Calderdale Council

CALDERDALE LOCAL PLAN EXAMINATION MATTER 8 GROWTH, DELIVERY, INFRASTRUCTURE AND VIABILITY

Air Quality Assessment

70074883-001
APRIL 2021

PUBLIC

Calderdale Council

CALDERDALE LOCAL PLAN EXAMINATION MATTER 8 GROWTH, DELIVERY, INFRASTRUCTURE AND VIABILITY

Air Quality Assessment

TYPE OF DOCUMENT (VERSION) PUBLIC

PROJECT NO. 70074883

OUR REF. NO. 70074883-001

DATE: APRIL 2021

Calderdale Council

CALDERDALE LOCAL PLAN EXAMINATION MATTER 8 GROWTH, DELIVERY, INFRASTRUCTURE AND VIABILITY

Air Quality Assessment

WSP

Three White Rose Office Park
Millshaw Park Lane
Leeds
LS11 0DL

WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Draft	Final		
Date				
Prepared by	Amber Sunderland	Amber Sunderland		
Signature	Sunderland, Amber (UKACS009) Digitally signed by Sunderland, Amber (UKACS009) DN: cn=Sunderland, Amber (UKACS009), ou=Active, email=Amber.Sunderland@wsp.com Date: 2021.04.09 11:25:37 +01'00'	Sunderland, Amber (UKACS009) Digitally signed by Sunderland, Amber (UKACS009) DN: cn=Sunderland, Amber (UKACS009), ou=Active, email=Amber.Sunderland@wsp.com Date: 2021.04.09 11:25:54 +01'00'		
Checked by	Lee Shelton	Lee Shelton		
Signature	Digitally signed by Shelton, Lee (UKLFS001) DN: cn=Shelton, Lee (UKLFS001), ou=Active, email=Lee.Shelton@wsp.com Reason: I have reviewed this document Date: 2021.04.09 12:07:01 +01'00'	Digitally signed by Shelton, Lee (UKLFS001) DN: cn=Shelton, Lee (UKLFS001), ou=Active, email=Lee.Shelton@wsp.com Reason: I have reviewed this document Date: 2021.04.09 12:07:37 +01'00'		
Authorised by	Stuart Bennett	Stuart Bennett		
Signature	Bennett, Stuart (UKSMB004) I am approving this document 2021.04.09 19:02:25 +01'00'	Bennett, Stuart (UKSMB004) I am approving this document 2021.04.09 19:04:58 +01'00'		
Project number	70074883	70074883		
Report number	001	001		
File reference				

CONTENTS

TABLES

FIGURES

APPENDICES

EXECUTIVE SUMMARY

A detailed air quality assessment has been completed to investigate the potential impacts associated with Calderdale Metropolitan Borough Council's draft Local Plan, which is currently under examination. The Local Plan will set the framework for development in the district and is subject to public consultation to agree the policies that will execute this framework.

Calderdale Council has identified a list of potential additional housing sites to meet a housing requirement aligned with forecasted economic growth. Sites across Brighouse, Mytholmroyd, Todmorden, Elland, Halifax, Northowram, Shelf and Ripponden were identified as meeting this requirement through a combination of extant and new planning consents. This includes two new garden suburbs on the edge of Brighouse.

An outcome from the Stage 2 examination of the Local Plan under Matter 8: Growth delivery, infrastructure and viability in October 2020 was a request from the Inspector to *"look at cumulative impacts on a range of locations/receptors in the borough and not solely on AQMAs*." To meet the requirement of the Inspector, this report provides a comprehensive and updated assessment of the impacts of the Local Plan on air quality to be examined before and at the Stage 3 hearing in May 2021.

To assess the changes in air quality across Calderdale, detailed atmospheric dispersion modelling has been used to predict pollutant concentrations using traffic input datasets from the Calderdale Strategic Transport Model. These data have been used to predict the cumulative impact of the Local Plan on regional and local air quality. The Do Something Without Local Plan cumulative scenario represents the impact on air quality from the combination of natural traffic growth including the contribution from the Kirklees and Bradford local plans. The Do Something With Local Plan cumulative is the Do Something Without Local Plan scenario with the addition of traffic from the Calderdale Local Plan. The modelling has followed best practice methodologies and model performance has been validated against local monitoring data. However, it should be noted that as pollutant predictions are made using data from a strategic transport model, the accuracy in traffic flow predictions is lower at greater distance from the strategic road network.

A judgement of the impact of the Calderdale Local Plan on air quality has been made on the balance of the key evidence presented in this assessment report which is the:

- modelling assessment results which take into consideration model performance, embedded assessment conservatism, monitored concentration trends, and predicted pollutant concentrations inside Air Quality Management Areas and areas constrained by high monitored pollutant concentrations and junction capacity
- comparison of predicted pollutant concentrations against the national air quality strategy objectives and European Union limit values
- assessment of compliance with national and local planning policy.

On the balance of the evidence, it is judged that the Local Plan will not significantly impact on local air quality, and therefore human health, across the borough. However, these results do not eliminate the requirement for specific planning applications to develop allocated sites for housing from detailed impact assessment based on locally verified traffic data. These applications should be completed in accordance with the West Yorkshire Low Emissions Strategy Air Quality & Emissions

Technical Planning Guidance to ensure that appropriate mitigation to protect human health is secured and compliance with the National Planning Policy Framework, Unitary Development Plan Policy EP1 and Local Plan Policy EN2 Air Quality is achieved.

1. INTRODUCTION

1.1.1. This Air Quality Assessment investigates the potential impacts associated with Calderdale Metropolitan Borough Council's ('Council') new Local Plan[1] ("Local Plan"). The Local Plan will set the framework for development in the district and is subject to public consultation to agree the policies that will execute this framework.

1.1.2. The Local Plan Housing Update and Potential Supply report[2] presents a housing requirement figure and a list of potential additional housing sites to meet the requirement of 14,950 dwellings that is aligned with forecasted economic growth. A total of 23 sites across Brighouse, Mytholmroyd, Todmorden, Elland, Halifax, Northowram, Shelf and Ripponden were identified as meeting this requirement through a combination of extant and new planning consents. Furthermore, two new garden suburbs on the edge of Brighouse have been identified in the emerging Local Plan.

1.1.3. During Stage 2 examination of the Local Plan, the following comments were received from the Inspector regarding "Matter 8: Growth delivery, infrastructure and viability" of the Local Plan[3]:

- *What effect will the growth proposed in the Plan and the Council's recent consultation paper have on air quality? Where are these effects demonstrated in the Council's evidence base?*
- *How is the Council proposing to mitigate the effects of growth and meet national/EU air quality targets? Are there any particular implications linked to the proposed spatial distribution of growth in the Plan?*

1.1.4. On the 5th August WSP provided a technical memo[4] in response to questions reporting on the findings of a review of the existing air quality evidence base. However, following the Stage 2 examination hearing on the 7th October, the Inspector expressed concern as to the veracity of the evidence base. This was expressed by the Inspector[5] as a requirement for the Council to submit additional examination information to:

> *"look at cumulative impacts on a range of locations/receptors in the borough and not solely on AQMAs."*

1.1.5. To meet the requirement of the Inspector, this report provides a comprehensive and updated assessment of the impacts of the Local Plan on air quality to be examined before and at the Stage 3 hearing in May 2021. It is supported by the following technical appendices:

- Appendix A – Atmospheric Dispersion Modelling
- Appendix B – Dispersion Model Verification

---

[1] Calderdale Metropolitan Borough Council (2018). Calderdale Council Local Plan Publication Draft (August 2018) [Examination library reference: **SD 01.1a**]

[2] Calderdale Metropolitan Borough Council (2020). Calderdale Local Plan Housing Requirement Update and Potential Supply. [Examination library reference: **CC39**]

[3] Stage 2 examination of the Calderdale Local Plan Matter 8 Growth delivery, infrastructure and viability. Inspectors Pre-Hearing Questions. [Examination library reference: **INS11**]

[4] WSP (2020). Local Plan Stage 2 Examination – Matter 8 Growth Delivery, Infrastructure and Viability. Air Quality and Carbon Evidence Base Review. WSP August 2020. [Examination library reference: **HS8.1 Appendix 1**]

[5] Stage 2 examination of the Calderdale Local Plan Matter 8 Growth delivery, infrastructure and viability. Inspectors Post-Hearing Questions. [Examination library reference: **INS18**]

- Appendix C – Supplementary Local Results
- Appendix D – Monitoring Data

2. LEGISLATION, POLICY AND GUIDANCE

2.1. EUROPEAN & NATIONAL LEGISLATION

EU DIRECTIVE ON AMBIENT AIR QUALITY DIRECTIVE (2008/50/EC)

2.1.1. The European Union (EU) Directive on ambient air quality (2008/50/EC)[6] is the primary driver for managing and improving air quality for each member state of the EU. The Directive sets legally binding limit values for concentrations of pollutants in ambient (outdoor) air, including NO_x and NO_2.

2.1.2. EU limit values are set for individual pollutants and comprise a concentration value, an averaging time over which it is to be measured, the number of allowed exceedances per year (if any), and a date by which it must be achieved.

AIR QUALITY REGULATIONS

2.1.3. The EU Directive has been transposed into English law through a series of Air Quality Regulations[7,8,9] the most recent being the Air Quality Standards Regulations 2016[10]. Equivalent regulations exist in the other national administrations; Scotland, Wales, and Northern Ireland.

2.1.4. The responsibility for meeting the prescribed air quality limit values is devolved to the national administrations. In England, the Secretary of State for Environment, Food, and Rural Affairs has responsibility for adhering to the limit values, whilst the Department for Environment, Food and Rural Affairs (Defra) co-ordinate the assessment of compliance with limit values and development of Air Quality Plans for the UK (last updated in 2017).

UK AIR QUALITY STRATEGY

2.1.5. The UK Government and the devolved administrations are required under the Environment Act 1995 to produce a national air quality strategy. The Air Quality Strategy (AQS) was last reviewed and published in 2007[11]. The AQS provides a framework for reducing air pollution in the UK and implements the Air Quality (England) Regulations 2000, setting national objectives for local authorities in England.

2.1.6. The AQS sets standards and objectives for nine key air pollutants to protect human health. These are benzene (C_6H_6), 1,3 butadiene (C_4H_6), carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), particulate matter (PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2), ozone (O_3), and polycyclic aromatic hydrocarbons (PAHs).

2.1.7. In addition, the AQS has set an annual objective for oxides of nitrogen (NO_x) for the protection of vegetation and ecosystems.

---

[6] European Parliament (2008) Council Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe

[7] The Air Quality (England) Regulations 2000 – SI 2000 No.928

[8] The Air Quality (England) (Amendment) Regulations 2002 – SI 2002 No.3043

[9] The Air Quality Standards Regulations 2010 – SI 2010 No.1001

[10] The Air Quality Standards (Amendment) Regulations 2016 – SI 2016 No.1184

[11] Department for Environment, Food and Rural Affairs (Defra) and the Devolved Administrations (2007). The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volumes 1 and 2)

2.1.8. The relevant UK standard and objective, and the equivalent EU limit value for NO_2, PM_{10} and $PM_{2.5}$ are given in **Table 2-1**.

Table 2-1 – National Air Quality Objectives/EU Limit Value Set for Protection of Human Health

Pollutant	Applied to	Objective	Measured as	Date to be achieved by and maintained thereafter	European Obligations	Date to be achieved by and maintained thereafter
Nitrogen dioxide (NO_2)	UK	200µg/m³ not to be exceeded more than 18 times a year	1 hour mean	31.12.2005	UK	200µg/m³ not to be exceeded more than 18 times a year
	UK	40µg/m³	annual mean	31.12.2005	UK	40µg/m³
Particulate Matter (PM_{10})	UK (except Scotland)	40µg/m³	annual mean	31.12.2004	UK (except Scotland)	40µg/m³
	UK (except Scotland)	50µg/m³ not to be exceeded more than 35 times a year	24-hour mean	31.12.2004	UK (except Scotland)	50µg/m³ not to be exceeded more than 35 times a year
Particulate Matter ($PM_{2.5}$)	UK (except Scotland)	25µg/m³	annual mean	2020	UK (except Scotland)	25µg/m³

2.1.9. After the departure of the UK from the EU, the Environment Bill[12] will introduce a duty to set a legally-binding target for fine particulate matter ($PM_{2.5}$), in addition to at least one further long-term air quality target by October 2022. The European Union (Withdrawal) Act[13] ensures that the whole body of existing EU environmental law continues to have effect in UK law.

2.2. RELEVANT PLANNING POLICY CONTEXT

NATIONAL PLANNING POLICY FRAMEWORK

2.2.1. The Government's overall planning policies for England are described in the National Planning Policy Framework (NPPF)[14]. The core underpinning principle of the Framework is the presumption in favour of sustainable development, defined as:

- '… meeting the needs of the present without compromising the ability of future generations to meet their own needs

[12] Environment Bill 220 2019-21 (as amended in Committee) 27 November 2020. https://publications.parliament.uk/pa/bills/cbill/58-01/0009/20009.pdf. Accessed April 2021.

[13] European Union (Withdrawal) Act (2018). https://www.legislation.gov.uk/ukpga/2018/16/contents/enacted. Accessed April 2021.

[14] Ministry of Housing, Communities and Local Government (February 2019). National Planning Policy Framework

2.2.2. One of the three overarching objectives of the NPPF is that planning should 'to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.'

2.2.3. In relation to air quality, the following paragraphs in the document are relevant:

- Paragraph 54, which states *'Local planning authorities should consider whether otherwise unacceptable development could be made acceptable through the use of conditions or planning obligations. Planning obligations should only be used where it is not possible to address unacceptable impacts through a planning condition.'*
- Paragraph 102, which relates to the need to consider transport related issues at the earliest stages of plan making and development proposals, so that *'…c) opportunities to promote walking, cycling and public transport use are identified and pursued; d) the environmental impacts of traffic and transport infrastructure can be identified, assessed and taken into account – including appropriate opportunities for avoiding and mitigating any adverse effects, and for net environmental gains...'.*
- Paragraph 103, which states *'Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions and improve air quality and public health.*
- Paragraph 170, which states *'Planning policies and decisions should contribute to and enhance the natural and local environment by: …e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.*
- Paragraph 180, which states *'Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.'*
- Paragraph 181, which states *'Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan.'*
- Paragraph 183, which states *'The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has*

been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.'

LOCAL PLANNING POLICY

Calderdale Local Plan Publication Draft 2018

2.2.4. The publication draft of the Calderdale Local Plan (2018)[1] includes a number of proposed policies that incorporate consideration of air quality, including the following:

"Policy EN2 Air Quality –

All proposals that have the potential to increase local air pollution either individually or cumulatively must be accompanied by proportionate evidence to show that the impact of the development has been assessed... Proposals that are not accompanied by that evidence or which do not incorporate adequate mitigation measures as indicated by the guidance will not be permitted.

Where the development introduces new receptors into Air Quality Management Areas the development must incorporate sustainable measures that protect the new receptors from unacceptable levels of air pollution. Where sustainable measures cannot be introduced which prevent receptors from being exposed to unacceptable levels of air pollution, development will not be permitted."

2.2.5. With respect to transport investment decisions, Policy IM2 states that "…*improving air quality*…" should be a key consideration as part of any transport investment application. Calderdale Unitary Development Plan.

2.2.6. As the new local plan is yet to be finalised, the Calderdale Council Unitary Development Plan[15] remains the council's primary planning document. The Development Plan has the following policy related to air quality:

"Policy EP 1

Protection of Air Quality

Development which might cause air pollution (including from modes of transport) will only be permitted if:

1. *It would not harm the health and safety of users of the site and surrounding area; and*
2. *It would not harm the quality and enjoyment of the environment.*

Where permission is granted, appropriate conditions and/or planning obligations will be attached to ensure that air quality is maintained."

[15] Calderdale Metropolitan Borough Council (2018). Calderdale Council Replacement Unitary Development Plan, Adopted 25/08/06, Amended 3/08/09. https://www.calderdale.gov.uk/v2/residents/environment-planning-and-building/planning/planning-policy/unitary-development-plan. Accessed April 2021.

3. SCOPE AND METHODOLOGY

3.1. SCOPE

3.1.1. This section provides details of the data and information supplied for the purpose of undertaking the Local Plan air quality assessment at human receptors. It also describes the adopted methodology for assessing and appraising the potential air quality impacts associated with the Local Plan which are consistent with the West Yorkshire Low Emissions Strategy (WYLES) Air Quality & Emissions Technical Planning Guidance and other best practice documents.

3.1.2. Information on the assessment of air quality at designated ecological sites can be found in the Calderdale Local Plan Habitats Regulations Assessment[16] (HRA). The underlying assessment methodologies applied to the HRA and this assessment are broadly consistent allowing for interim dataset and model updates as described in **Appendix A**.

3.2. DATA AND RESOURCES

3.2.1. An index of the key data, resources and best practice guidance documents used within the assessment are presented in **Table 3-1**.

Table 3-1 – Key Data, Resources and Best Practice Guidance Documents

Data/Resource	Summary	Source/Reference
Defra national background pollutant mapping data	Background 1km x 1km grid pollutant data obtained for the respective grid squares encompassing the study area	Annual mean data sourced from Defra: https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018
Defra Local Air Quality Management (LAQM) Tools	A suite of tools to enable collation of vehicle emissions inventory data, background pollutant adjustment, and conversion of NO_x to NO_2	All LAQM tools sourced from Defra: *https://laqm.defra.gov.uk/review-and-assessment/tools/tools.html*
Atmospheric dispersion modelling system for roads (ADMS-Roads)	Dispersion model capable of predicting dispersion of vehicle emissions from the assessed road network and calculating pollutant concentrations at identified receptors	ADMS-Roads v5.0.0.1 developed by Cambridge Environmental Research Consultants (CERC) Ltd

[16] WSP (2021). Calderdale Local Plan Habitats Regulations Assessment Air Quality Assessment (2021).

Data/Resource	Summary	Source/Reference
Baseline and future years traffic data for all model scenarios	Traffic data provided in appropriate format to enable air pollutant emissions inventory (NO_x) databases to be generated prior to dispersion modelling	Data supplied by project transport consultant (WSP) (see **Appendix A**). Based on Saturn modelling, which takes into account growth from the new Calderdale Local Plan in addition to growth from other committed plans (Kirklees adopted & Bradford draft Local Plans), as applicable.
Met Data	Hourly sequential met data obtained from to input to ADMS-Roads model.	Data from Emley Moor monitoring station for year 2019 (with cloud cover from Bingley and Leeds Bradford). See **Appendix A**
LAQM Technical Air Quality Guidance	Guidance document, including information on dispersion modelling and model verification / adjustment	Defra (2016) *Local Air Quality Management Technical Guidance TG16*[17]
Land Use Planning & Development Control Guidance	Guidance provided by the Institute of Air Quality Management (IAQM) that includes air quality impact descriptor criteria	Document published by IAQM (2017) *Land-Use Planning & Development Control: Planning for Air Quality*[18]
West Yorkshire Low Emissions Strategy[19]	Air Quality & Emissions Technical Planning Guidance	Document published in August 2016 by the West Yorkshire Low Emissions Strategy group which has membership of City of Bradford MBC, Calderdale Council, Kirklees Council, Leeds City Council, Wakefield Council, the West Yorkshire combined authority and Public health England.
Design Manual for Roads and Bridges (DMRB) – Air Quality	DMRB guidance for assessing air quality impacts on sensitive human receptors and designated ecological sites	DMRB LA 105 Air Quality[20]

[17] Defra (2018) Part IV The Environment Act 1995 and Environment (Northern Ireland) Order 2002 Part III, Local Air Quality Management Technical Guidance LAQM.TG16

[18] Environmental Protection UK and Institute of Air Quality Management (Version 1.2 Updated January 2017). Land Use Planning & Development Control: Planning for Air Quality

[19] West Yorkshire Combined Authority (2016). West Yorkshire Low Emissions Strategy - Air Quality Planning Technical Guide. August 2016. [Examination library reference: **CC09**]

[20] Design Manual for Roads and Bridges. Highways England, Transport Scotland, Welsh Government and Department for Infrastructure. LA 105 Air Quality

3.3. BASELINE ASSESSMENT

3.3.1. Calderdale Council's Annual Status Report[21] (ASR) provides information about automatic and passive monitoring completed in the borough, in fulfilment of the requirements of Local Air Quality Management (LAQM) as set out in Part IV of the Environment Act (1995) and the relevant Policy and Technical Guidance documents.

CALDERDALE COUNCIL MONITORING

3.3.2. The Council's latest automatic and passive monitoring locations are shown in **Figure 6-1** and the key observations of the monitoring data reported for the period 2015 to 2019, which are shown in **Appendix D**) are:

- NO_x/NO_2 – a clear downward trend in NO_2 concentrations has been monitored between 2015 and 2019. Monitoring results at many sites indicate that most Air Quality Management Areas (AQMAs) are seeing a decrease in NO_2 concentrations. However, all the AQMAs have receptors at which the annual mean objective was exceeded in 2019.
- PM_{10} – results between 2015 and 2019 were generally static and under the annual mean objective
- $PM_{2.5}$ - results between 2015 and 2019 were generally static and under the annual mean objective.

3.3.3. To summarise, between 2015 and 2019, trends in NO_2 concentrations were downwards, while those for both particulate matter fractions were generally static.

DEFRA BACKGROUND CONCENTRATIONS

3.3.4. Background air pollutant concentrations were obtained for the corresponding $1km^2$ grid squares covering the study area from Defra's published national pollutant mapping data. These are shown in **Appendix C Figure 6-2, Figure 6-3, Figure 6-4, Figure 6-5, Figure 6-6, Figure 6-7, Figure 6-7** and **Figure 6-7.** The key changes in background air quality expected in Calderdale during the life of the Local Plan are:

- NO_x/NO_2 – The lowest NO_X/NO_2 concentrations tend to be observed west of the borough, with a trend of increasing concentrations moving eastwards. NO_2 concentrations are predicted to fall below the annual mean objective for the base year (2019), however, zones of higher concentrations are observed in areas such as Brighouse, Clifton, Elland and Halifax. Whilst 2030 projections maintain the eastward pattern of increasing NO_X/NO_2 and higher localised concentrations, a substantial reduction of background NO_X/NO_2 concentrations is predicted over the next 10 years, with a maximum reduction in NO_2 of approximately $8µg/m^3$ by 2030.
- PM_{10} – A clear reduction in background PM_{10} concentrations is observed between 2019 and 2030 projections. This is particularly evident in localised zones such as Halifax, Brighouse and Elland.
- $PM_{2.5}$ – Whilst maximum predicted $PM_{2.5}$ concentrations don't appear to drop substantially, background concentrations projected between 2019 and 2030 show that zones of maximum concentrations become much smaller and localised, particularly in the eastern region of the district.

[21] Calderdale Metropolitan Borough Council (2020). Annual Status Report (June 2020). https://www.calderdale.gov.uk/v2/sites/default/files/air-quality-annual-status-report.pdf. Accessed April 2021.

3.3.5. To summarise, between 2015 and 2019, the trend in NO_2 and the particulate matter fractions is downwards. However, the rate of reduction in NO_2 is predicted is higher than the particulate matter as this air quality benefits from successive policies and emerging technologies aimed at reducing roadside concentrations.

3.4. IDENTIFYING CONSTRAINTS

3.4.1. To aid site selection for future development, air quality constraints risk mapping was produced for the borough based on AQMA and junction capacity constraint data in 2016[4]. The constraints risk mapping concluded that it is highly unlikely that any areas that are not currently highlighted as a risk would become an air quality risk in the future because concentrations are expected to fall as cleaner Euro 6 (VI) and electric vehicles penetrate the local fleet.

3.4.2. As this work was completed in 2016, updated air quality constraints mapping has been completed following the same red-amber-green traffic light system representing the following information:

HIGH CONSTRAINTS (RED)

- All existing declared AQMAs across the borough. This includes the new AQMA on the A58 at New Bank, Halifax, which was declared February 2020 because of exceedances of the annual mean NO_2 objective. The AQMAs are:
  - Calderdale No.1 AQMA, Salterhebble and Huddersfield Road
  - Calderdale No.2 AQMA, Sowerby Bridge
  - Calderdale No.3 AQMA, Hebden Bridge
  - Calderdale No.4 AQMA, Luddendenfoot
  - Calderdale No.5 AQMA, Stump Cross
  - Calderdale No.6 AQMA, Brighouse
  - Calderdale No.7 AQMA, Hipperholme
  - Calderdale No.8 AQMA, New Bank, Halifax

MODERATE CONSTRAINTS (AMBER)

- Areas either within 200m of a declared AQMA
- Locations where monitoring data lies within 10% of the annual mean objective (>36µg/m^3 for NO_2) which are:
  - Mytholmroyd
  - Godly Gardens
  - West Vale
  - Ainley Top
  - Scammonden
  - Clifton
- Areas within 200m of those junctions that have been determined as having capacity constraints which are located within the surrounding areas of:
  - Sowerby Bridge
  - Shelf
  - Northowram
  - Ovenden

- Kings Cross
- Stump Cross
- Halifax
- Salterhebble
- Elland
- Brighouse
- Clifton
- Rastrick

LOW CONSTRAINTS (GREEN)

- Areas not ranked as high or moderately constrained.

3.4.3. The updated constraints map and key locations included in the study area are shown in **Figure 6-8**. **Figure 6-8** shows that eastern Calderdale remains the preferred area for development and that the two Garden Suburb sites in Rastrick and Clifton are still located in areas that were identified as having low air quality constraints in the 2016 constraints risk mapping.

3.5. TRAFFIC MODELLING DATA

SATURN MODEL

3.5.1. The traffic data used in the detailed modelling of air emission was extracted from the same Calderdale Strategic Transport Model as that used in the assessment of impacts in the HRA[16] by the WSP traffic specialist. As such it has been developed with the following underlying assumptions:

- **General growth** - growth attributable to the Local Plan has been used in place of TemPro, which is more up to date and spatially more accurate. TemPro takes information from the published local plans and therefore lags behind compared with the data from publication drafts for new local plans. For Bradford and Kirklees, TemPro is used for the majority of growth with specific developments added in close to Calderdale's boundary to give better accuracy. Wider growth on the Motorways and for travel through the area (without origin/destination in Calderdale) is taken from national road traffic forecasts.

- **Inside Calderdale** - in Calderdale the TemPro growth in households is lower than predicted in the Local Plan. The number of jobs related to employment land that is within the Local Plan is also higher than TemPro. Therefore, the use of Local Plan growth provides a more conservative assessment of traffic growth. The Local Plan growth includes the requirement for an increase to 14,950 dwellings from 12,600 as described in the Calderdale Local Plan Housing Requirement Update and Potential Supply paper[2].

- **Outside Calderdale** - outside Calderdale, specific developments have only been included for Kirklees and Bradford sites within a 2km buffer of Calderdale's border as these will be the most influential on the Calderdale network. Other areas of Kirklees and Bradford are not represented in enough detail in the model to apply specific development growth. All other areas have used the National Trip Ends Model v7.2 dataset to apply an appropriate factored growth in demand as described in the Local Plan Transport evidence base.

- **Smart Motorways project (M62 junction 25 to 30)** - the Calderdale Strategic Transport Model did not incorporate the changes in traffic flows associated with the proposed M62 Smart Motorways project (M62 junction 25 to 30), which does not form part of the Calderdale Local Plan. Therefore, the assumed traffic growth associated with the M62 Smart Motorways project was applied to scenarios incorporating cumulative traffic growth assuming a 7% growth factor. This assumption was corroborated in observed changes in traffic flows associated with the M62 Junction 26-27[22] and M1 Junctions 25-28 Smart Motorways projects[23].

3.5.2. The traffic network modelled covers those areas potentially sensitive to changes in ambient air quality, where the traffic predictions are considered to be most reliable, and is therefore appropriate for the air quality assessment.

TRAFFIC DATA FORMAT

3.5.3. The traffic data used in the assessment comprises Annual Average Daily Traffic (AADT) flows, vehicle speeds (km/h) and the percentage of Heavy-Duty Vehicles (HDVs) applicable to the Affected Road Network (ARN) in all assessment years[24]. A time varying emissions file was applied to the AADT values to ensure that the short-term peaks in air pollution are properly represented.

