposed to the borough as a whole which is currently not considered quantifiable. Reduction based on professional judgement.	N	<0.5µg/m³
7	WBC AND WSCC Staff Travel Planning	This measure could be quantified upon known number of persons adhering to travel plan	N	<0.5µg/m³
8	Improve Emissions from Council's Vehicle fleet	Currently in planning stage and is waiting for funding allocation. As change in fleet/trips not yet known as measure not possible to quantify measures	N	<0.5µg/m³
9	Increase availability of AQ information in relation to impacts on Public Health	While this measure will increase awareness and prioritisation of air quality as an issue, it is unlikely to result in any direct reductions in concentrations.	N	<0.5µg/m³
10	Promotion of Air Alert	Will promote behavioural change, but not considered possible to quantify. Reduction based on professional judgement.	N	<0.5µg/m³
11	Re-assess traffic light sequencing in AQMA	This will support A27 highway improvements through the reduction in congestion however it is not possible to quantify an extent at this time.	N	<0.5µg/m³
12	Safe Cycling and Walking Routes	Insufficient detail to quantify this measure. Reduction based on professional judgement.	N	<0.5µg/m³
13	Travel plans for significant/major developments	This is likely to reduce emissions across the AQMA but depending on the number of and scale of large developments it is not possible to quantify.	N	<0.5µg/m³
14	Car Sharing	Number of persons using www.westsussexcarshare.com needed to quantify.	N	<0.5 µg/m³
15	Cycling & Walking promotion	Insufficient detail to quantify this measure. Reduction based on professional judgement.	N	<0.5µg/m³
16	Worthing College Travel Plan Review	Unknown effectiveness at this stage. Reduction based on professional judgement	N	<0.5µg/m³

6.1.1 Measure Quantification – A27 Highway Improvements

It has been assumed that this measure may result in the average speed within the AQMA increasing due to reduced congestion and queuing. The Emissions Factors Toolkit (EFT) latest version was updated with an increase of 5kph across all road links used in the detailed modelling assessment. Detailed modelling was then conducted with the updated emissions rates to see the impact of reducing congestion and thus increasing the average speed within the junction.

The modelling presented an average reduction in NO_2 of 1.6µg/m³ across all modelled receptors within the AQMA. It is likely that the reduction will not be this high due to there still being queuing of traffic at junctions, however it does show the potential change that may result from this measure and thus the effectiveness of easing congestion throughout the AQMA .

6.1.2 Measure Quantification – EV Charging Infrastructure

There is an expected 0.006% reduction in road emissions of NOx per EV rather than combustion engine vehicle using latest Emissions Factors Toolkit. It has been assumed that there will be an uptake of EVs from combustion vehicles of 5% within the borough resulting in an average change of 1011 (6%) AADT across the AQMA.

The model was run with a reduction of 6% across all road link emissions resulting in an average NO_2 decrease of 0.1 µg/m³.

While the effectiveness of the measure in isolation results in a negligible reduction in NO_2 concentrations within the AQMA it indicates a positive change towards normalising EV usage in the borough.

6.2 Cost Benefit Analysis of Measures

6.2.1 Methodology

Using the above assumptions around the quantitative pollution reduction and assumed costs, each measure was given a score as set out below.

Table 6-2 - Cost Score

Estimated Cost of Measure	Score
< £10k	7
£10k - £50k	6
£50k - £100k	5
£100k - £500k	4
£500k - £1m	3
£1m - £10m	2
> £10m	1

Table 6-3 - Benefit Score

Estimated Reduction in Pollutant Concentrations	Score
>0.5µg/m^3	1
0.5-1 µg/m^3	2
1-2 µg/m^3	3
2-3 µg/m^3	4
3-4 µg/m^3	5
4-5 µg/m^3	6
>5 µg/m^3	7

Using the scores above, the below matrix was implemented to work out the cost-benefit. Higher scores are awarded for those measures which are cheapest with the greatest effect, with the lowest scores awarded for those which will be costly with limited reduction in pollution.

Table 6-4 - Cost Benefit Scoring Matrix

		Estimated Reduction in Pollutant Concentrations						
		>0.5µg/m^3	0.5 1 µg/m^3	1 2 µg/m^3	1 2 µg/m^3	2 3 µg/m^3	3 4 µg/m^3	>4 µg/m^3
Cost of Measure	< £10k	6	8	10	12	14	16	18
	£10k £50k	5	6	8	10	12	14	16
	£50k £100k	4	5	6	8	10	12	14
	£100k £500k	3	4	5	6	8	10	12
	£500k £1m	2	3	4	5	6	8	10

		Estimated Reduction in Pollutant Concentrations						
		$>0.5\mu g/m^3$	0.5 1 $\mu g/m^3$	1 2 $\mu g/m^3$	1 2 $\mu g/m^3$	2 3 $\mu g/m^3$	3 4 $\mu g/m^3$	>4 $\mu g/m^3$
	£1m £10m	1	2	3	4	5	6	8
	> £10m	0	1	2	3	4	5	6

The analysis should also account for the feasibility of implementing the measures, with those likely to progress given a higher priority than those which are acknowledged to be a challenge to implement. The feasibility score factors in local influences such as political backing, accessibility to funding options and resources available. As such, each measure was assigned a 'Feasibility score based on the table below. The score from the matrix was multiplied by this score.

Table 6-5 - Feasibility Scores

Feasibility Score	Score
Measure has already been started and just requires progressing	7
Very easy to implement, and political good will towards this, sufficient resources	6
Easy to implement, general political goodwill and available resources	5
Possible to implement but may require some learning/campaigning, moderately time intensive	4
Possible to implement but not straightforward and will require some learning/campaigning, moderately time intensive	3
Challenging to implement, would require some campaigning, time intensive	2
Very Difficult to implement, no political appetite, time and resource intensive	1

6.2.2 Cost-Benefit Analysis

Following the above assessment, it has been possible to rank the measures by cost, benefit, and feasibility, this is shown in Table 6-6 below. With the feasibility weighting meaning that measures which are the easiest to progress are scored higher, these are prioritised.

The results of the cost benefit analysis highlight the importance of feasibility for measure implementation and subsequent completion. Major measures, such as the A27 Highway Improvements, are likely to see the greatest improvement in air quality across the AQMA. However, due to their scale, they take considerably more planning and often face greater barriers to implementation (such as funding) than smaller scale measures. This is reflected in Table 6-6 where lower budget measures such as

Car Sharing and Travel Planning ranked considerably high. Nevertheless, it is still important to consider and progress measures ranked lower as they can provide additional benefits outside of the direct reduction in emissions.

Table 6-6- Cost Benefit Analysis of Measures

Measure No.	Measure	Cost	Cost Score	Air Quality Effect Score	Feasibility Score	Overall Score
14	Car Sharing	< £10k	7	2	5	40
3	Embed Air Quality Emissions Mitigation Planning Guidance for Sussex into the planning process/planning policies	< £10k	7	1	5	30
7	WBC and WSCC Staff Travel Planning	£10k - £50k	6	1	5	25
4	EV vehicles and infrastructure	£50k - £100k	5	1	5	20
5	Worthing Car Club	£50k - £100k	5	1	5	20
10	Promotion of Air Alert	£10k - £50k	6	1	4	20
11	Re-assess traffic light sequencing in AQMA	£10k - £50k	6	1	4	20
15	Cycling & Walking promotion	£10k - £50k	6	1	4	20
2	Cut Engine, Cut Pollution Signs	< £10k	6	1	4	20
9	Increase availability of AQ information in relation to impacts on Public Health	< £10k	7	1	3	18
16	Worthing College Travel Plan Review	£10k - £50k	7	1	3	18
13	Travel plans for significant/major developments	£500k - £1m	6	1	3	15
1	A27 Highway Improvements	> £10m	3	2	3	9
6	Public transport improvement	£500k - £1m	1	3	4	8
12	Safe Cycling and Walking Routes	£1m - £10m	4	2	1	4
8	Improve Emissions from Council's Vehicle fleet	£1m - £10m	3	1	2	4

6.3 Year of Objective Compliance

The Detailed modelling report has used the assessment methodology within LAQM.TG(22) to provide the following estimated year of compliance, with only national measures being considered will be 2026.

The projected NO_2 annual mean concentrations following the above approach are presented in Table 6-7.

Table 6-7 – Projected Annual Mean NO_2 Concentrations – Worthing AQMA Receptor R28A

Receptor 28A											
2019 Annual Mean Concentration (µg/m³)	**Predicted Annual Mean Concentration (µg/m³)**										
	2020	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
47.2	**44.5**	**41.8**	39.3	37.2	35.2	33.4	31.9	30.6	29.4	28.4	27.5
In **bold**, exceedance of the NO_2 annual mean AQS objective of 40µg/m³ Vehicle Adjustment Factor = Rest of UK (HDV >10%)											

Table 6-7 indicates that the first year by which Receptor 28A will be exposed to a concentration below the annual mean NO_2 AQS objective will be 2022 (previous year). Additionally, it is expected that concentrations are expected to drop below 10% of the annual mean NO_2 AQS objective by 2024. 2022 is therefore considered the predicted year of compliance for those receptors used within the model, which are believed to represent worst case exposure within the Worthing AQMA, in the absence of the implementation of any specific intervention measures to further bring forward local air quality improvements in the area.

The projected NO_2 annual mean concentrations for monitoring station N30A are presented in Table 6-8.

Table 6-8 – Projected Annual Mean NO_2 Concentrations – Worthing AQMA N30A

N30A											
2019 Annual Mean Concentration (µg/m³)	**Predicted Annual Mean Concentration (µg/m³)**										
	2020	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
56.6	**53.3**	**50.1**	**47.1**	**44.6**	**42.2**	**40.0**	38.2	36.6	35.2	33.9	32.9
In **bold**, exceedance of the NO_2 annual mean AQS objective of 40µg/m³ Vehicle Adjustment Factor = Rest of UK (HDV >10%)											

Table 6-8 indicates that the first year by which N30A will be exposed to a concentration below the annual mean NO2 AQS objective will be 2026. Additionally, it is expected that concentrations are expected to drop below 10% of the annual mean NO2 AQS objective by 2028. 2026 is therefore considered the predicted year of compliance for N30A. This indicates that without implementation of any specific intervention measures, N30A will be compliant to the AQS within three years, even though N30A is not a representative point of exposure along the A27.

Appendix A: Response to Consultation

Table A.1 – Summary of Responses to Consultation and Stakeholder Engagement on the AQAP

Consultee	Category	Response
National Highways	National Highways	National Highways acknowledges that the A27 in Worthing constitutes a relevant source contributing to the failure to meet Air Quality standards in the area. We are currently still developing a procedure for confirming the formal relationship as an "Air Quality Partner", however we accept that Worthing fall into this category. In the absence of the formalities we acknowledge the formal duty to cooperate. It is clear from the draft Air Quality Action Plan that Worthing are keen to see action on the A27, which is part of the Strategic Road Network. National Highways will keep Worthing updated on any progress with this scheme and we will continue dialogue to ensure that any scheme aligns with local air quality goals. At present, however, we are unable to formally commit to delivery of the scheme.

Consultee	Category	Response
		We note the proposals for a steering group to manage the implementation of the Air Quality Action Plan. National Highways are pleased to offer to attend or present at meetings of this group should this be required, or be beneficial for the coordination of work. We are also happy to provide written updates to the steering group where appropriate. The National Highways Air Quality team is also happy to commit to work with relevant teams at National Highways and Worthing to identify actions that can be delivered jointly to improve local air quality or enhance other actions in your plan. With a view to confirming specific actions within 12 months

West Sussex County Council Transport Planning & Policy	Highway Authority (not A27)	***Overall support*** We support the draft AQAP and believe this is a proportionate and suitable response to the challenge of tackling air pollution in the Borough. The general range of activity set out within the action plan measures dovetail with various measures in our West Sussex Transport Plan 2022-2036, our West Sussex Walking and Cycling Strategy 2016-2026 (which is in the process of being reviewed), the West Sussex Bus Service Improvement Plan and the West Sussex Electric Vehicle Strategy 2019-2030. ***Monitoring and modelling data*** Section 2.2.2 reports that local monitoring data recorded a figure of 44.7 µg/m3 which exceeds the annual mean Air Quality Objectives (AQO) of 40 µg/m3. However, it is unclear if this figure is distance corrected as implied by the 2019 data referenced and adjacent data in Table 2.3. If distance corrected data is provided, what does this mean for level of compliance with the air quality objective? Section 3.4 'Required Reduction in Emissions' appears to be based on 2019 data. Given the reductions in monitored pollution levels that have been recorded post-COVID since 2019, can information be presented on the required reductions based on 2022 onwards data, to inform a clearer evidence base on the latest level of compliance of the AQMA with air quality objectives and to inform potential interventions? Section 6.3 'Year of Objective Compliance' also appears unclear as it states that 2026 is expected to be the year of compliance based on modelling of

		receptor N30A, however the text states that this is not a representative point of exposure. Further clarification around the expected year of compliance based on the representative point of exposure would also be helpful – is this modelled receptor 28A? The County Council is striving to reduce traffic emissions including nitrous oxide (NOx) and particulate matter emissions (PM10 and PM.2.5) across the County through improving electric vehicle charging infrastructure and by promoting mode shift by improving access to sustainable transport modes and infrastructure. It will continue to do this through a programme of measures under the umbrella of the West Sussex Transport Plan. However, it is important to highlight that it is likely to be difficult to justify significant interventions - which will require a business case, funding and a period of time to implement - solely on the grounds of tackling the air quality standard exceedance problem because monitoring data and modelling presented in Appendix C suggests there will very soon be compliance, if not already, with the air quality standard, largely due to the continuing improvement in the vehicle fleet. ***Specific measures*** Regarding specific measures identified within the Action Plan, under 3.5.1 Priority 1 and section 5.1.4, it should be noted that Worthing Station Railway Approach improvements are now under construction. It is also noted that there is an erroneous text duplication in section 3.5.3 of

		the report at the top of page 24. ***Summary*** We hope these comments are helpful, and we look forward to continuing to work with Worthing Borough Council on initiatives identified within the Air Quality Action Plan but which can also support wider initiatives to reduce transport emissions, reduce traffic congestion, mitigate the impacts of development, and promote sustainable transport access.
Public Consultation	Public	See Appendix F

Appendix B: Reasons for Not Pursuing Action Plan Measures

Table B.1 – Action Plan Measures Not Pursued and the Reasons for that Decision.

Action category	Action description	Reason action is not being pursued (including Stakeholder views)
Promoting Low Emission Transport	Low Emission Zone (LEZ) or Clean Air Zone (CAZ)	National Highways do not currently consider a CAZ/LEZ a viable measure. WSCC concerns around displacement of vehicles onto surrounding local roads.

Appendix C: Technical Modelling Report

Worthing Borough Council

Detailed Modelling Study

November 2023

Move Forward with Confidence

Document Control Sheet

Identification	
Client	Worthing Borough Council
Document Title	Detailed Modelling Study
Bureau Veritas Ref No.	AIR18434846

Contact Details		
Company Name	Bureau Veritas UK Limited	Worthing Borough Council
Contact Name	Hannah Broomfield-Payne	Nadeem Shad
Position	Principal Consultant	Team Leader Environmental Protection, Public Health & Regulation
Address	5th Floor 66 Prescot Street London E1 8HG	Portland House, 44 Richmond Road, Worthing, West Sussex, BN11 1HS
Telephone	07969 050370	01273 263303
e-mail	hannah.broomfield-payne@bureauveritas.com	nadeem.shad@adur-worthing.gov.uk
Websites	www.bureauveritas.co.uk	https://www.adur-worthing.gov.uk/

Configuration				
Version	**Date**	**Author**	**Reason for Issue/Summary of Changes**	**Status**
1.0	16/08/2023	S Garrington		Draft
1.1	03/11/2023	S Garrington	Traffic Input updates	Draft

	Name	Job Title	Signature
Prepared By	S Garrington	Consultant	S Garrington
Approved By	H Broomfield-Payne	Principal Consultant	HBP

Table of Contents

List of Tables

List of Figures

Executive Summary

Bureau Veritas have been commissioned by Worthing Borough Council (WBC) to complete a detailed modelling study of an Air Quality Management Area (AQMA) in Worthing declared in 2010 to inform their Air Quality Action Plan (AQAP). The Council has yet to publish an AQAP for this AQMA due to a combination of factors, including their recent declaration coinciding with a shifting of priorities during 2020 as a result of the Covid-19 pandemic and nationally enforced lockdowns.

A dispersion modelling assessment has been completed whereby NO_2 concentrations have been predicted across all relevant areas at specific receptor locations. This has been used to supplement local monitoring data to provide a clear picture of the pollutant concentrations within Worthing.

Currently there is one AQMA within Worthing, declared as a result of exceedances of the 40 µg/m^3 annual mean objective for Nitrogen Dioxide (NO_2). The AQMA is defined as follows;

- Worthing AQMA No.2 – An area encompassing Crockhurst Hill, Offington Corner Roundabout, Warren Road, Grove Lodge Roundabout, Upper Brighton Road up to and including the Downlands Retail Centre and Lyons Way.

The aim of this detailed modelling study is to increase the Council's understanding of pollutant concentrations within Worthing Borough Council in order to provide technical input into the AQAP and identify if changes to the current AQMA is required.

In order to provide technical input into an updated AQAP that will cover the AQMA boundary, the air quality modelling accounted for a pre-COVID-19 baseline using 2019 traffic data, 2019 monitoring data and the latest Local Air Quality Management (LAQM) tools.

Within the AQMA, the modelling has predicted that the 40µg/m^3 NO_2 annual mean Air Quality Strategy (AQS) objective is exceeded at a total of 3 (10%) of modelled receptor locations (i.e. residents within the AQMA), with 3 (10%) further location modelling concentrations within 10% of the objective.

