Air Quality Constraints Assessment

Stakehill Business Park, Rochdale

Client: Trustees of J.P. Milne Will Trust

Reference: 2171-1r1

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Report Issue

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Executive Summary

Redmore Environmental Ltd was commissioned by the Trustees of J.P. Milne Will Trust to undertake an Air Quality Constraints Assessment in support of a mixed-use development on a parcel of land adjacent to Stakehill Business Park, Rochdale.

The site is bound to the north and east by the A627(M). This may cause elevated pollution levels due to vehicle exhaust emissions and act as a constraint to residential land use proposed as part of the scheme. As such, an Air Quality Constraints Assessment has been undertaken in order to determine baseline conditions at the site, consider its suitability for the proposed end-use and inform the masterplan design process.

Dispersion modelling was undertaken in order to predict pollutant concentrations across the proposed development site as a result of emissions from the local highway network. Outputs were subsequently verified using local monitoring data.

The results of the dispersion modelling assessment indicated that predicted pollutant levels were below the relevant criteria at all sensitive locations across the development. As such, the site is considered suitable for residential use from an air quality perspective.

Based on the assessment results, it is concluded that poor air quality is not considered a constraint to use of the site for residential development.

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1.0 INTRODUCTION

1.1 Background

1.1.1 Redmore Environmental Ltd was commissioned by the Trustees of J.P. Milne Will Trust to undertake an Air Quality Constraints Assessment in support of a mixed-use development on a parcel of land adjacent to Stakehill Business Park, Rochdale.

1.1.2 Development at this location may lead to the exposure of future occupants to elevated pollution levels. As such, an Air Quality Constraints Assessment was required in order to determine baseline conditions at the site and consider its suitability for the proposed end-use.

1.2 Site Location and Context

1.2.1 The site comprises a 66 acre parcel of land adjacent to Stakehill Business Park, Rochdale, at approximate National Grid Reference (NGR): 389315, 408399. Reference should be made to Figure 1 for a map of the site and surrounding area.

1.2.2 It is proposed to develop the site to provide residential and employment units.

1.2.3 The site is bound to the north and east by the A627(M). This may cause elevated pollution levels due to vehicle exhaust emissions and act as a constraint to residential land use proposed as part of the scheme. An Air Quality Constraints Assessment was therefore undertaken in order to define baseline conditions, consider its suitability for the proposed end-use and inform the masterplan design process. This is detailed in the following report.

2.0 LEGISLATION AND POLICY

2.1 European Directives

2.1.1 European Union (EU) air quality legislation is provided within Directive 2008/50/EC, which came into force on 11th June 2008. This Directive consolidated previous legislation which was designed to deal with specific pollutants in a consistent manner and provided new Air Quality Limit Values (AQLVs) for particulate matter with an aerodynamic diameter of less than 2.5µm. The consolidated Directives include:

- Directive 1999/30/EC - the First Air Quality "Daughter" Directive - sets ambient AQLVs for nitrogen dioxide (NO_2), oxides of nitrogen (NO_x), sulphur dioxide, lead and particulate matter with an aerodynamic diameter of less than 10µm (PM_{10});
- Directive 2000/69/EC - the Second Air Quality "Daughter" Directive - sets ambient AQLVs for benzene and carbon monoxide; and,
- Directive 2002/3/EC - the Third Air Quality "Daughter" Directive - seeks to establish long-term objectives, target values, an alert threshold and an information threshold for concentrations of ozone in ambient air.

2.1.2 The fourth daughter Directive was not included within the consolidation and is described as:

- Directive 2004/107/EC - sets health-based limits on polycyclic aromatic hydrocarbons, cadmium, arsenic, nickel and mercury, for which there is a requirement to reduce exposure to as low as reasonably achievable.

2.2 UK Legislation

2.2.1 The Air Quality Standards Regulations (2010) came into force on 11th June 2010 and transpose EU Directive 2008/50/EC into UK law. AQLVs were published in these regulations for 7 pollutants, as well as Target Values for an additional 5 pollutants.

2.2.2 Part IV of the Environment Act (1995) requires UK government to produce a national Air Quality Strategy (AQS) which contains standards, objectives and measures for improving ambient air quality. The most recent AQS was produced by the Department for

Environment, Food and Rural Affairs (DEFRA) and published in July 2007[1]. The AQS sets out Air Quality Objectives (AQOs) that are maximum ambient pollutant concentrations that are not to be exceeded either without exception or with a permitted number of exceedences over a specified timescale. These are generally in line with the AQLVs, although the requirements for the determination of compliance vary.

2.2.3 Table 1 presents the AQOs for pollutants considered within this assessment.

Table 1 Air Quality Objectives

Pollutant	Air Quality Objective	
	Concentration (µg/m^3)	Averaging Period
NO_2	40	Annual mean
	200	1-hour mean, not to be exceeded on more than 18 occasions per annum
PM_{10}	40	Annual mean
	50	24-hour mean, not to be exceeded on more than 35 occasions per annum

2.2.4 Table 2 summarises the advice provided in DEFRA guidance[2] on where the AQOs for pollutants considered within this report apply.

Table 2 Examples of Where the Air Quality Objectives Apply

Averaging Period	Objective Should Apply At	Objective Should Not Apply At
Annual mean	All locations where members of the public might be regularly exposed Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access Hotels, unless people live there as their permanent residence Gardens of residential properties Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term

[1] The AQS for England, Scotland, Wales and Northern Ireland, DEFRA, 2007.

[2] Local Air Quality Management Technical Guidance (TG16), DEFRA, 2018.