AFFECTED ROAD NETWORK DEFINITION

3.5.4. DMRB LA105[20] defines the ARN as all roads in the traffic model, and adjoining roads within 200m, that trigger the following traffic scoping criteria:

- AADT >=1,000; or
- HDV AADT >=200; or
- a change in speed band; or
- a change in carriageway alignment by >=5m.

3.5.5. The 1,000 vehicles and 200 HDVs represent the lowest threshold above which the traffic model can represent change in traffic conditions to a reasonable level of confidence.

3.5.6. However, further scoping of traffic data was completed to obtain a practical study area that is focussed on areas of specific concern. A two-step process that uses both traffic and air quality criteria was applied to ensure cumulative impacts on a range of locations/receptors in the borough, and not solely on AQMAs, are assessed.

Step 1 - Traffic Data Screening

3.5.7. The traffic data were scoped against the criteria contained within DMRB LA105 to determine 'affected' roads based on the changes between the Do Minimum Future Baseline, Do Something Without Calderdale Local Plan and Do Something With Calderdale Local Plan traffic in the assessment year 2032.

3.5.8. The Step 1 criterion was applied sequentially, first considering the data against the effect of the Local Plan 'alone' and then, assuming they do not trigger the thresholds 'alone', in-combination with other Plans and Projects.

[22] Highways England (April 2016) *Post Opening Project Evaluation: M62 J25-30 Smart Motorway - One Year After*

[23] Highways England (May 2017) *M1 Junction 25 to 28 Widening - Five Years After Opening Evaluation*

[24] Due to the size of the traffic model output datasets used in the air quality assessment, the data are not reported within this report.

Step 2 – Monitoring Data Screening

3.5.9. Air quality monitoring data coupled with baseline traffic flows were used to establish a local relationship between roadside-NO_2 concentrations and traffic flows. Once these relationships were established, the number of vehicles required to cause an exceedance of the AQS objective for annual mean at the nearest roadside receptor[25] was determined. This was used to determine a 'headroom threshold' against which the change in traffic flow with the operation of the Local Plan (in-combination with other plans and projects) was compared. These 'headroom calculations' enabled the identification of monitoring locations not exceeding the air quality objective, but which are at risk of doing so due to predicted traffic growth.

3.5.10. This two-step screening approach enabled the identification of a range of at-risk roads in the borough in addition to AQMAs at which roadside pollutant concentration predictions were made using atmospheric dispersion modelling.

3.6. ATMOSPHERIC DISPERSION MODELLING

3.6.1. The atmospheric dispersion modelling method is summarised in this section and described in further detail in **Appendix A**.

DISPERSION MODEL

3.6.2. Atmospheric dispersion modelling of vehicle emissions using was completed using Cambridge Environmental Consultants (CERC) ADMS-Roads v5.0.0.1 model.

STUDY AREA

3.6.3. The study area was defined by the ARN and the two-step scoping process and as such it includes road links inside and outside Calderdale's AQMAs and all other highly constrained areas as described in **Section 3.5**. The extent of the study area is shown in **Figure 6-9**.

SENSITIVE RECEPTORS

3.6.4. Representative sensitive receptors were chosen to ensure that those receptors with the highest pollutant concentrations (closest to the road, junctions etc.) or anticipated to experience highest level of change (next to roads within the ARN with the largest change in the traffic screening criteria) are included in the air quality assessment. The impact on air quality at all receptors within 4m of the ARN was therefore assessed as representative of receptors within the 200m envelope used to define the ARN in DMRB LA105. It should be noted therefore that the maximum predictions and impacts are predicted at the roadside, which is not necessarily where long-term exposure will occur. Where roadside compliance at 4m is achieved, it can be assumed that compliance is achieved elsewhere in the 200m envelope as pollutant concentrations fall with distance from the roadside.

3.6.5. An array of receptors was selected at a distance of 4m from each road link according to the guidance on Compliance Risk Assessment in DMRB LA105. These points were interpolated along the length of each link 4m perpendicular from the road edge using the supplied traffic data network (SATURN). The interpolation of a number of points along the length of the link enabled the identification of areas where concentrations may be at their highest, and also to provide an average

[25] The concentration at the nearest roadside receptor to the monitor was determined by adjusting the monitored concentration using the Defra nitrogen dioxide fall off with distance calculator https://laqm.defra.gov.uk/tools-monitoring-data/no2-falloff.html.

concentration along each link. Whilst the guidance from DMRB LA105 states that any receptors within 25m of a junction should be excluded, these receptors have been retained in the model and identified as such. Local authorities are obliged to follow the guidance from Defra[17] and monitor in the locations of worst-case exposure. Since exposure is typically located at junctions, an indication of these locations is considered valuable for the Local Plan.

3.6.6. Although, DMRB LA105 recommends that human receptors be selected at a distance of 15m from the running lane, these were not specifically modelled due to the coarse spatial nature of the strategic traffic network supplied for the modelling exercise, such that the relationship between road links and nearby human receptors was not accurately represented by the model.

3.6.7. The sensitive receptors are shown in **Figure 6-10**.

ASSESSMENT SCENARIOS

3.6.8. The operational phase assessment focussed on the following scenarios, for which traffic data were provided to facilitate atmospheric dispersion modelling of vehicle emissions using CERC's ADMS-Roads v5.0 model:

- **2019 Baseline & Model Verification (Base Year)**
- **2032 Future Baseline (Do Minimum)** (*assumes no growth in traffic from 2019, with 2030*[26] *vehicle emissions factors applied)*
- **2032 Without Calderdale Local Plan (Do Something Without Local Plan)** *(inclusive of other Local Plans*[27]*, with 2030 vehicle emissions factors applied)*
- **2032 With Calderdale Local Plan (Do Something With Local Plan)** (*inclusive of other Local Plans, with 2030 vehicle emissions factors applied*).

3.6.9. The Do Something Without Local Plan scenario is a cumulative scenario that includes the contribution from the Kirklees and Bradford Local Plans, and a 7% growth factor on the relevant M62 links as described in **3.5 Traffic Modelling Data**. The Do Something With Local Plan scenario is fully cumulative because it includes the additional traffic changes attributable to the Local Plan.

VEHICLE EMISSIONS INVENTORIES

3.6.10. The traffic data were used to develop NO_x emissions inventory databases for each scenario using the Defra Emissions Factors Toolkit (EFT) version 10.1. This accounts for traffic flow characteristics, including:

- Road type (e.g. urban, rural, motorway);
- Total vehicle flow by link (AADT);
- Percentage of Heavy-Duty Vehicles (HDVs) per link; and
- Average link speed (km/h).

[26] 2030 is the latest forecast year for vehicle emissions factors provided by Defra. The application of 2030 emissions to 2032 traffic is conservative because it excludes 2 years of vehicle renewal and penetration of cleaner vehicles into the fleet.

[27] Comprising traffic growth associated with Kirklees Council Local Plan and City of Bradford Metropolitan Borough Council Local Plan, including addition of background national traffic growth forecasts.

3.6.11. The emissions database outputs for each respective scenario provided road link-specific pollutant emission rates (g/km/s), which were input to the ADMS-Roads model to enable prediction of road-NO_x concentrations at identified sensitive receptor locations.

MODEL VERIFICATION

3.6.12. The atmospheric dispersion modelling verification process is summarised in this section and described in further detail in **Appendix B**.

3.6.13. Verification of the ADMS-Roads model outputs was undertaken by comparing the annual mean NO_2 base year (2019) model outputs with local monitoring data. This enabled appropriate model adjustment factors, derived with reference to LAQM.TG16, to be applied to model outputs to ensure the dispersion model was configured to reproduce the monitoring data as accurately as possible.

3.6.14. Further detailed information of the modelling process, input data and the model verification and adjustment procedure is presented in **Appendix B**.

3.7. COMPLIANCE AND SIGNIFICANCE

3.7.1. Compliance is assessed at the sensitive receptors against the National Air Quality Strategy objectives described in **Table 2-1**.

EP UK / IAQM

3.7.2. The approach provided in the EPUK/IAQM guidance[18] has been used to assist in describing the air quality effects of emissions from traffic associated with the Local Plan modelling scenarios.

3.7.3. This EPUK/IAQM guidance recommends that the degree of an impact is described by expressing the magnitude of incremental change in pollution concentration as a proportion of the relevant assessment level and examining this change in the context of the new total concentration and its relationship with the assessment criterion, as summarised in **Table 3-2**.

Table 3-2 – EPUK & IAQM – Impact Descriptors for Individual Receptors

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

Notes: AQAL = Air Quality Assessment Level, which for this assessment related to the UK Air Quality Strategy objectives. Where the %change in concentrations is <0.5%, the change is described as 'Negligible' regardless of the concentration. When defining the concentration as a percentage of the AQAL, 'without scheme' concentration should be used where there is a decrease in pollutant concentration and the 'with scheme;' concentration where there is an increase. Where concentrations increase, the impact is described as adverse, and where it decreases as beneficial

3.7.4. The EPUK/IAQM guidance notes that the criteria above should be used to describe impacts at individual receptors and should be considered as a starting point to make a judgement on significance of effects, as other influences may need to be accounted for.

3.7.5. The EPUK/IAQM guidance states that for most road transport related emissions, long-term average concentrations are the most useful for evaluating the impacts. The guidance does not include criteria for determining the significance of the effect on hourly mean NO_2 concentrations or daily mean PM_{10} concentrations.

DMRB LA105

3.7.6. The approach provided in the DMRB LA 105 has also been used within this assessment to assist in describing the air quality effects of emissions from traffic associated with the Local Plan modelling scenarios in the context of the strategic road network. The judgement of significance is determined by the number of receptors of a specified magnitude of change in NO_2 and PM_{10}. The guidance bands are show in **Table 3-3**.

EU DIRECTIVE COMPLIANCE

3.7.7. The EU Directive on ambient air quality (2008/50/EC) sets out a range of mandatory limit values for different pollutants as shown in **Table 2-1**. Defra assess and annually report on the status of air quality in the UK, as compared to the limit value for each pollutant, to the European Commission. For the purposes of their assessment and reporting, the UK is divided in to 43 zones and agglomerations (hereafter referred to as zones). The main pollutants of concern with respect to compliance are NO_2 and PM_{10}.

3.7.8. The study area lies in two agglomerations which are the West Yorkshire Urban Area (UK0004) and Yorkshire and Humberside (UK0034). Within the study area there are 36 Pollution Climate Mapping (PCM) (**Table 3-1**) links that overlap links included within the ARN. The predicted annual mean NO_2 concentrations provided by the PCM model adjacent to these roads are presented in **Figure 6-17**.

3.7.9. It is expected that the post-Brexit Environment Bill will require the United Kingdom to comply with the limit values of the EU Directive and therefore compliance of the Local Plan with the limit values on the PCM is assessed. The potential for the Local Plan to impact compliance within the stipulated timeframe by the European Union is included in the judgement of significance.

Table 3-3 – DMRB LA105 Guideline Band for the Number of Receptors Informing a Judgement of Significant Air Quality Effects

Magnitude of change in annual mean NO_2 or PM_{10} ($\mu g/m^3$)	Total number of receptors with	
	Worsening of an air quality objective already above the objective or the creation of a new exceedance	Improvement of an air quality objective already above the objective or removal of a new exceedance
Large (>4)	1 to 10	1 to 10
Medium (>2)	10 to 30	10 to 30
Small (>0.4)	30 to 60	30 to 60

LIMITATIONS AND ASSUMPTIONS

3.7.10. There are uncertainties associated with both measured and predicted concentrations. The model (ADMS-Roads) used in this assessment relies on input data (including predicted traffic flows), which are subject to uncertainty. The model itself simplifies complex physical systems into a range of algorithms. In addition, local micro-climatic conditions may affect the concentrations of pollutants that the ADMS-Roads model will not take into account.

3.7.11. In order to reduce the uncertainty associated with predicted concentrations, model verification has been carried out with reference to guidance set out in LAQM.TG16[17] (see **Appendix B** for details). As the model has been verified against local authority monitoring data within the study area and adjusted accordingly, there can be reasonable confidence in the predicted concentrations.

3.7.12. For the provision of future year (2032) traffic data by the project transport consultants (WSP), background traffic growth was derived using national trip end model forecast (TemPro) growth factors. These factors were applied to derive the overall cap on traffic growth for all modelled scenarios in 2032. The models with Local Plan growth substitute the TemPro data with the specific development growth in the appropriate geographical area. The TemPro factors are relatively coarse in comparison with the more specific development data used when calculating flows from the Local Plan as well as cumulative growth from other local plans (i.e. Bradford and Kirklees). As such, when local plan developments are introduced, the traffic growth and distribution from these replaces the TemPro growth factors within the transport model. Therefore, there is potential for anomalies with respect to the difference between modelled scenarios (e.g. '*With Local Plan*' versus '*Without Local Plan*') where traffic growth associated with the Local Plan is expected to be lower in some areas of the ARN than the growth using TemPro factors in the absence of a Local Plan.

3.7.13. Some areas of Kirklees and Bradford are not represented in enough detail in the transport model to apply specific development growth. Furthermore, Figure 3.2 of the Calderdale Strategic Transport Model Local Validation Report[31] shows the focus of transport model calibration count sites is the urban areas of eastern Calderdale namely Halifax, Elland and Brighouse. It can therefore be expected that transport model accuracy is lower on feeder roads leading into Calderdale at the margins of the study area which are outside of the borough. Of particular note are the locations along Tong Street to the south-east of Bradford and along a section of the M62 approximately 1,345m north-east of Chainbar Roundabout. Traffic flows are predicted to increase on Tong Street and the M62 by 23.1% and 37.5% respectively, from the Do Minimum to the Do Something With

Local Plan scenarios. This includes increases in HDV traffic flows along Tong Street and the M62 of 72.4% and 69.2% respectively. As such increases yield non-representative results, the reporting of predicted concentration maxima in **Section 4.2 Regional Results** and the magnitude of increase therefore includes predictions made inside Calderdale only.

3.7.14. Vehicle emissions for the future year scenarios (2032) have been conservatively represented using EFT v10.1 emissions factors for 2030. This provides a conservative assessment of air pollutant concentrations associated with vehicle emissions because reductions in emissions between 2030 and 2032 can be expected.

3.7.15. The sensitivity test completed to assess the additional influence of the M62 Junctions 25-30 Smart Motorway project on air quality impacts has assumed that a 7% uplift on total vehicle flows will occur in both the Without and With Calderdale Local Plan scenarios on the respective road links. This represents an upper estimate of potential increased flows within the context of the review completed for similar operational smart motorway schemes, where the observed uplift in traffic ranged from 0% to 7% after 1-5 years following scheme opening.

PROFESSIONAL JUDGEMENT

3.7.16. A judgement of significance of the Local Plan has been made combining the following factors:

- The existing and future air quality in the absence of the development manifest in the modelled predictions
- The extent of current and future population exposure to the impacts
- Limitations and assumptions
- The EP UK/IAQM and DMRB LA105 guidance on the judgement of significance

4. ASSESSMENT RESULTS

4.1. INTRODUCTION

4.1.1. The distribution of identified sensitive receptors within the study area is presented in **Figure 6-10**. A total of 7,743 receptors were identified.

4.1.2. A summary of the predicted annual mean NO_2, PM_{10} and $PM_{2.5}$ concentration results across the study area, incorporating all receptors, in the Base Year (2019), Do Minimum (2032) and the two Do Something (2032) scenarios is presented in this section.

4.1.3. The drawings summarising the results across the study area are shown **Figure 6-11, Figure 6-12, Figure 6-13, Figure 6-14, Figure 6-15** and **Figure 6-16**.

4.2. REGIONAL RESULTS

WITHOUT LOCAL PLAN

4.2.1. Results for the entire study area, without the contribution from the Local Plan, are presented in **Table 4-1, Figure 6-11** and **Figure 6-12.**

Table 4-1 – Assessment Results Without Local Plan (inclusive of other Local Plans)

Without Calderdale Local Plan (inclusive of other Local Plans)		**Opening Year 2032**		
Pollutant		**NO_2**	**PM_{10}**	**$PM_{2.5}$**
Annual Mean Limit Value (µg/m³)		**40**	**40**	**25**
Number of receptors greater than limit value	DM (2032) Exceedances	0	0	0
	DS (2032) Exceedances	12	1	0
	Removed Exceedances	0	0	0
	New Exceedances	12	1	0
Total Number of receptors	Improvement in Concentration	356	703	339
	No Change in Concentration	626	704	1,774
	Deterioration in Concentration	6,761	6,336	5,630
Do Something-Do Minimum Annual Mean Change (µg/m³) *	Maximum Improvement	1.8	2.0	0.6
	Maximum Worsening	12.6	13.4	4.2

*The reported maximum improvement and worsening outside Calderdale are excluded due to the lack of reliability in the traffic data (see **Limitations and Assumptions**).

4.2.2. **Table 4-1** and **Figure 6-14** show that with the contribution from natural traffic growth and the Kirklees and Bradford local plans in 2032, there will be improvements and deteriorations in air quality. However, concentrations will deteriorate at the majority of assessed receptors for all pollutants.

4.2.3. For key pollutant NO_2, 12 exceedances are predicted in the study area but these are outside Calderdale south-east of Bradford on Tong Street and on the M62 north-east of Cleckheaton as shown in **Figure 6-11** and **Figure 6-12.** The exceedances north-east of Cleckheaton exist in the Do Something Without Local Plan scenario and there are no exceedances in Calderdale. The maximum improvement in air quality (1.8µg/m^3) will be lower than the maximum deterioration (12.6µg/m^3). The maximum deterioration in NO_2 of 12.6µg/m^3 is located on the outskirts of Calderdale, at the eastern boundary, along Cooper Bridge Road.

4.2.4. **Table 4-2** shows without Local Plan results classified according to the EP UK/IAQM magnitude of change criteria (**Table 3-2**).

Table 4-2 – Assessment Results Without Local Plan (impact descriptors) (EP UK / IAQM)

Descriptor	NO_2	PM_{10}	$PM_{2.5}$
Substantial adverse	12	0	0
Moderate adverse	107	341	47
Slight adverse	516	596	254
Negligible adverse	6,126	5,399	5,329
No change	626	704	1774
Negligible beneficial	356	689	339
Slight beneficial	0	14	0
Moderate beneficial	0	0	0
Substantial beneficial	0	0	0

4.2.5. **Table 4-2** shows without the Local Plan more adverse impacts are predicted and the majority of receptors are classified as negligible adverse for all pollutants. There are 107 moderate adverse and 12 substantial adverse impacts for NO_2 predicted without the contribution from the Local Plan.

4.2.6. **Table 4-3** shows the without Local Plan results classified according to the DMRB LA105 magnitude of change criteria (**Table 3-3**).

Table 4-3 – Assessment Results Without Local Plan (predicted magnitude of change in pollutant concentrations) (DMRB LA105)

Without Calderdale Local Plan (inclusive of other Local Plans) Change in annual mean concentration (Do Something – Do Minimum 2032 (µg/m³))	NO_2	PM_{10}	$PM_{2.5}$
>4 Increase	122	351	6
>2 to 4 Increase	569	621	127
>0.4 to 2 Increase	3,199	2,462	1,095
0 to 0.4 Increase	2,871	2,902	4,402
No Change	626	704	1774
0 to 0.4 Decrease	293	504	313
>0.4 to 2 Decrease	63	180	26
>2 to 4 Decrease	0	19	0
>4 Decrease	0	0	0

4.2.7. **Table 4-3** shows that the majority of improvements and deteriorations in air quality are in the range 0.0 to 2.0µg/m³. It also shows that here are far more deteriorations in this range than improvements. There are predicted to be 122 deteriorations in NO_2, 351 in PM_{10} and six in $PM_{2.5}$ above 4.0µg/m³.

4.2.8. **Table 4-4** shows the number of receptors at which a significant effect can be classified without the Local Plan in accordance with DMRB LA105.

Table 4-4 – Assessment Results Without Local Plan (receptors constituting a significant effect for NO_2) (DMRB LA105)

Without Calderdale Local Plan (inclusive of other Local Plans) Magnitude of Change in Annual Average NO_2 (µg/m³)	Worsening of air quality that already exceeds objective, risks exceeding the objective or creation of a new exceedance	Improvement of air quality that already exceeds objective, risks exceeding the objective or the removal of an existing exceedance
Large (>4)	12	0
Medium (>2 to 4)	0	0
Small (>0.4 to 2)	0	0

4.2.9. **Table 4-4** shows that there are 12 receptors where new exceedances of NO_2 concentrations are experienced. At one of these receptors, there is also a new exceedance of PM_{10} concentrations. All these receptors are outside Calderdale where the modelled traffic data is less accurate.

WITH LOCAL PLAN

4.2.10. Results for the entire study area, with the contribution from the Local Plan, are presented in **Table 4-5 and Figure 6-11** and **Figure 6-13.**

Table 4-5 – Assessment Results With Local Plan (inclusive of other Local Plans)

With Calderdale Local Plan (inclusive of other Local Plans)		Opening Year 2032		
Pollutant		**NO_2**	**PM_{10}**	**$PM_{2.5}$**
Annual Mean Limit Value (µg/m³)		**40**	**40**	**25**
Number of receptors greater than limit value	DM (2032) Exceedances	0	0	0
	DS (2032) Exceedances	12	1	0
	Removed Exceedances	0	0	0
	New Exceedances	12	1	0
Total Number of receptors	Improvement in Concentration	143	358	225
	No Change in Concentration	100	213	901
	Deterioration in Concentration	7,500	7,172	6,617
Do Something-Do Minimum Annual Mean Change (µg/m³)*	Maximum Improvement in Calderdale	1.7	1.8	0.6
	Maximum Worsening in Calderdale	13.2	13.6	4.2

*The reported maximum improvement and worsening outside Calderdale are excluded due to the lack of reliability in the traffic data (see **Limitations and Assumptions**).

4.2.11. **Table 4-5** and **Figure 6-15** show that with the contribution from natural traffic growth, the Kirklees and Bradford local plans and the Local Plan in 2032, there will be improvements and deteriorations in air quality. However, concentrations will deteriorate at the majority of assessed receptors for all pollutants and there will be more as a result of the Local Plan.

4.2.12. For key pollutant NO_2, **Figure 6-13** shows 12 exceedances are predicted in the study area but these remain outside Calderdale in south-west Bradford There are no new exceedances inside or outside Calderdale with the addition of traffic from the Local Plan. The maximum improvement in air quality (1.7µg/m³) will be lower than the maximum deterioration (13.2µg/m³). The maximum deterioration in NO_2 of 13.2µg/m³ is located on the outskirts of Calderdale, near the eastern boundary, along Cooper Bridge Road.

4.2.13. **Table 4-6** shows the with Local Plan results classified according to the EP UK/IAQM magnitude of change criteria.

Table 4-6 – Assessment Results With Local Plan (impact descriptors) (EP UK / IAQM)

Descriptor	NO_2	PM_{10}	$PM_{2.5}$
Substantial adverse	12	1	0
Moderate adverse	187	363	49
Slight adverse	906	639	278
Negligible adverse	6,395	6,169	6,290
No change	100	213	901
Negligible beneficial	143	345	225
Slight beneficial	0	13	0
Moderate beneficial	0	0	0
Substantial beneficial	0	0	0

4.2.14. **Table 4-6** shows there are 187 moderate adverse and 12 substantial adverse impacts for NO_2 predicted with the contribution from the Local Plan. This is an increase of 80 moderate adverse impacts with the Local Plan but no change to the number of substantial adverse impacts. There is an increase in the number of moderate adverse PM_{10} and $PM_{2.5}$ impacts and one new substantial adverse PM_{10} impact with the Local Plan. There are no new exceedances of any of the objectives as a result of traffic from the Local Plan.

4.2.15. **Table 4-7** shows the with Local Plan results classified according to the DMRB LA105 magnitude of change criteria (**Table 3-3**).

Table 4-7 – Assessment Results With Local Plan (predicted magnitude of change in pollutant concentrations) (DMRB LA105)

With Calderdale Local Plan (inclusive of other Local Plans) Change in annual mean concentration (Do Something – Do Minimum 2032 (µg/m^3))	NO_2	PM_{10}	$PM_{2.5}$
>4 Increase	206	372	9
>2 to 4 Increase	1,006	671	152
>0.4 to 2 Increase	4,294	3,698	1,530
0 to 0.4 Increase	1,994	2,431	4,926
No Change	100	213	901
0 to 0.4 Decrease	89	202	201
>0.4 to 2 Decrease	54	137	24

With Calderdale Local Plan (inclusive of other Local Plans) Change in annual mean concentration (Do Something – Do Minimum 2032 (µg/m^3))	NO_2	PM_{10}	$PM_{2.5}$
>2 to 4 Decrease	0	19	0
>4 Decrease	0	0	0

4.2.16. **Table 4-7** shows that the majority of improvements and deteriorations in air quality remain in the range 0.0µg/m^3 to 2.0µg/m^3. It also shows that there are more deteriorations in this range than improvements. Above 4.0µg/m^3, there are 206 deteriorations in NO_2, 372 in PM_{10} and 9 in $PM_{2.5}$ which is an increase of 84 receptors for NO_2, 21 receptors for PM_{10} and 3 for $PM_{2.5}$ with the inclusion of Local Plan traffic.

4.2.17. **Table 4-8** shows the number of receptors at which a significant effect can be classified with the Local Plan in accordance with DMRB LA105.

Table 4-8 – Assessment Results With Local Plan (receptors constituting a significant effect for NO_2) (DMRB LA105)

With Calderdale Local Plan (inclusive of other Local Plans) Magnitude of Change in Annual Average NO_2 (µg/m^3)	Worsening of air quality that already exceeds objective, risks exceeding the objective or creation of a new exceedance	Improvement of air quality that already exceeds objective, risks exceeding the objective or the removal of an existing exceedance
Large (>4)	12	0
Medium (>2 to 4)	0	0
Small (>0.4 to 2)	0	0

4.2.18. **Table 4-8** shows that there are 12 receptors where the NO_2 concentration worsens in locations already exceeding the objective. In comparison to **Table 4-4**, this shows that the Local Plan produces no new significant NO_2 effects. With the Local Plan no new receptors are predicted to have a worse PM_{10} concentration than the one already in exceedance. There is no difference to the number of receptors exceeding the objective where NO_2 and PM_{10} is predicted to worsen as a result of the inclusion of Local Plan traffic.

SUMMARY

4.2.19. The regional results show the Kirklees and Bradford local plans and the Local Plan in 2032 will trigger improvements and deteriorations in air quality. Of the total number of deteriorations predicted with the Local Plan in place (7,500 shown in **Table 4-5**) some 6,761 or 90% (**Table 4-1**) are produced by traffic from the Kirklees and Bradford local plans.

4.2.20. The Local Plan will increase the magnitude of deteriorations due to increases in traffic as shown by the positive difference in NO_2 concentration between the with and without Local Plan results shown in **Figure 6-16**. However, the Local Plan it is not predicted to cause any new objective exceedances anywhere in the study area that do not already exist as a result of traffic from the Kirklees and Bradford local plans.

4.2.21. For key pollutant NO_2, 12 exceedances are predicted in the study area but these are outside Calderdale in south-east Bradford and north-east of Cleckheaton as shown in **Figure 6-11.** There are no new exceedances in Calderdale with the addition of traffic from the Local Plan. As the predicted exceedances are made alongside road links at the margins of the Calderdale Strategic Transport Model, confidence in the accuracy of the predictions is lower in these locations than inside Calderdale for the reasons described in the **Limitations and Assumptions** section.

4.2.22. When applying the EP UK/IAQM descriptors, substantial adverse NO_2 impacts are predicted at approximately 0.3% of all receptors adjacent to the ARN. However, the same number is predicted with and without the Local Plan in place. The number of moderate adverse NO_2 impacts is increased by the Local Plan.

4.2.23. Following the DMRB LA105 guidance bands, the majority of improvements and deteriorations in air quality remain in the range 0.0µg/m^3 to 2.0µg/m^3 with the inclusion of Local Plan traffic. The results show that 12 receptors are predicted to experience a significant adverse effect without the Local Plan. However, the Local Plan makes no difference to the number of receptors exceeding the objective inside or outside Calderdale in 2032.