Areas of exceedance or near exceedance of the annual mean NO_2 AQS objective were concentrated to roadside locations near junctions where key arterial roads meet. This confirms that vehicle traffic is the main cause of elevated levels of NO_2 concentrations within the Worthing AQMA. Roads contributing to concentrations within the AQMA include the A27 Upper Brighton Road and Grove Lodge Roundabout.

A NO_x 'source apportionment' exercise has been completed which demonstrates that Diesel Cars are found to the main contributors to total road NO_x concentrations within the Worthing AQMA.

A reduction of approximately 22.4% in Road NO_x at the worst-case receptor is required to meet the AQS for annual mean NO_2.

The high traffic volume and congestion at the main junction of the A27 Upper Brighton Road and Grove Lodge Roundabout are considered to be the key contributors to elevated levels of NO_2 annual mean concentrations within the AQMA.

Following the completion of the detailed modelling study, the following recommendations are made:

- Continue to monitor NO_2 across the AQMA. Monitoring should be expanded to problem areas along the A27, most notably around the Grove Lodge Roundabout where the exceedances from the modelling assessment were located.

- Based on source apportionment results, any future intervention measures should be targeted at reducing vehicle emissions from Diesel Cars and LGVs, which are both observed to be the two largest contributors to total vehicle emissions in areas of exceedance.

- Measures to reduce congestion at the main junction of the where the A27 Upper Brighton Road meets the Grove Lodge Roundabout, and the dual carriageway split of Upper Brighton Road would also help to reduce emissions of NO_2 in the Worthing AQMA.

1 Introduction

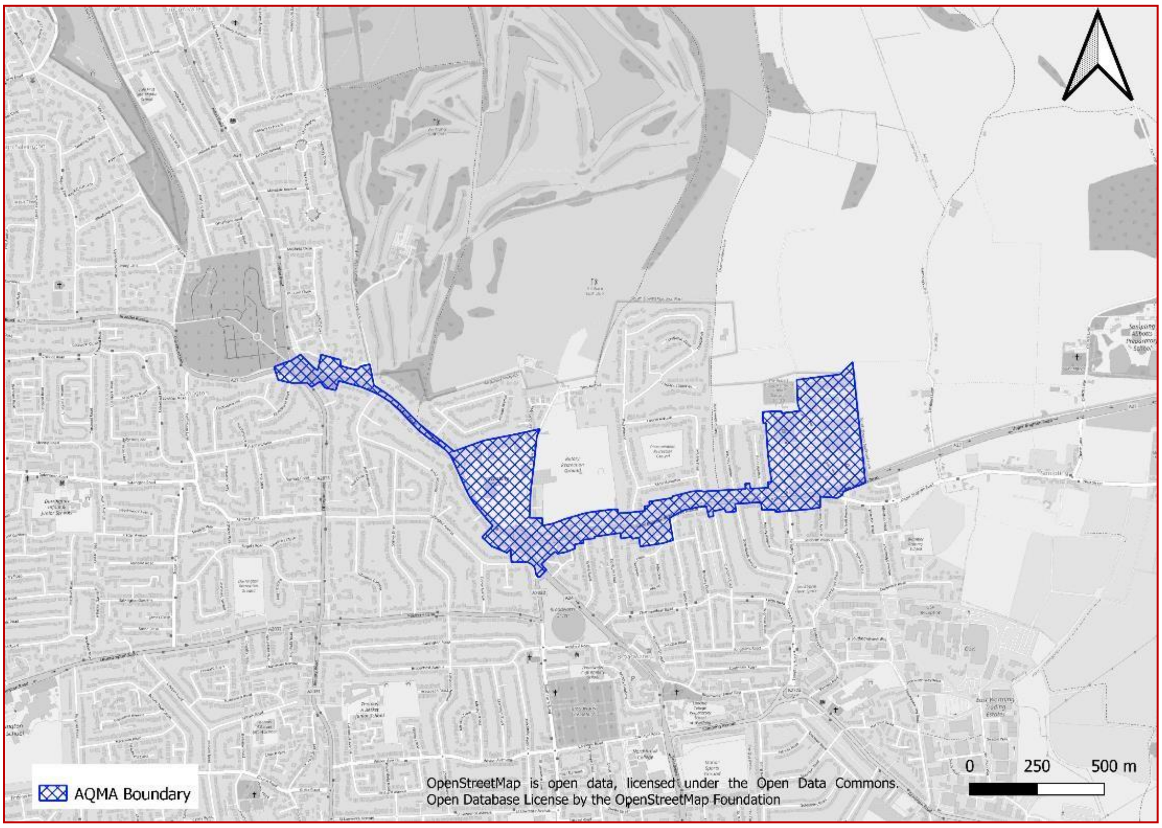
Bureau Veritas have been commissioned by Worthing Borough Council (WBC) to complete a detailed modelling study of the declared Air Quality Management Area (AQMA) within Worthing to inform their Air Quality Action Plan (AQAP). The Council has yet to publish an AQAP for the AQMA due to a combination of factors, including their recent declaration coinciding with a shifting of priorities during 2020 as a result of the Covid-19 pandemic and nationally enforced lockdowns. Currently there is only one AQMA within Worthing Borough Council, declared as a result of exceedances of the 40 µg/m^3 annual mean objective for Nitrogen Dioxide (NO_2). The AQMA is defined as follows;

- **Worthing AQMA No.2** – An area encompassing Crockhurst Hill, Offington Corner Roundabout, Warren Road, Grove Lodge Roundabout, Upper Brighton Road up to and including the Downlands Retail Centre and Lyons Way.

Location of the AQMA is shown in Figure 1-1.

This detailed modelling study has covered the whole AQMA and has used pre-COVID-19 traffic data and local authority monitoring data to identify the extent of NO_2 exceedances in order to inform the AQAP.

Figure 1-1 – Location of Worthing AQMA No.2



1.1 Scope of Assessment

It is the general purpose and intent of this assessment to determine, with reasonable certainty, the magnitude and geographical extent of any exceedances of the AQS objectives for NO_2, enabling WBC to provide a focused consideration on developing measures as part of the AQAP for the AQMA.

The following are the objectives of the assessment:

- To assess the air quality at selected locations (“receptors”) representative of worst-case exposure relative to the averaging period of focus (i.e. annual objective - façades of the existing residential units), based on modelling of emissions from road traffic on the local road network;
- To establish the spatial extent of any likely exceedances of the UK annual mean NO_2 AQS objective limit, and to identify the spatial extent of any areas within 10%;
- To establish the required reduction in emissions to comply with the UK AQS objectives; and
- To determine the relative contributions of various source types to the overall pollutant concentrations within the AQMA, through source apportionment, in order to inform an updated AQAP.

The approach adopted in this assessment to assess the impact of road traffic emissions on air quality utilised the atmospheric dispersion model ADMS-Roads version 5.0.0.3, focusing on emissions of oxides of nitrogen (NO_x), which comprise of nitric oxide (NO) and nitrogen dioxide (NO_2).

In order to provide consistency with the Council’s own work on air quality, the guiding principles for air quality assessments, as set out in the latest guidance provided by Defra for air quality assessment (LAQM.TG(22))[1], have been used.

[1] LAQM Technical Guidance LAQM.TG(22) – August 2022. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.

2 Air Quality – Legislative Context

2.1 Air Quality Strategy

The importance of existing and future pollutant concentrations can be assessed in relation to the national air quality standards and objectives established by Government. The Air Quality Strategy[2] (AQS) provides the over-arching strategic framework for air quality management in the UK and contains national air quality standards and objectives established by the UK Government and Devolved Administrations to protect human health.

The AQS objectives for NO_2 are presented in Table 2-1.

Table 2-1 – Relevant AQS Objectives for the Assessed Pollutants in England

Pollutant	AQS Objective	Concentration Measured as:	Date for Achievement
Nitrogen dioxide (NO_2)	200 µg/m³ not to be exceeded more than 18 times per year	1-hour mean	31st December 2005
	40 µg/m³	Annual mean	31st December 2005

2.2 Local Air Quality Management (LAQM)

Part IV of the Environment Act 1995 (as amended 2021) places statutory duty on local authorities to periodically review and assess air quality within their area and determine whether they are likely to meet the AQS objectives set down by Government for a number of pollutants – a process known as Local Air Quality Management (LAQM). The AQS objectives that apply to LAQM are defined for seven pollutants: benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide and particulate matter.

Local Authorities were formerly required to report on all of these pollutants, but following an update to the regime in 2016, the core of LAQM reporting is now focussed on the objectives of three pollutants; NO_2, PM_{10} and SO_2. Where the results of the Review and Assessment process highlight that problems in the attainment of the health-based objectives pertaining to the above pollutants will arise, the authority is required to declare an AQMA – a geographic area defined by high concentrations of pollution and exceedances of health-based standards.

The areas in which the AQS objectives apply are defined in the AQS as locations outside (i.e. at the façade) of buildings or other natural or man-made structures above or below ground where members of the public are regularly present and might reasonably be expected to be exposed to pollutant concentrations over the relevant averaging period of the AQS objective.

Following any given declaration, the Local Authority is subsequently required to develop an Air Quality Action Plan (AQAP), which will contain measures to address the identified air quality issue, and bring the location into compliance with the relevant objective as soon as possible.

[2] Defra (2023), The Air Quality Strategy for England, https://www.gov.uk/government/publications/the-air-quality-strategy-for-england/air-quality-strategy-framework-for-local-authority-delivery .

3 Review and Assessment of Air Quality Undertaken by the Council

3.1 Local Air Quality Management

WBC currently has one AQMA, declared as a result of exceedances of the 40 µg/m^3 annual mean objective for Nitrogen Dioxide (NO_2).

The most recent LAQM report completed by the Council was the 2022 ASR[3], containing the 2021 monitoring data. The 2022 ASR acknowledged the need for an AQAP as their most recent AQAP was published in 2015.

The air quality modelling has accounted for a pre-COVID-19 base using 2019 traffic data, 2019 monitoring data and the latest Local Air Quality Management (LAQM) tools. Air quality monitoring data decreased significantly during 2020 and 2021 due to a decrease of traffic under the lockdowns during the COVID-19 pandemic. According to the traffic data from Department for Transport (DfT)[4], traffic in West Sussex showed a sharp decline of 22.2% from 2019 to 2020 which shows the impact of lockdown during the COVID-19 pandemic. For 2022, the air quality monitoring and traffic shows a slight recovery back towards the pre-COVID-19 values.

This report details the findings of this analysis, and provides recommendation on matters related to NO_2 exceedances, in order to inform a new targeted set of measures within the AQAP.

3.2 Review of Air Quality Monitoring

3.2.1 Local Automatic Air Quality Monitoring

WBC undertakes automatic (continuous) monitoring at one location.

The details of the automatic monitoring within Worthing AQMA for 2017 - 2021 are shown in Table 3-1.

Table 3-1 WBC Automatic Monitoring

Site ID	Site Location	In AQMA	Annual Mean NO_2 Concentration (µg/m^3)					
			2017	2018	2019	2020	2021	2022
WT2	Grove Lodge	Yes	35.8	36.8	32.9	26.0	27.6	25.4

Note: Exceedances of the annual mean AQS objective of 40 µg/m^3 marked in bold

3.2.2 Local Non-Automatic Air Quality Monitoring

WBC's non-automatic monitoring programme consists of recording NO_2 concentrations using a network of 32 sites.

The details of the 8 diffusion tubes within the Worthing AQMA for 2017 - 2022 are shown in Table 3-2.

[3] https://sussex-air.net/reports/AnnualStatusReports/A&W_ASR_2022.pd7

[4] https://roadtraffic.dft.gov.uk/local-authorities/117

Table 3-2 WBC Passive Monitoring

Site ID	Site Location	In AQMA	Annual Mean NO_2 Concentration (µg/m³)				
			2018	2019	2020	2021	2022
N39	SW of Roundabout, Grove lodge	Yes	32.7	28.5	24.1	23.7	24.4
N44	AQMS O/S 21 Upper Brighton Road	Yes	**40.7**	36.1	31.1	29.8	27.8
N30A	Grove Lodge Cottages	Yes	**60.1**	**56.6**	**45.1**	**44.4**	**44.7**
N43	23 Upper Brighton Road	Yes	22.3	19.9	17.6	17.2	16.6
N25	Warren Court	Yes	20.3	17.8	14.8	15.4	15.4
N5	First Avenue	Yes	25.6	28.3	24.5	23.0	21.5
N29	Downlands Parade	Yes	23.6	29.9	25.6	24.2	26.0
N53	Offington Corner	Yes	33.9	30.7	30.2	23.7	24.4

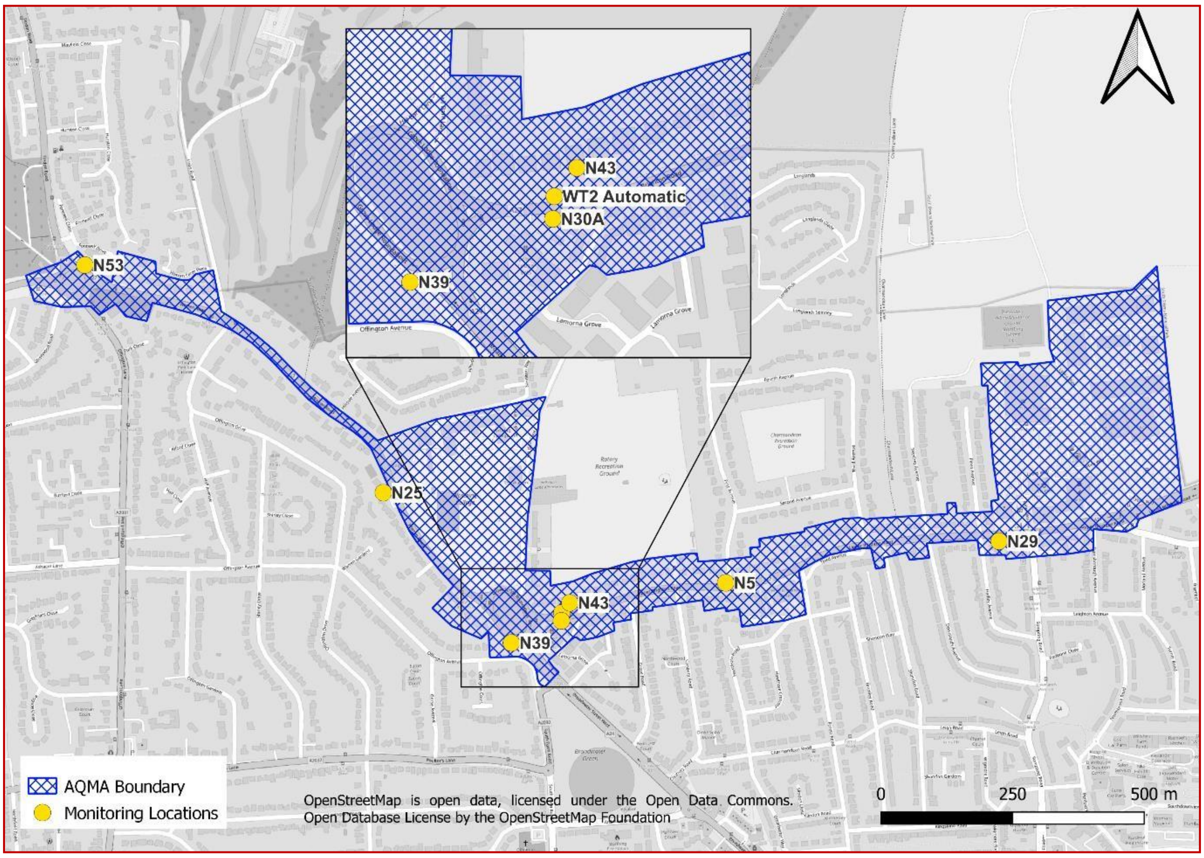
Note: Exceedances of the annual mean AQS objective of 40 µg/m³ marked in bold

Monitoring location N30A exceeded the annual mean AQS for NO_2 in all monitoring years between 2018-2022. Monitoring location N44 was within 10% of the exceedance value during 2019 but has since decreased substantially. The empirical relationship given in LAQM.TG(22)[1] states that exceedances of the 1-hour mean objective for NO_2 is only likely to occur where annual mean concentrations are 60µg/m³ or above at a location of relevant exposure. This indicates that an exceedance of the 1-hour mean objective was likely to have occurred at N30A in 2018.

The decline of concentrations in 2020 and 2021 within the AQMA indicates the impact of lockdown during the COVID-19 pandemic. An average decline in mean NO_2 concentration of 16.6% was observed in Worthing AQMA from 2019 to 2020. While 2022 is not considered a year affected by the COVID-19 pandemic, concentrations remain similar to 2020 and 2021 with a mixture of the monitoring sites within the AQMA showing marginal increases and decreases. 2022 concentrations are substantially lower than those observed in 2019. Therefore, the traffic data and monitoring data prior to 2020 are used to represent a normalised circumstance with no interference from COIVD-19 in combination with a worst-case scenario in the AQMA.

Figure 3-1 illustrate the locations of the monitoring locations within the Worthing AQMA.

Figure 3-1 –WBC Monitoring Locations



Note: N44 is co-located with WT2.

3.3 Defra Background Concentration Estimates

Defra maintains a nationwide model of existing and future background air pollutant concentrations at a 1km x 1km grid square resolution. This data includes annual average concentration for NO_x, NO_2, PM_{10} and $PM_{2.5}$, using a base year of 2018 (the year in which comparisons between modelled and monitoring are made)[5]. The model used to determine the background pollutant levels is semi-empirical in nature: it uses the National Atmospheric Emissions Inventory (NAEI) emissions to model the concentrations of pollutants at the centroid of each 1km grid square, but then calibrates these concentrations in relation to actual monitoring data.

