

# **SHEFFIELD AND ROTHERHAM CLEAN AIR ZONE FEASIBILITY STUDY**

## **LOCAL PLAN AIR QUALITY MODELLING METHODOLOGY REPORT (AQ3)**

**29 January 2019**



## DOCUMENT CONTROL

| Version | Name        |   | Position              | Date       | Changes |
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## 1. INTRODUCTION

### 1.1 Context

1.1.1 The UK Government has named Sheffield and Rotherham as one of 28 areas in England which contains locations where the annual average concentrations of Nitrogen Dioxide (NO<sub>2</sub>) exceed statutory limits and are projected to continue to do so over and beyond the next 3-4 years.

1.1.2 The two Councils have therefore been tasked with developing a strategy which will help ensure that their Council areas become compliant with this statutory limit 'in the shortest possible time'.

### 1.2 Overview of this Document

1.2.1 This document is the Local Plan Air Quality Modelling Report (AQ3) which explains in detail how the Air Quality model has been used to undertake Baseline assessment of air quality and also testing of the forecast scenarios. This report provides information covering the key requirements as listed in the JAQU guidance for the "Evidence Package", which are as follows:

- A summary of the air quality monitoring data collected over recent years at a number of locations in Sheffield and Rotherham;
- The results of the baseline air quality modelling. Alongside this report data files with the 2017 Base Year and 2021 'Business as Usual' (BaU) Road links, referenced using their road census ID are provided for sites which are predicted to be non-compliant in 2021;
- A comparison of the modelled base year concentrations with measurements for both NO<sub>x</sub> and NO<sub>2</sub> concentrations (in line with validation, verification and uncertainty requirements as outlined in TG16) - this includes scatter plots and summary statistics for modelled vs measured annual mean concentrations;
- NO<sub>x</sub> emissions are presented for all road transport sources for the base year (2017) and 2021 BaU Baseline projections; The evidence submission is accompanied by an Excel file which lists the estimated annual NO<sub>x</sub> emissions in 2017 and 2021 for every link in the SCRTM3B traffic model, on a link-by-link basis. These are contained in supporting documents SD04 and SD05. NO<sub>2</sub> concentrations are presented for the subset of receptors relevant for validation and AQD assessment,

1.2.2 This report is part of the **Evidence Submission** pack and after review will be subsequently updated with feedback from JAQU. The current version of this report has been written after the baseline and scenario modelling for the OBC has been carried out. It will be updated to include scheme assessment as they become available and will be resubmitted as part of the **Full Business Case Submissions**.

### 1.3 Air Quality Model Version

1.3.1 Air dispersion modelling of pollutants from a number of roads, points and diffuse sources within the Rotherham and Sheffield domain has been carried out using the Airviro v4.00.61\_ct64<sup>®</sup> dispersion model (Estonian Environmental Research Centre (EERC), Eesti

Keskonnauuringute Keskus OU and Apertum IT AB). The years modelled were 2017 and 2021. There are no transport model outputs available for the intervening years so interpolation is used if necessary.