4.3. LOCAL RESULTS

4.3.1. Localised results are presented which address cumulative impacts on locations in the borough which are highly constrained. These locations include Calderdale's eight AQMAs, locations with monitored NO_2 concentrations within 10% of the annual mean NO_2 objective and constrained junctions.

4.3.2. **Appendix C Plate C-1** to **Plate C-38** show high resolution local NO_2 Do Something scenario results specific to the high and medium constrained locations identified in **Section 3.4**.

4.3.3. The maximum predicted results in each AQMA and constrained location for NO_2 are shown in **Table 4-9** (NO_2).

Table 4-9 - Maximum Local Predicted Concentrations NO_2 in 2032

Name	Location	Annual Mean NO_2 (µg/m^3) Without Local Plan	Annual Mean NO_2 (µg/m^3) With Local Plan	Impact (µg/m^3)
Calderdale No.6 AQMA	Brighouse	35.0	34.2	-0.8
Areas within 200m of AQMA (Amber)		27.0	26.8	-0.2
Areas within 200m of monitored NO_2 >36µg/m^3 (outside AQMA) (Amber)		32.3	32.6	0.3
Areas within 200m of constrained junctions (outside AQMA) (Amber)		32.0	36.4	4.4

4.3.4. **Table 4-9** shows that in all AQMAs, compliance with the annual mean objective will be achieved without the Local Plan. The highest predictions in 2032 are in the Brighouse AQMA where 35.0µg/m^3 is predicted without the Local Plan (**Appendix C**, **Table C-1** and **Plate C-25**). In consideration of the maximum error in the model of +3.87µg/m^3, and the roadside position of this receptor point, exceedances in Brighouse at residential receptors are unlikely. The Local Plan is predicted to reduce the maximum annual mean concentration in Brighouse by 0.8µg/m^3, however, this is accompanied by an equal increase (0.8µg/m^3) in the average annual mean concentration predicted in wider the area (**Table 4-12**). These small changes in predicted concentrations are a function of general increases in traffic flow and variations in local traffic redistribution as a result of the Clifton and Rastrick Garden Suburb developments.

4.3.5. In areas outside the AQMAs, the highest concentrations of 32.6µg/m^3 (Ainley Top **Appendix C Table C-1** and **Plate C-15**) and 36.4µg/m^3 (Halifax **Appendix C, Table C-1** and **Plate C-29**) are predicted to be under the objective. However, in Halifax the maximum error of +2.19µg/m^3 could see the prediction approach the objective at the roadside. An objective exceedance at locations of long-term exposure are however highly unlikely.

4.3.6. **Table 4-10** shows the maximum predicted local concentrations of PM_{10} in 2032.

Table 4-10 – Maximum Local Predicted Concentrations PM_{10} in 2032

Name	Location	Annual Mean PM_{10} (µg/m^3) Without Local Plan	Annual Mean PM_{10} (µg/m^3) With Local Plan	Impact (µg/m^3)
Calderdale No.8 AQMA	New Bank	21.9	22.7	0.8
Areas within 200m of AQMA (Amber)		20.7	21.3	0.6
Areas within 200m of monitored NO_2 >36µg/m^3 (outside AQMA) (Amber)		23.4	23.8	0.4
Areas within 200m of constrained junctions (outside AQMA) (Amber)		36.3	36.5	0.2

4.3.7. **Table 4-10** shows that in all AQMAs, compliance with the annual mean PM_{10} objective of 40µg/m^3 will be achieved without the Local Plan. The highest predictions in 2032 are in the New Bank (**Appendix C Table C-2** and **Plate C-29**) and Brighouse AQMAs (**Appendix C, Table C-2** and **Plate C-25**) where a concentration of 21.2µg/m^3 and above is predicted without the Local Plan. In consideration of the verification zone errors of +3.87µg/m^3 and +3.56µg/m^3 at New Bank and Brighouse, exceedances of the objective are unlikely from the cumulative effects of traffic growth. The Local Plan will increase the concentration at New Bank and in Brighouse by less than 1.0µg/m^3 meaning that an exceedance of the objective is unlikely.

4.3.8. In areas outside the AQMAs, the highest concentration of 36.3µg/m^3 is predicted at Clifton (**Appendix C Table C-2** and **Plate C-1**) close to the M62 motorway but this is still under the objective. The Local Plan will increase the maximum concentration by 0.2µg/m^3 at this location and considering the average model error in this verification zone of +3.56µg/m^3, and the position of this receptor less than 4m from the roadside, an objective exceedance at residential receptors is unlikely.

4.3.9. **Table 4-1** shows the maximum predicted local concentrations of $PM_{2.5}$ in 2032.

Table 4-11 – Maximum Local Predicted Concentrations $PM_{2.5}$ in 2032

Name	Location	Annual Mean $PM_{2.5}$ (µg/m³) Without Local Plan	Annual Mean $PM_{2.5}$ (µg/m³) With Local Plan	Impact (µg/m³)
Brighouse	Calderdale No.6 AQMA	11.5	11.8	0.3
Areas within 200m of AQMA (Amber)		11.0	11.2	0.2
Areas within 200m of monitored NO_2 >36µg/m³ (outside AQMA) (Amber)		11.4	11.7	0.3
Areas within 200m of constrained junctions (outside AQMA) (Amber)		16.0	16.1	0.1

4.3.10. **Table 4-11** shows that in all AQMAs, compliance with the annual mean $PM_{2.5}$ objective of 25µg/m³ will be achieved without the Local Plan. The highest predictions in 2032 are in the New Bank (**Appendix C Table C-3** and **Plate C-29**) and Brighouse (**Appendix C Table C-3** and **Plate C-25**) AQMAs where 11.2µg/m³ and above are predicted without the Local Plan. In consideration of the verification zone errors of +3.87µg/m³ and +3.56µg/m³ at New Bank and Brighouse, exceedances of the objective are unlikely from the cumulative effects of traffic growth. The Local Plan will increase the concentration at New Bank and in Brighouse by less than 0.3 µg/m³ meaning that an exceedance of the objective is unlikely.

4.3.11. In areas outside the AQMAs, the highest concentration of 16.0µg/m³ is predicted at Clifton adjacent to the M62 (**Appendix C Table C-3** and **Plate C-1**), which is under the objective. The Local Plan will increase the maximum concentration by 0.1 µg/m³ at this location meaning an objective exceedance is unlikely.

4.3.12. The local NO_2 results for the red and amber constrained areas are summarised in **Table 4-12** with cross reference to the Plates in **Appendix C – Supplementary Local Results**.

Table 4-12 – Local Results Summary (NO_2)

Name	Constraint	Average Annual Mean NO_2 (µg/m^3) With Local Plan	Maximum Annual Mean NO_2 (µg/m^3) With Local Plan	Appendix C Plate
No.1 Salterhebble and Huddersfield Road	AQMA	16.3	18.8	**C-7, C-8**
No.2 Sowerby Bridge		10.8	13.8	**C-3, C-4**
No.3 Hebden Bridge		14.1	19.5	**C-19, C-20**
No.4 Luddendenfoot		11.2	13.2	**C-21, C-22**
No.5 Stump Cross		18.3	19.7	**C-23, C-24**
No.6 Brighouse		19.3	34.2	**C-25, C-26**
No.7 Hipperholme		16.3	20.7	**C-27, C-28**
No.8 New Bank, Halifax		20.9	24.8	**C-29, C-30**
No.1 Salterhebble and Huddersfield Road	Areas within 200m of a declared AQMA	13.6	19.3	**C-7, C-8**
No.2 Sowerby Bridge		9.5	11.4	**C-3, C-4**
No.3 Hebden Bridge		11.2	17.8	**C-19, C-20**
No.4 Luddendenfoot		12.8	16.5	**C-21, C-22**
No.5 Stump Cross		16.0	17.8	**C-23, C-24**
No.6 Brighouse		16.6	26.8	**C-25, C-26**
No.7 Hipperholme		13.8	18.1	**C-27, C-28**
No.8 New Bank, Halifax		18.6	23.4	**C-29, C-30**
Mytholmroyd	Areas within 200m of monitored concentrations within 10% of the annual mean NO_2 objective	9.8	11.4	**C-31, C-32**
Godly Gardens		15.2	16.0	**C-33, C-34**
West Vale		10.7	11.2	**C-15, C-16**
Ainley Top		19.3	32.6	**C-15, C-16**
Scammonden		14.6	15.1	**C-35, C-36**
Clifton		20.3	28.0	**C-1, C-2**
Sowerby Bridge		9.7	11.4	**C-3, C-4**

Name	Constraint	Average Annual Mean NO_2 (µg/m³) With Local Plan	Maximum Annual Mean NO_2 (µg/m³) With Local Plan	Appendix C Plate
Shelf	Within 200m of capacity constrained junction	14.5	17.2	**C-5, C-6**
Northowram		11.1	11.9	**C-9, C-10**
Ovenden		14.0	16.0	**C-13, C-14**
Kings Cross		16.0	18.4	**C-11, C-12**
Stump Cross		16.0	17.8	**C-23, C-24**
Halifax		19.0	36.4	**C-29, C-30**
Salterhebble		14.1	20.7	**C-7, C-8**
Elland		14.9	19.8	**C-15, C-16**
Brighouse		16.9	25.6	**C-25, C-26**
Clifton		22.2	31.1	**C-1, C-2**
Rastrick		17.0	27.6	**C-17, C-18**

4.3.13. **Table 4-12** shows the variability in model predictions on a local level. Maximum NO_2 concentrations above 30.0µg/m³ are predicted in the following four locations:

- Halifax (36.4µg/m³) along Ovenden Road joining the Orange Street Roundabout
- Calderdale AQMA No.6 Brighouse (34.2µg/m³) on Huddersfield Road at the A641/A643/A644 junction
- Ainley Top (32.6µg/m³) along Ainley Top Roundabout
- Clifton (31.1µg/m³) along the M62/A644 Roundabout.

4.3.14. The maximum predicted NO_2 concentration of 36.4µg/m³ occurs in Halifax within 200m of the constrained junction at Orange Street Roundabout (A58/A629). Whilst the maximum concentration falls within 10% of the NO_2 annual mean objective, it is not an exceedance and represents the worst-case concentration out of 424 roadside receptors within 200m of the junction. It is not a location at which long term human exposure will occur. The mean average annual concentration across these 424 receptors is 19.0µg/m³, which is under half the 40.0µg/m³ objective.

4.3.15. The Local Plan is predicted to cause deteriorations in NO_2 concentrations above 4.0µg/m³ broadly corresponding with those areas where the above maxima are predicted:

- Halifax (**Plate C-29**) along Ovenden Road at the Orange Street Roundabout (~ 310m west of AQMA No. 8 New Bank) representing a maximum increase of 10.4µg/m³ in Halifax.
- AQMA No.6 Brighouse (**Plate C-25**) on Huddersfield Road at the A641/A643/A644 junction, representing a maximum increase of 8.4µg/m³ in Brighouse.
- Ainley Top (**Plate C-15**) along Ainley Top Roundabout, representing a maximum increase of 10.2µg/m³ in Ainley Top, and the surrounding areas of Elland and Westvale.

- Clifton (**Plate C-20**) along the M62/A644 Roundabout (~ 1,200m east-southeast of Brighouse AQMA), representing a maximum increase of 7.4µg/m³ for Clifton.

4.3.16. Even with these increases, the maximum and annual mean predicted concentrations are under the objective for the four identified locations with the contribution to local traffic from the Local Plan including that from the proposed Clifton and Rastrick Garden Suburb developments. There is no long-term human exposure where these roadside maxima are predicted to occur and by inference no exceedances will occur anywhere within a 200m envelope.

SUMMARY

4.3.17. The local results show the Kirklees and Bradford local plans and the Local Plan in 2032 will trigger improvements and deteriorations in air quality across Calderdale. While the local results confirm that the Local Plan makes no difference to the number of receptors exceeding the objectives inside or outside Calderdale, they do show that the model predictions are highly variable on a local level.

4.3.18. Central Halifax, Brighouse and neighbouring Clifton, which are subject to increased traffic flows from the proposed garden suburbs, are the locations at which the highest NO_2, PM_{10} and $PM_{2.5}$ predictions are made. Although the Local plan modelling results indicate compliance with all statutory objectives in 2032, a specific planning application to develop these sites for housing would require a detailed impact assessment based on locally verified traffic data completed in accordance with the WYLES Air Quality & Emissions Technical Planning Guidance to ensure that appropriate mitigation to protect human health is secured.

4.4. EU DIRECTIVE COMPLIANCE RESULTS

4.4.1. Predicted concentrations at the EU Directive compliance links are shown in **Table 4-13**.

Table 4-13 – EU Directive Compliance Link Results (with Local Plan)

Scenario	Zone	Compliant Zone?	Projected Compliance Year	Max DS NO_2 Concentration (µg/m³)	Max NO_2 Change (DS-DM) (µg/m³)	Max Equivalent PCM NO_2 (µg/m³)
With Local Plan	UK0004	N	>2030	39.3	13.2	31.4
	UK0034	N	2025	39.6	12.5	30.7
Without Local Plan	UK0004	N	>2030	38.7	12.6	30.8
	UK0034	N	2025	38.1	11.0	29.2

4.4.2. A total of 318 model links mapped on to 36 of the Defra PCM Compliance links. All 318 links are predicted to experience Do-Something concentrations in excess of the PCM equivalent predicted Do-Something concentration. Whilst all of the Do-Something concentrations are below the limit value for NO_2 of 40 µg/m³, the fact that the predicted Do-Something concentrations are above the concentrations at the Defra PCM Compliance links where they overlap, suggests that achieving compliance with the EU limit value could be slowed by the traffic contribution from the Local Plan.

5. DISCUSSION

5.1.1. The assessment of changes in air quality across Calderdale has been made using an assessment process based on conservative estimates of vehicle emissions (2030 instead of 2032), and traffic predictions from a strategic transport model where the focus of traffic model validation was in the busiest areas of the borough.

5.1.2. The predictions made are cumulative in nature, representing the combined impact of natural traffic growth including the contribution from Kirklees and Bradford local plans (Do Something Without Local Plan) compared to the cumulative impact with the Calderdale Local Plan (Do Something With Local Plan) included. All predictions are made at receptors located within 4m from the roadside which do not necessarily represent locations of human exposure. Therefore, in demonstrating compliance at these locations it can be inferred that compliance will be achieved at locations of long-term human exposure set further back from the roadside.

5.1.3. The Local Plan assessment year is 2032 and projections for future year emissions were made using Defra's EFT. EFTv9.0 was used in the updated HRA, incorporating emissions factors for Euro 6 vehicles in 2020. However, real-world monitoring data[28] suggests that newer and older Euro 6 diesel vehicles were emitting under the limits required by the Real Driving Emissions tests in 2019. Therefore, the data suggests that EFT v9.0 is likely to over-predict drive-cycle average NO_x emissions from Euro 6 diesel cars in the future. Euro 6 diesel emissions are better represented in the updated EFTv10.1[29] which has been used in this assessment. Although there is greater confidence in EFT v10.1, modal shift to public transport and the rate of uptake of cleaner electric vehicles are difficult to predict. EFT v10.1 predicts that 7.5% of car vehicle-kilometres on England's urban roads in 2030 will be by fully electric vehicles, with the equivalent values for rural roads and motorways being 7.2% and 6.8% respectively. If the uptake of fully electric vehicles is more rapid than assumed in the EFT, then NO_x emissions will fall more quickly than predicted and may not be accurately represented in the EFT v10.1 as applied to the local fleet in Calderdale. This is possible since the government announced policy intent to ban all sales of new petrol and diesel cars by 2030[30] after the release of EFT v10.1. The assessment results are therefore subject to embedded conservatism.

5.1.4. The impact of uncertainty on the model's ability to reproduce monitoring data has been mitigated using model validation. This validation has shown that in all model verification zones in the study area, the model is able to reproduce the monitored predictions within an average of ±4ug/m^3 which is inside the guideline stipulated with the Defra guidance LAQM.TG16. Therefore, we can have good confidence in the model performance when using the modelled results to judge the significance of the impact of the Local Plan in air quality.

---

[28] European Automobile Manufacturers Association (2019). *Access to Euro 6 RDE data (https://www.acea.be/publications/article/access-to-euro-6-rde-monitoring-data).* Feb 2019.

[29] Air Quality Consultants (2020). Comparison of EFT v10 with EFT v9. September 2020.

[30] UK Government (2020). Government takes historic step towards net-zero with end of sale of new petrol and diesel cars by 2030. https://www.gov.uk/government/news/government-takes-historic-step-towards-net-zero-with-end-of-sale-of-new-petrol-and-diesel-cars-by-2030. November 2020.

5.1.5. A judgement has been made on the balance of the key evidence presented in the modelling assessment which is summarised as follows:

- The assessment process is subject to inherent uncertainty associated with the input datasets and modelling tools. This error has been mitigated through model validation process which has determined that the model performs within the guideline margin for error stipulated in the Defra guidance across Calderdale
- Monitored concentrations in Calderdale and have consistently trended downwards at all roadside monitoring locations between 2015 and 2019
- Both adverse and beneficial impacts on local air quality are predicted as a result of the Local Plan
- Although more moderate and substantial adverse impacts are predicted as a result of the cumulative impact of the Local Plan in 2032, no new exceedances of national air quality strategy objectives or EU limit values are predicted as a result of the cumulative impacts of the Local Plan
- The Local Plan could slow compliance with EU Directive 2008/50/EC if compliance with that directive is still required in 2032 post-Brexit
- In Calderdale's AQMAs, no new objective exceedances are predicted and by 2032 compliance is predicted in all of the AQMAs
- At all non-AQMA locations with high monitored concentrations and constrained junctions no new exceedances are predicted and by 2032 all locations will be in compliance with the Local Plan in place.

6. CONCLUSION

6.1.1. On the balance of the evidence, it is judged that the Calderdale Local Plan will not significantly impact on local air quality, and therefore human health, across the borough. However, these results do not eliminate the requirement for specific planning applications to develop allocated sites for housing from detailed impact assessment based on locally verified traffic data. These applications should be completed in accordance with the WYLES Air Quality & Emissions Technical Planning Guidance to ensure that appropriate mitigation to protect human health is secured and compliance with the NPPF, Unitary Development Plan Policy EP1 and Local Plan Policy EN2 Air Quality is achieved.

FIGURES

Appendix A

ATMOSPHERIC DISPERSION MODELLING

APPENDIX A – ATMOSPHERIC DISPERSION MODELLING

INTRODUCTION

The main pollutants of concern to designated sites from road traffic are oxides of nitrogen (NO_x/NO_2), since these pollutants are most likely to approach their relevant air quality limit values in proximity to major road links.

The developments associated with the introduction of the Local Plan have the potential to change the total flow, distribution and characteristics of traffic movements on the affected road links, which would result in changes to emissions of the aforementioned pollutants. The air quality assessment was completed to predict the potential impacts of these changes on ambient pollutant concentrations at identified sensitive ecological receptors within proximity to affected roads.

The air quality conditions were described for the base year (2019) and Assessment Years (2032). In 2032, the dispersion modelling assessment considered both the 'Without' Local Plan and 'With' Local Plan scenarios.

Modelling methodology

Atmospheric dispersion model

The predicted impacts on local air quality associated with changes to vehicle emissions as a result of the operation of the scheme were assessed using Cambridge Environmental Research Consultants (CERC) atmospheric dispersion modelling system for roads (ADMS-Roads v5.0.0.1).

ADMS-Roads applies advanced algorithms for the height-dependence of wind speed, turbulence and stability to produce improved predictions of air pollutant concentrations within the given model domain. It can predict long-term and short-term concentrations, as well as calculations of percentile concentrations.

ADMS-Roads is a validated model, developed in the UK by CERC. The model validation process includes comparisons with data from the UK's Automatic Urban Rural Network (AURN) and specific verification exercises using standard field, laboratory and numerical data sets. CERC is also involved in European programmes on model harmonisation, and their models were compared favourably against other EU and U.S. EPA systems. Further information in relation to this is available from the CERC web site at http://www.cerc.co.uk/environmental-software/model-validation.html.

Atmospheric dispersion modelling process

The procedures involved in undertaking the dispersion modelling assessment are outlined below:

- Collation of input data – traffic data (flows, speeds, percentage of Heavy-Duty Vehicles (HDVs)), road network mapping, sensitive receptor coordinates and meteorological data
- Receptors were selected at 4m transect points perpendicular to the road edge for each road link within the ARN
- Input of data in to the ADMS-Roads model for the scenarios to be modelled
- Development of emissions inventories for each pollutant to be assessed, using Defra's emission factor toolkit (v10.1)
- Running the ADMS-Roads model for each considered scenario

- Conversion of modelled NO_X concentrations to Road NO_2 concentrations using Defra's NO_x-NO_2 calculator v8.1
- Addition of Defra background concentrations to the modelled concentrations;
- Verification and adjustment of modelled road-NO_x contributions from the assessed road network through analysing the ADMS-Roads modelled road-NO_x outputs versus Council monitored road-NO_x for the base year scenario (2019);
- Analysis of changes in pollutant concentrations between the 'Without' and 'With' scenarios to assess the significance of impacts associated with the Local Plan on designated sites in CC.

Traffic data

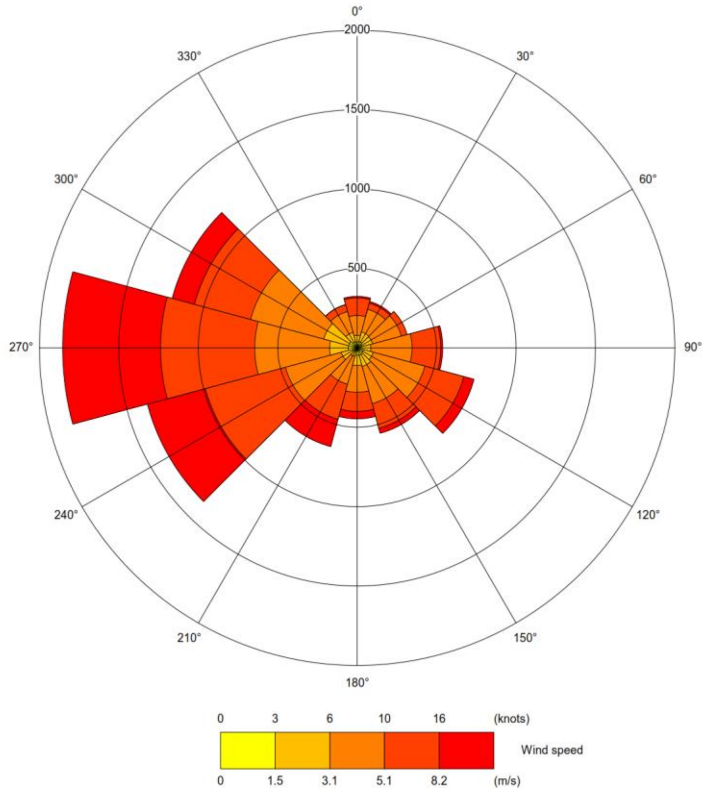
Traffic flow data comprising AADT, traffic composition (percentage HDVs) and average link speeds (km/h) were used in the modelling as provided for the ARN by the projects transport consultant WSP. Full details of traffic flows are available on request.

Meteorological Data

ADMS-Roads utilises hourly sequential meteorological data; including wind direction, wind speed, temperature, precipitation and cloud cover, to facilitate the prediction of pollution dispersion between source and receptor.

Meteorological data input to the model were obtained from the closest meteorological station, Emley Moor, for the year 2019. The 2019 data was used to be consistent with the base/verification traffic year and were applied to the remaining scenarios for the air quality assessment. The 2019 wind rose is presented as **Figure A.1**.

Figure A.1 – Emley Moor 2019 Wind Rose



Conversion of NO_x to NO_2

NO_x concentrations were predicted using the ADMS-Roads model. The modelled road contribution of NO_x at the modelled receptor locations was then converted to Road NO_2 using the NO_x to NO_2 calculator (v8.1), in accordance with Defra guidance.

Appendix B

DISPERSION MODEL VERIFICATION

APPENDIX B – DISPERSION MODEL VERIFICATION

MODEL VERIFICATION METHODOLOGY

MODEL VALIDATION

The ADMS-Roads dispersion model has been validated for road traffic assessments and is considered to be fit for purpose. Model validation undertaken by the software developer Cambridge Environmental Research Consultants (CERC) is unlikely to have included validation in the vicinity of the scheme considered in this assessment. It is therefore necessary to perform a comparison of model results with local monitoring data at relevant locations.

MODEL VERIFICATION

The comparison of modelled concentrations with local monitored concentrations is a process termed 'verification'. Model verification investigates the discrepancies between modelled and measured concentrations, which can arise due to the presence of inaccuracies and/or uncertainties in model input data, modelling and monitoring data assumptions. The following are examples of potential causes of such discrepancy:

- Estimates of background pollutant concentrations
- Meteorological data uncertainties
- Traffic data uncertainties
- Model input parameters, such as 'roughness length
- Overall limitations of the dispersion model.

Full details of the model verification process specific to the Proposed Scheme modelling assessment are provided in the 'Assessment Verification Methodology' section below.

MODEL PRECISION

Residual uncertainty may remain after systematic error or 'model accuracy' has been accounted for in the final predictions. Residual uncertainty may be considered synonymous with the 'precision' of the model predictions, i.e. how wide the scatter or residual variability of the predicted values compare with the monitored true value, once systematic error has been allowed for. The quantification of model precision provides an estimate of how the final predictions may deviate from true (monitored) values at the same location over the same period. Suitable local monitoring data for the purpose of verification is used for model verification.

An evaluation of model performance has been undertaken to establish confidence in model results. LAQM.TG16 identifies a number of statistical procedures that are appropriate to evaluate model performance and assess the uncertainty. The statistical parameters used in this assessment are:

- Root mean square error (RMSE)
- Fractional bias (FB)
- Correlation coefficient (CC).

A brief explanation of each statistic is provided in **Table B.1** and further details can be found in Defra's LAQM.TG16 document.

Table B.1 – Model Performance Statistics

Statistical Parameter	Comments	Ideal Value
RMSE	▪ RMSE is used to define the average error or uncertainty of the model. ▪ The units of RMSE are the same as the quantities compared. ▪ 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/m^3, if an RMSE of 10 µg/m^3 or above is determined for a model it is 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 4 µg/m^3 for the annual mean NO_2 Objective.	0.0
Fractional Bias	▪ It is used to identify if the model shows a systematic tendency to over or under predict. FB values vary between +2 and -2 and has an ideal value of zero. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.	0.0
Correlation Co-efficient	▪ It is used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship. This statistic can be particularly useful when comparing a large number of model and observed data points.	1.00

The calculations were carried out before and after model adjustment to provide information on the improvement of the model predictions as a result of the application of the verification adjustment factors.

The verification process involves a review of the modelled pollutant concentrations against corresponding monitoring data to determine how well the air quality model has performed. Depending on the outcome it may be considered that the model has performed adequately and that there is no need to adjust any of the modelled results LAQM.TG (16).

Alternatively, the model may perform outside of the ideal performance limits as stated by LAQM.TG16 (i.e. model agrees within +/-25% of monitored equivalent). There is then a need to check all the input data to ensure that it is reasonable and accurately represented in the air quality modelling process.

Where all input data, such as traffic data, emissions rates, and background concentrations have been checked and considered as reasonable, then the modelled results require adjustment to best align with the monitoring data. In this instance, the model outputs of road-NO_x were compared with the 'measured' road-NO_x, determined from the NO_2 concentrations measured using diffusion tubes at the monitoring locations, utilising the NO_x from NO_2 calculator provided by Defra and the NO_2 background concentration (from the Defra background maps).

Such is the variability in land-use across Calderdale, several unique verification adjustment factors were applied to the modelled concentrations across the study area to account for different land-use zones in the study area e.g. major roads, local roads.

ASSESSMENT VERIFICATION SUMMARY

The air quality model was run to predict the 2019 annual mean road-NO_x contribution at 31 out of 51 Council roadside diffusion tubes within the study area. The sites were the closest monitors in the study area for which Saturn traffic model outputs were available. **Table B.2** provides a summary of the monitoring sites included and excluded from the model verification process.