Due to the absence of local background monitoring nearby to the Worthing AQMA, pollutant background concentrations used for the purposes of this assessment have been obtained from the Defra supplied background maps for the relevant 1km x 1km grid squares covering the modelled domain for the year 2019. The relevant annual mean background concentration will be added to the predicted annual mean road contributions in order to predict the total pollutant concentration at each receptor location. The total pollutant concentration can then be compared against the relevant AQS objective to determine the event of an exceedance.

The Defra mapped background concentrations for the base year of 2019, which cover the modelled domain, are presented in Table 3-3. All of the mapped background concentrations presented are

[5] Defra Background Maps (2019), available at https://uk-air.defra.gov.uk/data/laqm-background-home

well below the respective annual mean AQS objectives. No adjustment for background concentration variability with height has been made.

Table 3-3 – Defra Background Pollutant Concentrations Covering the Modelled Domain

2019 Annual Mean Background Concentration (µg/m³) [1]			
Grid Reference (x)	**Grid Reference (Y)**	**Total Background NOx**	**Total Background NO_2**
514500	104500	17.3	12.9
513500	105500	15.6	11.8
515500	105500	14.8	11.1

Note:
[1] Values obtained from the 2019 Defra Mapped Background estimates for the relevant 1km x 1km grid squares covering the modelled domain

4 Assessment Methodology

To predict pollutant concentrations of road traffic emissions the atmospheric model ADMS Roads version 5.0.0.3 was utilised to model a 2019 baseline predictions scenario. The guiding principles for air quality assessments as set out in the latest guidance and tools provided by Defra for air quality assessment LAQM.TG(22)[1] have been used.

The approach used in this assessment has been based on the following:

- Prediction of NO_2 concentrations to which existing receptors may be exposed for comparison with the relevant AQS objectives to verify whether they comply;
- Quantification of relative NO_2 contribution of sources to overall NO_2 pollutant concentration; and,
- Determination of the geographical extent of any potential exceedances in regard to the existing AQMA boundary.

Concentrations of NO_2 have been predicted with a base year of 2019, with model inputs relevant to the assessment based upon the same year. A base year prior to 2020 was used due to the impact of the COVID-19 pandemic affecting pollutant concentrations in 2020. Reductions in travel gave rise to a change of air pollutant emissions associated with road traffic. To demonstrate, an averageNO_2 monitoring concentration decline of 16.6% was observed in Worthing AQMA from 2019 to 2020and remained stable through 2021 and 2022. Therefore, using pre-pandemic traffic levels would more likely represent normalised vehicle activity within the AQMA and provide for a conservative assessment.

4.1 Traffic Inputs

Traffic flows and vehicle class compositions for the 2019 baseline scenario were collected from the Department for Transport (DfT) traffic count point database. The data from DfT database was provided as annual average daily traffic (AADT).

It should be noted that although the DfT traffic was obtained for the baseline year of 2019, data of some count points was estimated using previous year's AADT on this link.

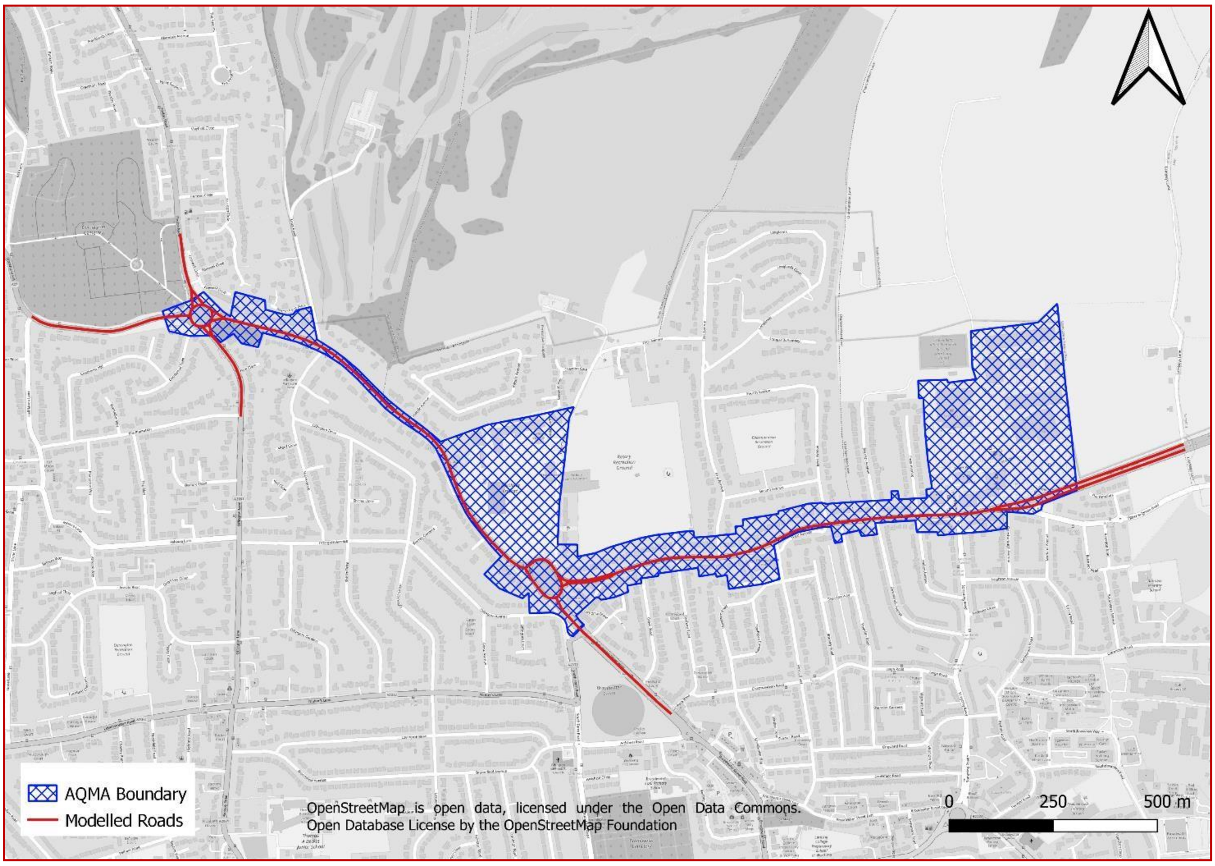
Traffic speeds were modelled at the relevant speed limit for each road. Where appropriate, vehicle speeds have been reduced in accordance with LAQM TG(22)[1] to simulate queues at junctions, traffic lights and other locations where queues or slower traffic are known to be an issue.

The Emissions Factors Toolkit (EFT) version 11.0 developed by Defra[6] has been used to determine vehicle emission factors for input into the ADMS-Roads model, based upon the traffic data inputs.

Details of the traffic flows used in this assessment are provided in Table B.1 of the Appendices. The entire modelled road network across the Worthing AQMA is presented in Figure 4-1.

[6] Defra, Emissions Factors Toolkit (2021). https://laqm.defra.gov.uk/air-quality/air-quality-assessment/emissions-factors-toolkit/

Figure 4-1 – Modelled Road Network



4.2 General Model Inputs

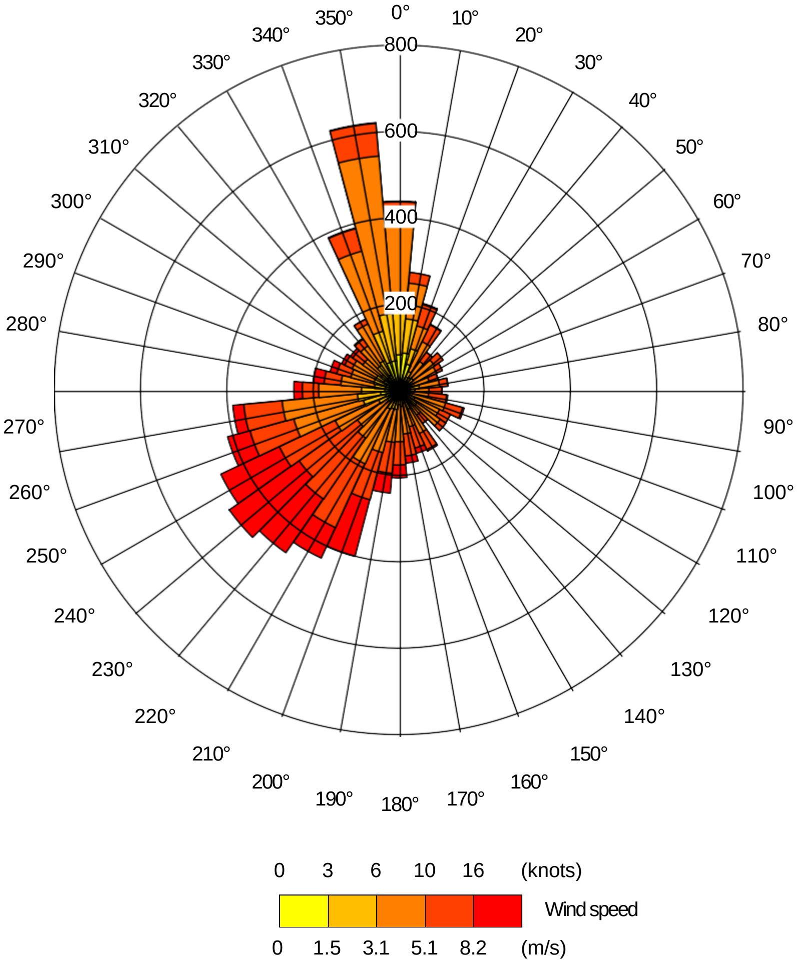
A site surface roughness value of 0.5 m was entered into the ADMS-roads model, consistent with the open-suburban nature of the modelled domain. In accordance with CERC's ADMS Roads User Guide[7], a minimum Monin-Obukhov length of 10 m was used for the ADMS Road model to reflect the suburban topography of the model domain.

One year of hourly sequential meteorological data from a representative synoptic station is required by the dispersion model. 2019 meteorological data from Shoreham weather station has been used in this assessment. The station is located approximately 7.5 km east of the AQMA (furthest point from the meteorological site) and is considered representative of the meteorological conditions experienced throughout the district. A surface roughness value of 0.3 m was used for the area surrounding the meteorological station.

A wind rose for this site for the year 2019 is shown in Figure 4-2.

[7] CERC (2020), ADMS-Roads User Guide Version 5

Figure 4-2 – Wind Rose for Shoreham Data 2019



Most dispersion models do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75m/s. It is recommended in LAQM.TG(22)[1] that the meteorological data file be tested within a dispersion model and the relevant output log file checked, to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedances. LAQM.TG(22)[1] recommends that meteorological data should have a percentage of usable hours greater than 85%. If the data capture is less than 85% short-term concentration predictions should be expressed as percentiles rather than as numbers of exceedances. The 2019 meteorological data from Shoreham includes 8,619 lines of usable hourly data out of the total 8,760 for the year, i.e. 98.3% usable data. This is therefore suitable for the dispersion modelling exercise.

4.3 Modelled Sensitive Receptors

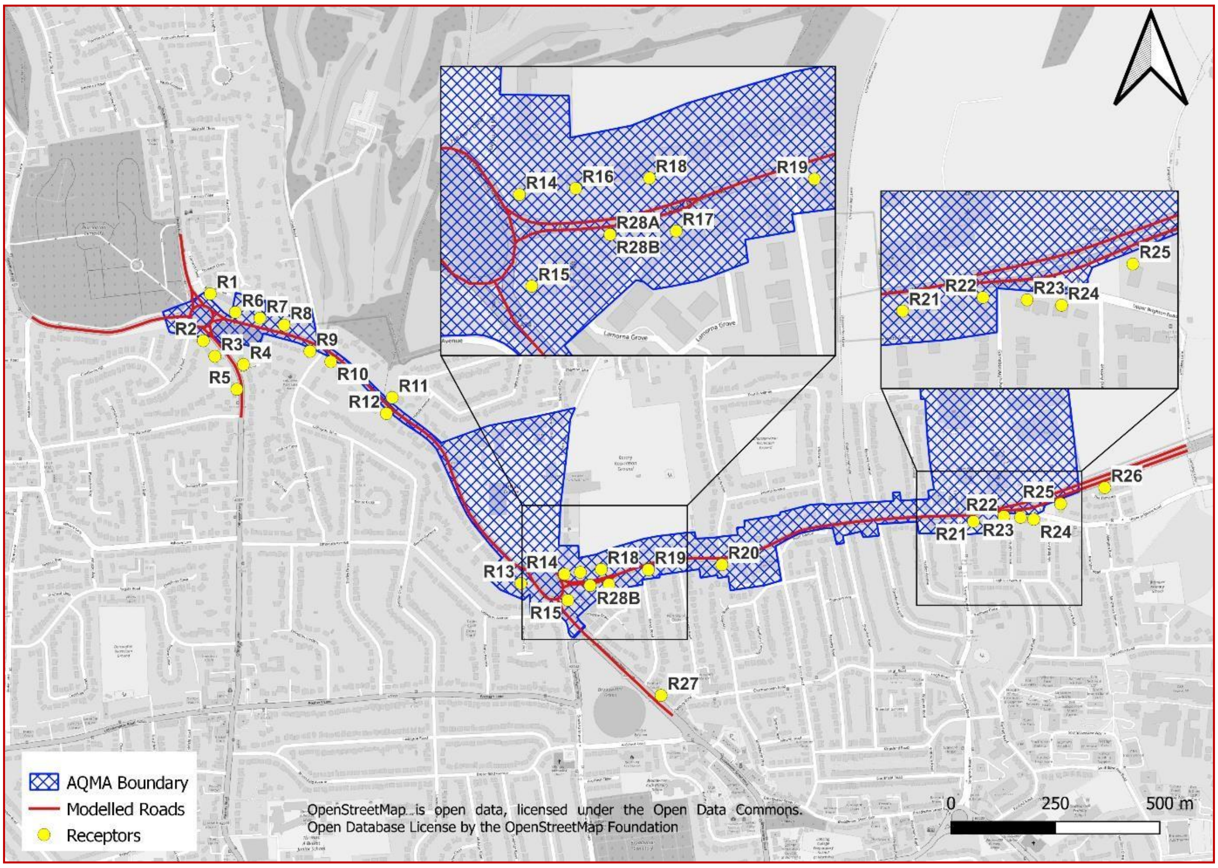
A total of 29 (R28 was modelled at both 1.5m and 4m to assess both stories of the building) discrete receptors for the Worthing AQMA were included within the assessment to represent locations of relevant exposure. The locations were identified through completion of a desktop study of residential properties. Details of the receptors are presented within Table 4-1 and their locations are illustrated in Figure 4-3.

The receptors were included at a height of 1.5m to represent ground level exposure and 4m to represent first floor exposure.

Table 4-1 – Total NO_x Source Apportionment Across All Receptors

Receptor ID	X	Y	Height	Closest address/post code	Receptor Type
R1	513280	105646	1.5	12 Fontwell Dr, Worthing BN14 0AF	Residential
R2	513263	105534	1.5	115 Offington Ln, Worthing BN14 9RW	Residential
R3	513291	105497	1.5	109 Offington Ln, Worthing BN14 9RW	Residential
R4	513359	105477	1.5	20 Park Cl, Worthing BN14 9RP	Residential
R5	513343	105418	1.5	97 Offington Ln, Worthing BN14 9RW	Residential
R6	513340	105602	1.5	142 Warren Rd, Worthing BN14 9RB	Residential
R7	513399	105588	1.5	130 Warren Rd, Worthing BN14 9RB	Residential
R8	513456	105572	1.5	128 Warren Rd, Worthing BN14 9RB	Residential
R9	513519	105509	1.5	83 Warren Rd, Worthing BN14 9QU	Residential
R10	513569	105484	1.5	101 Warren Rd, Worthing BN14 9QU	Residential
R11	513716	105398	1.5	115 Warren Rd, Worthing BN14 9RA	Residential
R12	513702	105360	1.5	75 Warren Rd, Worthing BN14 9QU	Residential
R13	514024	104953	1.5	3 Warren Rd, Worthing BN14 9QH	Residential
R14	514128	104975	1.5	3 Upper Brighton Rd, Worthing BN14 9HY	Residential
R15	514136	104913	1.5	128 Broadwater St W, Worthing BN14 9DJ	Residential
R16	514166	104980	1.5	7 Upper Brighton Rd, Worthing BN14 9HY	Residential
R17	514235	104951	1.5	84 Upper Brighton Rd, Worthing BN14 9HR	Residential
R18	514216	104987	1.5	27 Upper Brighton Rd, Worthing BN14 9HY	Residential
R19	514329	104986	1.5	54A Grove Rd, Worthing BN14 9DG	Residential
R20	514505	104998	1.5	56 Upper Brighton Rd, Worthing BN14 9HT	Residential
R21	515108	105101	1.5	2 Downlands Gardens, Worthing BN14 9EZ	Residential
R22	515181	105114	1.5	27 Gainsborough Ave, Worthing BN14 8QR	Residential
R23	515221	105111	1.5	156 Sompting By-Pass, Worthing BN14 9JR	Residential
R24	515252	105107	1.5	162 Sompting By-Pass, Worthing BN14 9JR	Residential
R25	515317	105144	1.5	157 Upper Brighton Rd, Worthing BN14 9JS	Residential
R26	515422	105182	1.5	19 The Templars, Worthing BN14 9JT	Residential
R27	514359	104685	1.5	104 Broadwater St W, Worthing BN14 9DF	Residential
R28A	514190	104948	1.5	19 Upper Brighton Rd, Worthing BN14 9HY	Residential
R28B	514190	104948	4	19 Upper Brighton Rd, Worthing BN14 9HY	Residential

Figure 4-3 – Worthing AQMA Modelled Receptors



4.4 Model Outputs

The background pollutant values discussed in Section 3.3 have been used in conjunction with the concentrations predicted by the ADMS-Roads model to calculate predicted total annual mean concentrations of NO_x.