Averaging Period	Objective Should Apply At	Objective Should Not Apply At
24-hour mean	All locations where the annual mean objective would apply, together with hotels Gardens of residential properties	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
1-hour mean	All locations where the annual mean and 24 and 8-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets) Those parts of car parks, bus stations and railway stations etc which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer	Kerbside sites where the public would not be expected to have regular access

2.3 Local Air Quality Management

2.3.1 Under Section 82 of the Environment Act (1995) (Part IV) Local Authorities (LAs) are required to periodically review and assess air quality within their area of jurisdiction under the system of Local Air Quality Management (LAQM). This review and assessment of air quality involves comparing present and likely future pollutant concentrations against the AQOs. If it is predicted that levels at locations of relevant exposure, as summarised in Table 2, are likely to be exceeded, the LA is required to declare an Air Quality Management Area (AQMA). For each AQMA the LA is required to produce an Air Quality Action Plan, the objective of which is to reduce pollutant concentrations in pursuit of the AQOs.

3.0 BASELINE

3.1 Introduction

3.1.1 Existing air quality conditions in the vicinity of the development site were identified in order to provide a baseline for assessment. These are detailed in the following Sections.

3.2 Local Air Quality Management

3.2.1 As required by the Environment Act (1995), Rochdale Borough Council (RBC) has undertaken Review and Assessment of air quality within their area of jurisdiction. This process has indicated that annual mean concentrations of NO_2 are above the AQO within the borough. As such, a number of roads within Rochdale have been included within the Greater Manchester Combined Authority (GMCA) AQMA. This is described as follows:

> "This is the part of the Greater Manchester Combined Authority AQMA located within the Rochdale Borough Council area."

3.2.2 The site is bound by the A627(M) which is included in the AQMA. As such, there is the potential for exposure of future occupants to elevated pollution levels. This has been considered throughout the assessment.

3.2.3 RBC has concluded that concentrations of all other pollutants considered within the AQS are currently below the relevant AQOs. As such, no further AQMAs have been designated.

3.3 Air Quality Monitoring

3.3.1 Monitoring of pollutant concentrations is undertaken by RBC throughout their area of jurisdiction. Recent results recorded in the vicinity of the development are shown in Table 3.

Table 3 Monitoring Results

Monitoring Site		Monitored NO_2 Concentration (µg/m³)		
		2016	2017	2018
2	Trows Lane	36.6	39.7	31.1
3	52 Cherrington Drive	32.9	26.6	23.7
4	Middleton Library	34.0	33.5	30.7

3.3.2 As shown in Table 3, annual mean NO_2 concentrations were below the relevant AQO at the three monitoring locations in recent years. Reference should be made to Figure 2 for a map of the survey positions.

3.3.3 RBC do not undertake PM_{10} monitoring within their administrative extents.

3.4 Background Pollutant Concentrations

3.4.1 Predictions of background NO_2 and PM_{10} concentrations on a 1km by 1km grid basis have been produced by DEFRA for the entire of the UK to assist LAs in their Review and Assessment of air quality. The proposed development site is partially located in three grid squares. Data for these locations was downloaded from the DEFRA website[3]. Predicted background NO_2 concentrations are summarised in Table 4.

Table 4 Background Pollutant Concentration Predictions - NO_2

Grid Square (NGR)	Predicted Background NO_2 Concentration (µg/m³)		
	2018	2019	2030
388500, 408500	16.29	16.31	11.72
389500, 408500	16.33	16.53	11.34
389500, 407500	15.76	15.94	11.21

3.4.2 As shown in Table 4, predicted background NO_2 concentrations are below the relevant AQOs at the site.

[3] http://uk-air.defra.gov.uk/data/laqm-background-maps?year=2017.

3.4.3 Predicted background PM_{10} concentrations are summarised in Table 5.

Table 5 Background Pollutant Concentration Predictions - PM_{10}

Grid Square (NGR)	Predicted Background PM_{10} Concentration ($\mu g/m^3$)		
	2018	2019	2030
388500, 408500	12.29	10.93	10.43
389500, 408500	12.50	11.54	11.09
389500, 407500	12.24	11.17	10.67

3.4.4 As shown in Table 5, predicted background PM_{10} concentrations are below the relevant AQO at the site.

4.0 METHODOLOGY

4.1 Introduction

4.1.1 Residential development at the proposed location may lead to the exposure of future occupants to elevated pollution levels. In order to assess whether concentrations are a constraint to residential use at the site, detailed dispersion modelling was undertaken in accordance with the following methodology.

4.1.2 It should be noted that a proportion of the site will comprise employment units. These are not considered locations of relevant exposure for comparison with the AQOs in accordance with DEFRA guidance[4], as summarised in Table 2. As such, these areas were not considered further in the context of the assessment.

4.2 Dispersion Model

4.2.1 Dispersion modelling was undertaken in order to predict NO_2 and PM_{10} concentrations across the site using the ADMS-Roads dispersion model (version 4.1.1.0). ADMS-Roads is developed by Cambridge Environmental Research Consultants (CERC) and is routinely used throughout the world for the prediction of pollutant dispersion from road sources. Modelling predictions from this software package are accepted within the UK by the Environment Agency and DEFRA.

4.2.2 Modelling was undertaken for 2018 to allow verification against recent monitoring results and 2030 to represent the development opening year.

4.2.3 The model requires input data that details the following parameters:

- Assessment area;
- Traffic flow data;
- Vehicle emission factors;
- Spatial co-ordinates of emissions;
- Street width;
- Meteorological data;

[4] Local Air Quality Management Technical Guidance (TG16), DEFRA, 2018.