Table B.2 – Data Used in Model Verification

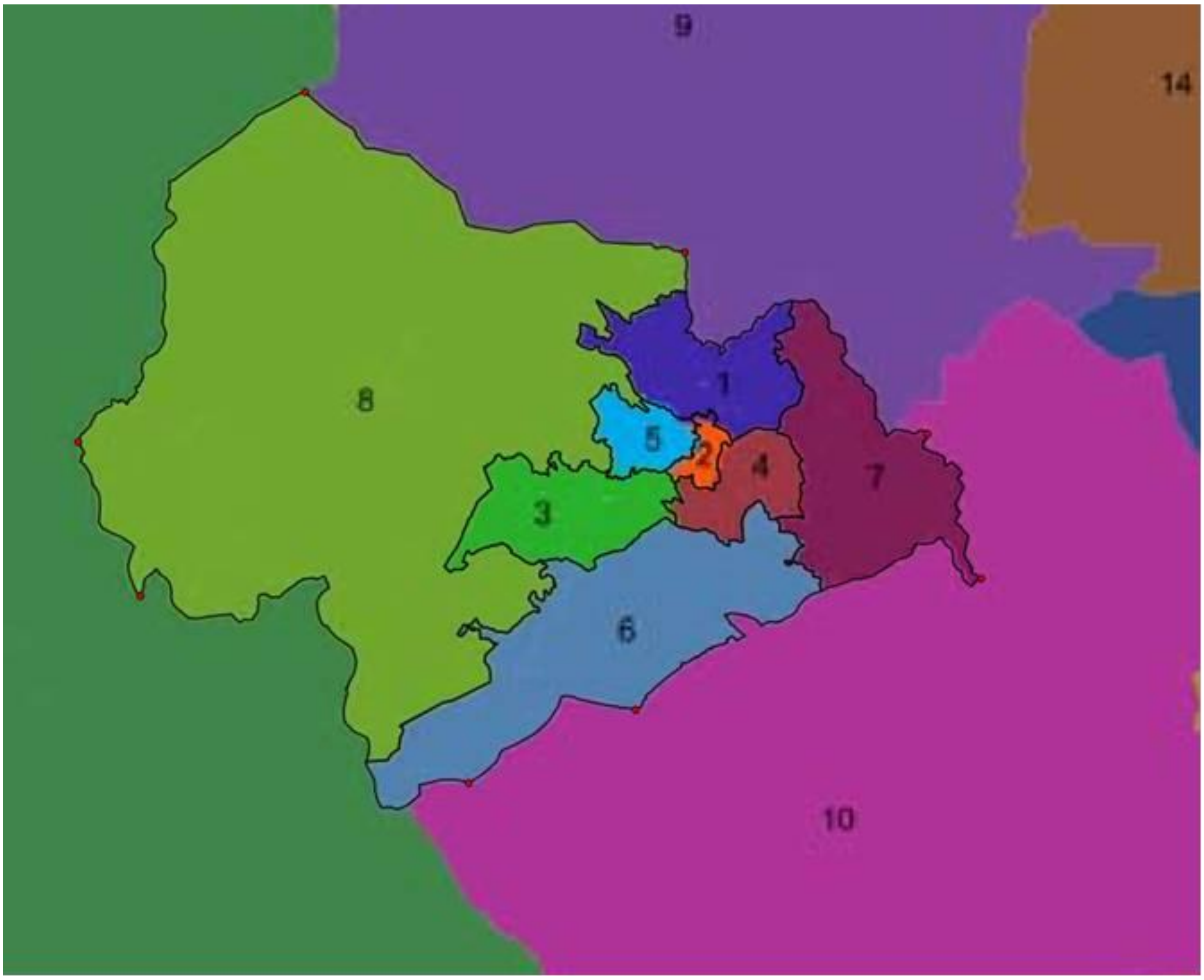
Site ID	Monitoring Site Location	Verification Zone	Included	Reason for exclusion
LV-NBN	New Bank	Zone 1	✓	
LV-NBS	New Bank		✓	
NB-NB1	New Bank		✓	
NB-GR	New Bank		✓	
SC5	Stump Cross		✓	
NB-GL	Godley Gardens		x	Positioned on traffic light with airflow obstructed
HH-LB	Hipperholme		x	Incomplete monitoring data
HH-LT	Hipperholme		x	Positioned by bus stop near layby (local source)
HH1	Hipperholme		x	Incomplete monitoring data
HH-TC	Hipperhome		x	Incomplete monitoring data
SB3	Sowerby Bridge	Zone 2	✓	
SB15	Sowerby Bridge		x	Positioned in street canyon near school, and on a bus route with steep incline
SB16	Sowerby Bridge		x	Positioned opposite a bus stop
SB1	Sowerby Bridge		x	Positioned next to construction site with diesel plant and on-road vehicles
AQC1	Salterhebble	Zone 3	✓	
AQC2	Salterhebble		✓	
AQC3	Salterhebble		✓	
CRH1	Salterhebble		✓	
AQ21	Salterhebble		✓	
AQ20	Salterhebble		x	Unrepresentative elevated location around the corner of a building with airflow obstructed
LV-SCA	Scammonden	Zone 4	✓	
LV-SAA	Ainley Top		✓	
CL1	Elland		✓	
AT-BR	Ainley Top		✓	
AT-MR	Ainley Top		✓	
AT-MR2	Ainley Top		✓	
WV-SR1	West Vale		x	Positioned on street canyon façade (airflow obstructed)
WV-SR2	West Vale		x	Positioned on street canyon façade (airflow obstructed)
LV - AT	Ainley Top		x	Positioned below road height along a bank

HTAH	Ainley Top		x	Positioned below road height, behind vegetation and in front of a house with airflow obstructed
LV-EWB	Elland		x	Positioned between cliff face and long line of dense vegetation (airflow obstructed)
LV-62W	Clifton	Zone 5	✓	
LV-62E	Clifton		✓	
WR2	Brighouse		✓	
BH3	Brighouse		✓	
BE4	Brighouse		✓	
BE2	Brighouse		✓	
LV-LEE	Bradley		x	Diffusion tube positioned along a road between a "street canyon" of tall trees, neighbouring water treatment works, long line of queuing traffic including HDVs
LV-BRD	Brighouse		x	Diffusion tube positioned in front of dense vegetation on the corner of a busy junction (incl. HDVs) with steep incline opposite a shopping centre and car park
HXR1	Brighouse		x	Diffusion tube located at a junction going up steep incline between a building façade and dense vegetation
HQ1	Hebden Bridge	Zone 6a	✓	
HB6	Hebden Bridge		✓	
HQ9	Hebden Bridge		✓	
BS1 HB	Hebden Bridge		✓	
MY-04	Mytholmroyd	Zone 6b	✓	
MY-05	Mytholmroyd		✓	
MY02	Mytholmroyd		✓	
MY01	Mytholmroyd		x	Positioned on a building façade opposite a car park (local source and obstructed airflow)
MY03	Mytholmroyd		x	Positioned near heavy, queuing traffic due to construction works, opposite car park (local source)
LF2	Luddendenfoot	Zone 6c	✓	
LF1	Luddendenfoot		x	Positioned within "street canyon" of building façade on one side and dense trees on other with two bus stops in between (local sources)

The study area was then divided into eight distinct 'verification zones' which were chosen based upon the availability of monitoring data, similarity of land use (road type and density, the level of urban development) and the presence of AQMAs. The eight verification zones broadly correspond with the 2011 census output areas used in the verification of the Calderdale Strategic Transport Model Local Validation Report[31]. These areas are shown in **Figure B.1**.

[31] WSP Parsons Brinkerhoff (2016). Calderdale Strategic Transport Model Local Validation Report (October 2016). https://www.calderdale.gov.uk/v2/residents/environment-planning-and-building/planning/planning-policy/local-plan/evidence-base/transport. Accessed April 2021.

Figure B.1 – Saturn Model 2011 Census Output Areas Used to Align Model Verification Zones



The RMSE value is considered the most useful indicator of overall model performance. The fractional bias and correlation coefficient statistics were also derived based on Defra LAQM.TG16 guidance, which states that this statistic is particularly useful for a larger number of data points. **Table B.3** below presents a summary of model performance before and after the verification exercise.

Table B.3 – Model Performance Summary

Site ID	Monitoring Site Location	Zone	RMSE (µg/m^3)		Fractional Bias		Correlation Co-efficient	
			Before adjustment	After adjustment	Before adjustment	After adjustment	Before adjustment	After adjustment
LV-NBN	New Bank	Zone 1	18.1	3.9	0.5	0.0	0.8	0.8
LV-NBS	New Bank							
NB-NB1	New Bank							
NB-GR	New Bank							
SC5	Stump Cross							
SB3	Sowerby Bridge	Zone 2	0.5	0.0	0.0	0.0	--	--
AQC1	Salterhebble	Zone 3	12.2	2.2	0.3	0.0	0.9	0.9
AQC2	Salterhebble							
AQC3	Salterhebble							
CRH1	Salterhebble							
AQ21	Salterhebble							
LV-SCA	Scammonden	Zone 4	3.8	3.8	0.0	0.0	0.5	0.5
LV-SAA	Ainley Top							
CL1	Elland							
AT-BR	Ainley Top							
AT-MR	Ainley Top							
AT-MR2	Ainley Top							
LV-62W	Clifton	Zone 5	11.3	3.6	0.3	0.0	0.6	0.7
LV-62E	Clifton							
WR2	Brighouse							
BH3	Brighouse							
BE4	Brighouse							
BE2	Brighouse							
HQ1	Hebden Bridge	Zone 6a	22.5	3.7	0.9	0.1	0.7	1.0
HB6	Hebden Bridge							
HQ9	Hebden Bridge							
BS1 HB	Hebden Bridge							
MY-04	Mytholmroyd	Zone 6b	9.9	0.6	0.4	0.0	1.0	1.0
MY-05	Mytholmroyd							
MY02	Mytholmroyd							
LF2	Luddendenfoot	Zone6c	15.2	0.0	0.7	0.0	--	--

--only one tube as usable for verification in this zone and so a correlation coefficient cannot be derived.

Table B.3 shows with road-NO_x adjustment factors applied to the modelled values, the total annual mean NO_2 concentrations derived in each verification zone are within +/-10% (4µg/m^3) of the monitored equivalents which is complaint with the guideline in LAQM.TG16 paragraph 7.541. Each verification zone displays a fractional bias close to zero after adjustment which means the model has no tendency toward under or over prediction.

Appendix C

SUPPLEMENTARY LOCAL RESULTS

APPENDIX C – SUPPLEMENTARY LOCAL RESULTS

MAXIMUM ANNUAL MEAN RESULTS

Tabulated results for the specific areas which are identified as highly or medium constrained are shown in **Table C.1** (NO_2), **Table C.2** (PM_{10}) and **Table C.3** ($PM_{2.5}$).

Table C.1 – Maximum Local NO_2 Results

Name	Location	Annual Mean NO_2 (µg/m^3) Without Local Plan	Annual Mean NO_2 (µg/m^3) With Local Plan	Impact (µg/m^3)
High Risk: Receptors within AQMAs				
Calderdale No.1 AQMA	Salterhebble and Huddersfield Road	18.3	18.8	0.5
Calderdale No.2 AQMA	Sowerby Bridge	13.4	13.8	0.4
Calderdale No.3 AQMA	Hebden Bridge	19.1	19.5	0.4
Calderdale No.4 AQMA	Luddendenfoot	12.6	13.2	0.6
Calderdale No.5 AQMA	Stump Cross	18.5	19.7	1.2
Calderdale No.6 AQMA	Brighouse	35.0	34.2	-0.8
Calderdale No.7 AQMA	Hipperholme	19.2	20.7	1.5
Calderdale No.8 AQMA	New Bank	23.6	24.8	1.2
Medium Risk: Receptors within 200m of AQMAs				
Calderdale No.1 AQMA	Salterhebble and Huddersfield Road	18.4	19.3	0.9
Calderdale No.2 AQMA	Sowerby Bridge	11.2	11.4	0.2
Calderdale No.3 AQMA	Hebden Bridge	17.1	17.8	0.7
Calderdale No.4 AQMA	Luddendenfoot	15.0	16.5	1.5
Calderdale No.5 AQMA	Stump Cross	17.0	17.8	0.8
Calderdale No.6 AQMA	Brighouse	27.0	26.8	-0.2
Calderdale No.7 AQMA	Hipperholme	17.4	18.1	0.7
Calderdale No.8 AQMA	New Bank	22.6	23.4	0.8
Medium Risk: Receptors within 200m of Monitored NO_2 >36µg/m^3 (outside AQMA)				
Mytholmroyd		11.1	11.4	0.3

Godly Gardens	15.6	16.0	0.4
West Vale	11.0	11.2	0.2
Ainley Top	32.3	32.6	0.3
Scammonden	15.1	15.1	<0.0
Clifton	24.9	28.0	3.1
Medium Risk: Receptors within 200m of Constrained Junctions (outside AQMA)			
Junctions within and surrounding Sowerby Bridge	11.2	11.4	0.2
Junctions within and surrounding Halifax	32.0	36.4	4.4
Junctions within and surrounding Salterhebble	18.2	19.3	1.1
Junctions within and surrounding Elland	27.3	27.6	0.3
Junctions within and surrounding Brighouse	22.7	25.6	2.9
Junctions within and surrounding Clifton	30.6	31.1	0.5

Table C.2 – Local PM_{10} Results

Name	Location	Annual Mean PM_{10} (µg/m^3) Without Local Plan	Annual Mean PM_{10} (µg/m^3) With Local Plan	Impact (µg/m^3)
High Risk: Receptors within AQMAs				
Calderdale No.1 AQMA	Salterhebble and Huddersfield road	16.9	17.2	0.3
Calderdale No.2 AQMA	Sowerby Bridge	12.7	13.0	0.3
Calderdale No.3 AQMA	Hebden Bridge	16.3	16.6	0.3
Calderdale No.4 AQMA	Luddendenfoot	16.4	17.0	0.6
Calderdale No.5 AQMA	Stump Cross	17.8	18.3	0.5
Calderdale No.6 AQMA	Brighouse	21.2	22.1	0.9
Calderdale No.7 AQMA	Hipperholme	15.8	16.1	0.3
Calderdale No.8 AQMA	New Bank	21.9	22.7	0.8
Medium Risk: Receptors within 200m of AQMAs				
Calderdale No.1 AQMA	Salterhebble and Huddersfield road	17.5	17.9	0.4
Calderdale No.2 AQMA	Sowerby Bridge	12.0	12.2	0.2
Calderdale No.3 AQMA	Hebden Bridge	16.3	16.6	0.3
Calderdale No.4 AQMA	Luddendenfoot	16.8	17.4	0.6
Calderdale No.5 AQMA	Stump Cross	17.6	18.1	0.5
Calderdale No.6 AQMA	Brighouse	19.6	20.6	1.0
Calderdale No.7 AQMA	Hipperholme	15.1	15.3	0.2
Calderdale No.8 AQMA	New Bank	20.7	21.3	0.6
Medium Risk: Receptors within 200m of Monitored NO_2 >36µg/m^3 (outside AQMA)				
Mytholmroyd		12.4	12.5	0.1
Godley Gardens		16.7	17.0	0.3
West Vale		11.3	11.4	0.1
Ainley Top		17.4	17.7	0.3

Scammonden	16.5	16.5	<0.0
Clifton	23.4	23.8	0.4
Medium Risk: Receptors within 200m of Constrained Junctions (outside AQMA)			
Junctions within and surrounding Sowerby Bridge	12.0	12.1	0.1
Junctions within and surrounding Halifax	20.7	21.3	0.6
Junctions within and surrounding Salterhebble	17.5	17.9	0.4
Junctions within and surrounding Elland	26.9	27.1	0.2
Junctions within and surrounding Brighouse	19.6	20.6	1.0
Junctions within and surrounding Clifton	36.3	36.5	0.2

Table C.3 – Local $PM_{2.5}$ Results

Name	Location	Annual Mean $PM_{2.5}$ (µg/m^3) Without Local Plan	Annual Mean $PM_{2.5}$ (µg/m^3) With Local Plan	Impact (µg/m^3)
High Constraint: Receptors within AQMAs				
Calderdale No.1 AQMA	Salterhebble and Huddersfield road	9.5	9.6	0.1
Calderdale No.2 AQMA	Sowerby Bridge	8.0	8.1	0.1
Calderdale No.3 AQMA	Hebden Bridge	8.6	8.7	0.1
Calderdale No.4 AQMA	Luddendenfoot	7.8	7.9	0.1
Calderdale No.5 AQMA	Stump Cross	9.5	9.7	0.2
Calderdale No.6 AQMA	Brighouse	11.5	11.8	0.3
Calderdale No.7 AQMA	Hipperholme	9.0	9.1	0.1
Calderdale No.8 AQMA	New Bank, Halifax	11.2	11.5	0.3
Moderate Constraint: Receptors within 200m of AQMAs				
Calderdale No.1 AQMA	Salterhebble and Huddersfield road	9.4	9.5	0.1
Calderdale No.2 AQMA	Sowerby Bridge	7.6	7.6	<0.0
Calderdale No.3 AQMA	Hebden Bridge	8.6	8.7	0.1
Calderdale No.4 AQMA	Luddendenfoot	8.7	8.9	0.2
Calderdale No.5 AQMA	Stump Cross	9.1	9.2	0.1
Calderdale No.6 AQMA	Brighouse	10.6	10.8	0.2
Calderdale No.7 AQMA	Hipperholme	8.8	9.0	0.2
Calderdale No.8 AQMA	New Bank, Halifax	11.0	11.2	0.2
Moderate Constraint: Receptors within 200m of Monitored NO_2 >36µg/m^3 (outside AQMA)				
Mytholmroyd		7.2	7.2	<0.0
Godly Gardens		8.9	9.1	0.2
West Vale		7.3	7.3	<0.0

Ainley Top	9.8	9.8	<0.0
Scammonden	9.0	9.0	<0.0
Clifton	11.4	11.7	0.3
Medium Risk: Receptors within 200m of Constrained Junctions (outside AQMA)			
Junctions within and surrounding Sowerby Bridge	7.6	7.7	0.1
Junctions within and surrounding Halifax	11.0	11.2	0.2
Junctions within and surrounding Salterhebble	9.3	9.5	0.2
Junctions within and surrounding Elland	13.4	13.5	0.1
Junctions within and surrounding Brighouse	10.6	10.8	0.2
Junctions within and surrounding Clifton	16.0	16.1	0.1

'DO-SOMETHING' NO_2 RESULTS WITH LOCAL PLAN (INCLUSIVE OF OTHER LOCAL PLANS)

Plate C-1 - Clifton Do-Something 2032 With Local Plan NO_2

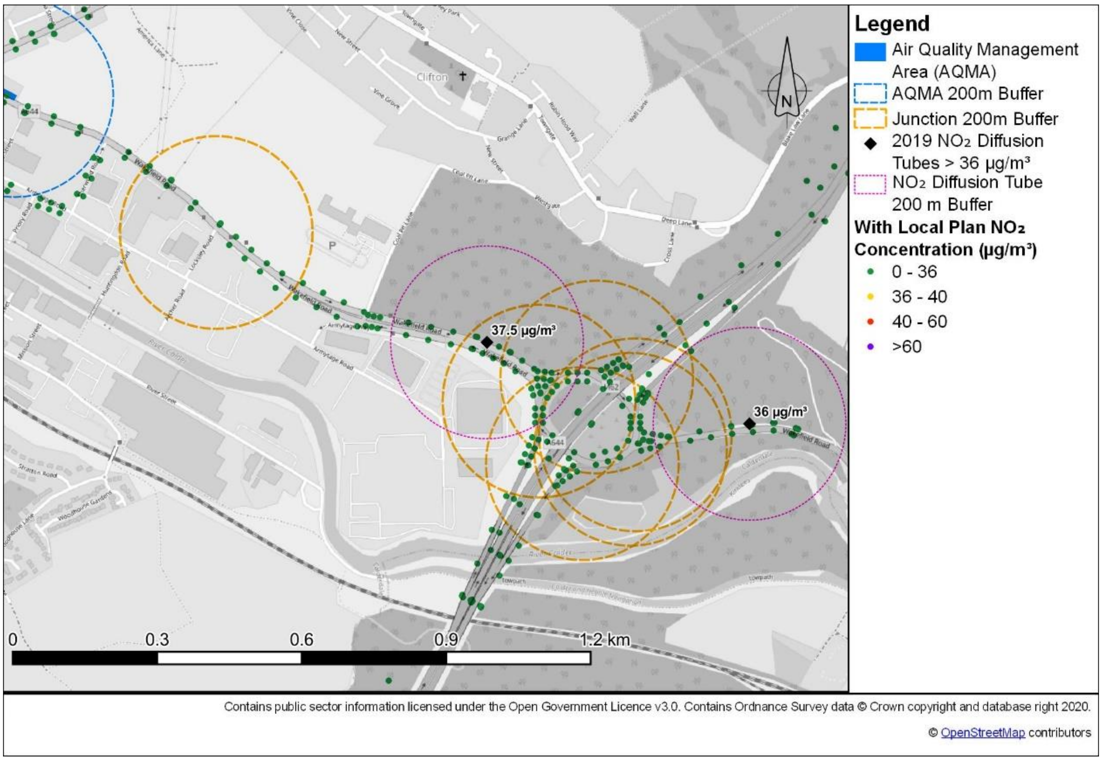


Plate C-2 - Clifton Do-Something 2032 With Local Plan Change in NO_2

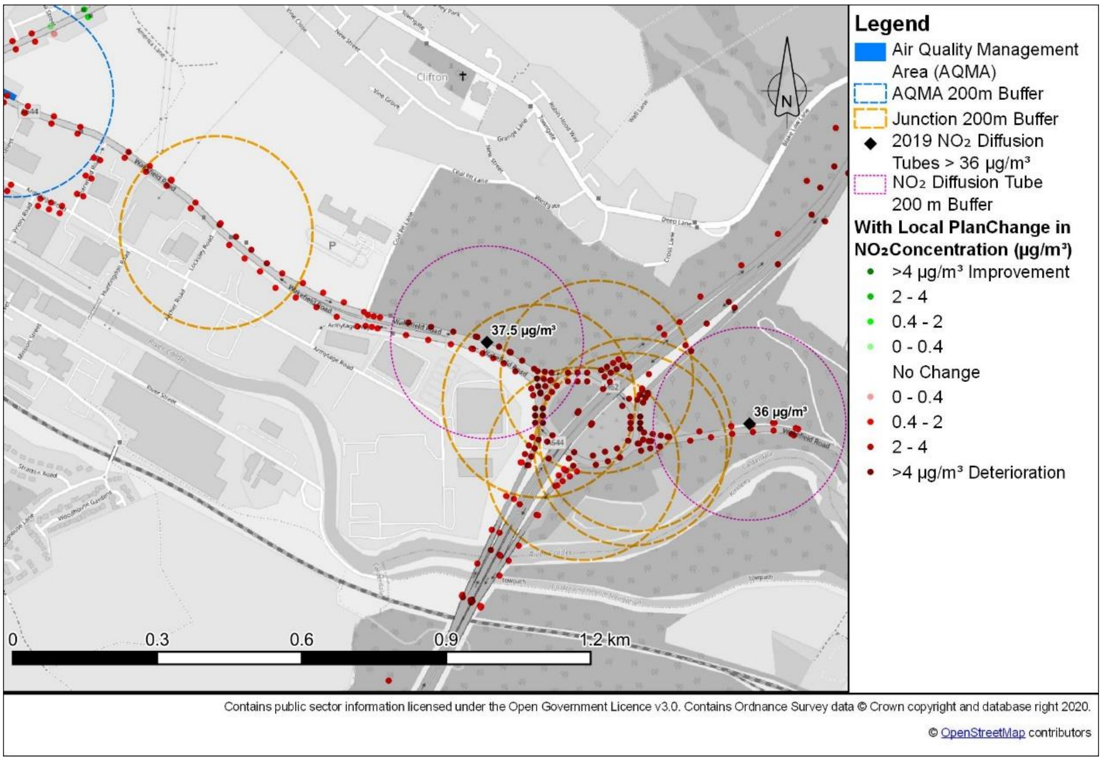


Plate C-3 - Calderdale AQMA No. 2 Sowerby Bridge Do-Something 2032 With Local Plan NO_2

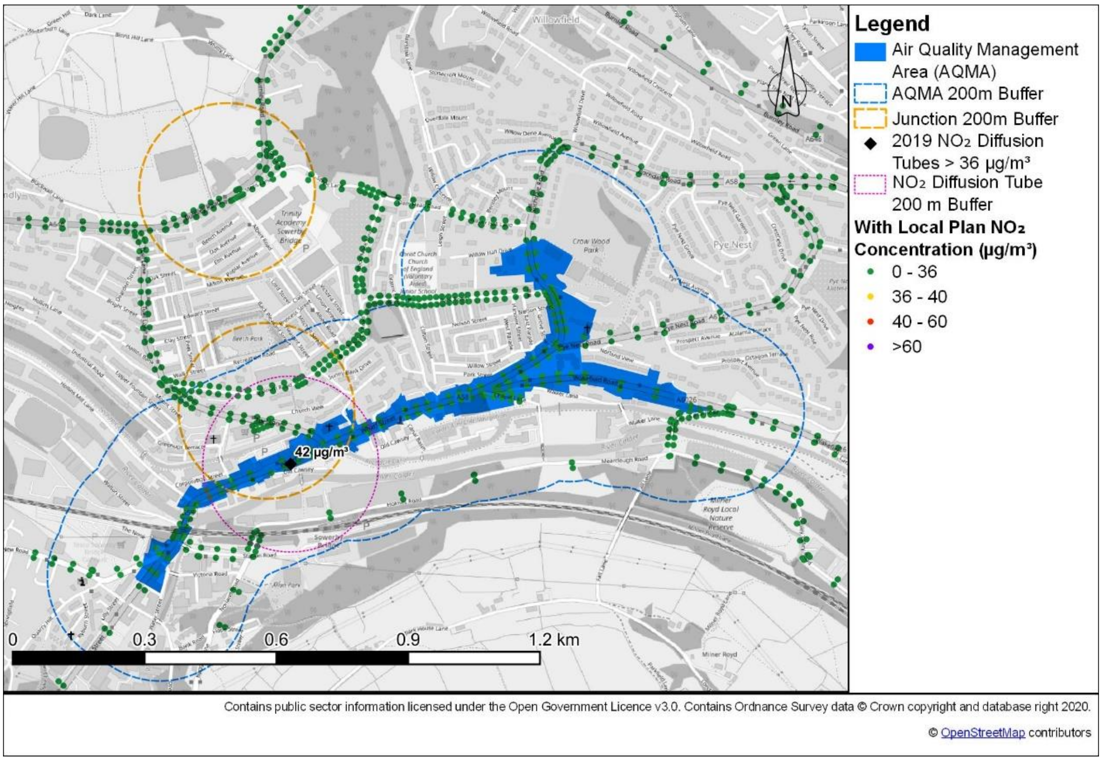


Plate C-4 - Calderdale AQMA No. 2 Sowerby Bridge Do-Something 2032 With Local Plan Change in NO_2