For the prediction of annual mean NO_2 concentrations for the modelled scenarios, the output of the ADMS-Roads model for road NO_x contributions has been converted to total NO_2 following the methodology in LAQM.TG(22)[1], using the NO_x to NO_2 conversion tool developed on behalf of Defra. This tool also utilises the total background NO_x and NO_2 concentrations. This assessment has utilised version 8.1 (August 2020) of the NO_x to NO_2 conversion tool[8]. The road contribution is then added to the appropriate NO_2 background concentration value to obtain an overall total NO_2 concentration.

For the prediction of short term NO_2 impacts, LAQM.TG(22)[1] advises that it is valid to assume that exceedances of the 1-hour mean AQS objective for NO_2 are only likely to occur where the annual mean NO_2 concentration is 60µg/m^3 or greater.

In addition to total annual mean concentrations, NO_x source apportionment was carried out for the following vehicle classes:

[8] Defra NO_x to NO_2 Calculator (2020), available at https://laqm.defra.gov.uk/air-quality/air-quality-assessment/nox-to-no2-calculator/

- Petrol Cars
- Diesel Cars
- Alternative Cars
- Petrol LGV
- Diesel LGV
- Alternative LGV
- HGV
- Buses
- Motorcycle

Verification of the ADMS-Roads assessment has been undertaken using a number of local authority diffusion tube monitoring locations. All NO_2 results presented in the assessment are those calculated following the process of model verification. Full details of the verification process are provided in Appendix A.

This provides vehicle contributions of NO_x as a proportion of the total NO_x concentration, which will allow the Council to develop specific AQAP measures targeting a reduction in emissions from specific vehicle types. Local fleet information has been derived from the DfT road traffic statistics.

It should be noted that emission sources of NO_2 are dominated by a combination of direct NO_2 (f-NO_2) and oxides of nitrogen (NO_x), the latter of which is chemically unstable and rapidly oxidised upon release to form NO_2. Reducing levels of NO_x emissions therefore reduces concentrations of NO_2. Consequently, the source apportionment study has only considered the emissions of NO_x, which are assumed to be representative of the main sources of $NO_{2,}$.

The source apportionment study has evaluated the following receptor combinations:

- The average NO_x contributions across all modelled locations. This provides useful information when considering possible action measures to test and adopt. It will however understate road NO_x concentrations in problem areas;

- The NO_x contributions at the receptor with the maximum road NO_x and NO_2 contribution. This provides a comparison to the previous two groups, with the identification of the most prominent vehicle source at receptor with the highest predicted NO_2 concentration.

4.5 Uncertainty

Due to the number of inputs that are associated with the modelling of the study area there is a level of uncertainty that has to be taken into account when drawing conclusions from the predicted concentrations of NO_2. The predicted concentrations are based upon the inputs of traffic data, background concentrations, emission factors, street canyon calculations, meteorological data, modelling terrain limitations and the availability of monitoring data from the assessment area(s).

The impact of COVID-19 and its subsequent lockdown periods on concentrations of NO_2 are still not fully understood and has caused a disparity in data monitoring for the years 2020 and 2021. Now that 2022 data is being released, it is not clear whether concentrations are returning back to pre-COVID-19 concentrations. For this reason, it is still best practice to use 2019 data.

4.5.1 Uncertainty in NO_x and NO_2 Trends

Recent studies have identified historical monitoring data within the UK that shows a disparity between measured concentration data and the projected decline in concentrations associated with emission forecasts for future years[9]. Ambient concentrations of NO_x and NO_2 have shown two distinct trends over the past twenty-five years: (1) a decrease in concentrations from around 1996

[9] Carslaw, D, Beevers, S, Westmoreland, E, Williams, M, Tate, J, Murrells, T, Steadman, J, Li, Y, Grice, S, Kent, Aand

Tsagatakis, I. 2011, Trends in NO_x and NO_2 emissions and ambient measurements in the UK, prepared for Defra, July 2011.

to 2002/04, followed by (2) a period of more stable concentrations from 2002/04 rather than the further decline in concentrations that was expected due to the improvements in vehicle emissions standards.

The reason for this disparity is related to the actual on-road performance of vehicles, in particular diesel cars and vans, when compared with calculations based on the Euro emission standards. Preliminary studies suggest the following:

- NO_x emissions from petrol vehicles appear to be in line with current projections and have decreased by 96% since the introduction of 3-way catalysts in 1993;

- NO_x emissions from diesel cars, under urban driving conditions, do not appear to have declined substantially, up to and including Euro 5. There is limited evidence that the same pattern may occur for motorway driving conditions; and

- NO_x emissions from HDVs equipped with Selective Catalytic Reduction (SCR) are much higher than expected when driving at low speeds.

This disparity in the historical national data highlights the uncertainty of future year projections of both NO_x and NO_2.

Defra and the Devolved Administrations have investigated these issues and have since published updated versions of the EFT that utilise COPERT 5 emission factors, which may go some way to addressing this disparity, but it is considered likely that a gap still remains. This assessment has utilised the latest EFT version 11.0 and associated tools published by Defra to help minimise any associated uncertainty when forming conclusions from the results.

5 Results

5.1 Modelled Concentrations

The assessment has considered emissions of NO_2 from road traffic at 29 existing receptor locations representing locations of relevant exposure.

Table 5-1 provides a summary of the modelled receptors split into groups based on the predicted annual mean NO_2 concentration. It can be seen that of the 29 discrete receptors, 3 (10%) are predicted to be above the NO_2 annual mean AQS objective limit, with a further 1 (3%) within 10%. The remaining 25 (86%) receptors were below the AQS for annual mean NO_2.

Table 5-1 – Summary of 2019 Modelled Receptor Results NO_2

Modelled NO_2 Concentration (µg/m^3)	Number of Receptors	Reference to the AQS Objective	Number of Receptors	% of Receptors
>60	0	**Above 60µg/m^3**	**0**	**0%**
>44	1	**Above 40µg/m^3 AQS Objective**	**3**	**10%**
40 - 44	2			
36 - 40	3	Within 10% of AQS Objective	3	10%
32 - 36	1	Below 36µg/m^3 AQS Objective	23	80%
<32	22			

The highest annual mean NO_2 concentration was recorded at Receptor 28A with a concentration of 47.2 µg/m^3, Receptor 28A is located along a façade of a residential property which immediately fronts onto a stretch of the A27 Upper Brighton Road, which is considered to be susceptible to congestion due to the convergence of high capacity around the Grove Lodge Roundabout and subsequent junctions. Receptor 28A is the ground level representative point of exposure for local authority monitoring location N30A which measured the highest concentration of 56.5µg/m^3 in Worthing AQMA in 2019. Receptor 28A is modelling a lower concentration than the monitoring station due to being modelled at the location of a ground floor window which is set back several metres from the road. N30A is also situated on a brick wall façade, which is influenced by reduced air flow and thus presents a higher concentration. This unrepresentative exposure concentration is evident in the underprediction for N30A during the verification of the model (Table A.3).

The empirical relationship given in LAQM.TG(22)[1] states that exceedance of the 1-hour mean objective for NO_2 is only likely to occur where annual mean concentrations are 60µg/m^3 or above. Given the NO_2 annual mean concentration recorded at Receptor 28A is below the hourly exceedance indicator (60µg/m^3), an exceedance of the hourly NO_2 AQS objective is unlikely at this location. This is also the case for monitoring location N30A which also does not exceed 60µg/m^3. There are no relevant locations with a modelled annual mean NO_2 concentration above 60µg/m^3, which suggests that an exceedance of the hourly NO_2 AQS objective is unlikely across the modelled area.

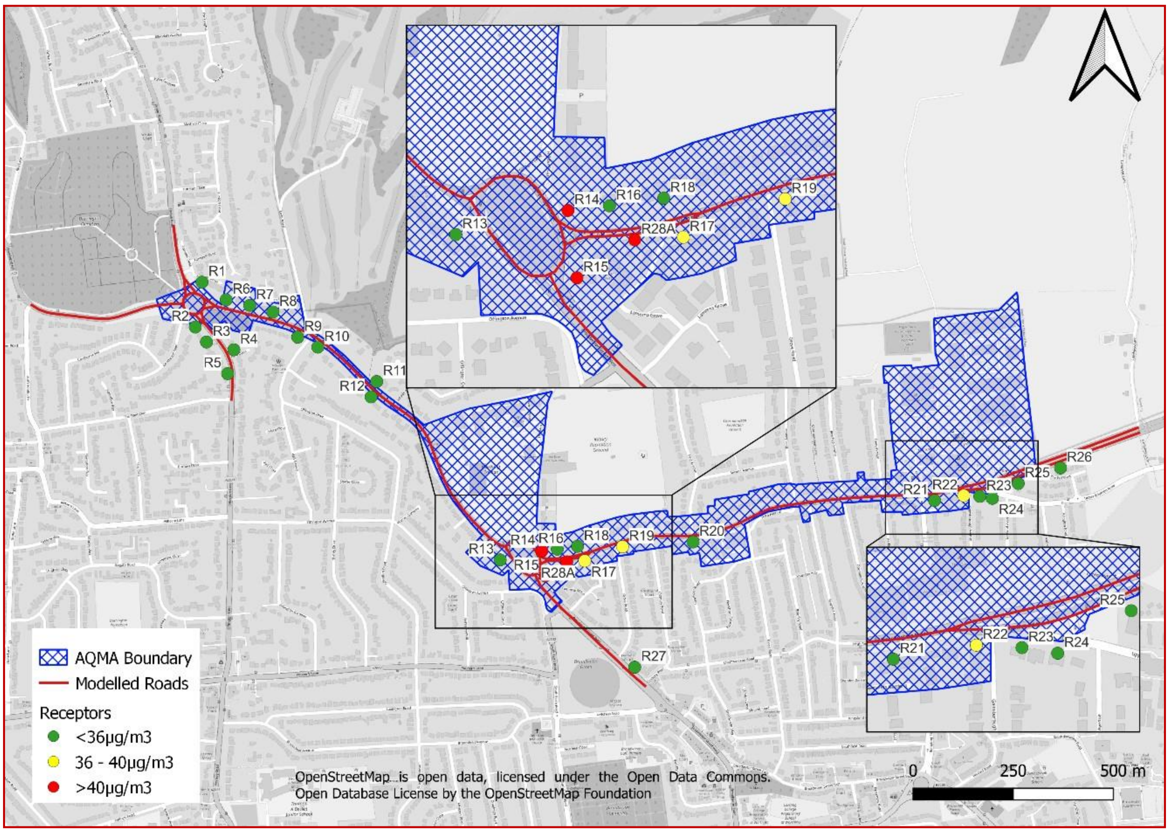
Figure 5-1 shows the locations of those receptors which are exceeding the 40µg/m^3 annual mean AQS objective and those receptors which are within 10% of the annual mean AQS objective (36 to 40µg/m^3). Based on these results, the following observations were made:

- Areas of exceedance or near exceedance of the annual mean NO_2 AQS objective were concentrated to roadside locations near junctions where key arterial roads meet, confirming vehicular traffic to be the main contributor to elevated levels of NO_2 concentrations within the Worthing AQMA. Notable roads include: A27 Upper Brighton Road, A24 Warren Road, and A24 Finton Road.

- These three roads are all busy roads with major junctions which are where the highest concentrations are observed. The high concentrations are likely due to the high traffic volume and congestion around the junctions.

A full set of concentration results for the discrete receptors used within the assessment is provided in Table C.1 of the Appendices.

Figure 5-1 – Modelled Receptors NO_2 Annual Mean Concentration Range



5.2 Estimated Year of Compliance

Following the identification of exceedances of the AQS objectives, it is useful to provide an estimate of the year by which concentrations at the identified locations of exceedances will become compliant with the relevant AQS objective. This is initially provided below assuming only the trends for futureair quality, as currently predicted by Defra, are realised. The implementation of specific intervention measures to mitigate the local air quality issues, as are currently being developed by the Council within an AQAP, would then be considered most likely to bring forwards the estimated date of compliance.

Following the methodology outlined in LAQM.TG(22)[1] paragraph 7.75 onward, the year by which concentrations at the identified locations of exceedances will become compliant with the NO_2 annual mean AQS objective has been estimated. This has been completed using the predicted modelled NO_2 concentrations from the 2019 Base scenario.

5.2.1 Worthing AQMA - Baseline 2019 NO_2 Concentrations

As a worst-case approach, the projection is based upon the receptor predicted as having the maximum annual mean NO_2 concentration, which in this case is Receptor 28A. A projection for the monitoring location N30A has also been provided for comparison. The appropriate roadside NO_2

projection factors, as provided on the LAQM Support website[10], are then applied to this concentration value to ascertain the estimated NO_2 annual mean reduction per annum, and hence the anticipated year of compliance. In this case, roadside projection factors for 'Rest of UK (HDV >10%)' have been applied, consistent with the worst-case receptor location.

The projected NO_2 annual mean concentrations following the above approach are presented in Table 5-2.

Table 5-2 – Projected Annual Mean NO_2 Concentrations – Worthing AQMA Receptor R28A

Receptor 28A											
2019 Annual Mean Concentration (µg/m³)	**Predicted Annual Mean Concentration (µg/m³)**										
	2020	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
47.2	**44.5**	**41.8**	39.3	37.2	35.2	33.4	31.9	30.6	29.4	28.4	27.5
In **bold**, exceedance of the NO_2 annual mean AQS objective of 40µg/m³ Vehicle Adjustment Factor = Rest of UK (HDV >10%)											

Table 5-2 indicates that the first year by which Receptor 28A will be exposed to a concentration below the annual mean NO_2 AQS objective will be 2022 (previous year). Additionally, it is expected that concentrations are expected to drop below 10% of the annual mean NO_2 AQS objective by 2024. 2022 is therefore considered the predicted year of compliance for those receptors used within the model, which are believed to represent worst case exposure within the Worthing AQMA, in the absence of the implementation of any specific intervention measures to further bring forward local air quality improvements in the area.

The projected NO_2 annual mean concentrations for monitoring station N30A are presented in Table 5-4.

Table 5-3 – Projected Annual Mean NO_2 Concentrations – Worthing AQMA N30A

N30A											
2019 Annual Mean Concentration (µg/m³)	**Predicted Annual Mean Concentration (µg/m³)**										
	2020	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
56.6	**53.3**	**50.1**	**47.1**	**44.6**	**42.2**	**40.0**	38.2	36.6	35.2	33.9	32.9
In **bold**, exceedance of the NO_2 annual mean AQS objective of 40µg/m³ Vehicle Adjustment Factor = Rest of UK (HDV >10%)											

Table 5-3 indicates that the first year by which N30A will be exposed to a concentration below the annual mean NO_2 AQS objective will be 2026. Additionally, it is expected that concentrations are expected to drop below 10% of the annual mean NO_2 AQS objective by 2028. 2026 is therefore considered the predicted year of compliance for N30A. This indicates that without implementation of any specific intervention measures, N30A will be compliant to the AQS within three years, even though N30A is not a representative point of exposure along the A27.

Table 5-3 also indicates that reductions in concentration are occurring at an increased rate when compared to monitoring data at N30A. This is due to the projection factors not taking into

[10] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/roadside-no2-projection-factors/

consideration the impact of COVID-19 and subsequent lockdown periods on NO_2 concentration, thus providing a worst-case outlook. This means that compliance at 28A may be earlier than projected.

Table 5-4 below also illustrates the required reduction in NO_x emissions for annual mean NO_2 concentrations to fall below the AQS of 40µg/m^3. As shown a 22.4% reduction in road NO_x is required to meet the AQS for annual mean NO_2 at the worst-case receptor (R28A) in Worthing AQMA.

Table 5-4 – Required Reduction in NO_x emissions to meet AQS for Annual Mean NO_2

Metric	Value (Concentrations as µg/m^3)
Worst-Case Relevant Exposure NO2 Concentration	47.2
Equivalent NOx Concentration	90.2
Background NOx	17.3
Background NO2	12.9
Road NOx - Current	72.8
Road NOx - Required (to achieve NO2 concentration of 39.9µg/m^3)	56.6
Required Road NOx Reduction	16.3
Required % Reduction	22.4%

5.3 Source Apportionment

To help inform the development of measures as part of the action plan stage of the project, a NOx source apportionment exercise was undertaken for the following vehicle classes:

- Petrol Cars
- Diesel Cars
- Alternative Car
- Petrol LGV
- Diesel LGV
- Alternative LGV
- HGV
- Buses
- Motorcycle

This will provide vehicle emission proportions of NO_x that will allow the Council to design specific AQAP measures targeting a reduction in emissions from specific vehicle types for each of the AQMAs.

It should be noted that emission sources of NO_2 are dominated by a combination of direct NO_2 (f-NO_2) and oxides of nitrogen (NO_x), the latter of which is chemically unstable and rapidly oxidised upon release to form NO_2. Reducing levels of NO_x emissions therefore reduces levels of NO_2. As a consequence, the source apportionment study has considered the emissions of NO_x which are assumed to be representative of the main sources of NO_2.

The sections below detail the source apportionment results for NO_x concentrations at modelled receptors for three scenarios:

- The average Total NO_x split across all modelled receptors. This provides useful information to understand the split between local and regional background sources as well as local road sources. In accordance with TG(22)[1]. Regional background is considered to be the emissions from background sources that the authority is unable to influence and the local background the background emissions they have some influence over. Local Sources give rise to the hotspot areas of exceedances, and the principal sources for the local authority.

- The location where the maximum road NO_x concentration has been predicted within the AQMA. This is likely to be in the area of most concern within the proposed AQMA and so a good place to test and adopt action measures. Any gains predicted by action measures are however likely to be greatest at this location and so would not represent gains across the whole modelled area.