- Roughness length (z_0); and,
- Monin-Obukhov length.

4.2.4 These are detailed in the following Sections.

4.3 Assessment Area

4.3.1 Ambient concentrations were predicted over the area NGR: 388400, 407520 to 389960, 409080. One Cartesian grid was used within the model to produce data suitable for contour plotting using the Surfer software package.

4.3.2 It should be noted that although the grid only covered the proposed site, road links were extended in order to ensure the impact of all relevant vehicle emissions in the vicinity of the development were considered.

4.3.3 Reference should be made to Figure 3 for a graphical representation of the assessment grid extents.

4.4 Traffic Flow Data

4.4.1 Traffic data for use in the assessment, including 24-hour Annual Average Daily Traffic (AADT) flows and fleet composition as Heavy Duty Vehicle (HDV) proportion, was provided by SCP Transport, the Transport Consultants for the project.

4.4.2 Traffic generation associated with the development, based on the most recent layout, was included in the 2030 scenario in order to provide a worst-case assessment of pollutant concentrations across the site.

4.4.3 Road widths and vehicle speeds were estimated from aerial photography and UK highway design standards. A summary of the traffic data used in the assessment is provided in Table 6.

Table 6 Traffic Data

Link		24-hour AADT Flow		HDV Prop. of Fleet (%)		Road Width (m)	Mean Vehicle Speed (km/h)
		2018	2030	2018	2030		
L1	Rochdale Road Roundabout	10,510	12,195	4.82	4.82	8.7	25
L2	A627M Eastbound slow	5,809	7,181	4.82	4.82	7.1	25
L3	A627M Eastbound	5,809	7,181	4.82	4.82	6.7	100
L4	A627M Eastbound slow	5,809	7,181	4.82	4.82	7.3	25
L5	A627M Westbound slow	5,809	7,181	4.82	4.82	7.3	25
L6	A627M Westbound	5,809	7,181	4.82	4.82	6.7	100
L7	A627M Westbound slow	5,809	7,181	4.82	4.82	7.3	25
L8	A672M Roundabout	19,783	22,613	7.61	7.61	9.3	25
L9	A672M Northbound Slip North of Roundabout	4,237	4,867	4.94	4.95	7.0	80
L10	A672M Northbound North of Roundabout	16,947	19,466	4.94	4.95	11.1	100
L11	A627M Northbound Slip to M62 Junction 20	16,947	19,466	4.94	4.95	10.2	80
L12	Junction 20 Roundabout	28,991	32,820	15.73	15.74	9.1	25
L13	M627M Southbound Slip from M62	16,947	19,466	4.94	4.95	7.3	80
L14	M627M Southbound North of Roundabout	16,947	19,466	4.94	4.95	9.7	100
L15	A627M Southbound Slip North of Roundabout	4,237	4,867	4.94	4.95	6.7	80
L16	M62 Westbound East of Roundabout	28,686	32,389	15.73	15.74	11.3	100
L17	M62 Westbound Slip East of Roundabout	7,171	8,097	15.73	15.74	7.6	80
L18	M62 Westbound Slip West of Roundabout	7,324	8,313	15.39	15.39	7.1	80
L19	M62 Westbound West of Roundabout	29,297	33,251	15.39	15.39	9.3	100

Link		24-hour AADT Flow		HDV Prop. of Fleet (%)		Road Width (m)	Mean Vehicle Speed (km/h)
		2018	2030	2018	2030		
L20	M62 Eastbound West of Roundabout	29,297	33,251	15.39	15.39	9.7	100
L21	M62 Eastbound Slip West of Roundabout	7,324	8,313	15.39	15.39	10.1	80
L22	M62 Eastbound Slip East of Roundabout	7,171	8,097	15.73	15.74	7.0	80
L23	M62 Eastbound East of Roundabout	28,686	32,389	15.73	15.74	11.3	100
L24	A627M Northbound North of M62 Junction 20	11,279	12,784	3.98	3.98	7.2	100
L25	A627M Southbound North of M62 Junction 20	11,279	12,784	3.98	3.98	7.2	100
L26	M62 Westbound	43,487	49,230	15.73	15.74	9.8	100
L27	M62 Eastbound	43,487	49,230	15.73	15.74	9.8	100
L28	Rochdale Road	15,233	18,084	2.83	2.83	11.2	45
L29	Rochdale Road	15,233	18,084	2.83	2.83	10.4	45
L30	Rochdale Road	15,233	18,084	2.83	2.83	13.9	25
L31	Rochdale Road	13,331	15,779	2.79	2.79	13.1	25
L32	Rochdale Road	13,331	15,779	2.79	2.79	10.6	45
L33	Rochdale Road slow to Junction with Holin Lane	13,331	15,779	2.79	2.79	11.2	25
L34	Rochdale Road South slow	13,216	15,360	3.27	3.27	11.8	25
L35	Long Street	13,216	15,360	3.27	3.27	8.7	40
L36	Holin Lane	10,467	12,087	1.71	1.72	9.3	45
L37	A664 Rochdale Road slow	13,412	15,319	3.41	3.41	7.9	25
L38	A664 Rochdale Road	13,412	15,319	3.41	3.41	9.7	45
L39	A627M Northbound South of Roundabout	22,619	25,760	7.61	7.61	7.6	100
L40	A627M Northbound Slip South of Roundabout	5,655	6,440	7.61	7.61	7.1	80