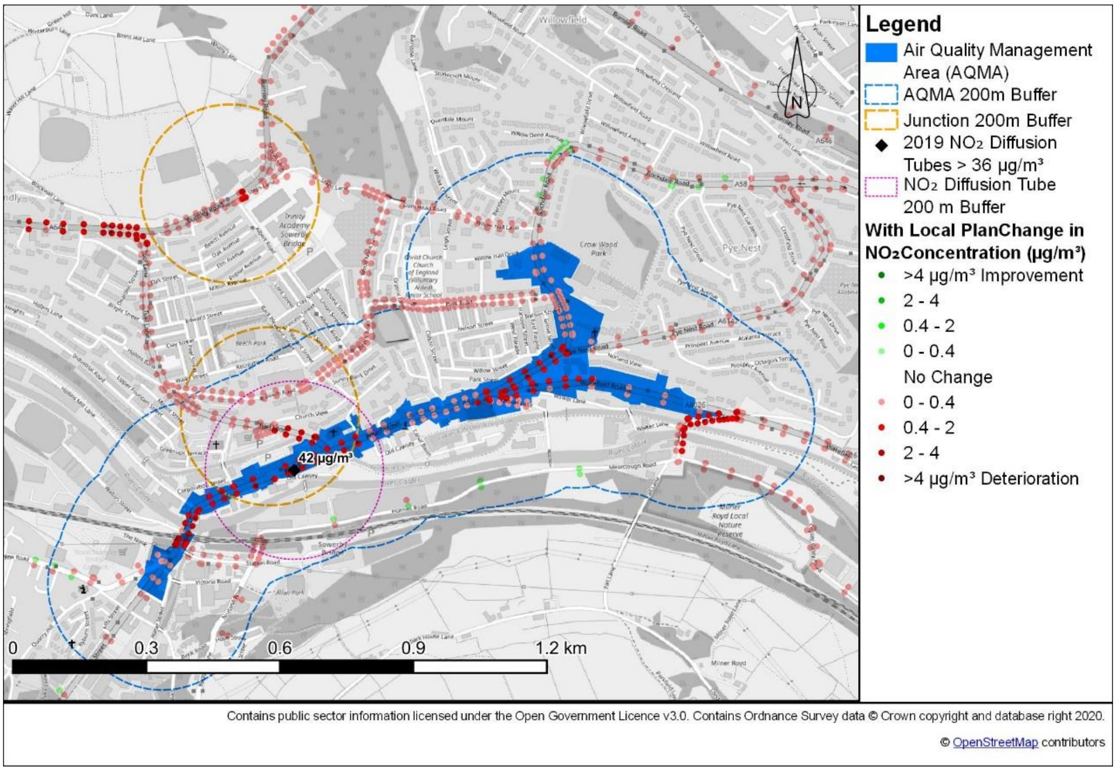


Plate C-5 - Shelf Do-Something 2032 With Local Plan NO_2

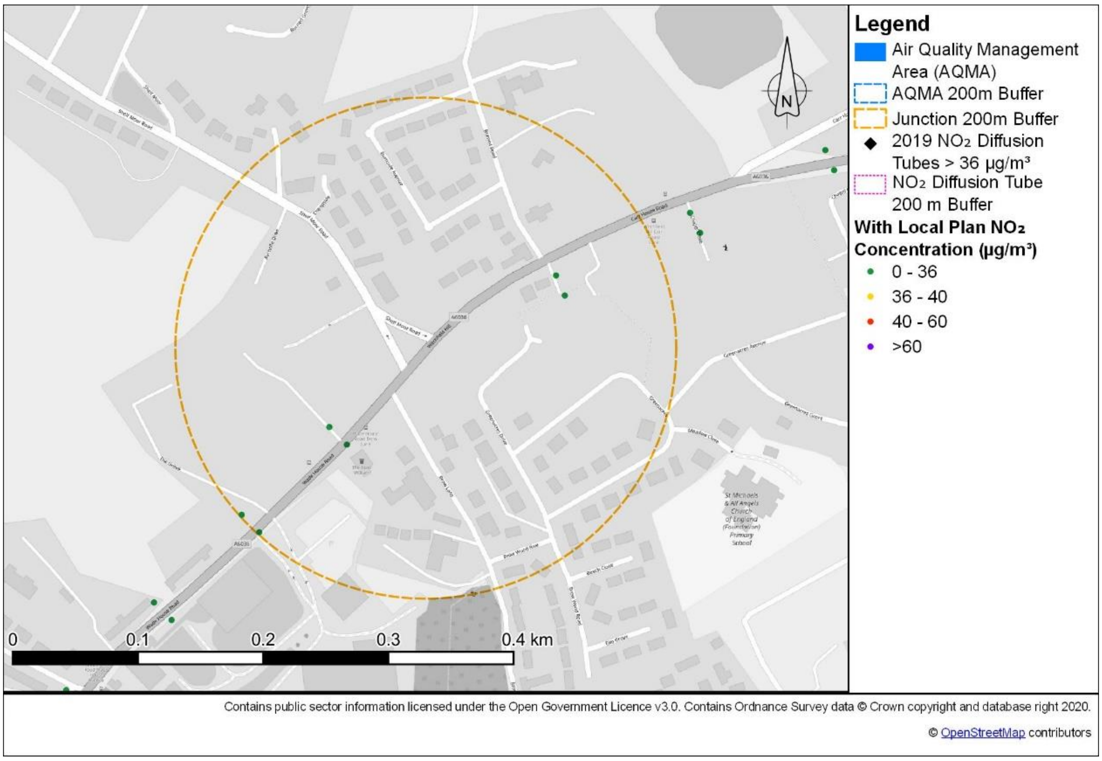


Plate C-6 - Shelf Do-Something 2032 With Local Plan Change in NO_2

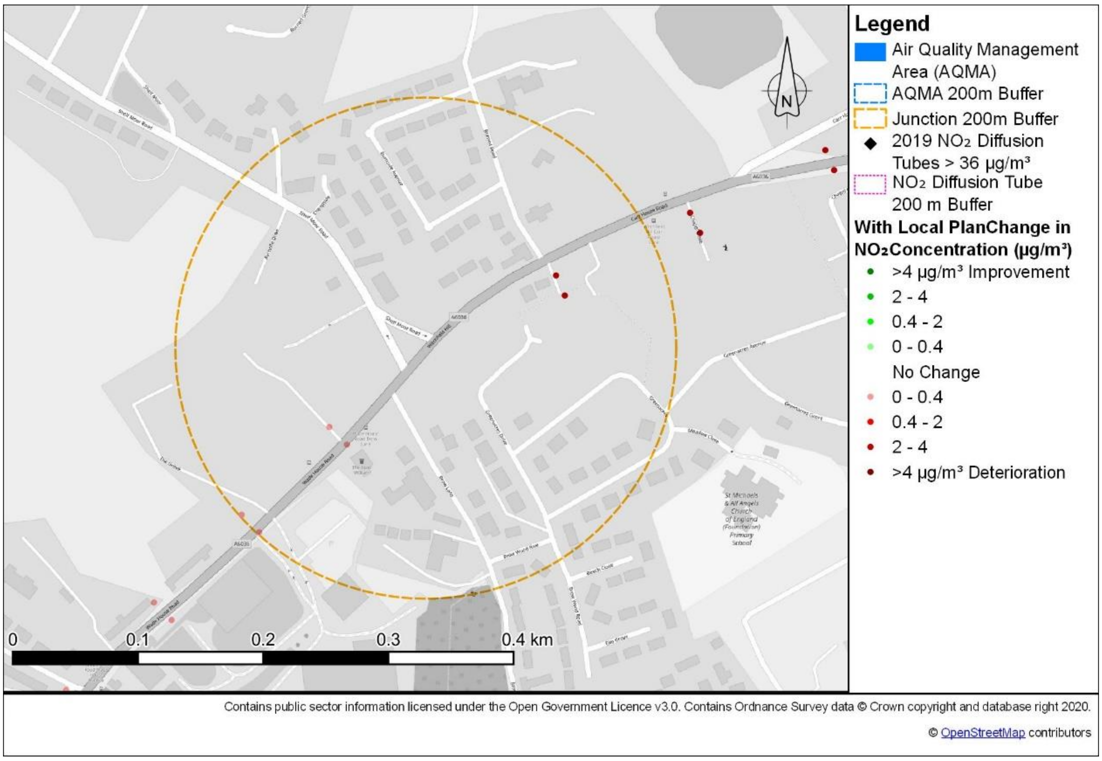


Plate C-7 - Calderdale AQMA No. 1 Salterhebble Do-Something 2032 With Local Plan NO_2

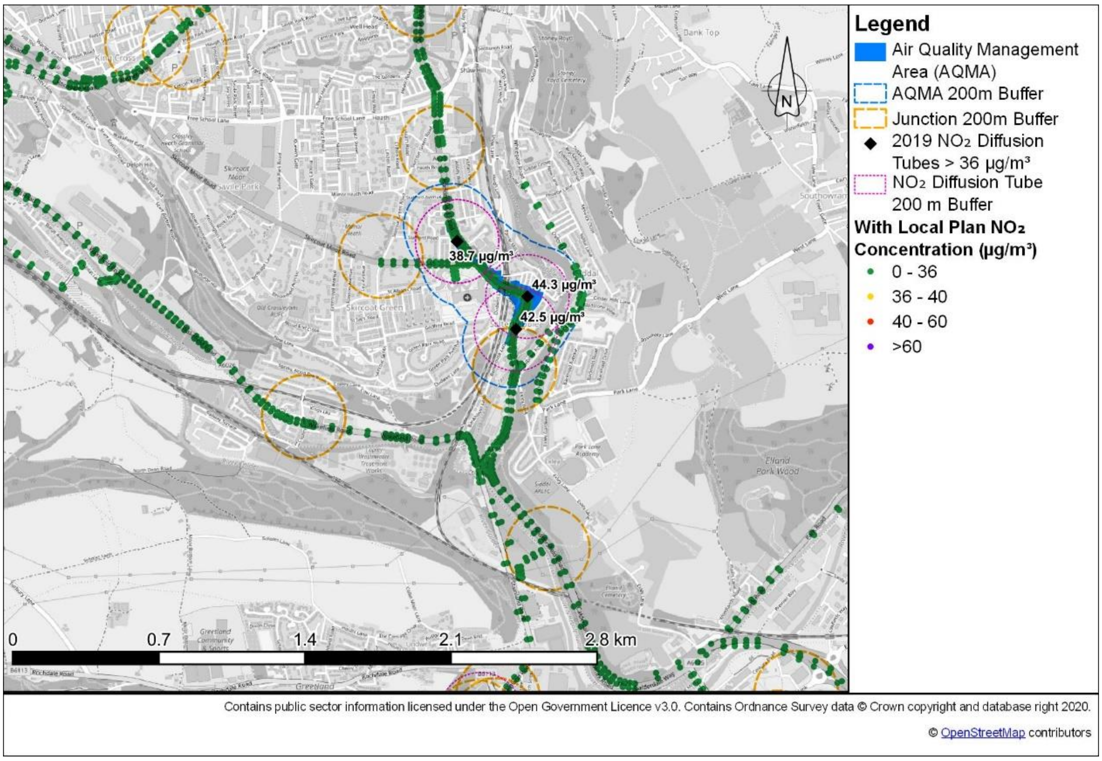


Plate C-8 - Calderdale AQMA No. 1 Salterhebble Do-Something 2032 With Local Plan Change in NO_2