5.3.1 Baseline 2019 NOx Concentrations

When considering the average NO_x background split across all modelled receptor locations within the AQMA, the following observations were found:

- Regional Background NO_x accounted for 13.1% (6.9µg/m^3)
- Local Background NO_x accounted for 19.7% (10.4µg/m^3)
- Local Road Traffic accounted for the largest majority, 67.2% (35.5µg/m^3)

When considering the average NO_x concentration across all modelled receptor locations within the AQMA, the following observations were found:

- Road traffic accounts for 35.5 µg/m^3 (67.2%) of total NO_x (52.8µg/m^3), with background accounting for 17.3µg/m^3 (32.8%);
- Of the total road NO_x, Disel Cars are the highest contributing vehicle class accounting for 44.8% (15.9µg/m^3);
- Diesel LGVs are found to be the second highest contributing vehicle class accounting for 33.1% (9.8µg/m^3);
- HGVs are the third highest contributing vehicle class accounting for 11.7% (4.2µg/m^3);
- Petrol Cars account for a total road NO_x of 7.2% (2.6µg/m^3),
- Buses account for a total road NO_x of 2.5% (0.9µg/m^3));
- All other vehicle types accounting for <1%.

When considering the modelled receptor location at which the maximum road NO_x concentration has been predicted:

- Road traffic accounts for 80.8% (72.8µg/m^3) of the total NO_x (90.2µg/m^3) – highlighting contributions from road traffic to be the core component in areas of exceedance;
- Of the total road NO_x, Disel Cars are found to be the highest contributing vehicle class accounting for 44.3% (32.3µg/m^3). This is very similar than the trend across all modelled receptors, indicating Diesel Cars are the predominant source of NO_x emissions across the AQMA;
- Diesel LGVs are found to be the second highest contributing vehicle class accounting for 32.8% (23.9µg/m^3). This observed percentage contribution is slightly lower than the observations found across the AQMA and suggests a lesser influence on exceedance within key areas of the AQMA;

- HGVs account for 12.3% (9.0µg/m^3) of the total road NO_x, Petrol Car account for 7.1% (5.1µg/m^3). This is very similar to the contribution observed across the whole AQMA;

- Buses account for 2.9% (2.1µg/m^3) of the total road NO_x. This is a slight increase to the contribution observed across the whole AQMA and suggests a marginally higher influence on exceedance within key areas of the AQMA;

- All other vehicle types are similarly found to contribute <1%.

The NO_x source apportionment exercise demonstrates a largely consistent ranking of contributing vehicle classes exhibited (Diesel Cars, Diesel LGVs, HGVs, Petrol Cars, Buses), where Diesel Cars primarily are found to be the main contributors to total road NO_x concentrations across the AQMA.

Whilst comparing modelled contributions at identified receptor locations within the AQMA against the max receptor within the AQMA, Diesel Cars were observed to have a very similar influence on total road NO_x concentrations within the AQMA. For all the other vehicle types at the max receptors, they have either a similar or slightly higher influence, excluding Diesel LGVs, on total road NO_x concentrations within the AQMA when compared the average across the AQMA.

Overall, this suggests the volume of traffic and congestion in the AQMA is considered to be the key contributor to elevated levels of NO_2 annual mean concentrations within the AQMA. The key location in the AQMA where elevated levels of NO_2 are observed are the where the A27 Upper Brighton Road meets the Grove Lodge Roundabout.

Table 5-5 and Table 5-6 illustrate the NO_x source apportionment results for the AQMA, with Figure 5-2 providing a graphical representation of the split in background concentrations, and local road source.

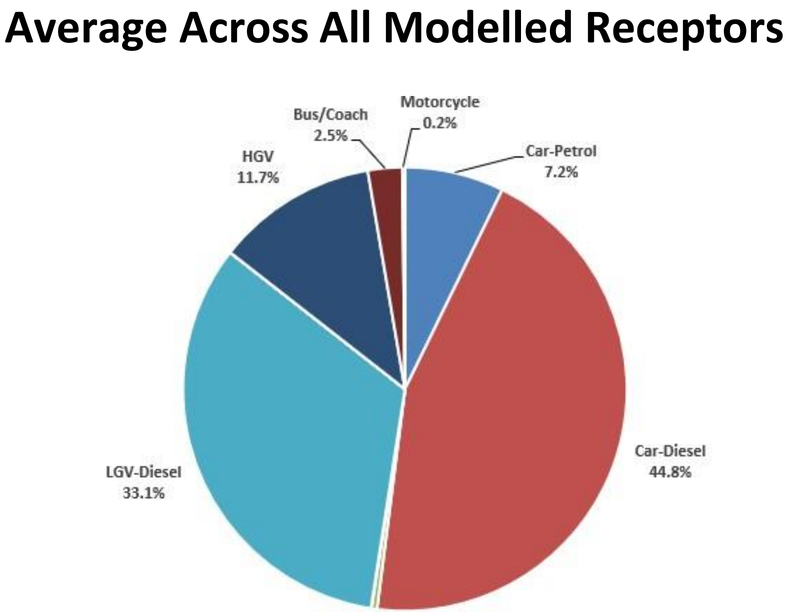
Table 5-5 – Total NO_x Source Apportionment Across All Receptors within the AQMA

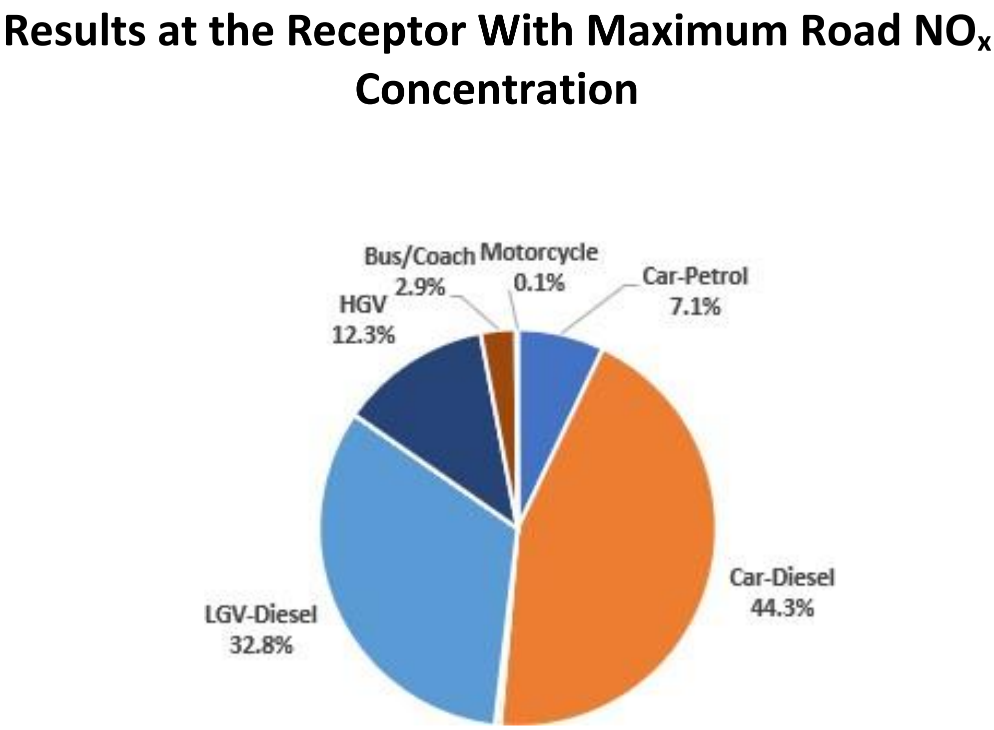
Results	Local Background NO_x	Regional Background NO_x	Local Road NO_x
NO_x Concentration (µg/m^3)	10.4	6.9	35.5
Percentage of total NO_x	19.7%	13.1%	67.2 %

Table 5-6 – Detailed Source Apportionment of Road NO_x Concentrations

Results	*All Vehicles*	*Car-Petrol*	*Car-Diesel*	*Car-Alternative*	*LGV-Petrol*	*LGV-Diesel*	*LGV-Alternative*	*HGV*	*Bus/Coach*	*Motorcycle*	*Background*
Average Across all Receptors within AQMA											
NO_x Concentration ($\mu g/m^3$)	35.5	2.6	15.9	0.1	0.0	11.8	0.0	4.2	0.9	0.1	17.3
Percentage of total NO_x	67.2%	4.9%	30.1%	0.3%	0.0%	22.2%	0.0%	7.9%	1.7%	0.1%	32.8%
Percentage Road Contribution to total NO_x	100.0%	7.2%	44.8%	0.4%	0.0%	33.1%	0.0%	11.7%	2.5%	0.2%	-
At Receptor with Maximum Road NO_x Concentration (Receptor 28A)											
NO_x Concentration ($\mu g/m^3$)	72.8	5.1	32.3	0.3	0.0	23.9	0.0	9.0	2.1	0.1	17.3
Percentage of total NO_x	80.8%	5.7%	35.8%	0.3%	0.0%	26.5%	0.0%	10.0%	2.3%	0.1%	19.2%
Percentage Road Contribution to total NO_x	100.0%	7.1%	44.3%	0.4%	0.0%	32.8%	0.0%	12.3%	2.9%	0.1%	-

Figure 5-2 Detailed Source Apportionment of NO_x Concentrations





6 Conclusions and Recommendations

The dispersion modelling exercise undertaken has provided the following updated perspective on NO_2 challenges within the declared AQMA.

6.1 Worthing AQMA

6.1.1 Predicted Concentrations

The model suggests that the 40µg/m^3 NO_2 annual mean AQS objective is exceeded at a total 3 (10%) receptor locations, with 3 (10%) further location within 10% of the objective.

The highest annual mean NO2 concentration was recorded at Receptor 28A with a concentration of 47.2 µg/m^3, Receptor 28A is located along a façade of a residential property which immediately fronts onto a stretch of the A27 Upper Brighton Road, which is considered to be susceptible to congestion due to the convergence of high capacity around the Grove Lodge Roundabout and subsequent junctions. Receptor 28A is the ground level point of exposure for local authority monitoring location N30A which measured the highest concentration of 56.5µg/m^3 in Worthing AQMA in 2019. Receptor 28A presents a lower concentration than the monitoring station due to being modelled at the location of the ground floor window which is set back several metres from the road. N30A is also situated on a brick wall façade, which is impacted by reduced air flow and thus presents a higher concentration. This means that N30A is not representative of the true point of exposure for the residential property.

The empirical relationship given in LAQM.TG(22)[1] state that exceedance of the 1 hour mean objective for NO_2 is only likely to occur where annual mean concentrations are 60µg/m^3 or above. Given the NO_2 annual mean concentration recorded at Receptor 28A is below the hourly exceedance indicator (60µg/m^3), an exceedance of the hourly NO_2 AQS objective is unlikely at this location. This is also the case for monitoring location N30A which also does not exceed 60µg/m^3. There are no relevant locations with a modelled annual mean NO_2 concentration above 60µg/m^3, which suggests that an exceedance of the hourly NO_2 AQS objective is unlikely across the modelled area.

Based on the modelled results, the following observations were made:

- Areas of exceedance or near exceedance of the annual mean NO_2 AQS objective were concentrated to roadside locations near junctions where key arterial roads meet, confirming vehicular traffic to be the main contributor to elevated levels of NO_2 concentrations within the Worthing AQMA. Notable roads include: A27 Upper Brighton Road, A24 Warren Road, and A24 Finton Road.

- These three roads are all busy roads with major junctions which are where the highest concentrations are observed. The high concentrations are likely due to the high traffic volume and congestion around the junctions.

6.1.1.1 Worthing Estimated Year of Compliance

Using the recommended method in TG(22)[1], the estimated year of compliance within the AQMA should no additional measures be put in place is 2022 (previous year) and will be below 10% of the AQS by 2024. Projections also show that the estimated year of compliance for monitoring station N30A is 2026. However, as previously mentioned, the accuracy of concentration at a high-risk receptor exposure (residential) is unlikely to be accurate.

A reduction of approximately 22.4% in Road NO_x at the worst-case receptor is required to meet the AQS for annual mean NO_2.

6.1.2 Worthing Source Apportionment

To help inform the development of measures as part of the AQAP, a NO_x source apportionment exercise was undertaken to provide an understanding of the main vehicle emission contributors within the AQMA.

The NOx source apportionment exercise demonstrates a largely consistent ranking of contributing vehicle classes exhibited (Diesel Cars, Diesel LGVs, HGVs, Petrol Cars, Buses), where Diesel Cars primarily are found to be the main contributors to total road NO_x concentrations across the AQMA.

Whilst comparing modelled contributions at identified receptor locations within the AQMA against the max receptor within the AQMA, Diesel Cars were observed to have a very similar influence on total road NOx concentrations within the AQMA. For all the other vehicle types at the max receptors, they have very similar or slightly lesser influence on total road NOx concentrations within the AQMA when compared the average across the AQMA.

Overall, this suggests the volume of Diesel Cars and subsequent congestion in the AQMA is considered to be the key contributor to elevated levels of NO_2 annual mean concentrations within the AQMA. This suggests it would be desirable to increase monitoring to problematic areas, focusing on vehicle type monitoring to increase the understanding of Diesel Car influence within the AQMA. The key location in the AQMA where elevated levels of NO_2 are observed are the where the A27 Upper Brighton Road meets the Grove Lodge Roundabout.

6.1.3 Worthing Future Recommendations

Following the completion of the detailed modelling assessment, the following recommendations are made:

- Continue to monitor NO_2 across the AQMA. Monitoring should be expanded to problem areas along the A27, most notably around the Grove Lodge Roundabout where the exceedances from the modelling assessment were located.

- Based on source apportionment results, any future intervention measures should be targeted at reducing vehicle emissions from Diesel Cars and Diesel LGVs, which are both observed to be the two largest contributors to total vehicle emissions in areas of exceedance.

- Measures to reduce congestion at the main junction of the where the A27 Upper Brighton Road meets the Grove Lodge Roundabout, and the dual carriageway split of Upper Brighton Road would also help to reduce emissions of NO_2 in the Worthing AQMA.

Appendices

Appendix A - ADMS Model Verification

The ADMS-Roads dispersion model has been widely validated for this type of assessment and is specifically listed in the Defra's LAQM.TG(22)[1] guidance as an accepted dispersion model.

Model validation undertaken by the software developer (CERC) will not have included validation in the vicinity of the proposed development site. It is therefore necessary to perform a comparison of modelled results with local monitoring data at relevant locations. This process of verification attempts to minimise modelling uncertainty and systematic error by correcting modelled results by an adjustment factor to gain greater confidence in the final results.

The predicted results from a dispersion model may differ from measured concentrations for a large number of reasons, including uncertainties associated with:

- Background concentration estimates;
- Source activity data such as traffic flows and emissions factors;
- Monitoring data, including locations; and
- Overall model limitations.

Model verification is the process by which these and other uncertainties are investigated and where possible minimised. In reality, the differences between modelled and monitored results are likely to be a combination of all of these aspects.

Model setup parameters and input data were checked prior to running the models in order to reduce these uncertainties. The following were checked to the extent possible to ensure accuracy:

- Traffic data;
- Distance between sources and monitoring as represented in the model;
- Speed estimates on roads;
- Background monitoring and background estimates; and
- Monitoring data.

The traffic data for this assessment has been collated using DfT traffic count data, as outlined in Section 4.

NO_2 Verification Calculations

During 2019, concentrations of NO_2 were monitored at 32 sites across Worthing Borough Council, all of which are diffusion tube sites. The following monitoring locations were used for verification:

N39, WT2, N30A, N25, N5, N29 and N53

Please note that N43 was excluded in the verification of the AQMA, as it has a much lower concentration recorded compared with diffusion tube in close proximity (N43 to WT2 recorded concentration 12.8 µg/m^3 higher). This location was set back from the road and due to specific conditions along the junction, the model was overpredicting significantly at this location and therefore cannot be used in verification. N44A was not used in the verification as this tube was co-located with the automatic (WT2) and was monitoring a lower concentration. This meant that the more accurate automatic monitor was used.

Full details of the diffusion tubes and automatic monitoring station locations and results are shown in Figure 3-1.

NO_2 Verification calculations

The verification of the modelling output was performed in accordance with the methodology provided in Chapter 7 of LAQM.TG(22)[1].

Verification was completed using the 2019 (2018 reference year) Defra background mapped concentrations for the relevant 1km x 1km grid squares within WBC (i.e. those within which the model verification locations are located), as displayed in **Error! Reference source not found.** of the Appendices.

Table A.1 below shows an initial comparison of the monitored and unverified modelled NO_2 results for the year 2019, in order to determine if verification and adjustment was required.

Table A.1 – Comparison of Unverified Modelled and Monitored NO_2 Concentrations

Site ID	Background NO_2	Monitored total NO_2 (µg/m^3)	Unverified Modelled total NO_2 (µg/m^3)	Difference (modelled vs. monitored) (%)
N39	12.9	28.5	22.8	-20.0
WT2	12.9	36.3	25.5	-29.9
N30A	12.9	56.6	27.6	-51.2
N25	11.8	17.8	16.5	-7.1
N5	10.8	28.3	22.7	-19.8
N29	11.8	28.6	18.4	-35.8
N53	11.1	29.9	24.0	-19.8

The data in the table above shows that the model was under predicting at all verification points, with the highest under prediction between the modelled and monitored concentrations observed at N30A (-51.2%). At this stage all model inputs were checked to ensure their accuracy, this includes road and monitoring sire geometry, traffic data, link emission rates, 2019 monitoring results, background concentrations and modelling features such as "street canyons". Following a level of QA/QC completed upon the model, no further improvement of the modelled results could be obtained on this occasion. The difference between modelled and monitored concentrations was greater than -25% at N30A, WT2, and N29, therefore adjustment of the results was necessary. The relevant data was then gathered to allow the adjustment factor to be calculated.