Link		24-hour AADT Flow		HDV Prop. of Fleet (%)		Road Width (m)	Mean Vehicle Speed (km/h)
		2018	2030	2018	2030		
L41	A627M Southbound Slip South of Roundabout	5,655	6,440	7.61	7.61	6.6	80
L42	A627M Southbound South of Roundabout	22,619	25,760	7.61	7.61	7.6	100
L43	A627 Northbound	29,674	33,920	7.61	7.61	7.0	100
L44	A627 Southbound	29,674	33,920	7.61	7.61	7.0	100
L45	Bentley Avenue slow	1,778	3,762	2.16	2.16	8.5	25
L46	Bentley Avenue	1,778	3,762	2.16	2.16	7.8	40

4.4.4 Reference should be made to Figure 3 for a graphical representation of the road link locations.

4.5 Emission Factors

4.5.1 Emission factors for each link were calculated using the relevant traffic flows and the Emissions Factor Toolkit (version 9.0). This has been produced by DEFRA and incorporates COPERT5 vehicle emission factors and fleet information.

4.5.2 There is current uncertainty over NO_2 concentrations within the UK, with the implementation of new vehicle emission standards not resulting in the previously expected reduction in roadside levels. Therefore, 2018 emission factors were utilised in preference to the opening year in order to provide robust concentration predictions. As predictions for 2018 were verified, it is considered the results are an indication of worst case concentrations during the operation of the proposals.

4.6 Meteorological Data

4.6.1 Meteorological data used in the assessment was taken from Manchester Airport meteorological station over the period 1st January 2018 to 31st December 2018 (inclusive). Manchester Airport meteorological station is located at NGR: 381792, 384116, which is approximately 25.3km south-west of the development. It is anticipated that conditions

would be reasonably similar over a distance of this magnitude. The data was therefore considered suitable for an assessment of this nature.

4.6.2 All meteorological records used in the assessment were provided by Atmospheric Dispersion Modelling (ADM) Ltd, which is an established distributor of data within the UK. Reference should be made to Figure 4 for a wind rose of utilised meteorological data.

4.7 Roughness Length

4.7.1 The z_0 is a modelling parameter applied to allow consideration of surface height roughness elements. A z_0 of 0.5m was used to describe the modelling extents. This value of z_0 is considered appropriate for the morphology of the area and is suggested within ADMS-Roads as being suitable for 'parkland, open suburbia'.

4.7.2 A z_0 of 0.2m was used to describe the meteorological site. This value of z_0 is considered appropriate for the morphology of the area and is suggested within ADMS-Roads as being suitable for 'agricultural areas (min)'.

4.8 Monin-Obukhov Length

4.8.1 The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 30m was used to describe the modelling extents and meteorological site. This value is considered appropriate for the nature of both areas and is suggested within ADMS-Roads as being suitable for 'cities and large towns'.

4.9 Background Concentrations

4.9.1 An annual mean NO_2 background concentration of 20.20µg/m^3 and PM_{10} background concentration of 13.77µg/m^3 taken from the grid square containing the 2 - Trows Lane and the 3 - Cherrington Drive diffusion tubes were used in the assessment. These were chosen to represent concentrations throughout the dispersion modelling extents without the contribution from road vehicles as they are higher than the DEFRA backgrounds for the grid square containing the site, as shown in Table 4 and Table 5.

4.9.2 Similarly to emission factors, background concentrations from 2018 were utilised in preference to the operational year. This provided a robust assessment and is likely to overestimate pollutant concentrations during the operation of the proposal.

4.10 NO_x to NO_2 Conversion

4.10.1 Predicted annual mean NO_x concentrations were converted to NO_2 concentrations using the spreadsheet (version 7.1) provided by DEFRA, which is the method detailed within DEFRA guidance[5].

4.11 Verification

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

- Estimates of background concentrations;
- Uncertainties in source activity data such as traffic flows and emission factors;
- Variations in meteorological conditions;
- Overall model limitations; and,
- Uncertainties associated with monitoring data, including locations.

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

4.11.3 For the purpose of the assessment model verification was undertaken for 2018 using traffic data, meteorological data and monitoring results from this year.

4.11.4 RBC undertook monitoring of NO_2 concentrations at three locations within the vicinity of roads included within the model during 2018. The results were obtained and the road contribution to total NO_x concentration calculated following the methodology contained within DEFRA guidance[6]. The monitored annual mean NO_2 concentrations and calculated road NO_x concentrations are summarised in Table 7.

[5] Local Air Quality Management Technical Guidance (TG16), DEFRA, 2018.

[6] Local Air Quality Management Technical Guidance (TG16), DEFRA, 2018.

Table 7 Verification - Monitoring Results

Monitoring Location		Monitored NO_2 Concentration (µg/m³)	Calculated Road NO_x Concentration (µg/m³)
2	Trows Lane	31.1	21.95
3	52 Cherrington Drive	23.7	6.89
4	Middleton Library	30.7	21.20