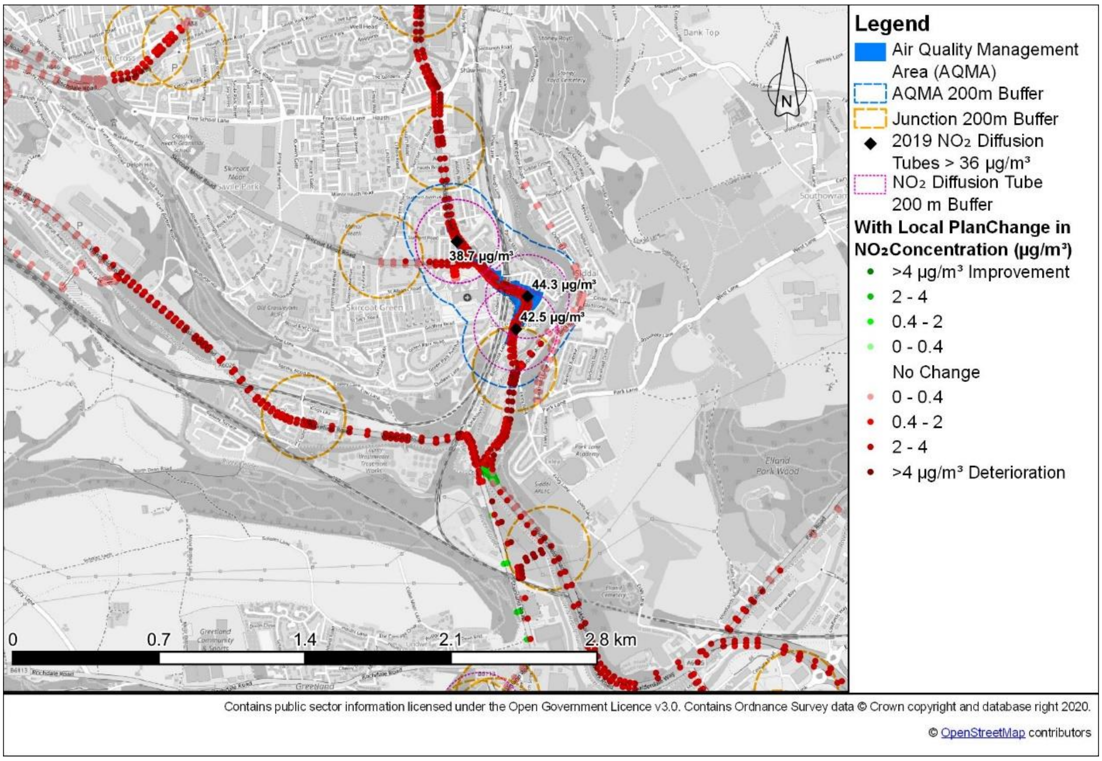


Plate C-9 - Northowram Do-Something 2032 With Local Plan NO_2

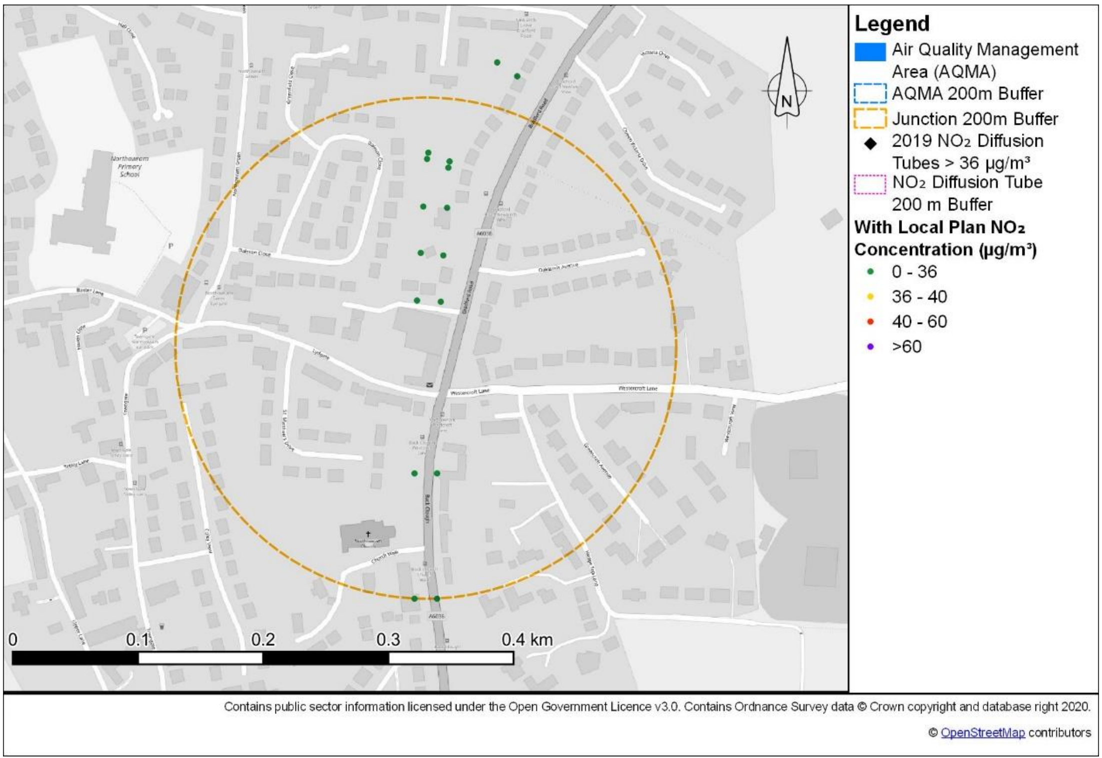


Plate C-10 - Northowram Do-Something 2032 With Local Plan Change in NO_2

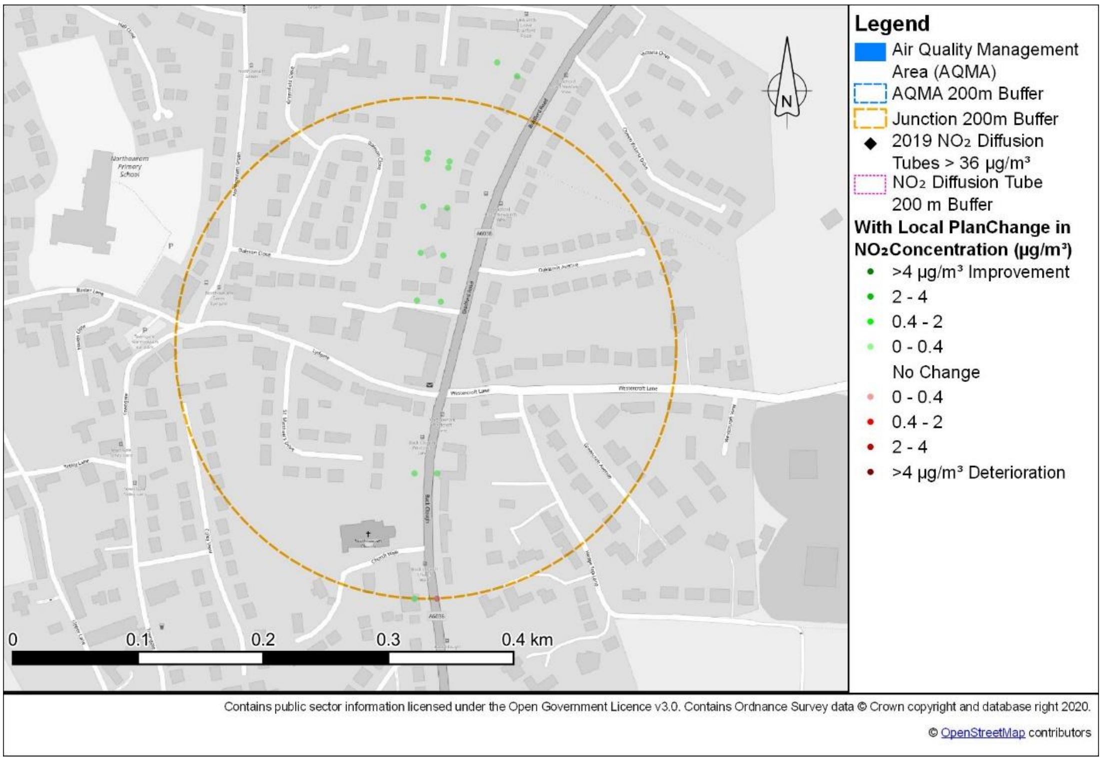


Plate C-11 - Kings Cross Do-Something 2032 With Local Plan NO_2

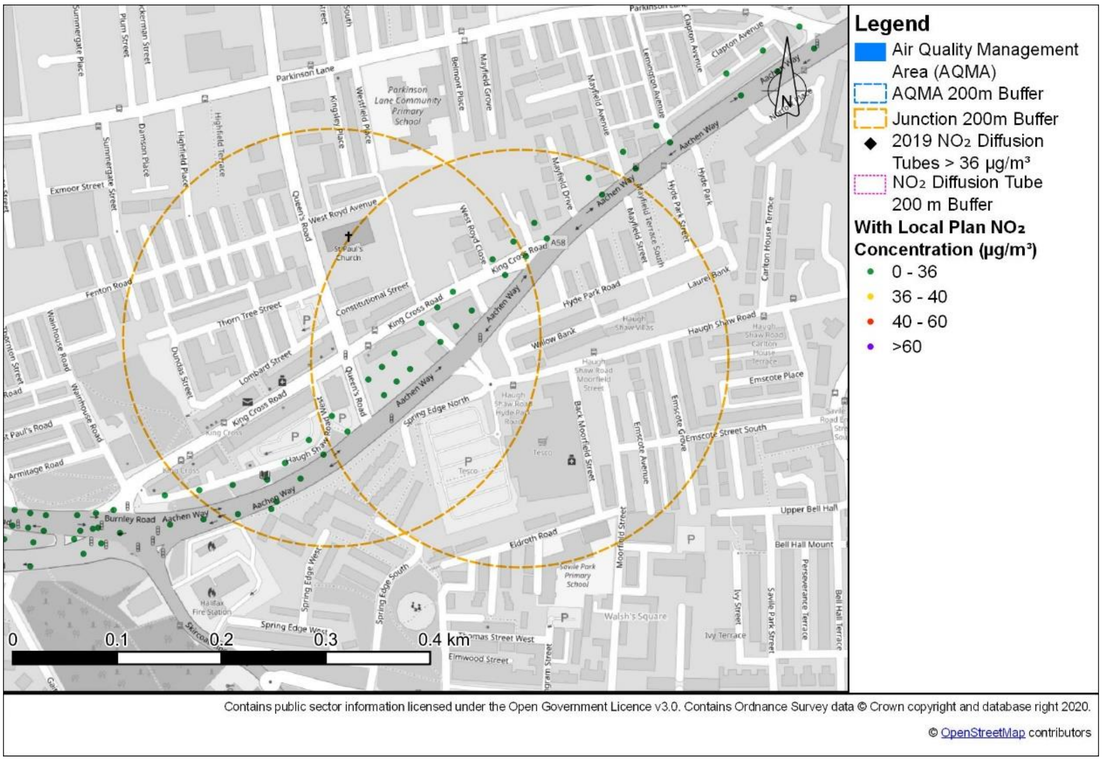


Plate C-12 - Kings Cross Do-Something 2032 With Local Plan Change in NO_2

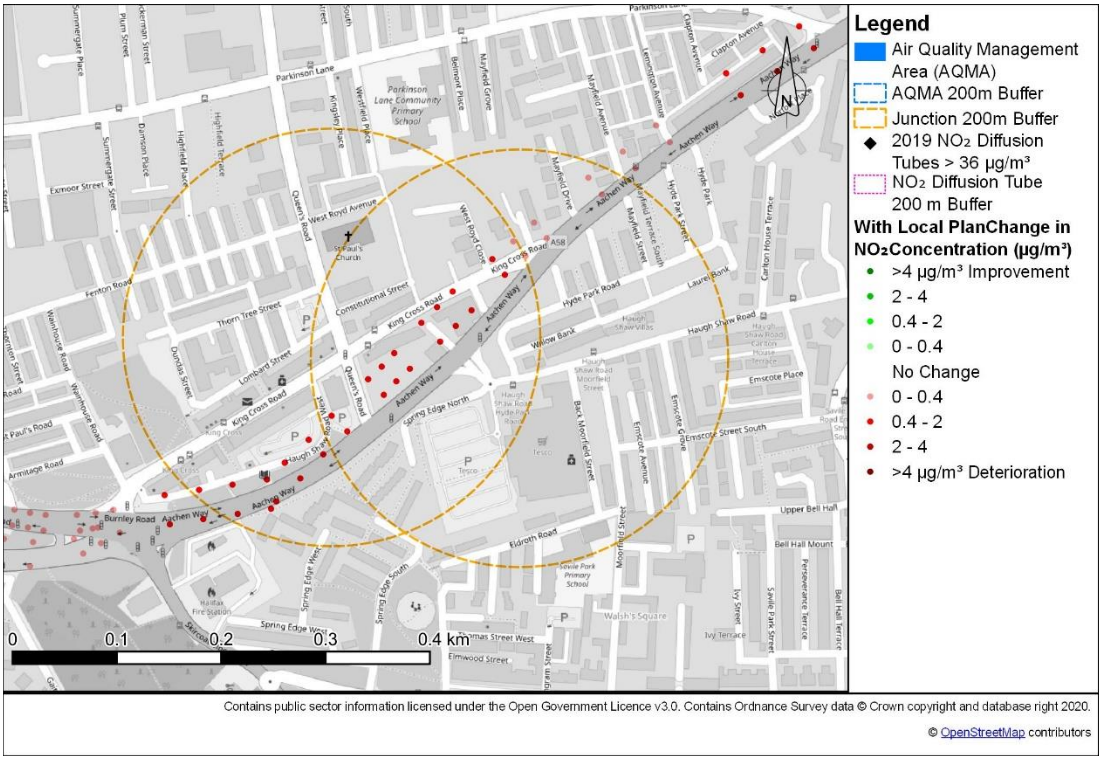


Plate C-13 - Ovenden Do-Something 2032 With Local Plan NO_2

Plate C-14 - Ovenden Do-Something 2032 With Local Plan Change in NO_2

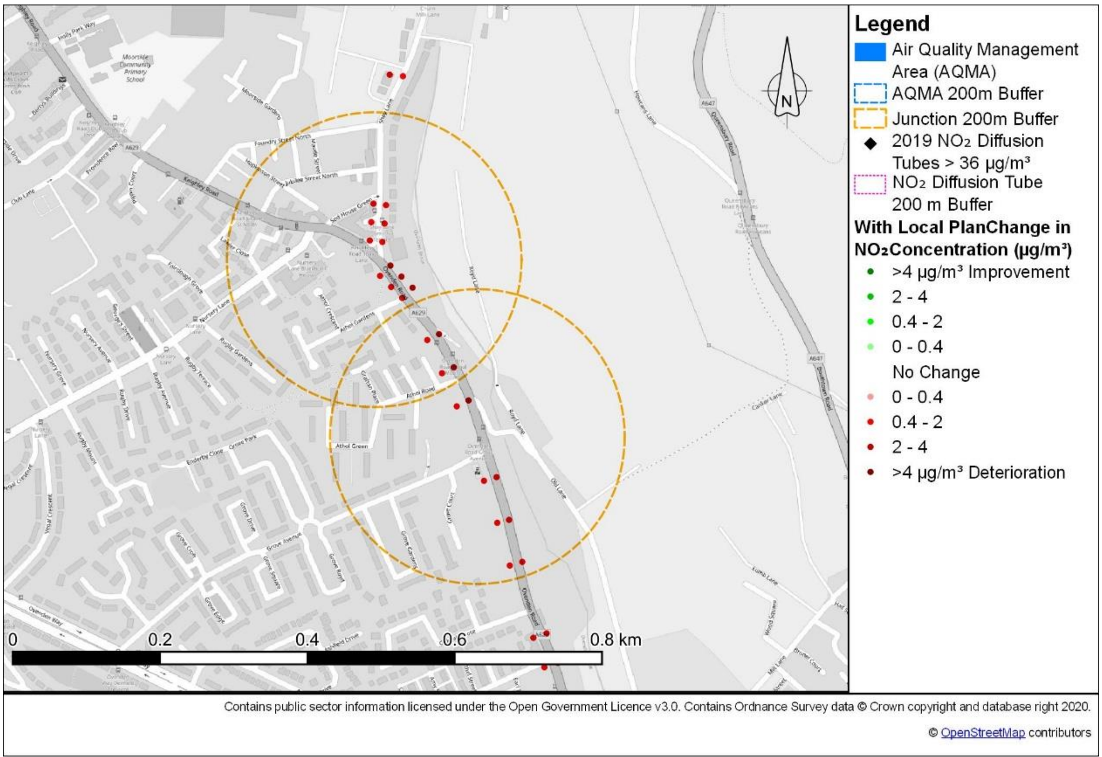


Plate C-15 Elland Do-Something 2032 With Local Plan NO_2

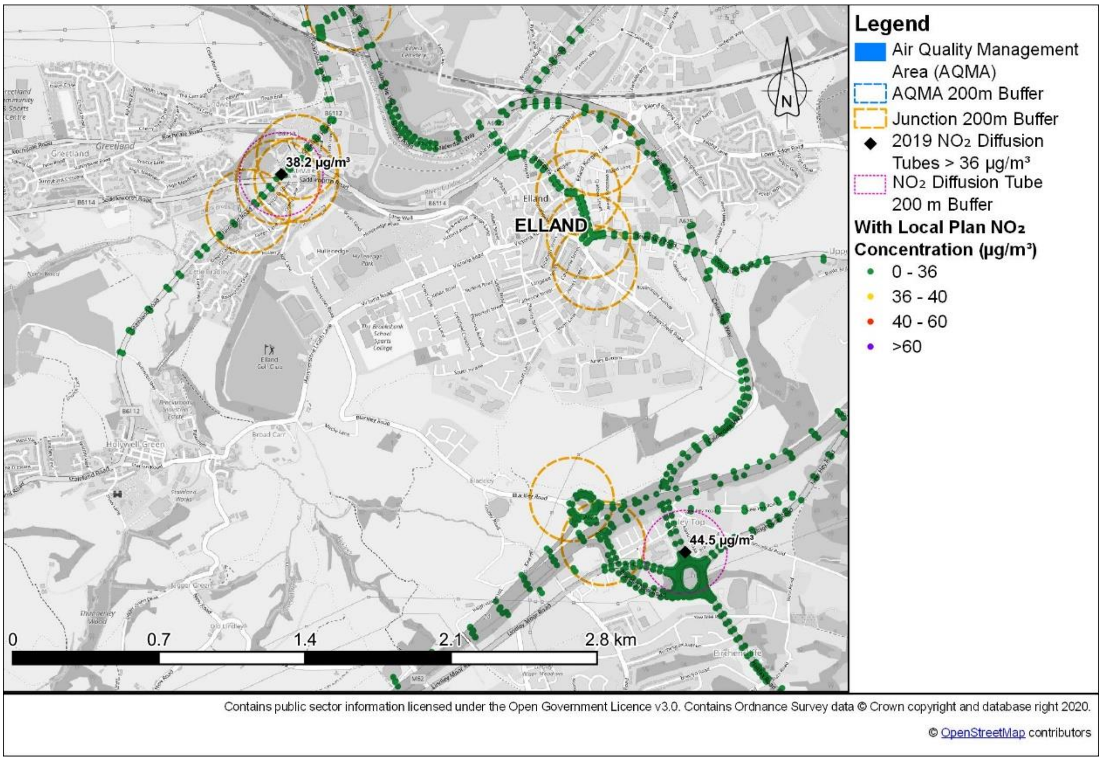


Plate C-16 Elland Do-Something 2032 With Local Plan Change in NO_2

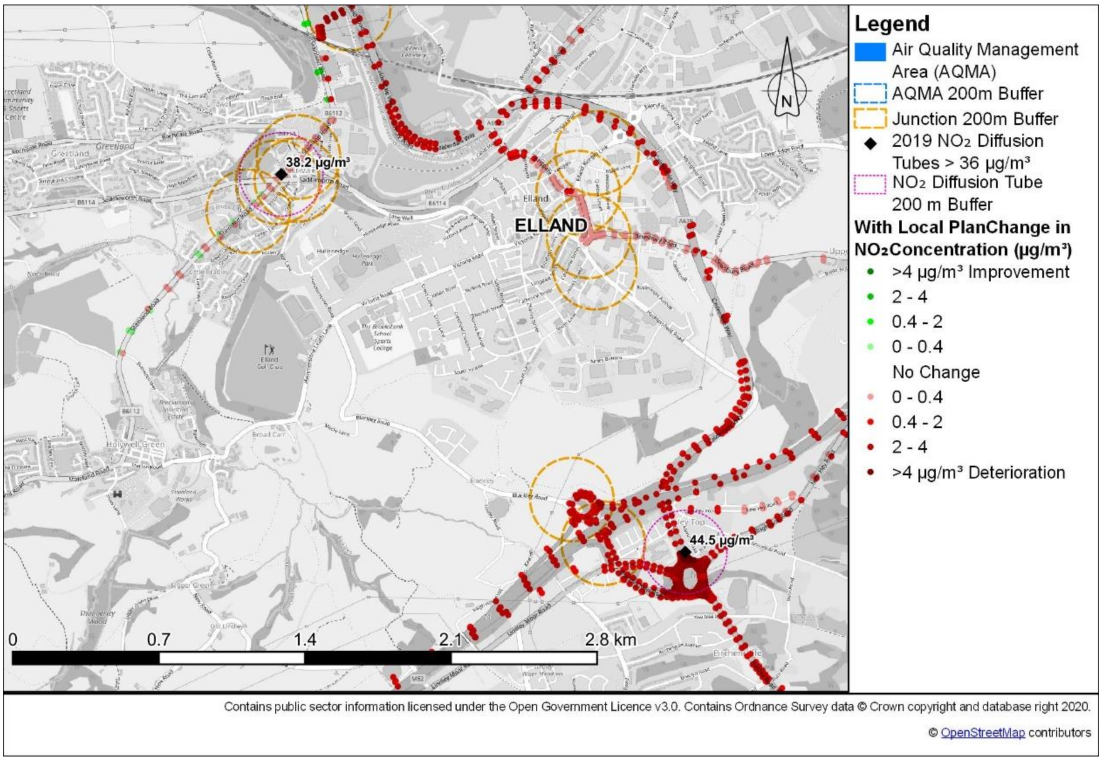


Plate C-17 Rastrick Do-Something 2032 With Local Plan NO_2

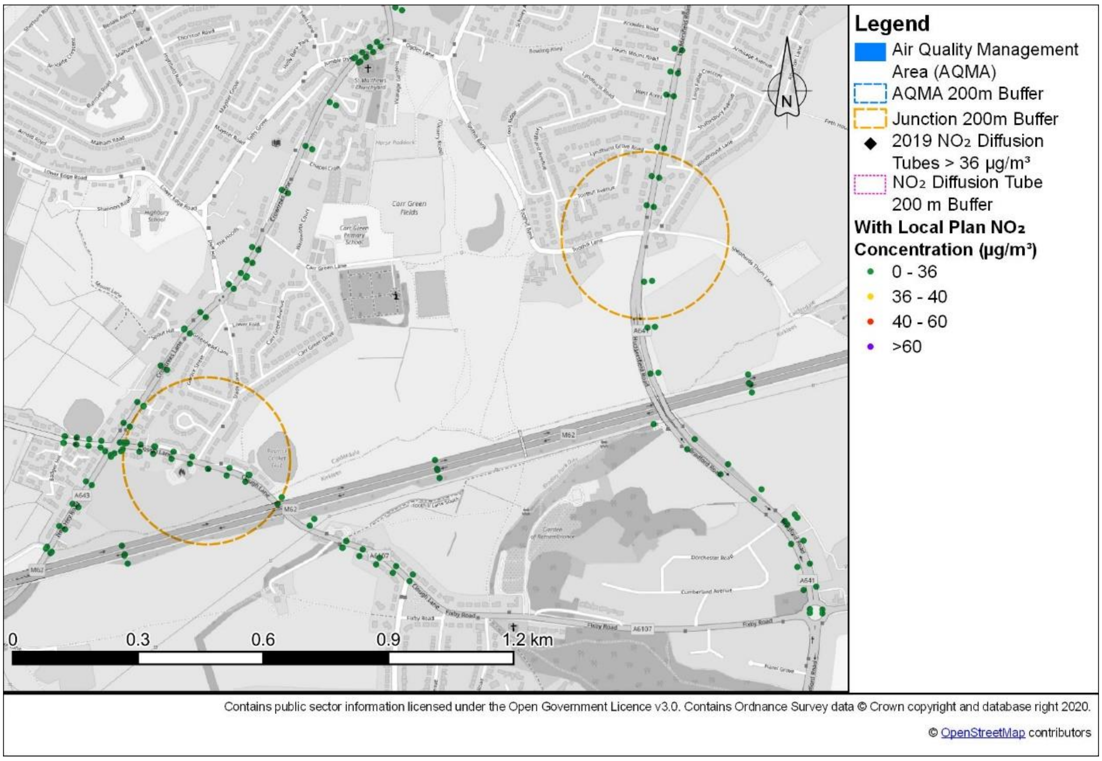


Plate C-18 Rastrick Do-Something 2032 With Local Plan Change in NO_2

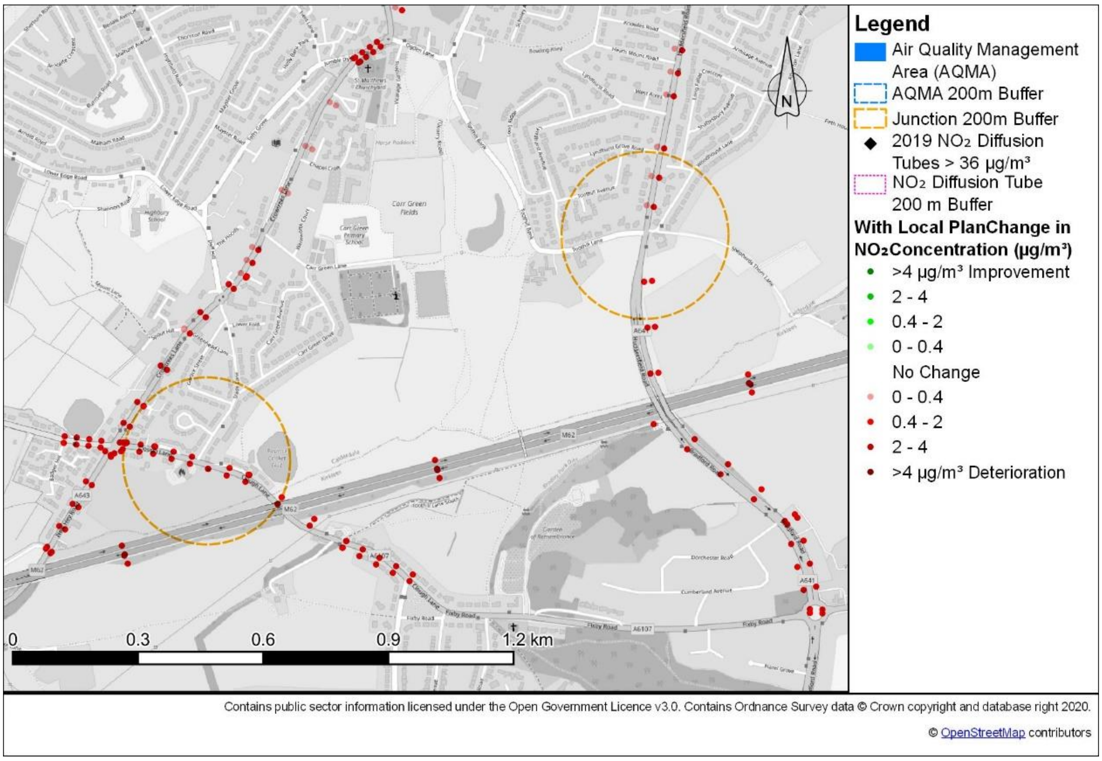
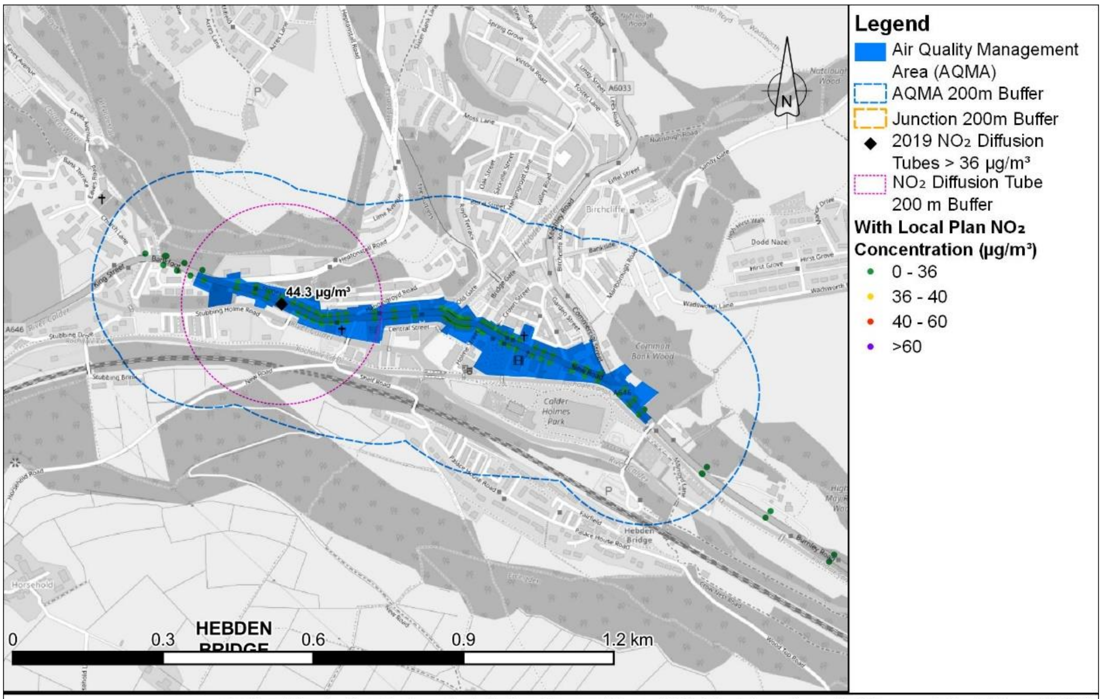
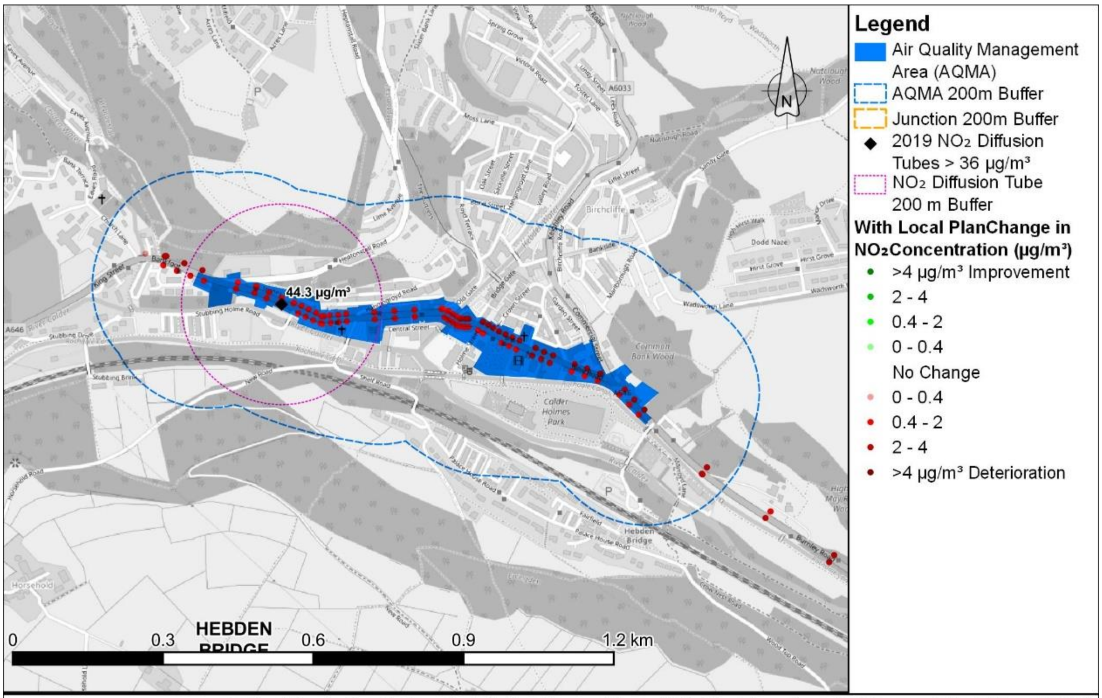


Plate C-19 Calderdale No.3 AQMA Hebden Bridge Do-Something 2032 With Local Plan NO_2



Contains public sector information licensed under the Open Government Licence v3.0. Contains Ordnance Survey data © Crown copyright and database right 2020.
© OpenStreetMap contributors

Plate C-20 Calderdale No.3 AQMA Hebden Bridge Do-Something 2032 With Local Plan Change in NO_2



Contains public sector information licensed under the Open Government Licence v3.0. Contains Ordnance Survey data © Crown copyright and database right 2020.
© OpenStreetMap contributors

Plate C-21 Calderdale AQMA No.4 Luddendenfoot Do-Something 2032 With Local Plan NO_2

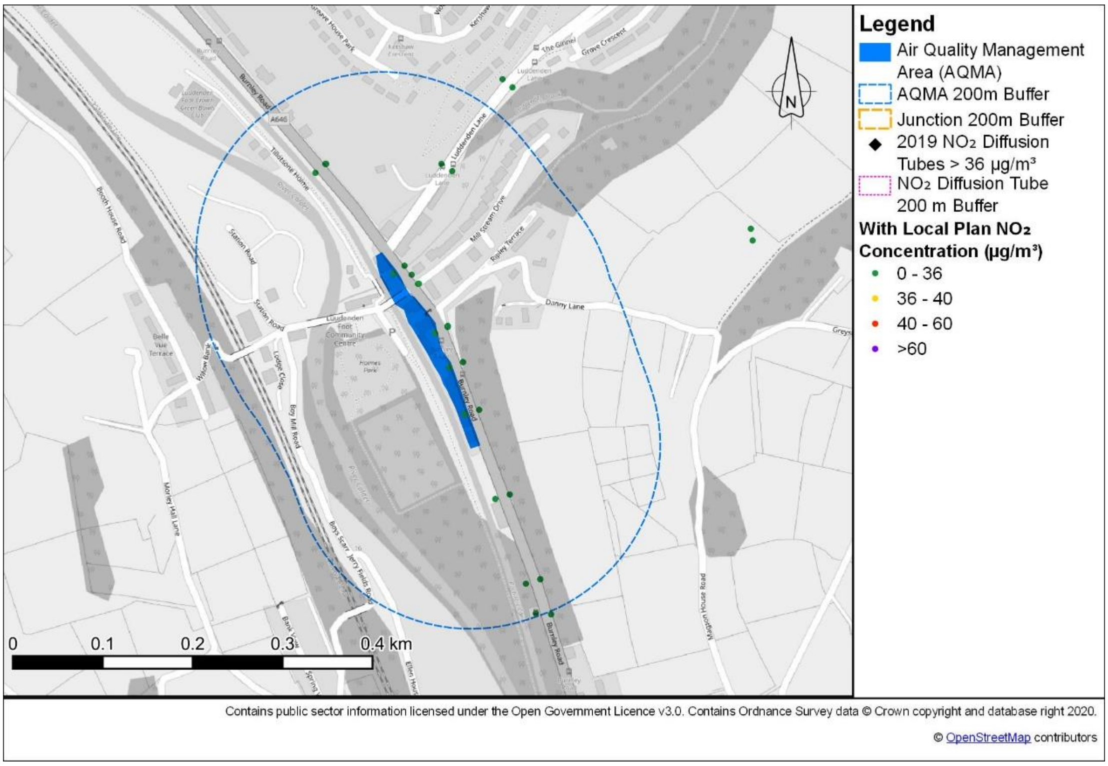


Plate C-22 Calderdale AQMA No.4 Luddendenfoot Do-Something 2032 With Local Plan Change in NO_2

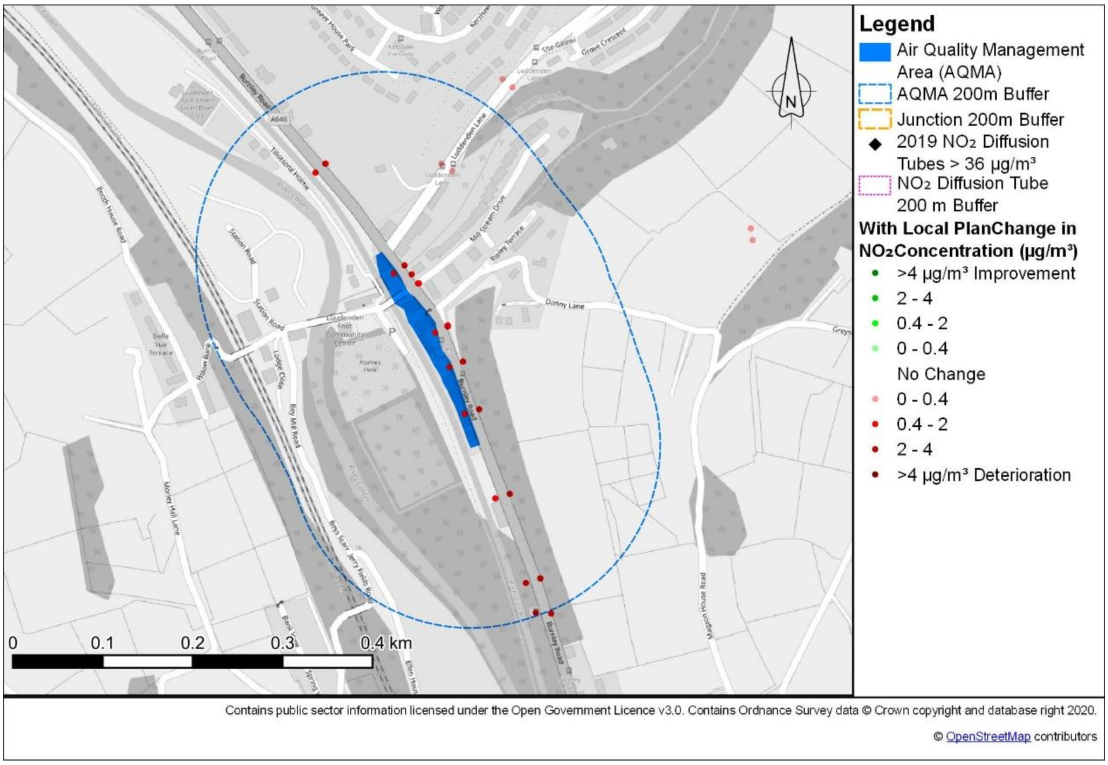


Plate C-23 Calderdale AQMA No.5 Stump Cross Do-Something 2032 With Local Plan NO_2

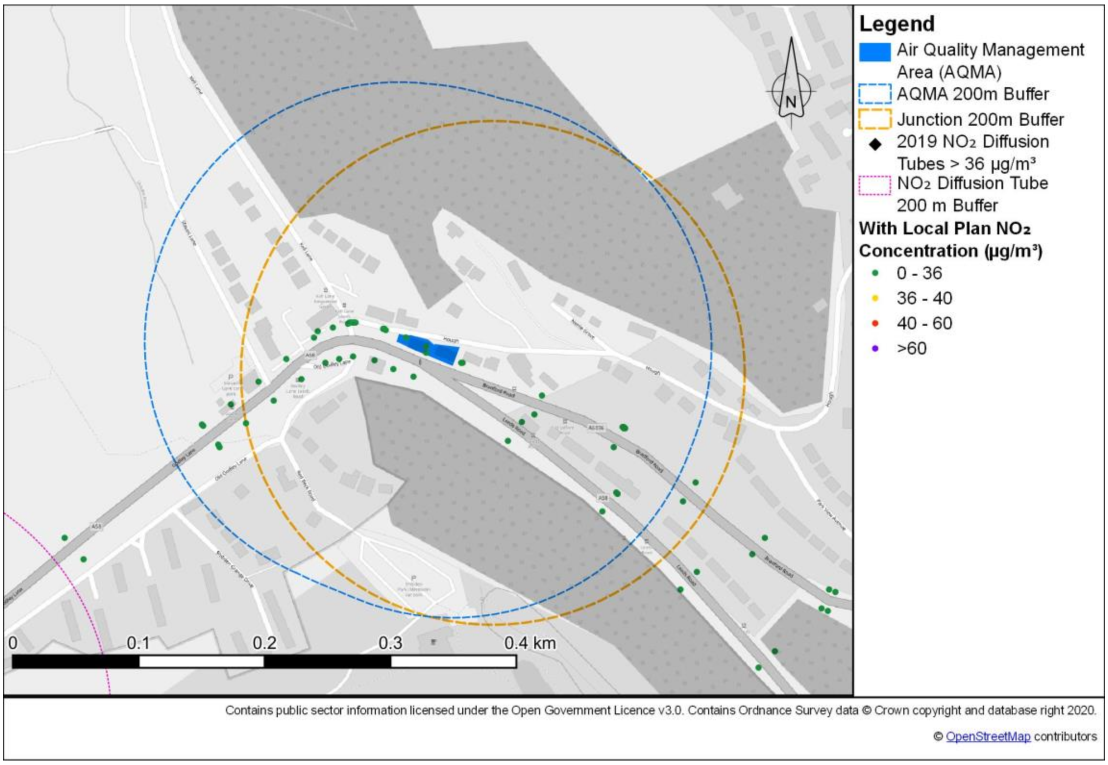


Plate C-24 Calderdale AQMA No.5 Stump Cross Do-Something 2032 With Local Plan Change in NO_2

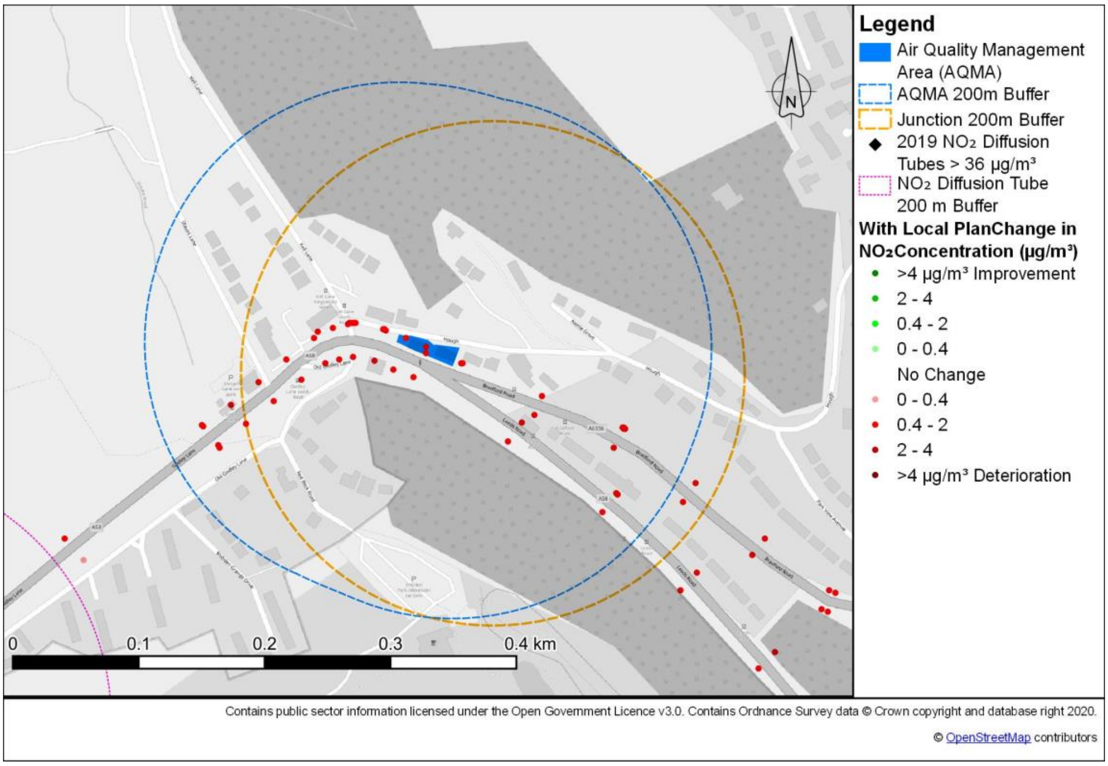


Plate C-25 Calderdale AQMA No. 6 Brighouse Do-Something 2032 With Local Plan NO_2