Model adjustment needs to be undertaken based for NO_x and not NO_2. For the Council operated monitoring results used in the calculation of the model adjustment, NO_x was derived from NO_2; these calculations were undertaken using a spreadsheet tool available from the LAQM website[11].

[11] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/nox-to-no2-calculator/

Table A.2 provides the relevant data required to calculate the model adjustment based onregression of the modelled and monitored road source contribution to NO_x.

Figure A.1 provides a comparison of the Modelled Road Contribution NO_x versus Monitored Road Contribution NO_x. The Total Monitored NO_x concentration has been derived by back-calculating NO_x from the NO_x/NO_2 empirical relationship using the spreadsheet tool available from Defra's website. The equation of the trend lines presented in Figure A.1 gives an adjustment factor for the modelled results of 1.2117.

Table A.2 – Data Required for Adjustment Factor Calculation

Site ID	Monitored total NO_2 (µg/m³)	Background NO_2 (µg/m³)	Background NO_x (µg/m³)	Monitored road contribution NO_x (total - background) (µg/m³)	Modelled road contribution NO_x (excludes background) (µg/m³)
N39	28.5	11.9	15.8	32.3	20.7
WT2	36.3	11.9	15.8	49.1	26.0
N30A	56.6	11.9	15.8	99.0	30.5
N25	17.8	11.3	14.9	12.1	9.7
N5	28.3	10.8	14.2	34.0	22.6
N29	28.6	11.1	14.8	33.9	13.4
N53	29.9	11.3	14.9	36.4	24.2

Figure A.1 – Comparison of the Modelled Road Contribution NO_x versus Monitored Road Contribution NO_x

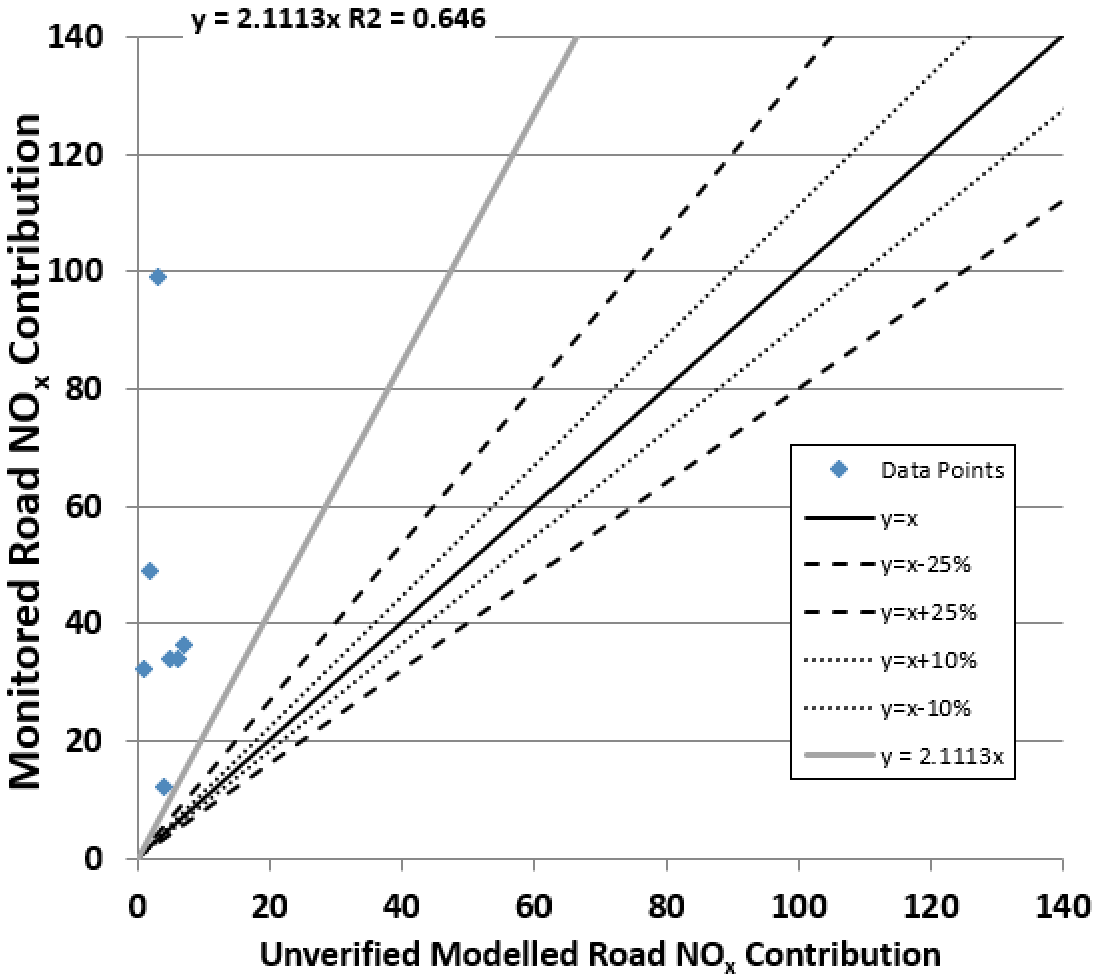


Table A.3 – Adjustment Factor and Comparison of Verified Results against Monitoring Results

Site ID	Ratio of monitored road contribution NO_x / modelled road contribution NOx	Adjustment factor for modelled road contribution NO_x	Adjusted modelled road contribution NO_x (µg/m³)	Modelled total NO_2 (based upon empirical NO_x / NO_2 relationship) (µg/m³)	Monitored total NO_2 (µg/m³)	Difference (adjusted modelled NO_2 vs. monitored NO_2) (%)
N39	1.56	2.111	43.7	33.8	28.5	18.7
WT2	1.89		54.9	38.9	36.3	7.1
N30A	3.25		64.4	42.9	56.6	-24.2
N25	1.25		20.5	22.1	17.8	24.4
N5	1.51		47.6	34.6	28.3	22.4
N29	2.53		28.3	25.9	28.6	-9.5
N53	1.50		51.0	36.6	29.9	22.5

Figure A.2 – Comparison of the Verified Modelled Total NO_2 versus Monitored NO_2

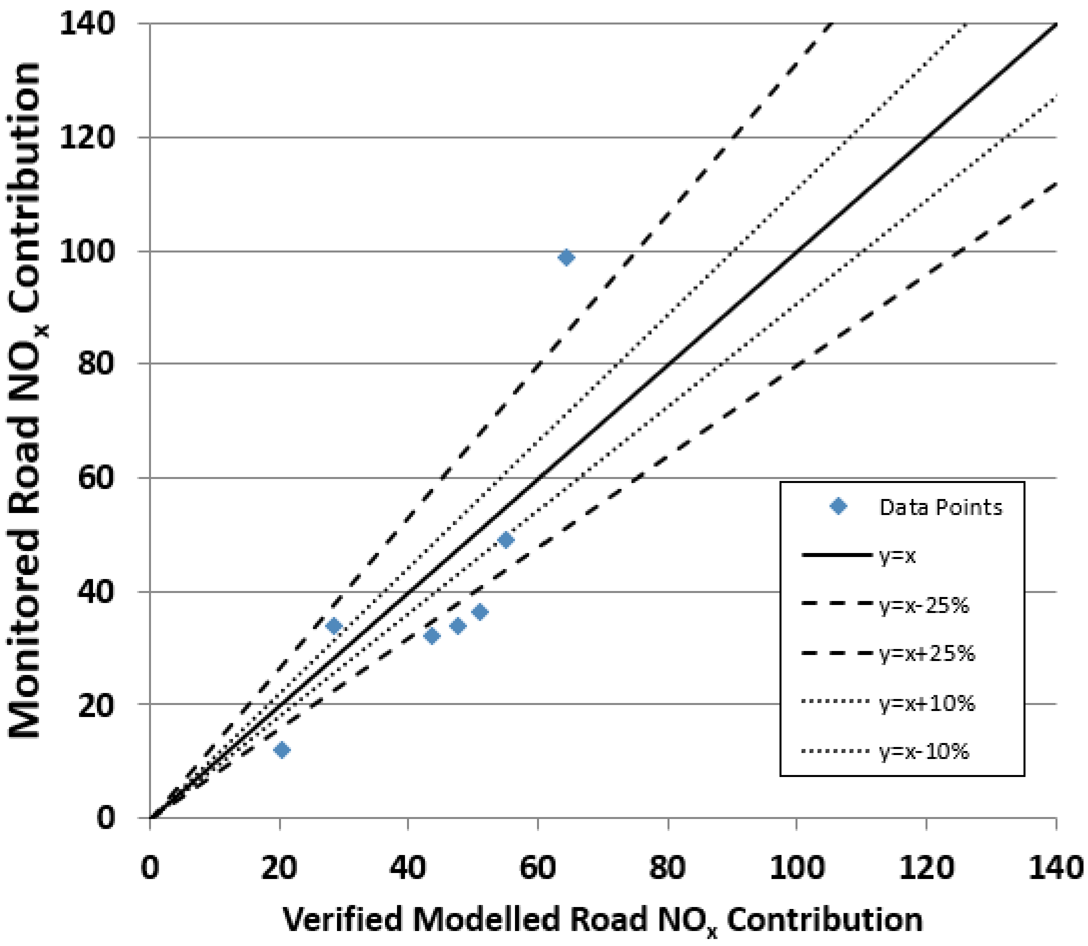


Table A.3 and Figure A.2 show the ratios between monitored and modelled NO_2 for each monitoring location after using the calculated adjustment factor. LAQM.TG(22)[1] states that:

"In order to provide more confidence in the model predictions and the decisions based on these, the majority of results should be within 25% of the monitored concentrations, ideally within 10%."

The sites show good agreement between the ratios of monitored and modelled NO_2,

A factor of 2.111 reduces the Root Mean Square Error (RMSE) from a value of 12.9 to 6.9, which is below the upper limit value of 10 µg/m^3, however above the ideal RMSE value of 4 µg/m^3, as stated within LAQM.TG(22).

The 2.111 adjustment factor was applied to the road contribution NOx concentrations predicted by the model to arrive at the final NO_2 concentrations.

Appendix B – Traffic Inputs

Table B.1 – Traffic Data used in the Detailed Assessment

Source	Traffic Point	Modelled Road Link Name		AADT	HGV (%)	Average Speed (kph)
DFT Traffic Data 2019	26302	1	A27	17,181	20.7	56
DFT Traffic Data 2019	26302	2	A27	17,181	20.7	56
DFT Traffic Data 2019	26302	3	A27	17,181	20.7	20
DFT Traffic Data 2019	26302	4	A27	17,181	20.7	20
DFT Traffic Data 2019	26302	5	A27	34,362	20.7	56
DFT Traffic Data 2019	26302	6	A27	34,362	20.7	48
DFT Traffic Data 2019	26302	7	A27	16,690	20.9	20
DFT Traffic Data 2019	Average (16261, 26302, 56246)	8	Grove Lodge Roundabout	29,336	18	20
DFT Traffic Data 2019	16261	9	A24	22,869	13.0	48
DFT Traffic Data 2019	16261	10	A24	22,869	13.0	20
DFT Traffic Data 2019	Average (16261, 26302, 56246)	11	Grove Lodge Roundabout	29,336	18.2	32
DFT Traffic Data 2019	56246	12	Warren Road	30,777	20.7	20
DFT Traffic Data 2019	56246	13	Warren Road	30,777	20.7	56
DFT Traffic Data 2019	56246	14	Warren Road	30,777	20.7	40
DFT Traffic Data 2019	Average (56246, 46284, 78241, 78242)	15	Offington Corner Roundabout	22,613	18.5	32
DFT Traffic Data 2019	56246	16	Warren Road	15,389	20.7	20
DFT Traffic Data 2019	56246	17	Warren Road	15,389	20.7	20
DFT Traffic Data 2019	78241	18	A24 Findon Road	12,979	15.8	20
DFT Traffic Data 2019	78241	19	A24 Findon Road	12,979	15.8	20
DFT Traffic Data 2019	78241	20	A24 Findon Road	25,957	15.8	20
DFT Traffic Data 2019	78242	21	A27 Arundel Road	22,776	22.9	20
DFT Traffic Data 2019	46284	22	A2031	10,940	14.5	20
DFT Traffic Data 2019	46284	23	A2031	10,940	14.5	48
DFT Traffic Data 2019	78242	24	A27 Arundel Road	22,776	22.9	56
DFT Traffic Data 2019	78241	25	A24 Findon Road	25,957	15.8	56
DFT Traffic Data 2019	46284	26	A2031	5,470	14.5	20
DFT Traffic Data 2019	46284	27	A2031	5,470	14.5	20
DFT Traffic Data 2019	26302	28	A27	14,087	20.4	56
DFT Traffic Data 2019	26302	29	A27	16690	20.9	20
DFT Traffic Data 2019	26302	30	A27	16690	20.9	24

Notes

Traffic flows and vehicle class compositions were taken from the DfT traffic count point database.
Traffic speeds were modelled at either the relevant speed limit for each road or based on the Google Traffic Database. Where appropriate, vehicle speeds have been reduced to simulate queues at junctions, traffic lights and other locations where queues or slower traffic are known to be an issue – in accordance with LAQM TG(22)[1]

Appendix C – Receptor Locations and Corresponding Modelled Predictions

Table C.1 – Predicted 2019 Annual Mean Concentrations of NO_2 at Discrete Receptor Locations

Receptor ID	X	Y	Height	Closest address/post code	2019 Annual Mean Concentration (µg/m^3)
					NO_2
R1	513280	105646	1.5	12 Fontwell Dr, Worthing BN14 0AF	27.2
R2	513263	105534	1.5	115 Offington Ln, Worthing BN14 9RW	29.3
R3	513291	105497	1.5	109 Offington Ln, Worthing BN14 9RW	23.9
R4	513359	105477	1.5	20 Park Cl, Worthing BN14 9RP	21.9
R5	513343	105418	1.5	97 Offington Ln, Worthing BN14 9RW	21.4
R6	513340	105602	1.5	142 Warren Rd, Worthing BN14 9RB	28.7
R7	513399	105588	1.5	130 Warren Rd, Worthing BN14 9RB	25.6
R8	513456	105572	1.5	128 Warren Rd, Worthing BN14 9RB	24.6
R9	513519	105509	1.5	83 Warren Rd, Worthing BN14 9QU	26.2
R10	513569	105484	1.5	101 Warren Rd, Worthing BN14 9QU	27.0
R11	513716	105398	1.5	115 Warren Rd, Worthing BN14 9RA	23.9
R12	513702	105360	1.5	75 Warren Rd, Worthing BN14 9QU	26.2
R13	514024	104953	1.5	3 Warren Rd, Worthing BN14 9QH	30.7
R14	514128	104975	1.5	3 Upper Brighton Rd, Worthing BN14 9HY	42.9
R15	514136	104913	1.5	128 Broadwater St W, Worthing BN14 9DJ	42.6
R16	514166	104980	1.5	7 Upper Brighton Rd, Worthing BN14 9HY	30.1
R17	514235	104951	1.5	84 Upper Brighton Rd, Worthing BN14 9HR	36.0
R18	514216	104987	1.5	27 Upper Brighton Rd, Worthing BN14 9HY	27.1
R19	514329	104986	1.5	54A Grove Rd, Worthing BN14 9DG	38.1
R20	514505	104998	1.5	56 Upper Brighton Rd, Worthing BN14 9HT	33.0

Receptor ID	X	Y	Height	Closest address/post code	2019 Annual Mean Concentration (µg/m^3)
					NO_2
R21	515108	105101	1.5	2 Downlands Gardens, Worthing BN14 9EZ	30.6
R22	515181	105114	1.5	27 Gainsborough Ave, Worthing BN14 8QR	36.2
R23	515221	105111	1.5	156 Sompting By-Pass, Worthing BN14 9JR	31.7
R24	515252	105107	1.5	162 Sompting By-Pass, Worthing BN14 9JR	26.9
R25	515317	105144	1.5	157 Upper Brighton Rd, Worthing BN14 9JS	31.6
R26	515422	105182	1.5	19 The Templars, Worthing BN14 9JT	28.6
R27	514359	104685	1.5	104 Broadwater St W, Worthing BN14 9DF	23.6
R28A	514190	104948	1.5	19 Upper Brighton Rd, Worthing BN14 9HY	47.2
R28B	514190	104948	4	19 Upper Brighton Rd, Worthing BN14 9HY	27.9

Appendix D: Steering Group Attendees

Invitees	From
Nadeem Shad	Worthing Borough Council Public Health & Regulation
Tessa Denny	Worthing Borough Council Public Health & Regulation
Jamie Dallen	West Sussex County Council Transport Planning and Policy
Hannah Broomfield-Payne	Bureau Veritas (for drafting the AQAP only)
Sam Garrington	Bureau Veritas (for drafting the AQAP only)
To be invited	
Stephen Inch	National Highways Air Quality Lead
Peter Phillips	National Highways Route Manager
Cllr Vicki Wells	Worthing Borough Council Cabinet Member for the Environment
Others	tbc

Appendix E: Defra Consultation Comments on Modelling Assessment

The following lists the comments made by Defra on the draft AQAP and the responses from Bureau Veritas (in *italics*).

4. That said, it is felt the model's performance at the excluded N43 should be included for a better understanding of the limitation in this region. Disagreement between two sites is not necessarily an appropriate reason for exclusion from consideration, as the model could have been set up sub-optimally for this location.

The model has been developed using the most reliable data available. Following multiple revisions and a thorough verification process, the current iteration has been determined to be the most accurate for real-world conditions. The rationale for underprediction and the argument for excluding N43 (location of the tube and distance correction for the nearest sensitive receptor) are detailed within the report.

It should be noted that N43 was excluded from the verification of the Air Quality Management Area (AQMA) due to its significantly lower recorded concentration compared to a nearby diffusion tube (N43 to WT2 recorded concentration 12.8 µg/m3 higher). This location was set back from the road, and specific conditions at the junction led to substantial overprediction by the model, making it unsuitable for verification. Similarly, N44A was not included in the verification as it was co-located with the automatic monitor (WT2) and recorded a lower concentration, necessitating the use of the more accurate automatic monitor.