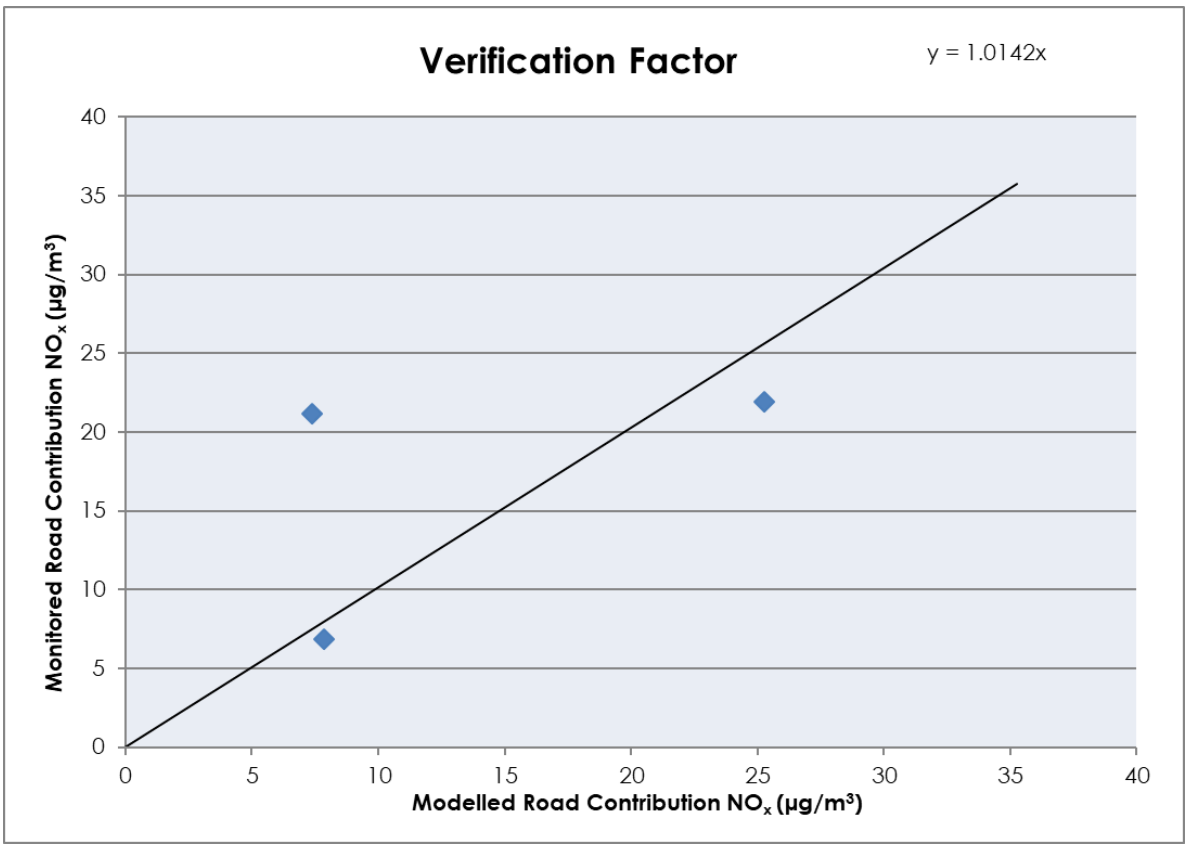
4.11.5 The annual mean road NO_x concentrations predicted from the dispersion model and the 2018 road NO_x concentrations calculated from the monitoring results are summarised in Table 8.

Table 8 Verification - Modelling Results

Monitoring Location		Calculated Road NO_x Concentration (µg/m³)	Modelled Road NO_x Concentration (µg/m³)
2	Trows Lane	21.95	25.26
3	52 Cherrington Drive	6.89	7.85
4	Middleton Library	21.20	7.37

4.11.6 The monitored and modelled road NO_x concentrations were graphed and the equation of the trendline based on linear progression though zero calculated. This indicated that a verification factor of 1.0142 was required to be applied to all road NO_x modelling results, as shown in Graph 1.

Graph 1 Verification



4.11.7 Monitoring of PM_{10} concentrations is not undertaken within the assessment extents. The NO_x verification factor was therefore used to adjust PM_{10} model predictions in lieu of more accurate data in accordance with DEFRA guidance[7].

[7] Local Air Quality Management Technical Guidance (TG16), DEFRA, 2018.

5.0 ASSESSMENT

5.1.1 Residential development at the proposed location may lead to the exposure of future occupants to elevated pollutant levels. Dispersion modelling was therefore undertaken with the inputs described in Section 4.0 to quantify air quality conditions at the site. Reference should be made to Figure 5 and 6 for graphical representations of the results.

5.1.2 As shown in Figure 5, annual mean NO_2 concentrations were predicted to be below the AQO of 40µg/m^3 at all locations across the site. The maximum level at the boundary was 29.88µg/m^3. As such, future residents are not predicted to be exposed to NO_2 concentrations above the AQO.

5.1.3 As shown in Figure 6, annual mean PM_{10} concentrations were predicted to be below the AQO of 40µg/m^3 at all locations across the site. The maximum level at the boundary was 14.83µg/m^3. As such, future residents are not predicted to be exposed to PM_{10} concentrations above the AQO.

5.1.4 Based on the assessment results, future residents are not predicted to be exposed to annual mean NO_2 and PM_{10} concentrations above the relevant AQOs at any location within the development. As such, the site is considered suitable for the proposed use from an air quality perspective.

6.0 CONCLUSION

6.1.1 Redmore Environmental Ltd was commissioned by the Trustees of J.P. Milne Will Trust to undertake an Air Quality Constraints Assessment in support of a mixed-use development on a parcel of land adjacent to Stakehill Business Park, Rochdale.

6.1.2 The site is bound to the north and east by the A627(M). This may cause elevated pollution levels due to vehicle exhaust emissions and act as a constraint to residential land use proposed as part of the scheme. As such, an Air Quality Constraints Assessment was undertaken in order to define baseline conditions, consider its suitability for the proposed end use and inform the masterplan design process.

6.1.3 Dispersion modelling was undertaken in order to predict pollutant concentrations across the proposed development site as a result of emissions from the local highway network. Outputs were subsequently verified using local monitoring data obtained from RBC.