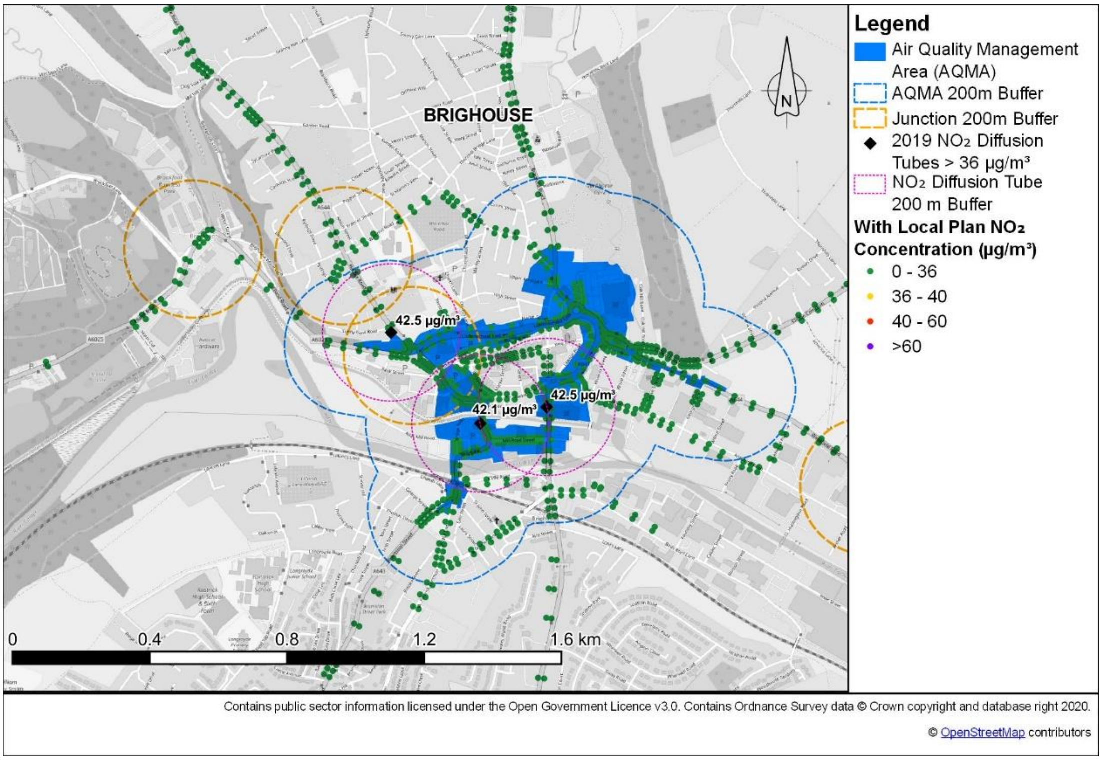


Plate C-26 Calderdale AQMA No. 6 Brighouse Do-Something 2032 With Local Plan Change in NO_2

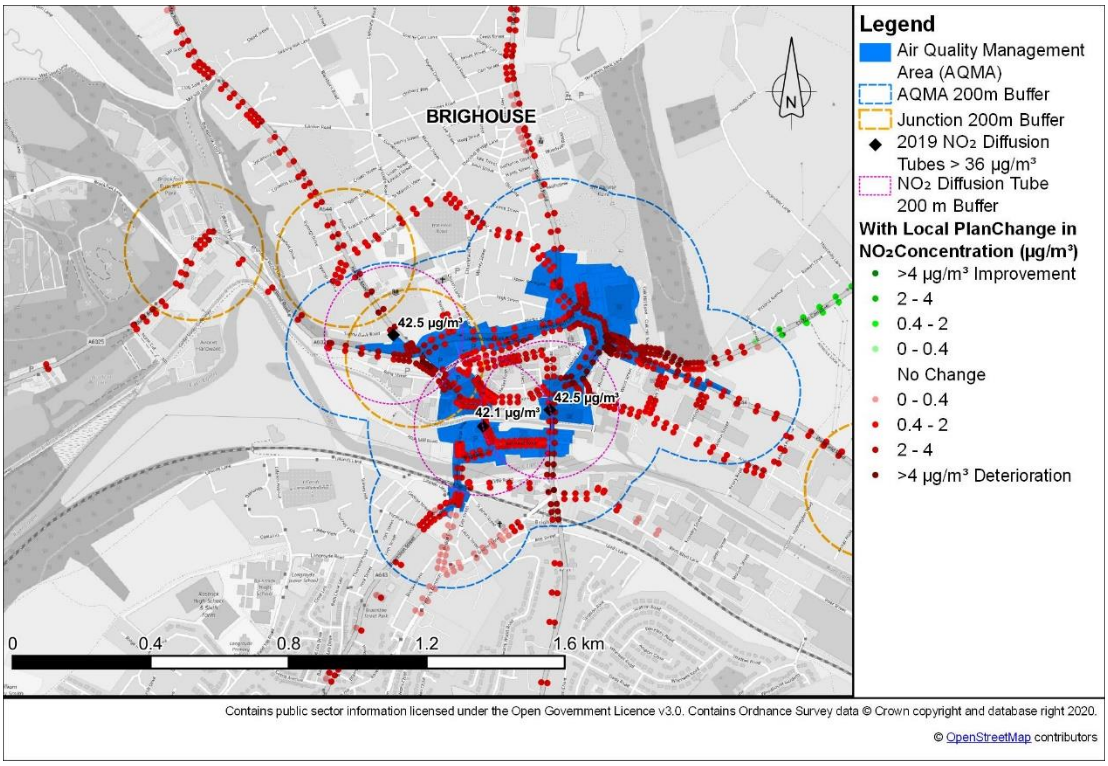
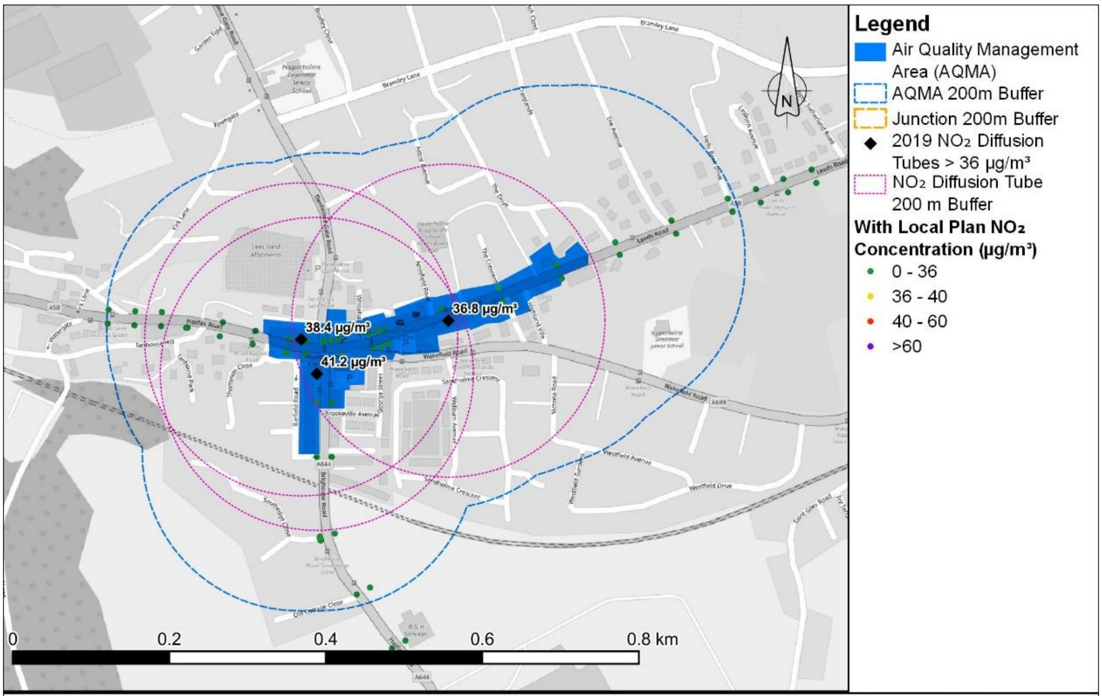
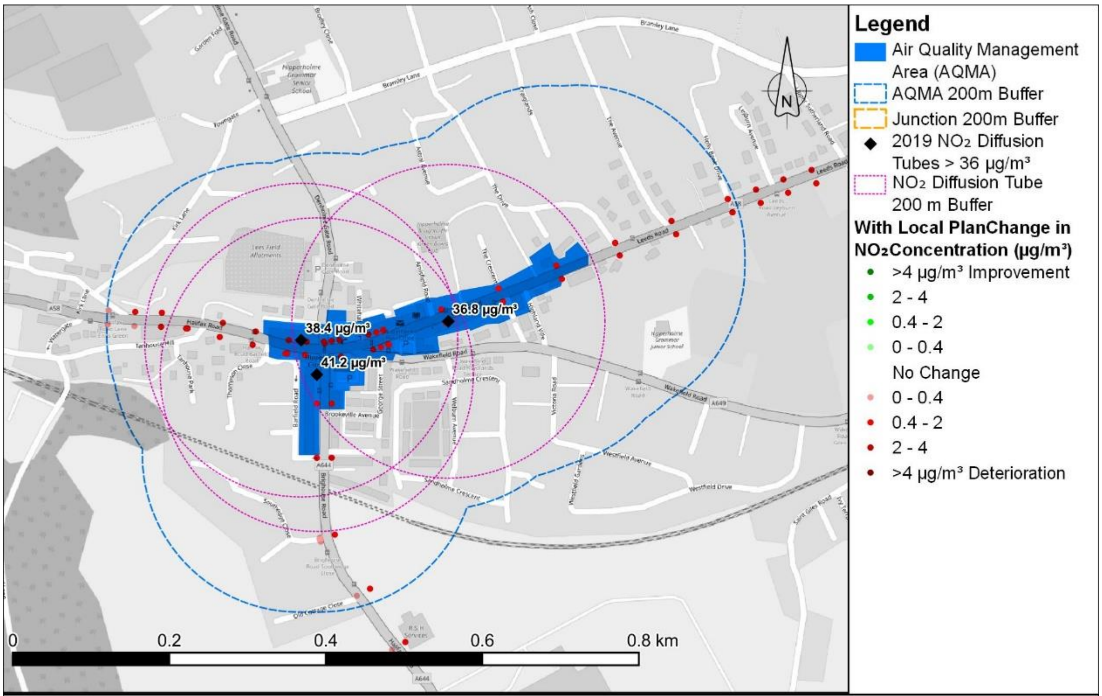


Plate C-27 Calderdale AQMA No.7 Hipperholme Do-Something 2032 With Local Plan NO_2



Contains public sector information licensed under the Open Government Licence v3.0. Contains Ordnance Survey data © Crown copyright and database right 2020.
© OpenStreetMap contributors

Plate C-28 Calderdale AQMA No.7 Hipperholme Do-Something 2032 With Local Plan Change in NO_2



Contains public sector information licensed under the Open Government Licence v3.0. Contains Ordnance Survey data © Crown copyright and database right 2020.
© OpenStreetMap contributors

Plate C-29 Calderdale AQMA No. 8 New Bank Do-Something 2032 With Local Plan NO_2

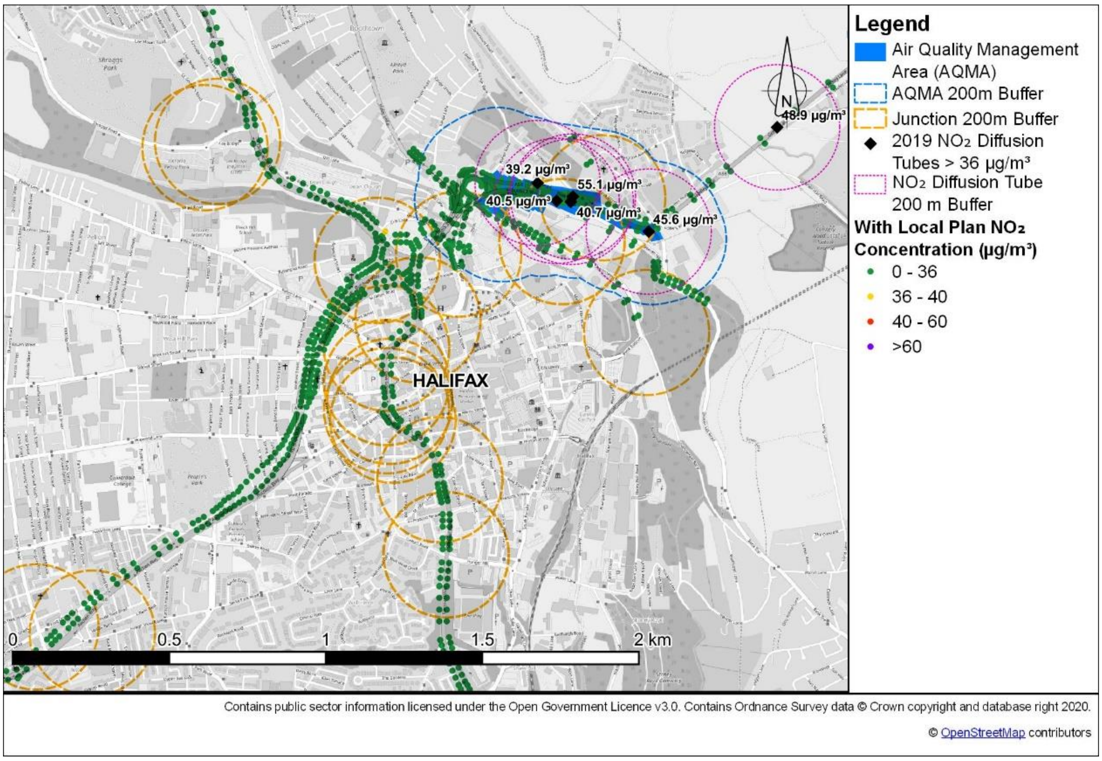


Plate C-30 Calderdale AQMA No. 8 New Bank Do-Something 2032 With Local Plan Change in NO_2

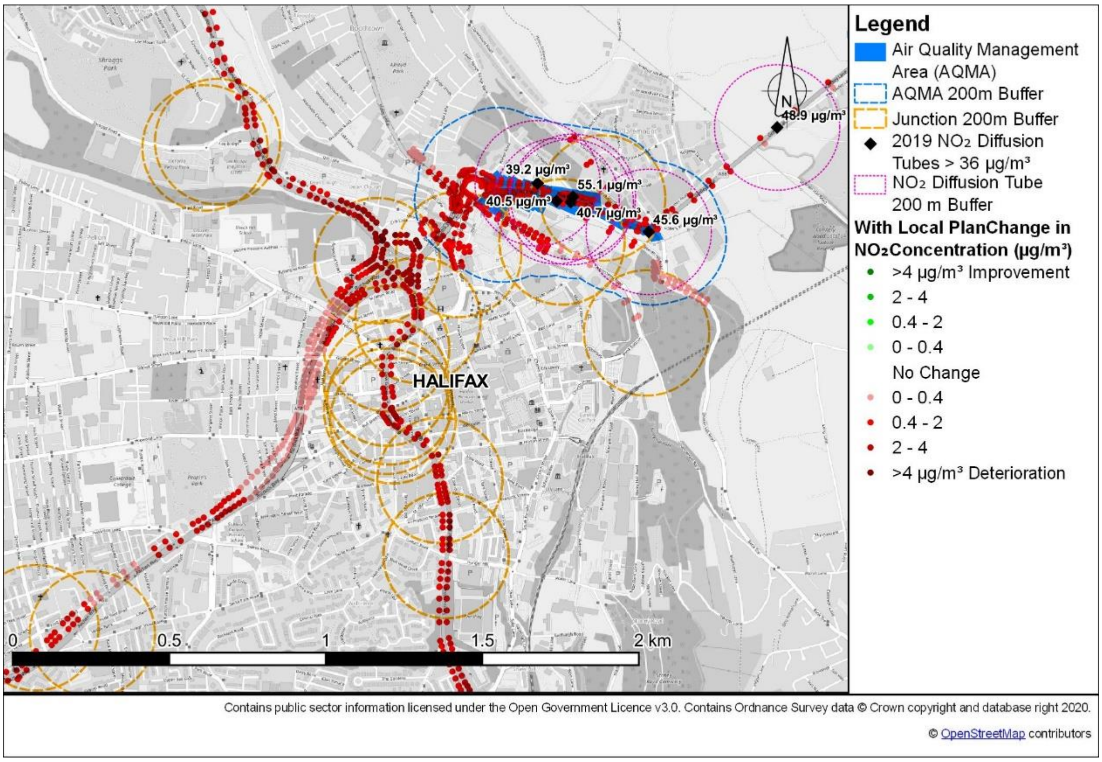


Plate C-31 Mytholmroyd Do-Something 2032 With Local Plan NO_2

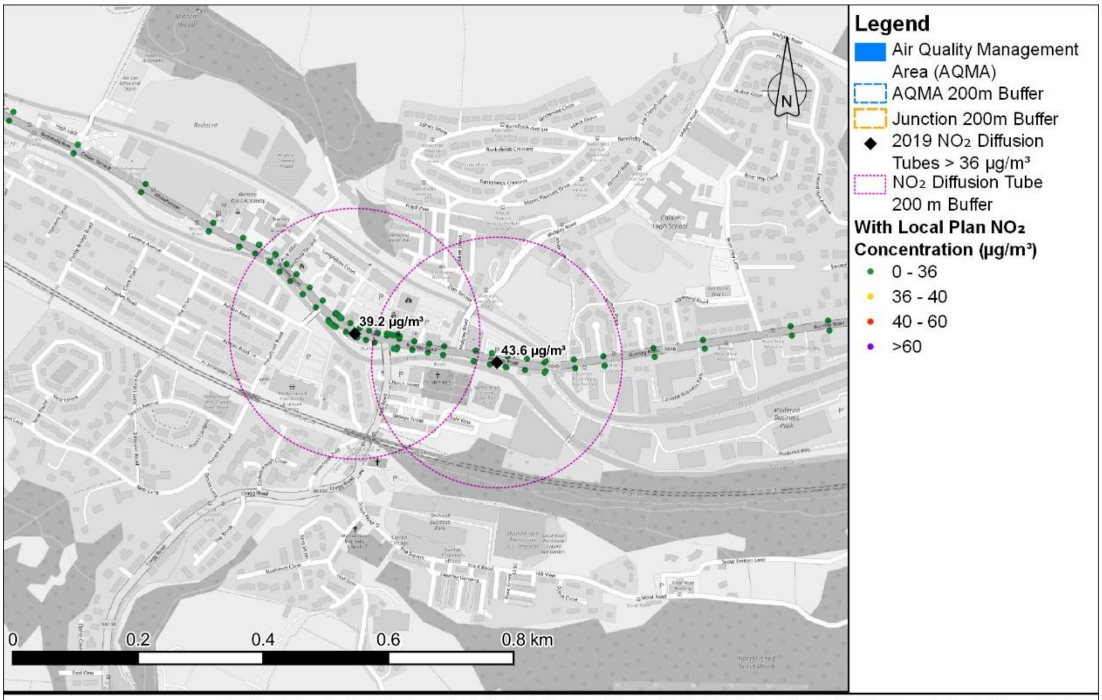


Plate C-32 Mytholmroyd Do-Something 2032 With Local Plan Change in NO_2

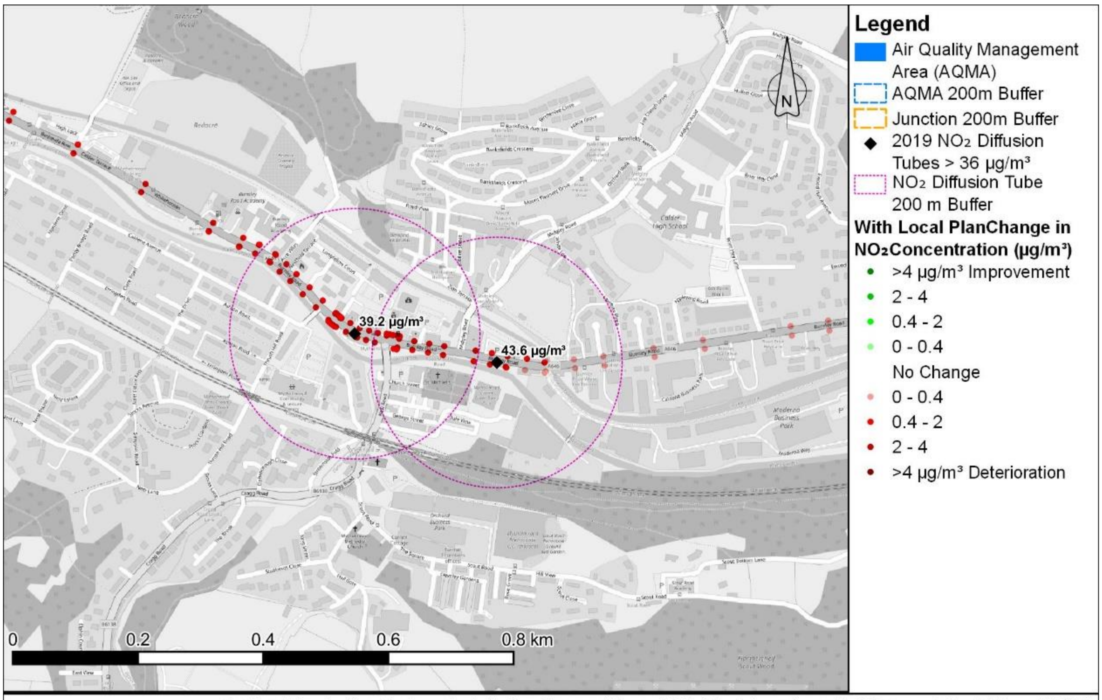


Plate C-33 Godly Gardens Do-Something 2032 With Local Plan NO_2

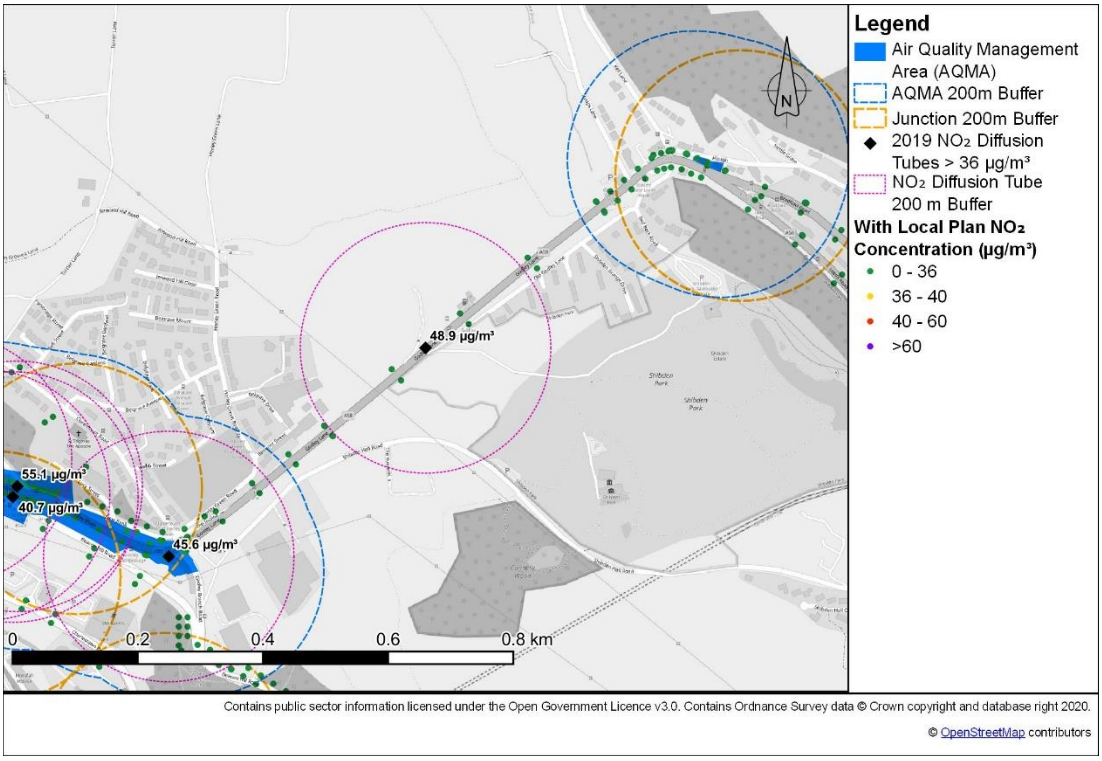


Plate C-34 Godly Gardens Do-Something 2032 With Local Plan Change in NO_2

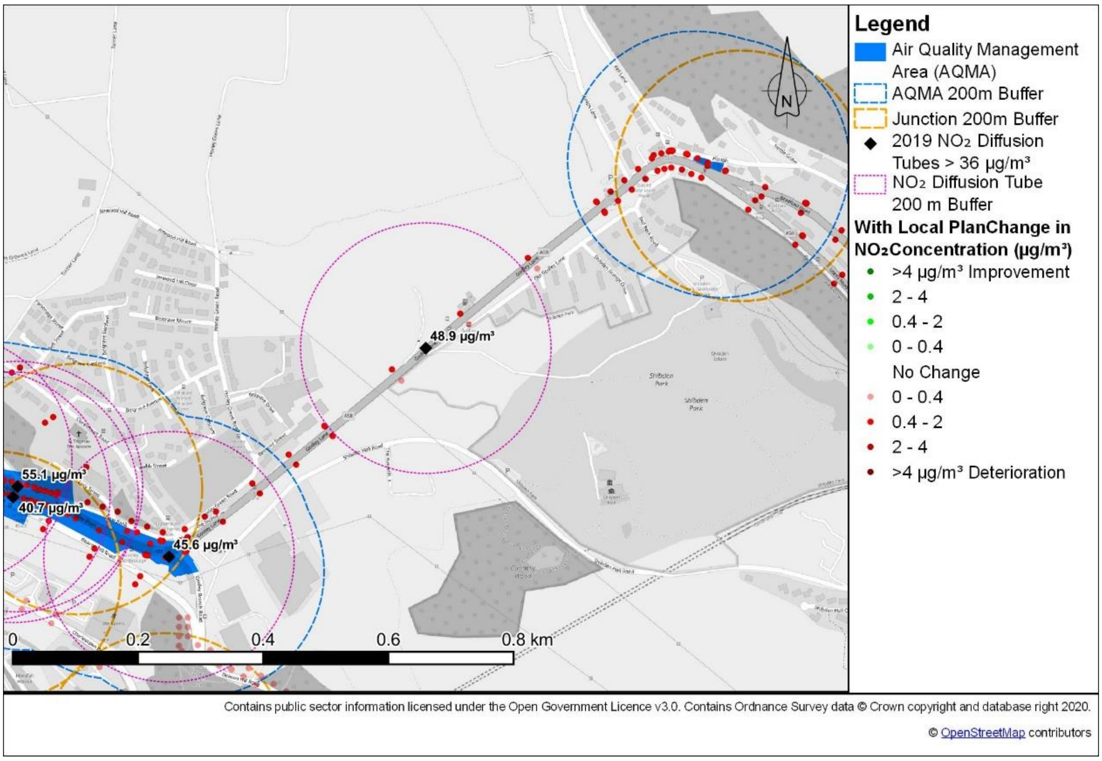


Plate C-35 Scammonden Do-Something 2032 With Local Plan NO_2

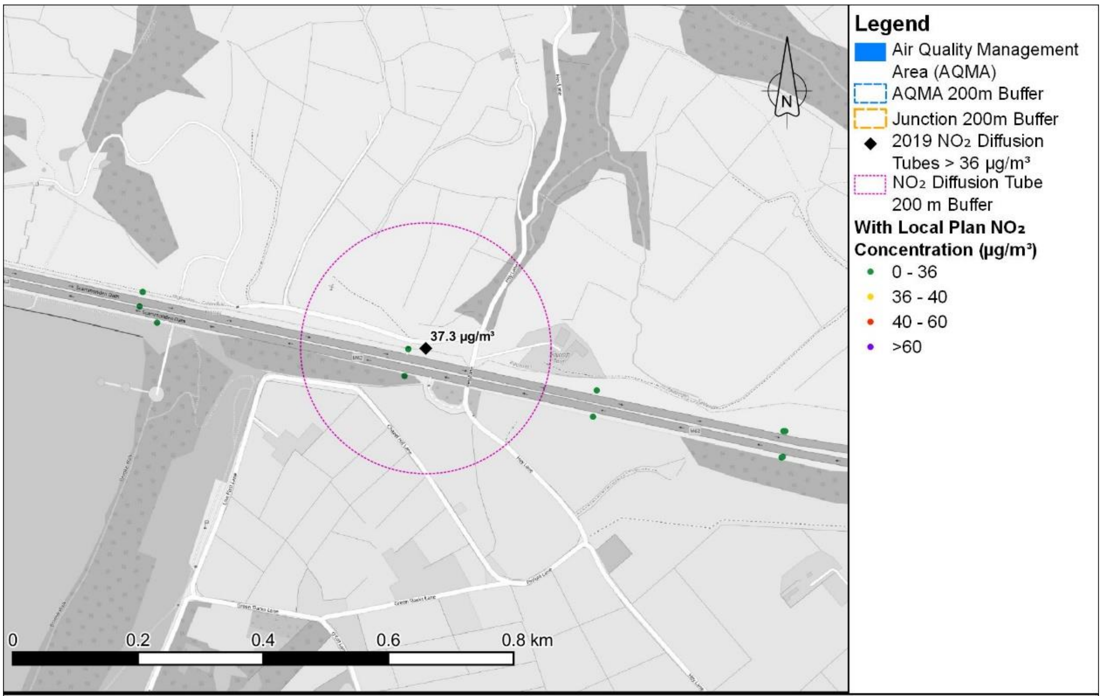
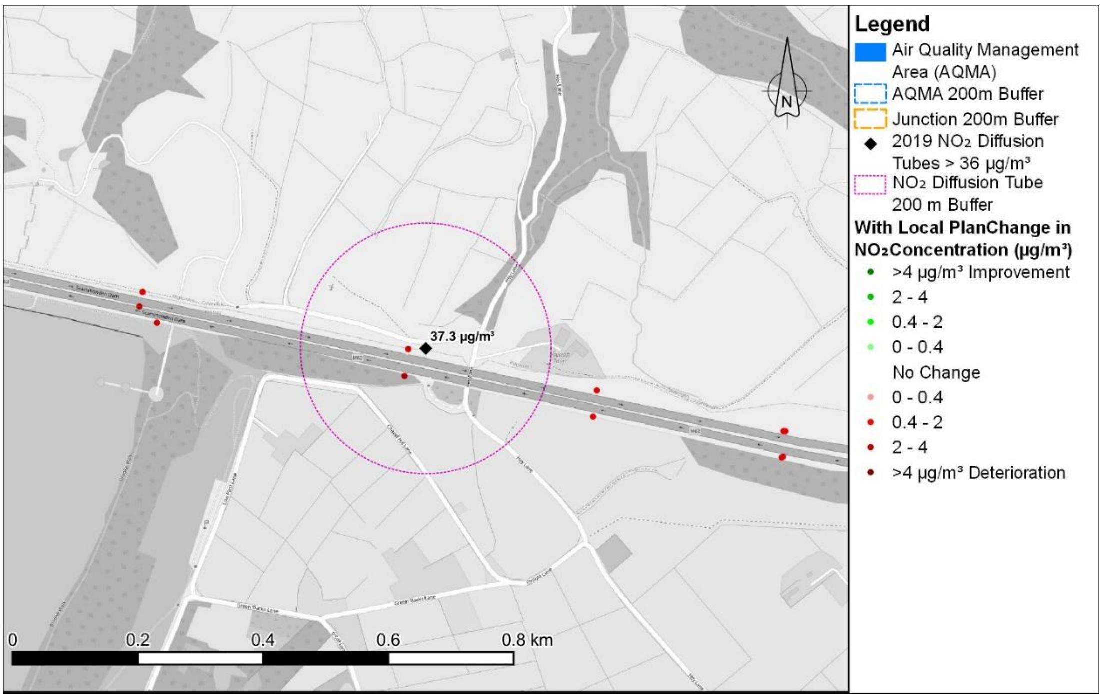


Plate C-36 Scammonden Do-Something 2032 With Local Plan Change in NO_2



Appendix D

MONITORING DATA

APPENDIX D – MONITORING DATA

Appendix D shows NO_2 diffusion tube monitoring results for the locations shown **Figure 6-1**.