For further consideration, the iteration of the model verification inclusive of N43A is shown below.

Table 9 Model Verification inclusive of N43

Site ID	Ratio of monitored road contribution NO_x / modelled road contribution NO_x	Adjustment factor for modelled road contribution NO_x	Modelled total NO_2 (µg/m^3)	Monitored total NO_2 (µg/m^3)	% Difference (adjusted modelled NO_2 vs. monitored NO_2)
N39	1.56	2.068	33.4	28.5	17.1
WT2	1.89		38.3	36.3	5.5
N30A	3.26		42.3	56.6	-25.4
N25	1.25		21.9	17.8	23.0
N5	1.51		34.1	28.3	20.6

N29	2.53		25.6	28.6	-10.6
N53	1.51		36.1	29.9	20.7
N43	1.12		26.3	19.9	32.1

The RMSE reduces from 12.1 to 6.8 with the above verification inclusive of N43. As shown, inclusion of N43 results in the modelled concentration at N30A being outside the recommended TG(22) criteria of being within 25% of the monitored concentration. As this is the only location to record an exceedance of the 40µg/m³ annual average NO_2 Air Quality Objective, It is considered that, based on the above, it is appropriate to exclude N43 to achieve a more representative overall model verification factor.

5. The RMSE could also be improved to a more robust value. Site N30A, especially, is underpredicting post correction, which is integral to the interpretation of the compliance within the AQMA, and so model performance should be further optimised here.

Detailed modelling has been completed in this area, including the use of advanced canyon modules and detailed modelling of predicted congestion from the traffic lights. The traffic data input is from the Department for Transport traffic count. While this is the most reliable and representative data available for the study, it is acknowledged that this may not be completely representative of the micro siting conditions at this particular diffusion tube. This is a limitation of the modelling study.

Applying a factor of 2.111 reduces the Root Mean Square Error (RMSE) from 12.9 to 6.9.

TG(22) states "If the RMSE values are higher than ±25% of the objective being assessed, it is recommended that the model inputs and verification should be revisited in order to make improvements. For example, if the model predictions are for the annual mean NO_2 objective of 40µg/m³ , if an RMSE of 10µg/m³ or above is determined for a model, the local authority would be advised to revisit the model parameters and model verification. Ideally an RMSE within 10% of the air quality objective would be derived, which equates to 4µg/m3 for the annual average NO_2 objective."

While it is accepted that the RMSE is outside the ideal value of 4µg/m³ it is within the 25% value specified of 10µg/m³ following the adjustment.

It should be noted that the modelled concentrations at this site are the highest across the model domain and above the Air Quality Objective of 40µg/m³. Therefore, for the purpose of decision making within the area, it is considered that the model is suitably robust.

6. A source apportionment exercise has been undertaken, with details on methodology provided in the Appendix. The study identifies road traffic is the predominant source of emissions, of which diesel cars are the largest contributors which should therefore be targeted for measures, which doesn't appear to have been carried through to the measures themselves.

Within the AQAP, it has been highlighted that measures to reduce road traffic emissions are the top priority. Measures focussing on modernising the national fleet *so as to reduce the number of Diesel vehicles and increase EVs specifically target this identified major contributor. Additional comments have been made within the AQAP to make this clearer.*

It is also noted that there are national initiatives aimed at reducing the number of diesel vehicles, which will consequently decrease the number of diesel vehicles within the Air Quality Management Area (AQMA) over the next 5-10 years. Additionally, measures have been implemented to promote the increased adoption of electric vehicles (EVs) across the AQMA and to modernize the council's fleet, thereby facilitating the transition away from diesel vehicles. Although these measures do not explicitly target diesel cars, they include provisions to reduce the number of diesel vehicles in the council's fleet and to enhance EV charging infrastructure, thereby encouraging greater EV usage across the AQMA and subsequently reducing diesel car emissions.

7. The discussion of the source apportionment in main section of the AQAP could be clearer. It is noted the information is readily available in the Appendix, however it would be preferable if the main AQAP was improved to allow for easier understanding (an alternative is to ensure the appendix is published with the AQAP to give the reader the full visibility of supporting information).

This advice is noted and within the final published AQAP, the Technical Report will be appended to the overall document.

a. Table 3-1 provides a local NO2 contribution of 35.4 µg/m3. It is not clear if this refers to local road traffic, or other local sources. The Appendix states the local road traffic accounts for 35.5 µg/m3.

The 35.5 µg/m³ mentioned in Section 5.3.1 of the detailed modelling study refers to the contributions of road traffic to ***NOx*** *levels across all receptors within the AQMA. In contrast, Table 3-1 focuses specifically on the contributions of local road traffic to* ***NO_2*** *levels at the maximum receptor within the AQMA.*

b. The values presented in Table 3-1 are for the average across all modelled receptors within the AQMA, whereas the vehicle split in Table 3-2 is from the receptor with the maximum modelled road NOx. This distinction is not made clear in the main report, the text in the AQAP only indicates source apportionment was conducted at the maximum receptor.

Table 3-1 provides detail on calculating the Local NO2 contribution at the max receptor. This then determines the NO_2 apportionment at the maximum receptor, as presented in Table 3-2. I have amended the title of Table 3-1 to make this clearer.

12. The action plan includes some quantification of measures where feasible, namely for A27 Highways improvements and assuming enhanced EV uptake. However limited information is provided on the methodology used to determine the estimated reduction in concentrations. For example, in Table 6-1 indicates a model was run to estimate the impacts of measure 1, but it does not seem to be related to the dispersion modelling in the technical appendix.

These models were run in addition to the main modelling presented in the detailed report to quantify the impact of the A27 improvements as well as increased electric vehicle (EV) adoption within the AQMA. The table below shows how the Average *speeds for each road link was increased by 5kph for the A27 improvements model to represent reduced congestion within the AQMA. The EV model assumed a 5% shift from diesel and petrol vehicles to EVs. The AADT for each road link was reduced by 5% within the EFT and it was assumed that emissions from EVs would be 0.*

Table 10 *Model inputs for the main detailed modelling study and the quantification of measures models.*

Source	Traffic Point	Modelled Road Link Name		AADT	HGV (%)	Average Speed (kph)	Average Speed Used in the A27 Improvements	AADT (Assumed 5% EV uptake)
DFT Traffic Data 2019	26302	1	A27	17,181	20.7	56	61	16,322
DFT Traffic Data 2019	26302	2	A27	17,181	20.7	56	61	16,322
DFT Traffic Data 2019	26302	3	A27	17,181	20.7	20	25	16,322
DFT Traffic Data 2019	26302	4	A27	17,181	20.7	20	25	16,322
DFT Traffic Data 2019	26302	5	A27	34,362	20.7	56	61	32,644
DFT Traffic Data 2019	26302	6	A27	34,362	20.7	48	53	32,644
DFT Traffic Data 2019	26302	7	A27	16,690	20.9	20	25	15,856
DFT Traffic Data 2019	Average (16261, 26302, 56246)	8	Grove Lodge Roundabout	29,336	18	20	25	27,869
DFT Traffic Data 2019	16261	9	A24	22,869	13.0	48	53	21,726
DFT Traffic Data 2019	16261	10	A24	22,869	13.0	20	25	21,726
DFT Traffic Data 2019	Average (16261, 26302, 56246)	11	Grove Lodge Roundabout	29,336	18.2	32	37	27,869
DFT Traffic Data 2019	56246	12	Warren Road	30,777	20.7	20	25	29,238
DFT Traffic Data 2019	56246	13	Warren Road	30,777	20.7	56	69	29,238
DFT Traffic Data 2019	56246	14	Warren Road	30,777	20.7	40	45	29,238
DFT Traffic Data 2019	Average (56246, 46284, 78241, 78242)	15	Offington Corner Roundabout	22,613	18.5	32	37	21,482
DFT Traffic Data 2019	56246	16	Warren Road	15,389	20.7	20	25	14,619
DFT Traffic Data 2019	56246	17	Warren Road	15,389	20.7	20	25	14,619

Source	Traffic Point	Modelled Road Link Name		AADT	HGV (%)	Average Speed (kph)	Average Speed Used in the A27 Improvements	AADT (Assumed 5% EV uptake)
DFT Traffic Data 2019	78241	18	A24 Findon Road	12,979	15.8	20	25	12,330
DFT Traffic Data 2019	78241	19	A24 Findon Road	12,979	15.8	20	25	12,330
DFT Traffic Data 2019	78241	20	A24 Findon Road	25,957	15.8	20	25	24,659
DFT Traffic Data 2019	78242	21	A27 Arundel Road	22,776	22.9	20	25	21,637
DFT Traffic Data 2019	46284	22	A2031	10,940	14.5	20	25	10,393
DFT Traffic Data 2019	46284	23	A2031	10,940	14.5	48	53	10,393
DFT Traffic Data 2019	78242	24	A27 Arundel Road	22,776	22.9	56	61	21,637
DFT Traffic Data 2019	78241	25	A24 Findon Road	25,957	15.8	56	61	24,659
DFT Traffic Data 2019	46284	26	A2031	5,470	14.5	20	25	5,197
DFT Traffic Data 2019	46284	27	A2031	5,470	14.5	20	25	5,197
DFT Traffic Data 2019	26302	28	A27	14,087	20.4	56	61	13,383
DFT Traffic Data 2019	26302	29	A27	16690	20.9	20	25	15,856
DFT Traffic Data 2019	26302	30	A27	16690	20.9	24	29	15,856
Notes Traffic flows and vehicle class compositions were taken from the DfT traffic count point database. Traffic speeds were modelled at either the relevant speed limit for each road or based on the Google Traffic Database. Where appropriate, vehicle speeds have been reduced to simulate queues at junctions, traffic lights and other locations where queues or slower traffic are known to be an issue – in accordance with LAQM TG(22)Error! Bookmark not defined.								

13. A cost benefit analysis has been undertaken, considering the cost, estimated reduction and feasibility of the measure. The scores in Table 6-6 should be checked as they do not align with the methodology outlined in the text above it. For example, measure 1 has been given an air quality effect score of 1. However, the quantified benefit in Table 6-1 for the measure is a 0.5-1.5 μg/m3 reduction, and Table 6-3 indicates this should be a ranking of 2 or 3.

Worthing Borough Council

This is acknowledged. The final version of the AQAP has been updated to align the air quality effect scores with the quantified benefits shown in Table 6-1. The scoring system categories are now consistent across quantification and the cost benefit analysis.

Appendix F: Results of Public Consultation

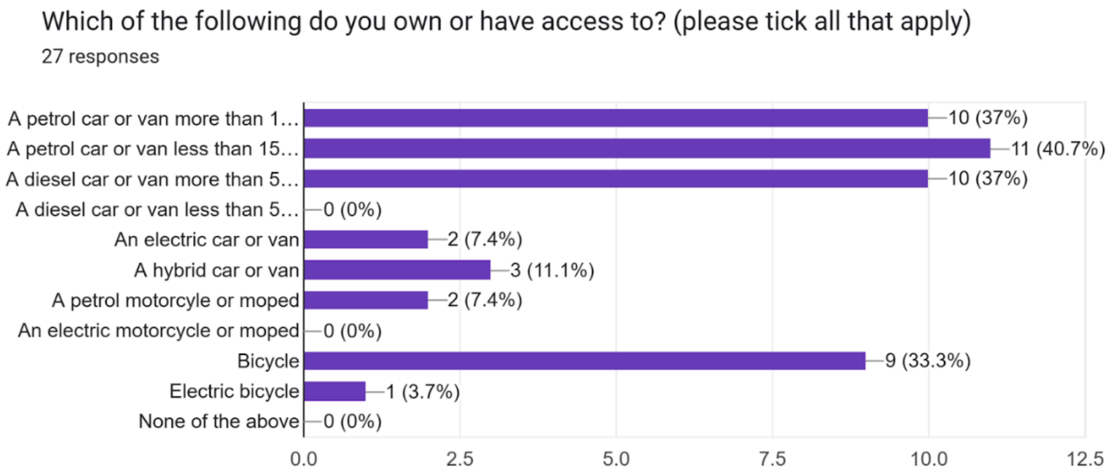
A period of consultation was held via the Adur & Worthing website between 5 August and 17 September 2024, where the draft AQAP was hosted and a Google Form provided to collate answers to questions we posed.

We received just 27 responses online and one by email (from West Sussex County Council).

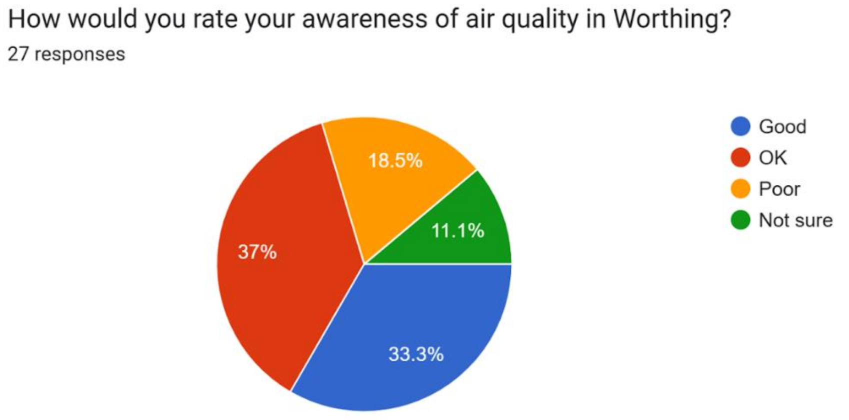
Of the 27 responses received online, 22 were from residents, 5 from persons working in the area, 2 from visitors and 3 classed as 'Other'.

A question on the respondents age group was included. This showed that all those who responded were over the age of 30.

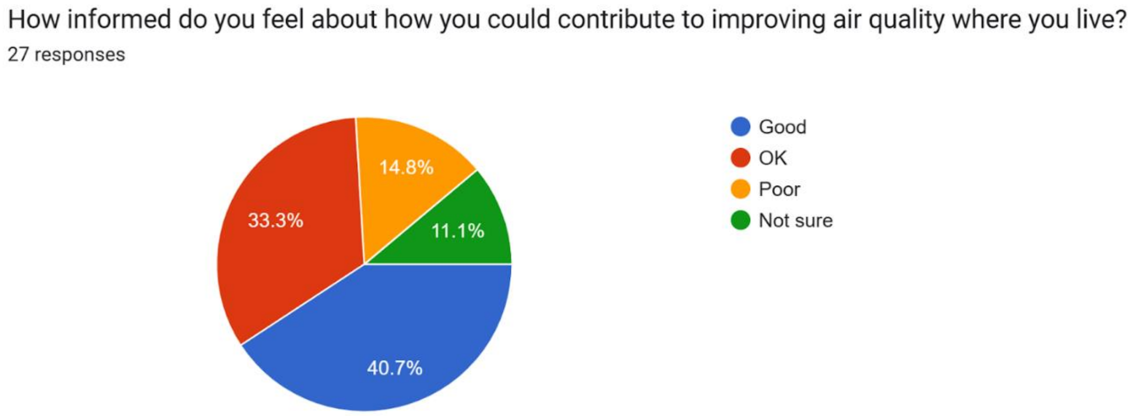
As emissions in the AQMA relate to transport, we asked a question about access to various modes of personal transport. The results are below.



Those that responded rated their awareness of Air Quality in Worthing as predominantly Good or OK.



Similarly awareness of how they could contribute to improving air quality was good or ok.

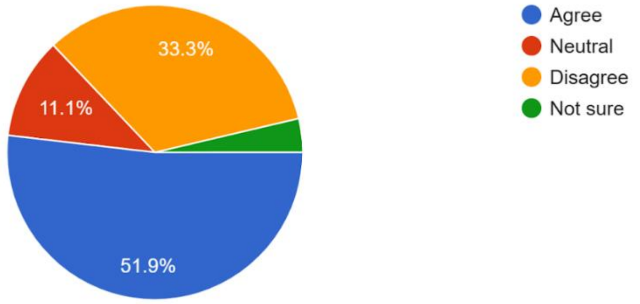


Section 2(1) asked *"To what extent do you agree that the following measures to improve air quality should be included in our Air Quality Action Plan?"*

Unsurprisingly many people agreed highway improvements, infrastructure, public transport and safe walking and cycling promotion should be included.