- 1.3.2 Airviro has been continuously developed since 1990 and has many users all over the world. It has been used in a number of intra-urban exposure studies in recent years (Korek et al., 2016; Jadaanet et al., 2016; Jerrett et al., 2004; Pierse et al., 2006). Its main advantage is being a web-based environmental management tool with embedded Geographical Information System (GIS) features which enables its application at urban and regional levels. In addition, it contains a dynamic emission database which allows for storage of static as well as dynamic emission characteristics for a large number of pollution sources, the latter is mainly used to characterise time-varying emissions from road, area and industrial sources. For example, Airviro calculates primary pollutant emissions for each road by utilising a database of updated information on the type of vehicle journeys, average daily traffic flows, speeds and vehicle mix.(SMHI, 2004).
- 1.3.3 A meteorological pre-processor routine within the software tool analysed the local weather data obtained from the weather mast within Sheffield city<sup>1</sup>, including the wind direction, velocity and vertical temperature profiles. These were used to determine the boundary layer scaling parameters – surface friction velocity and the Monin-Obukhov length. The wind fields were simulated using the diagnostic wind model available in the tool, which took into account the effects of topography, surface roughness and surface heating/cooling.
- 1.3.4 SCC and RMBC have used the Airviro system for air quality modelling, time series data collection and validation continuously for over 18 years, in partnership with Doncaster and Barnsley Councils.
- 1.3.5 Rotherham and Sheffield Councils used Airviro v4.00.61 dispersion modelling to simulate the dispersion of vehicle emissions of NO<sub>x</sub> from all major and minor road sources within the area and establish annual mean concentrations. The road links all the pollution climate mapping (PCM) road links as defined by Defra<sup>2</sup> is contained within the transport model. In accordance with LAQM TG16, the modelled road NO<sub>x</sub> is factored prior to further analysis. Emissions from industrial (point and area sources) domestic emissions (area sources) and background were simulated in a separate model run. Each simulation run included the area-wide domain, covering Rotherham and Sheffield. The concentrations of NO<sub>x</sub> are predicted using Airviro's Gaussian model. The methodology adopted, to model vehicle emissions within Airviro adheres to the modelling criteria agreed with the Joint Air Quality Unit (JAQU) as per the Air Quality Tracking Table AQ1 (appended and previously submitted and agreed with JAQU).
- 1.3.6 The 2017 baseline Business as Usual and 2021 Business as Usual years transport model outputs (with projected vehicle fleet composition) were modelled. Current fleet was established from relevant full year ANPR-based fleet profiles. For future years it was updated using EFT-based 'Business as Usual' and 'Do Something' Fleet Assumptions (as per JAQU Guidance). More information on this can be found in the Transport Methodology Report (T4).

<sup>1</sup> Located at Sheffield Hallam University City Athletics Stadium at Woodburn Road

<sup>2</sup> Defra PCM data referred to in this document is based on '2017 NO<sub>2</sub> projections data (2015 reference year)', obtained from <https://uk-air.defra.gov.uk/library/NO2ten/2017-NO2-projections-from-2015-data>, accessed October 2017

## 1.4 Local Fleet

1.4.1 The vehicle classes within the Rotherham and Sheffield Transport Model were subsequently proportioned into fuel and body type sub classes based on data collected by previously classified traffic counts and the Automatic Number Plate Recognition (ANPR) data across a number of representative sites within Sheffield and Rotherham. As we collected 12 months ANPR data, we had a good understanding of the local vehicle fleet. We flagged taxis and private hire vehicles so we could identify them as separate from private cars (essential for any CAZ Feasibility Study which may target taxis). In terms of the local bus fleet, as DVLA do not hold data on retrofitting and only provide Euro standard based on first registration, we obtained data from the South Yorkshire Passenger Transport Executive, who provide quarterly updates on Euro class in the South Yorkshire fleet.

Airviro models the dispersion of NO<sub>x</sub> emissions from across the whole domain. We used a similar methodology to that used by Leeds City Council for their CAZ Feasibility Study. If a model run was attempted using a 10m grid across the whole domain, the simulation run times became too long to fit with the timescales demanded of this study. Therefore, the base modelled grid size across the domain was a 250m x 250m grid (spatial resolution). This grid size was reduced to a 10m receptor grid when within 50m of a modelled road, point or line source emitting more than 0.000001g/s. This approach resulted in reasonable model run times. To do this, the “Quad Grid” function within Airviro Dispersion module was used, with the threshold emissions value set to > 0.000001 or 1e-06g/(s\*m) to ensure all road links with a significant emission rate were included.

1.4.2 The Defra NO<sub>x</sub> to NO<sub>2</sub> calculator v6.1 was used for the conversion of NO<sub>x</sub> to NO<sub>2</sub>. The road NO<sub>x</sub> output was factored after the simulation is complete. The factored road NO<sub>x</sub> was then entered into the Defra NO<sub>x</sub>:NO<sub>2</sub> calculator with relevant background values for the location and locally derived f-NO<sub>2</sub> (calculated for each road link for the Study) for each location. The Defra NO<sub>x</sub> to NO<sub>2</sub> calculator calculates annual mean nitrogen dioxide values for each location. These results are presented later in this report.