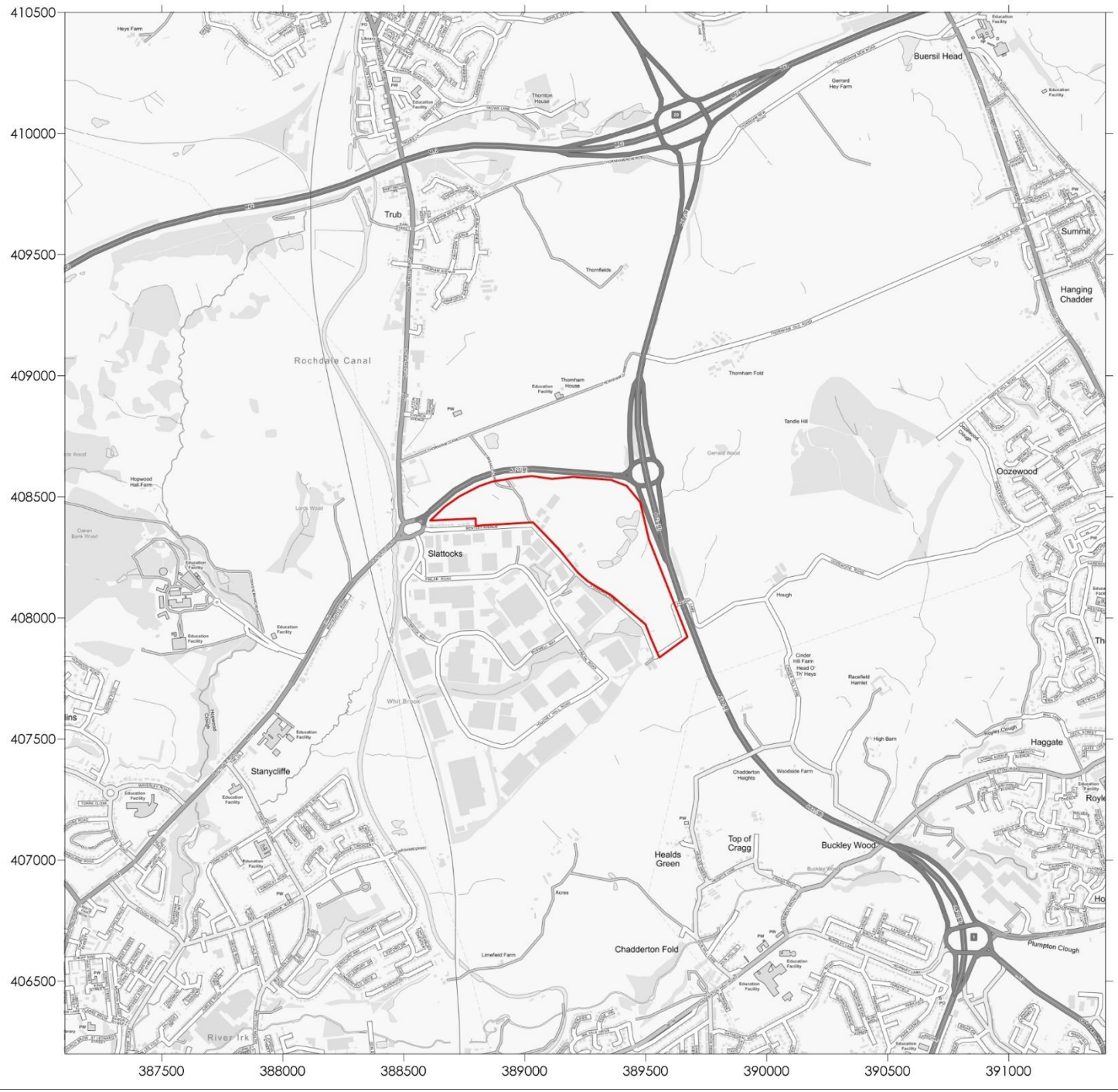
6.1.4 The results of the dispersion modelling assessment indicated that predicted annual mean NO_2 and PM_{10} concentrations were below the relevant AQOs at all locations across the development. As such, the site is considered suitable for the proposed end use from an air quality perspective.

6.1.5 Based on the assessment results, it is concluded that poor air quality is not considered a constraint to use of the site for residential development.

7.0 ABBREVIATIONS

AADT	Annual Average Daily Traffic
ADM	Atmospheric Dispersion Modelling
AQLV	Air Quality Limit Value
AQMA	Air Quality Management Area
AQO	Air Quality Objective
AQS	Air Quality Strategy
CERC	Cambridge Environmental Research Consultants
DEFRA	Department for Environment, Food and Rural Affairs
EU	European Union
HDV	Heavy Duty Vehicle
IAQM	Institute of Air Quality Management
LA	Local Authority
LAQM	Local Air Quality Management
NGR	National Grid Reference
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10µm
RBC	Rochdale Borough Council
z_0	Roughness length