Plate D-1 NO_2 Monitoring Results for the Hebden Bridge AQMA

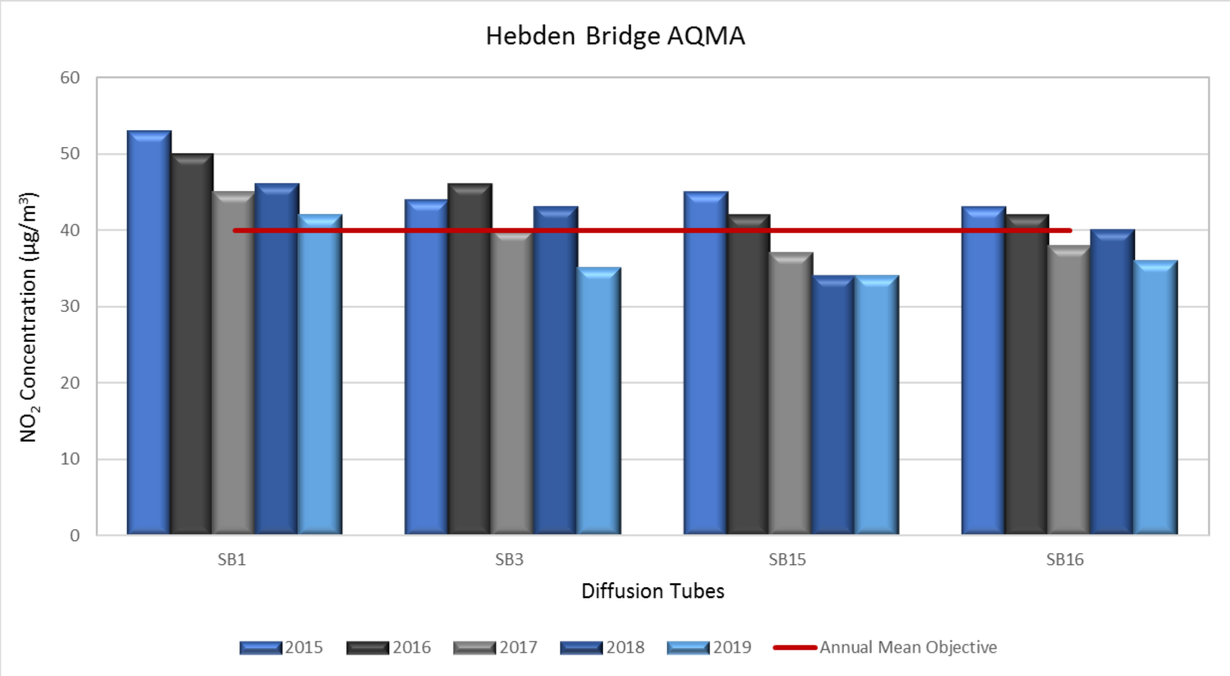


Plate D-2 NO_2 Monitoring Results for the Luddendenfoot AQMA

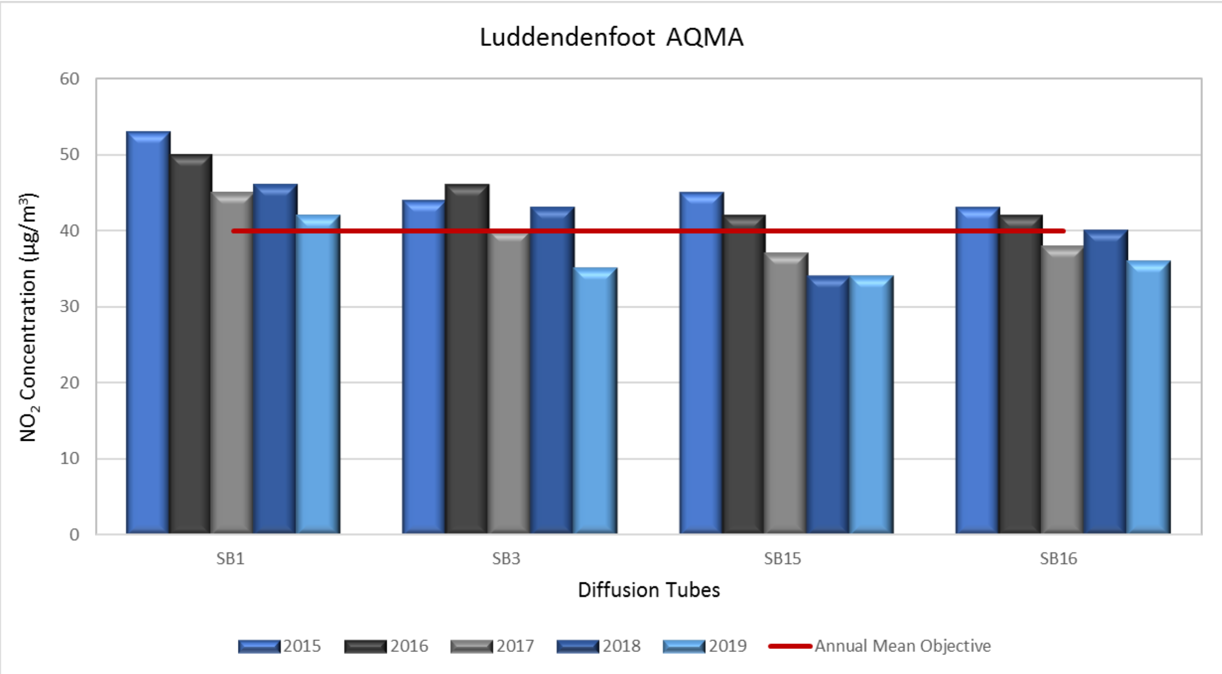


Plate D-3 NO_2 Monitoring Results for the Hebden Bridge AQMA

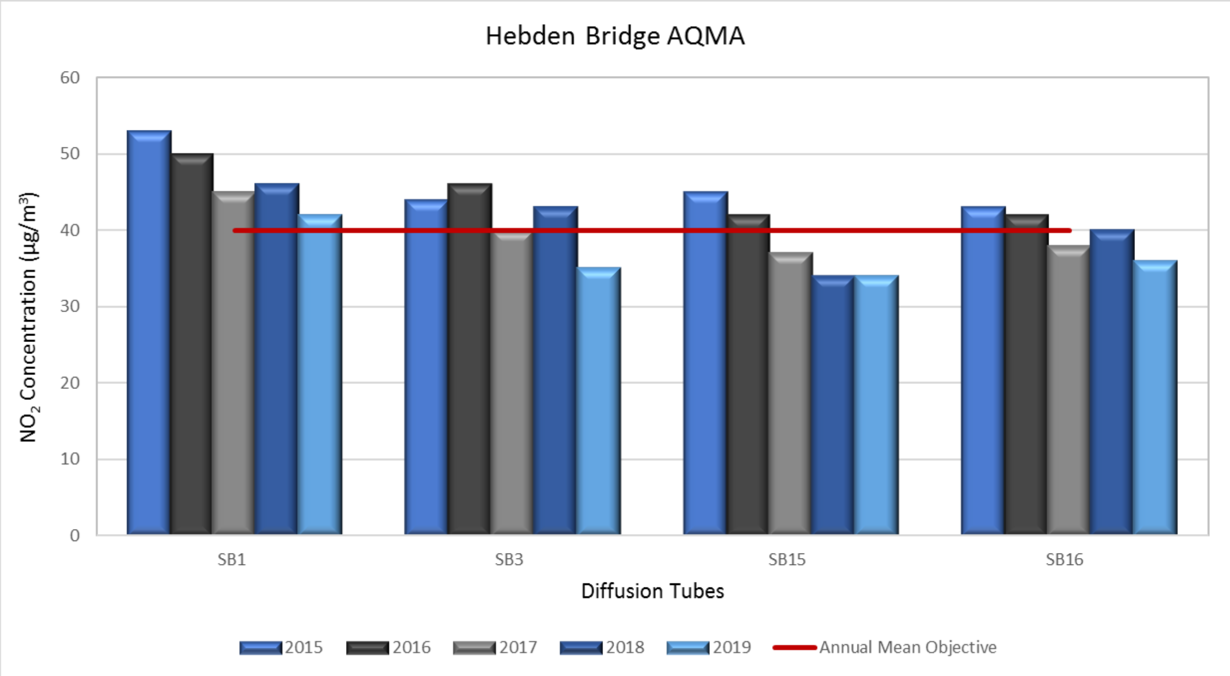


Plate D-4 NO_2 Monitoring Results for the Luddendenfoot AQMA

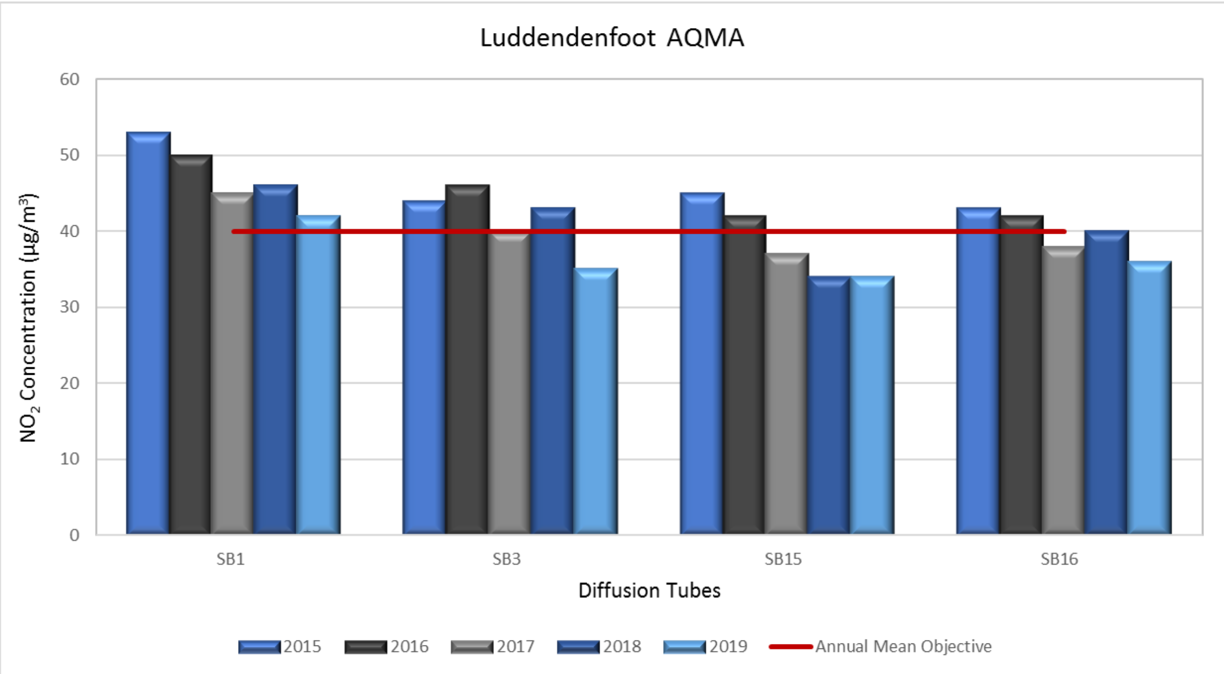


Plate D-5 NO_2 Monitoring Results for the Sowerby Bridge AQMA

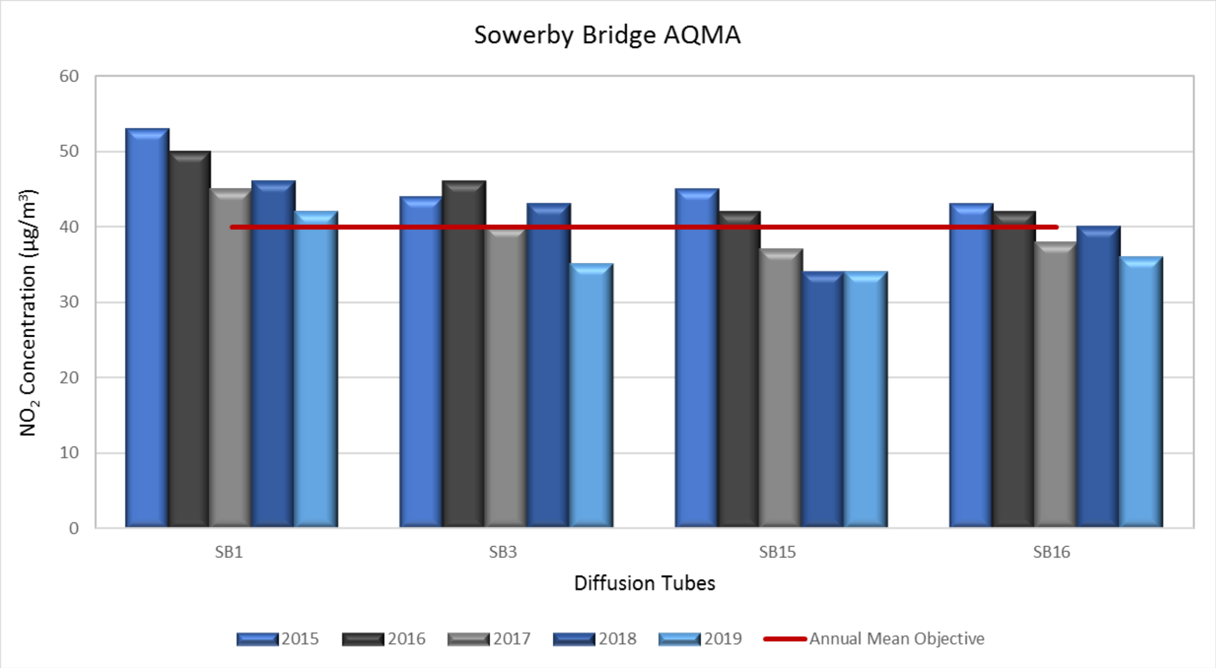


Plate D-6 NO_2 Monitoring Results for the Halifax AQMA

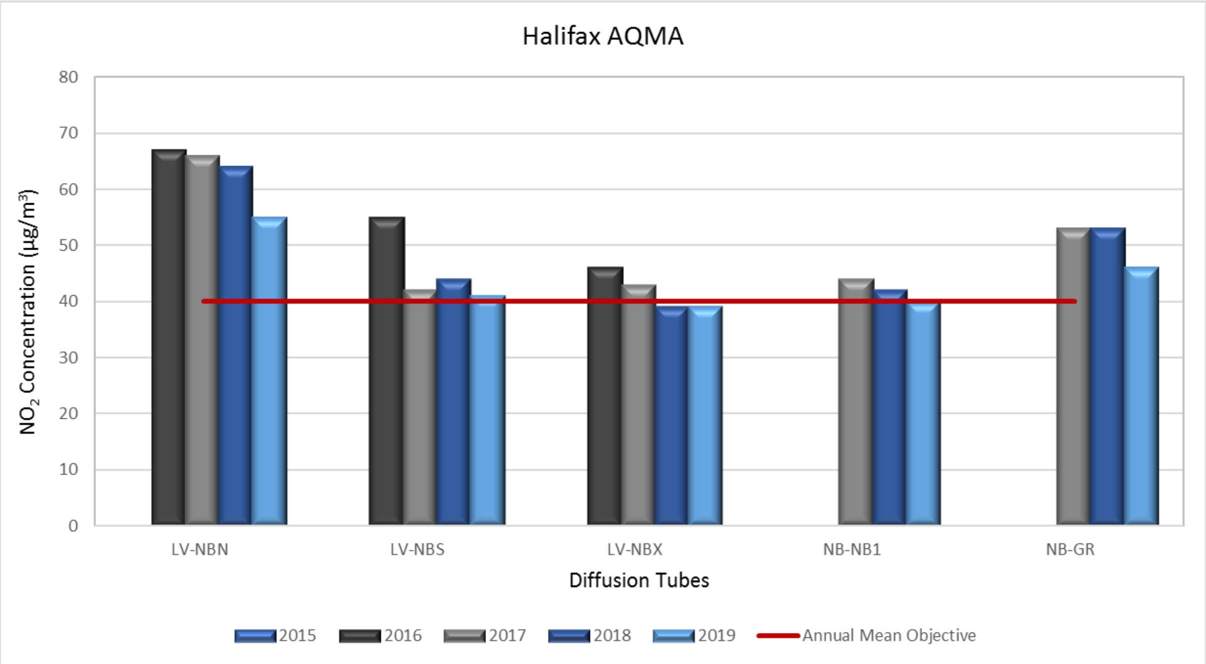


Plate D-7 NO_2 Monitoring Results for the Stump Cross AQMA

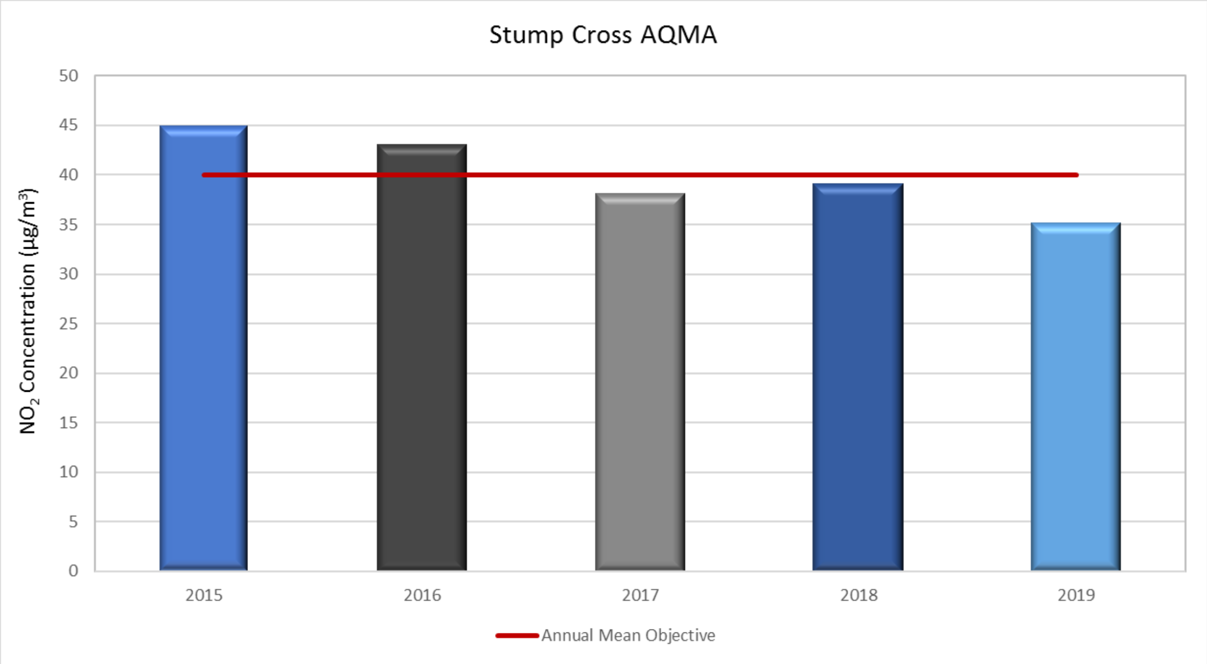


Plate D-8 NO_2 Monitoring Results for the Elland AQMA

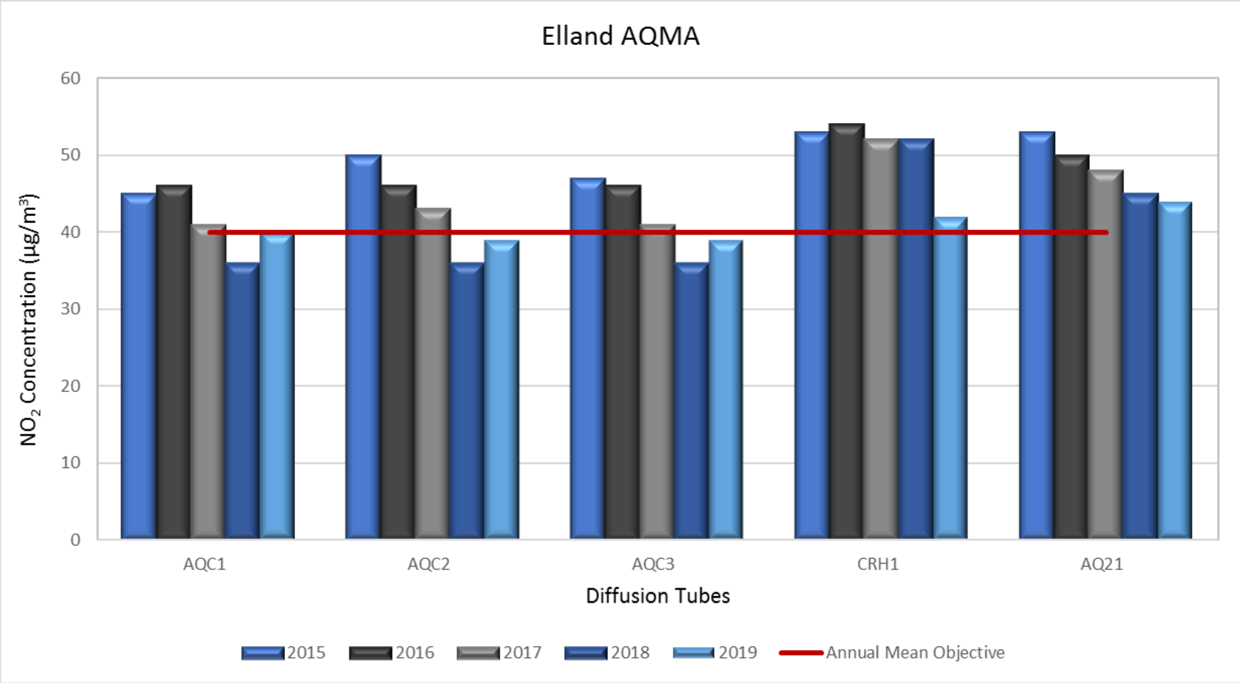
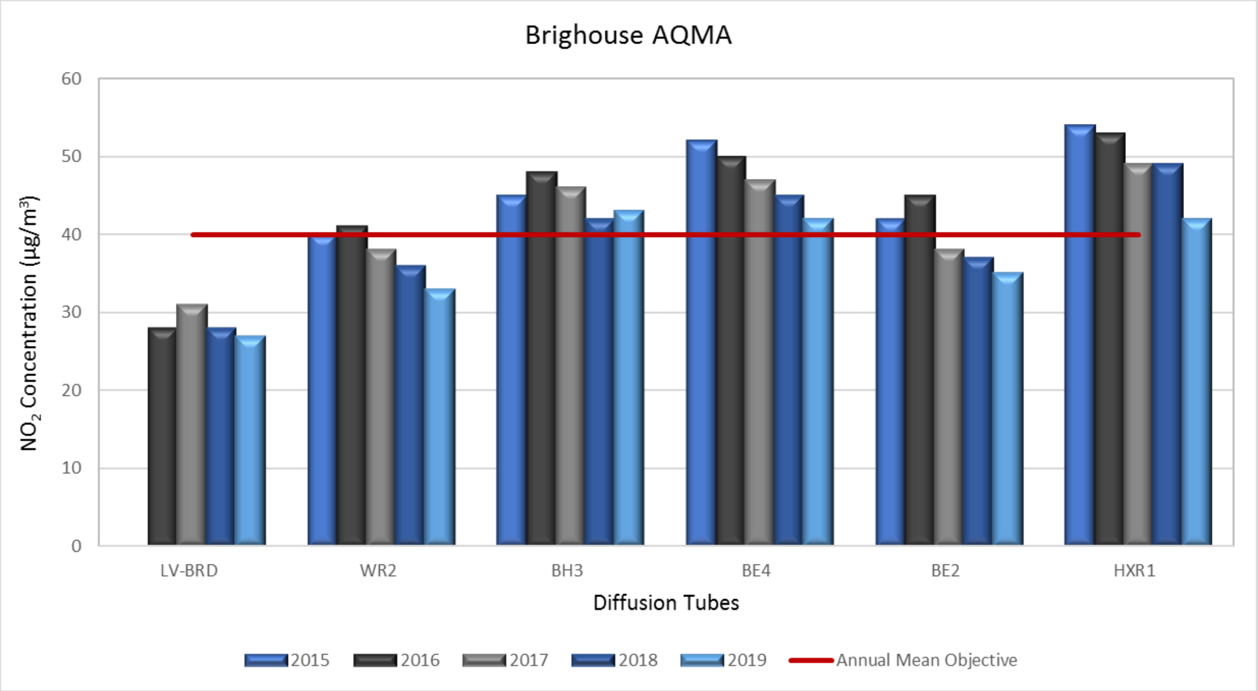


Plate D-9 NO_2 Monitoring Results for the Brighouse AQMA



Three White Rose Office Park
Millshaw Park Lane
Leeds
LS11 0DL

wsp.com