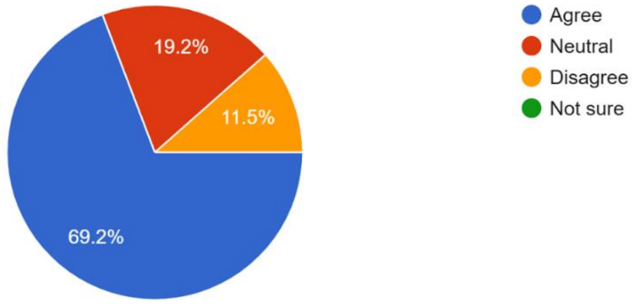
Highway improvements and transport infrastructure

27 responses



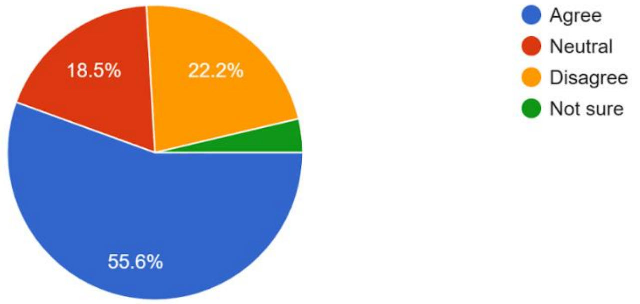
Public transport improvements

26 responses

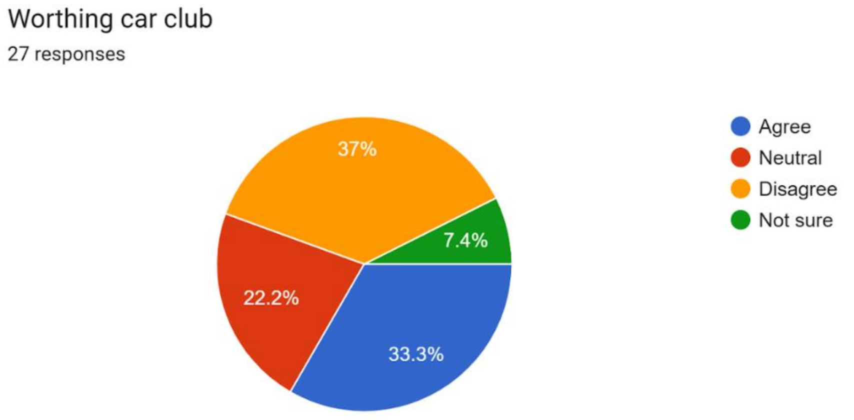


Promotion of walking and cycling/safe walking and cycling routes

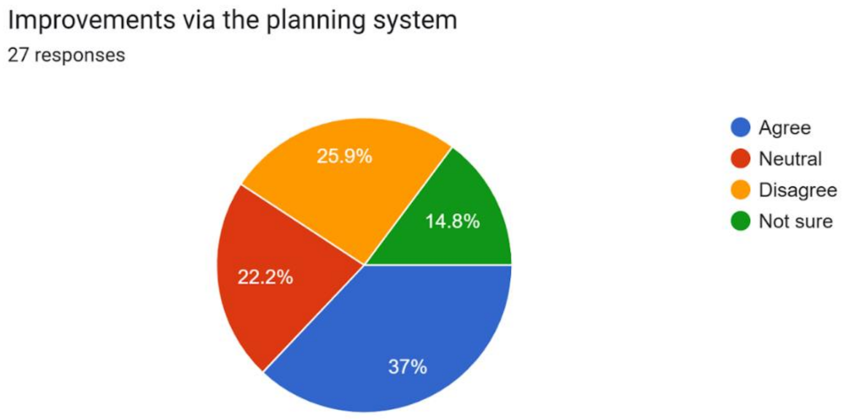
27 responses



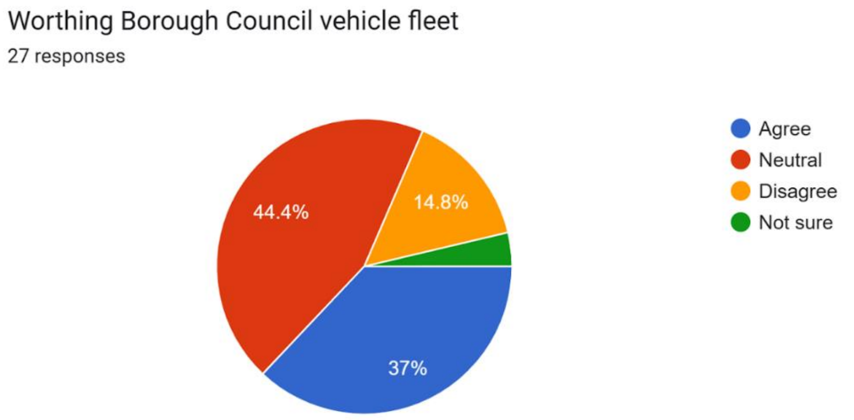
Actions such as car clubs and electric vehicles were less well supported.



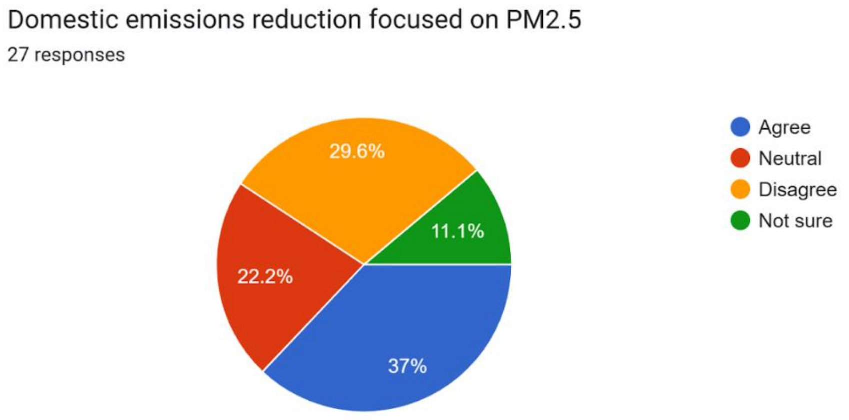
We asked about using the planning system as a tool to improve air quality. Nearly 60% either agreed or felt neutral on this.



44% of respondents were neutral on actions involving the Council's vehicle fleet with 37% agreeing.

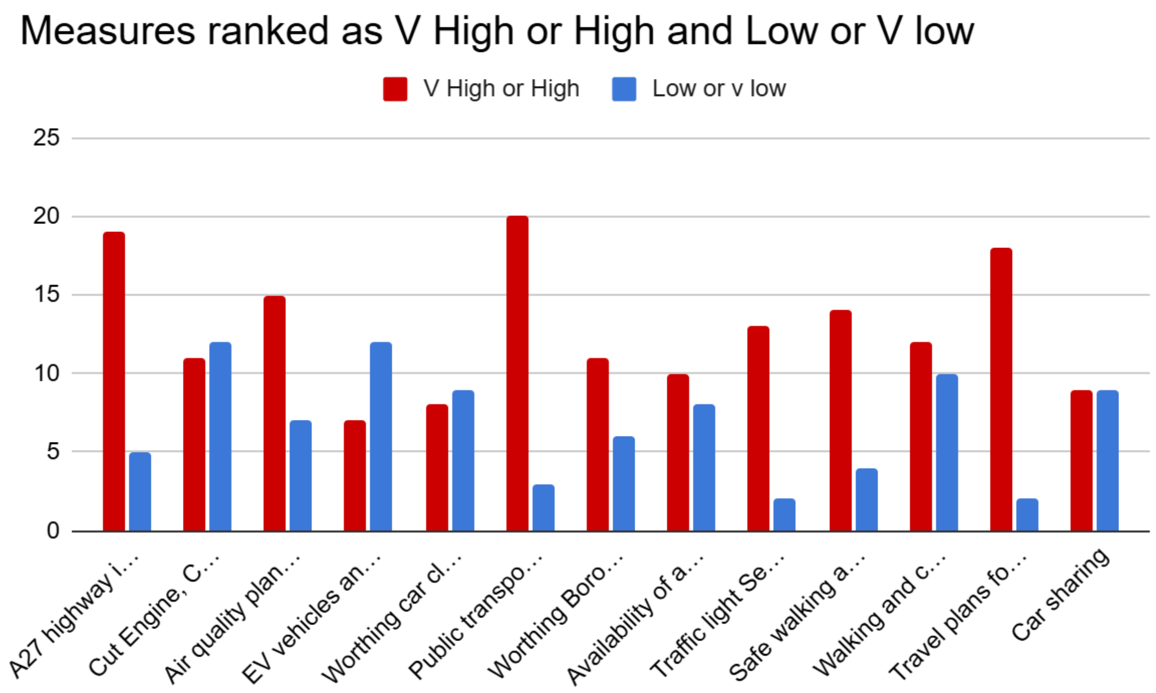


With transport emissions reducing nationally, focus has turned to emissions from domestic heating, in particular burning fuel in the home. When asked about actions to reduce these emissions just under 60% agreed or were neutral on this, with 30% disagreeing.



Section 2(2) asked *"what importance do you place on the measures listed? (Action Plan measures in Table 6.1of the draft)"*

The results are provided in the table below.



The following measures were ranked as V High or High.

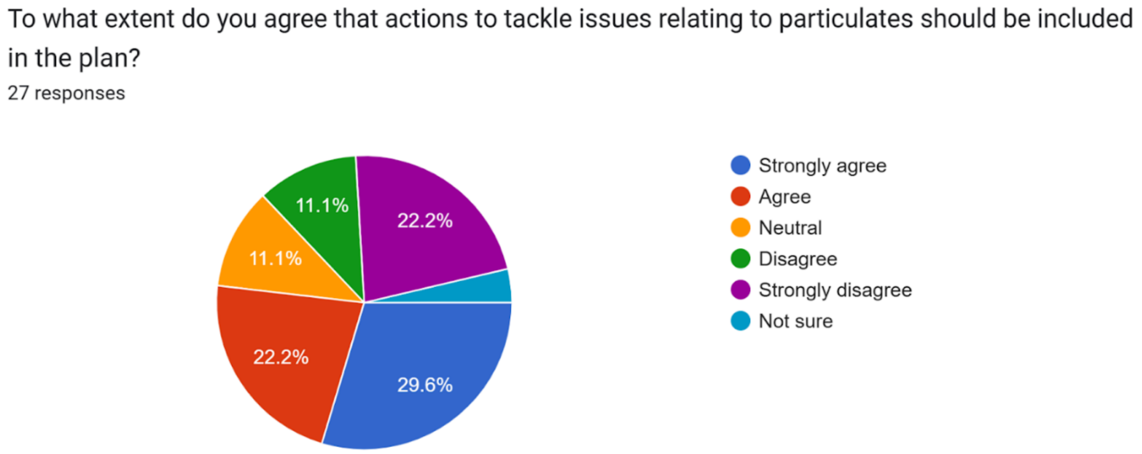
- A27 Highway Improvements
- Public transport improvements
- Travel plans for major developments
- Air quality planning guidance

- Traffic light Sequencing in the AQMA
- Safe walking and cycling routes

Only Cut Engine, Cut Pollution Signs, Electric vehicles & infrastructure and Worthing car club were rated low or v low instead of High of V high.

Section 3 asked *"To what extent do you agree that actions to tackle issues relating to particulates should be included in the plan?"*

As can be seen from the chart below a large proportion agreed with its inclusion (51.8%) with 33.3% disagreeing.



We asked for details of what extra support respondents think they might need to

- Choose active travel for more local journeys (eg cycle, walk)
- Choose public transport for more local journeys
- Reduce driving in my current vehicle(s)
- Purchase or hire a low or zero emission vehicle
- Adapt my driving style without rapid accelerations and hard braking
- Switch your home heating to cleaner energy like solar, electric and heat pumps
- Reduce or avoid bonfires at home

The responses are copied below.

- *A feasible solution of how a young, working family could get to nursery, school and work within 30 minutes when going in two different directions using public transport. Currently, it is impossible without use of a car.*
- *Switching home heating.*

- *Improve reliability and frequency of trains Worthing bound from London and further south to help negate the need or preference to drive.*
- *I feel it is important to get businesses who work within or come into the area to pledge to cut their engines when stationery e.g. courier drivers, contractors, etc. Also, schools should have a strict 'no idling' rule in the surrounding streets. Encouraging residents to reduce the amount they use motor vehicles to change their habits at the earliest opportunity. Improved and cheaper public transport. Improved cycle and active travel infrastructure.*
- *I bought a small hybrid car to avoid noise polution, avoid air polution when possible, to take up less space so others car park, smaller vehicles polute less make less noise, less risk to padestrians and road users, are lighter so less road damage etc etc. Stop supplying electric points for two ton expensive cars that damage peopke and the environment. The first thing that needs doing is the signs need to go up to turn engines off at level crossings, when parked. When doing deliveries (thousands of local amazonn vans could do this and make a huge difference) and most of all no engine idleing in residential areas. Our houses open straight onto the street. Cars often leave engines running for twenty mins plus for no reason. My neighbour died of lung cancer. TURN OFF YOUR ENGINE.*
- *Choose public transport for local journeys.*
- *The issue around Grove lodge is local traffic mixing with strategic traffic. So a way of taking local traffic away or a new route for strategic traffic needs to be a priority. Also a major college for Worthing has been sited in a location that is completely inaccessible for the majority of Worthing residents. Worthing needs a sixth form near a train station and easily accessible. Cycle improvements need to be made across Worthing including segregated cycle seats so they are safe and encourage more leisure and commuters. Improvements just at the area will not get people out of*

cars. It needs to stretch across town to the start of journeys. Bus travel is too expensive unless you have a bus pass. It costs £16 or more to take family to and from a destination which is prohibitively expensive. Why isn't there a family day pass or similar to make it a more affordable alternative to cars.

- *Better cycle routes, solar energy fitted to roof.*
- *Nothing will make me car share. Public transport is not efficient use of my time. Biggest issue for Worthing is poor road traffic management. Takes me 45mins to get out of Worthing. Unbelievable traffic queuing is the area. So much wasted use of fossil fuels. Sort out the traffic and reduce emissions massively.*
- *Solar energy is not cheap you would be best spending rate payers on large grants for solar as for air quality have you forgotten we live near the English Channel Worthing is not an inercity enviroment. Money.*
- *I'm pretty good already with my EV for most journeys and the electric bike or walking to and from appointments for hair etc. it would be great to have cheaper bus travel. I already use the trains as much as possible. It's unpleasant cycling down to the seafront but once there it is a pleasure to cycle along for miles. Not so easy when carrying back shopping. So I generally walk into Briadwater or up to Sainsbury's and go more often so I haven't got too much to carry.*
- *lower priced public transport, rideshare scheme like blablacar.Home heating to be as efficent as current heating but cheaper. Will not purchase zero emission vehicle until improvements are made to be more efficent, more enviromently friendly and easier to deal with if it breakdown and faster charging times and can do a longer distance with one charge.*
- *Traffic control measures on the A259 - public transport is inaccessible during peak times due to the volume of traffic.*

- *1. Active travel. More driver education to respect cyclists and walkers crossing the A27 to access the national Park. 2. Pulse very good some others end to early 3. Hardly used now 4. To expensive 5. Do that already 6. To expensive 7. No bonfires.*
- *More active travel incentives, better bus services to area's such as High Salvington and villages around Worthing.we have a good train service but fares are too high, they need to be lower to attract people onto the railway.*
- *Lobbying for and Promotion of an express/limited bus service between Brighton and Worthing/Chichester.*

Finally we offered the opportunity for any other comments. These are copied below.

- *Remove traffic lights around grove lodge roundabout and congestion would immediately be reduced. Ensure phasing of other traffic lights work consistently and stop putting in more traffic lights!*
- *Consultation from residents in surrounding areas about most popular/ common journeys to help ensure adequate coverage of public transport. This could then be followed by a revision of bus routes to support coverage and encourage us of public transport. Improved reliability of buses on all routes, not removing buses due to lack of drivers or cost effectiveness. Proper investment in local infrastructure of transport network - A27 is the main route from Dover to the West Country and deserves proper funding not just token gestures to appease locals. Most people living in Worthing/ Lancing, surrounding areas would agree that travelling in and out of the area is a nightmare.*
- *Feel that with less older disel and petrol cars and more ev vehicles coming along if the price is right. Also electric vans and newer type lorries the situation should solve itself. But do need to enable traffic to flow smoothly though area without to many holdups caused by traffic lights and synchronisation.*

- *A lot of these ideas are tinkering at the edges. Fundamentally, the problem will only be solved with a proper Worthing bypass, which now needs to be a tunnel.*
- *The air quality action plan fails to mention the closing of the Grafton multi storey car park to sell to developers to build flats. It fails to look at the impact on how this will impact air pollution when it will be harder to find a car space on nearby streets when alternative parking stations already at capacity or not Inna convenient location.*
- *Hydrogen is working so please stop spending money on electric charge points for the wealthy ev users who are buying bigger and bigger evs. These in manufacture cause more damage than using an old car for ten years. Money making should not decide our fate. TURN OFF YOUR ENGINE.*
- *The whole issue of vehicle air polution will solve itself as old vehicles reach the end of their life and are replaced with new or newer vehicles.The vendeta against car drivers is not a good way to transition to cleaner vehicles as it hts the poorest among the population the most.*
- *As more and more houses are built the problems are only going to get worse.*
- *Reduce speed limits.*
- *Reduced speed on roads e.g would be pointless and expensive.*
- *Move the college & get rid of traffic lights , most traffic is travelling trough ie lorries which can't walk or cycle especially with uk weather.*
- *as for Worthing by pass it should run past the old cement works passing steyning to Washington roundabout down to Findon and run parallel with Long Furlough to the A27.*
- *I think the Grive Kodge traffic lights should be on in peak periods only. So many times I've had to sit at a red light in the evening when there's absolutely nothing coming the other way at all- and when the lights broke a couple of summers ago the traffic can flowed much better. They are the cause of endless queues and the poor*

quality because nobody turns off their engine, too scared it'll go green and they won't be ready. With an EV it doesn't bother me but I walk past to my allotment and find the fumes quite overpowering. Teens all walk past to go to college so it isn't good for their young lungs.

- *Improve traffic jams vehicles won't be spewing out fumes.*
- *The draft Air Quality Action Plan must not make any restrictions on how we travel or heat our homes or anything else, and must not propose any measures that would increase our costs to do these things.*
- *If we were serious about improving air quality we would get serious about reducing traffic - a major contributor to poor health caused by exhaust pollution. Many of the pollution levels were taken during Covid when traffic was very low. They should be discounted and data after Covid used. The A259 and A27 are at capacity often during the day. Any improvement / increased capacity only fills with more traffic as shown through Goring and TOB since the new dualled A259 section at Roundstone opened. Pollution data should in measurements used by WHO or EU.*

Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority intends to achieve air quality limit values'
AQMA	Air Quality Management Area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
AQS	Air Quality Strategy
ASR	Air quality Annual Status Report
Defra	Department for Environment, Food and Rural Affairs
EU	European Union
LAQM	Local Air Quality Management
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
WBC	Worthing Borough Council
WSCC	West Sussex County Council