Figures



Legend

Site Boundary

Title
Figure 1 - Site Location Plan

Project
Air Quality Constriants Assessment
Stakehill Business Park, Rochdale

Project Reference
2171-1

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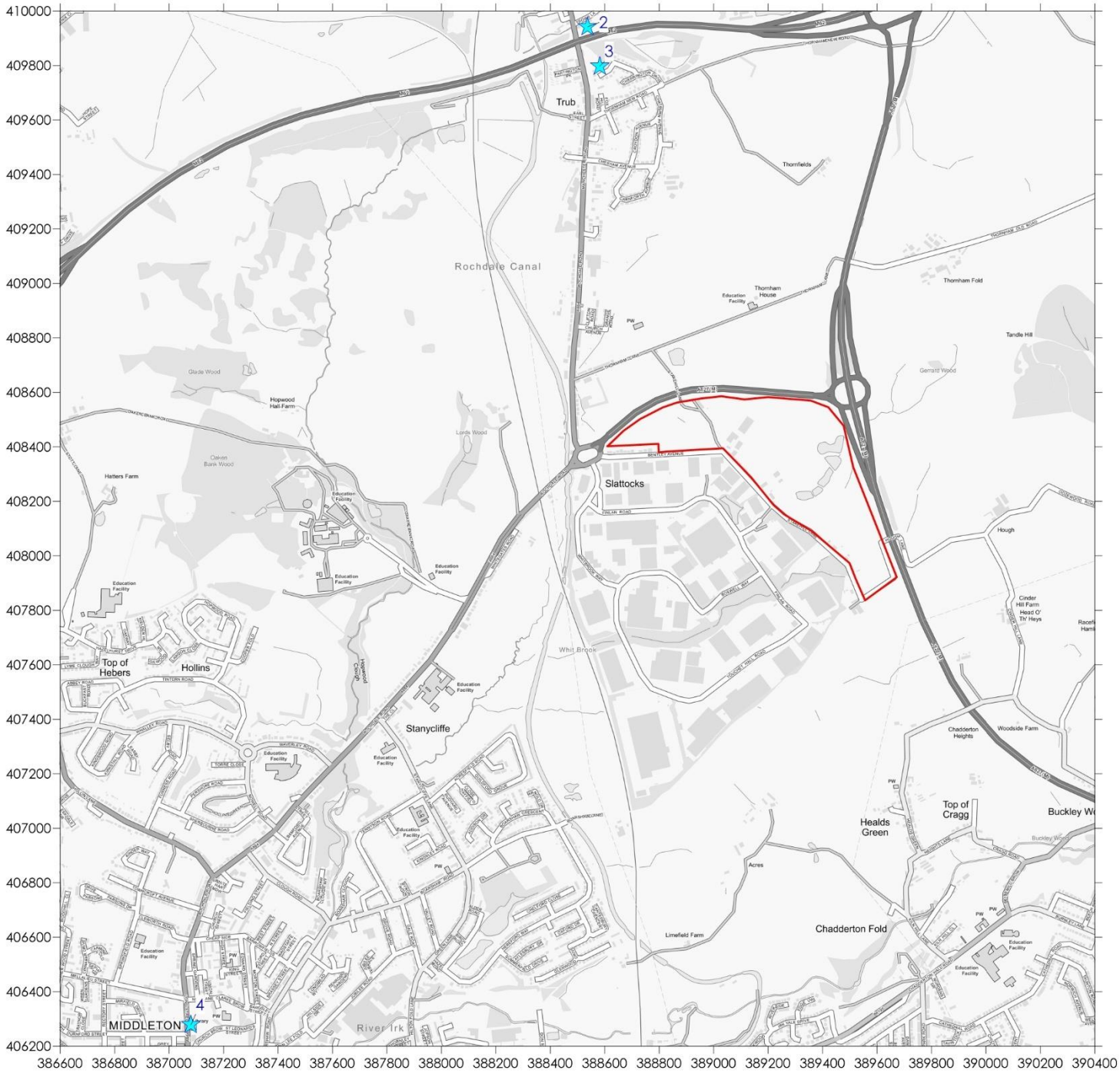

Legend

Site Boundary

Monitoring Locations

Title
Figure 2 - Monitoring Locations

Project
Air Quality Constriants Assessment
Stakehill Business Park, Rochdale

Project Reference
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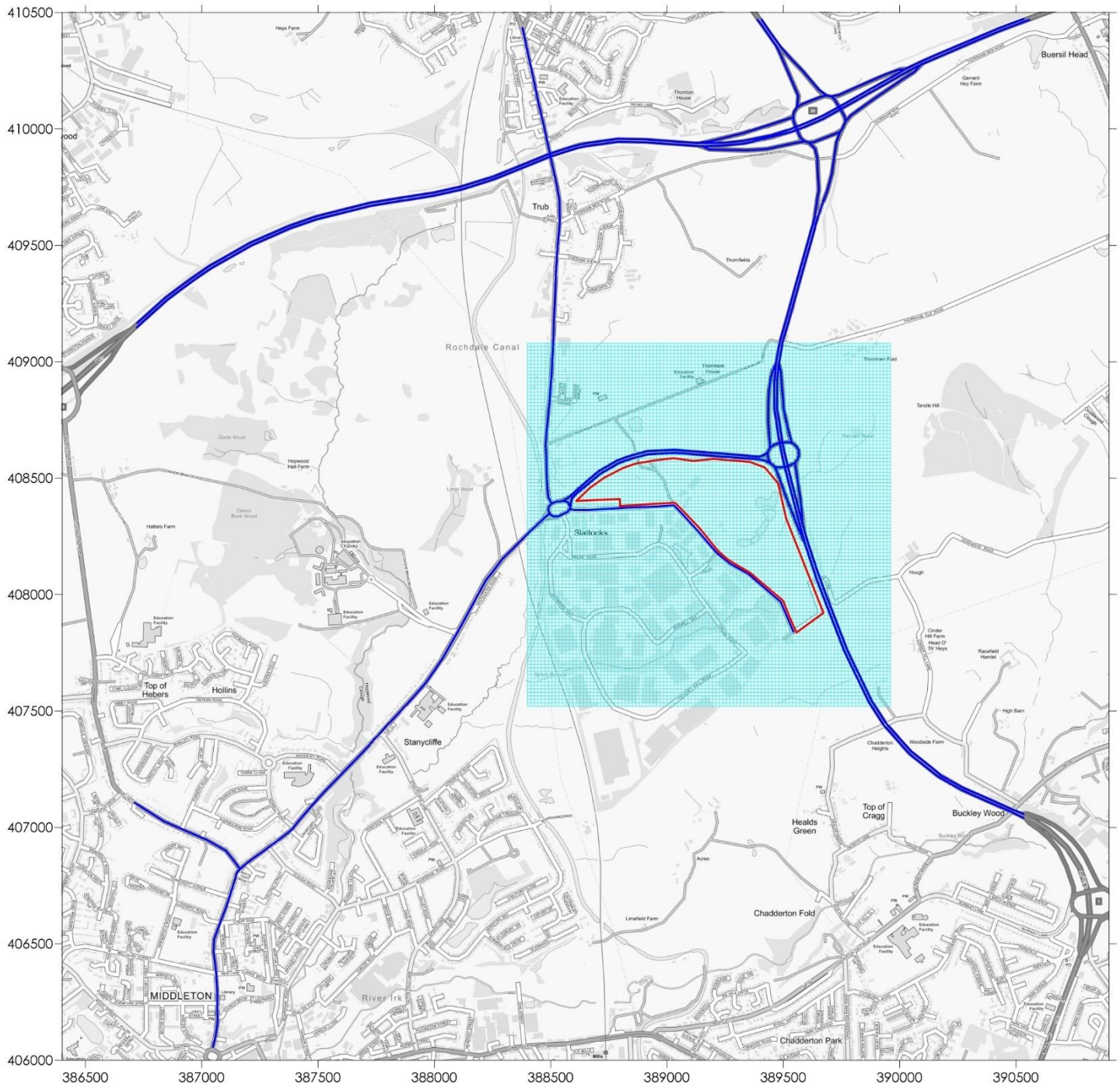

Legend

Site Boundary

Output Grid

Road Link

Title
Figure 3 - ADMS-Roads Inputs

Project
Air Quality Constriants Assessment
Stakehill Business Park, Rochdale

Project Reference
2171-1

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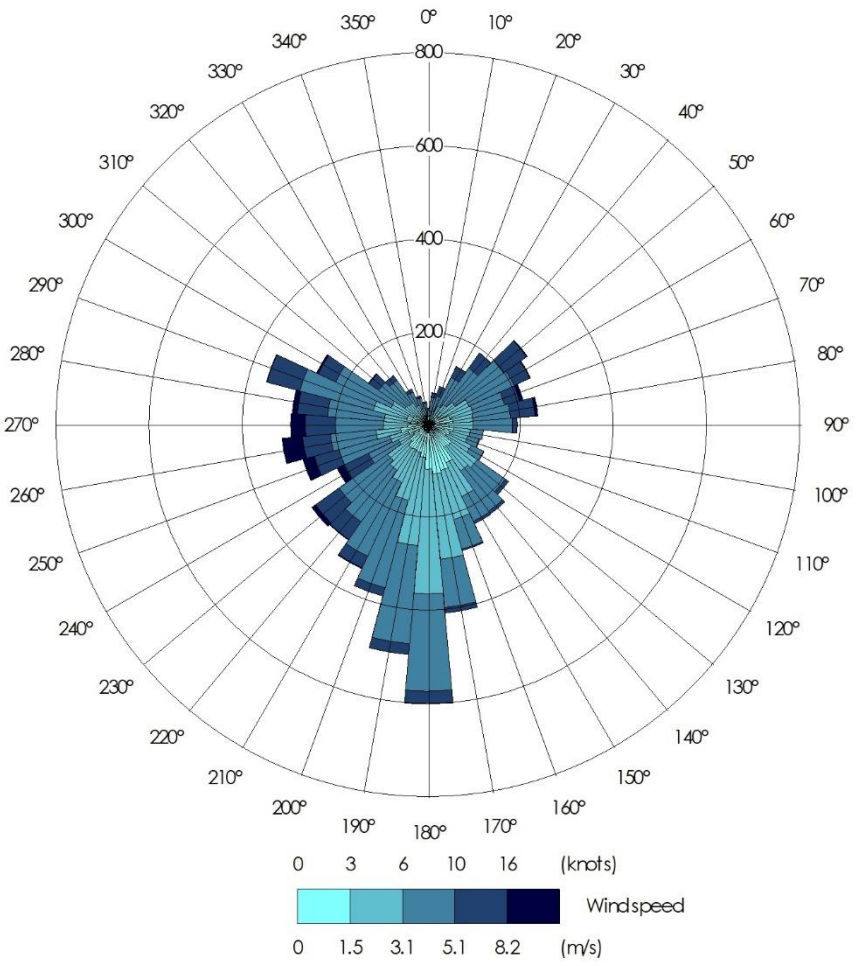

Legend

Title
Figure 4 - Wind Rose of 2018
Manchester Airport
Meteorological Data

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Air Quality Constriants Assessment
Stakehill Business Park, Rochdale

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Site Boundary

Annual Mean NO_2 Concentration ($\mu g/m^3$)

80
72
64
60
56
52
48
44
40
36
32
28

Title

Figure 5 - Predicted Annual Mean NO_2 Concentrations ($\mu g/m^3$)

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Site Boundary

Annual Mean PM_{10} Concentration ($\mu g/m^3$)

21
20
19
18
17
16
15
14

Title

Figure 6 - Predicted Annual Mean PM_{10} Concentrations ($\mu g/m^3$)

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