## 1.5 Structure of this Document

1.5.1 The remainder of this document is structured as follows:

- **Section 2** presents analysis of the local air quality monitoring data;
- **Section 3** describes the forecast baseline Air Quality Modelling along with the results for the main scenarios which have been tested to date;
- presents the NO<sub>x</sub> and NO<sub>2</sub> concentrations at all receptor locations relevant for the Air Quality Directive (AQD) for the Base Year, the baseline tests and all scenarios;
- **Section 4** describes the NO<sub>x</sub> to NO<sub>2</sub> conversion for all receptors;
- **Section 5** provides a summary of road link which are non compliant, a short explanation on target determination and of analytical assurance;

## 2. MONITORING DATA ANALYSIS

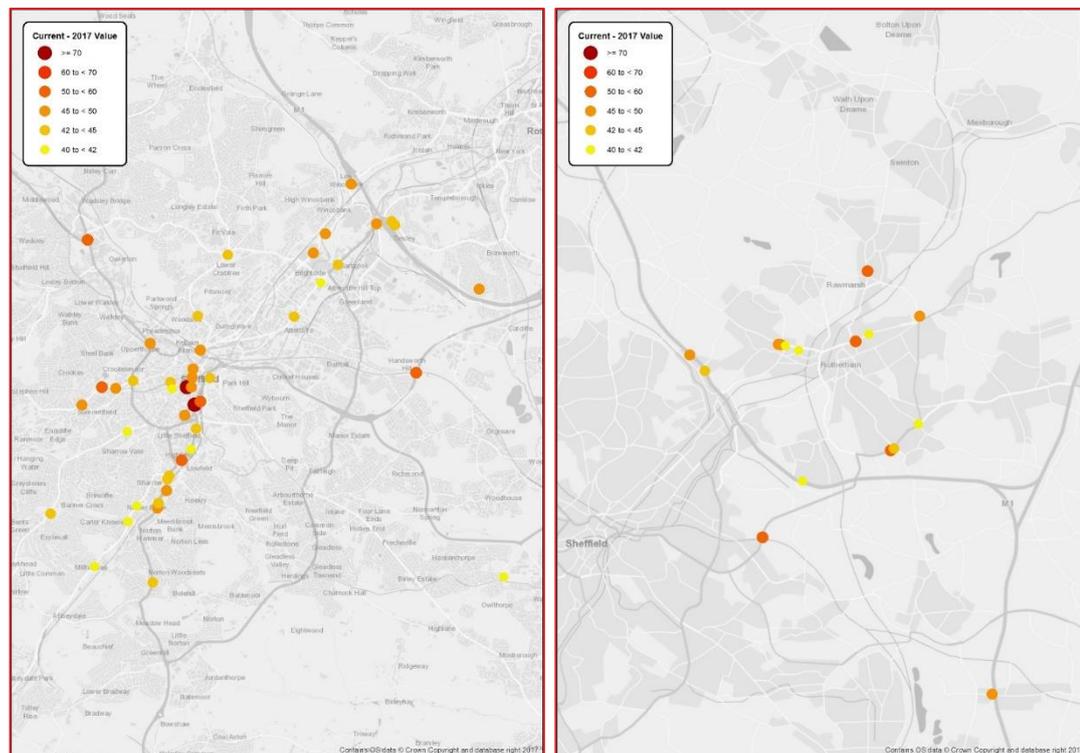
### 2.1 Introduction

2.1.1 This section presents a summary of observed data which has been collected from monitoring locations in Sheffield and Rotherham. This data was used to validate the 2017 Base Year Air Quality modelling data.

### 2.2 Observed Data

2.2.1 Observed Air Quality data is monitored at a number of sites throughout Sheffield and Rotherham. The figures below show the annual average concentrations of NO<sub>2</sub> at the non-compliant Air Quality Monitoring Sites in Sheffield and Rotherham in 2017. It shows those sites which exceed the EU Limit Value of 40µg/m<sup>3</sup>, with the graduated colour scheme highlighting the scale of the current exceedance.

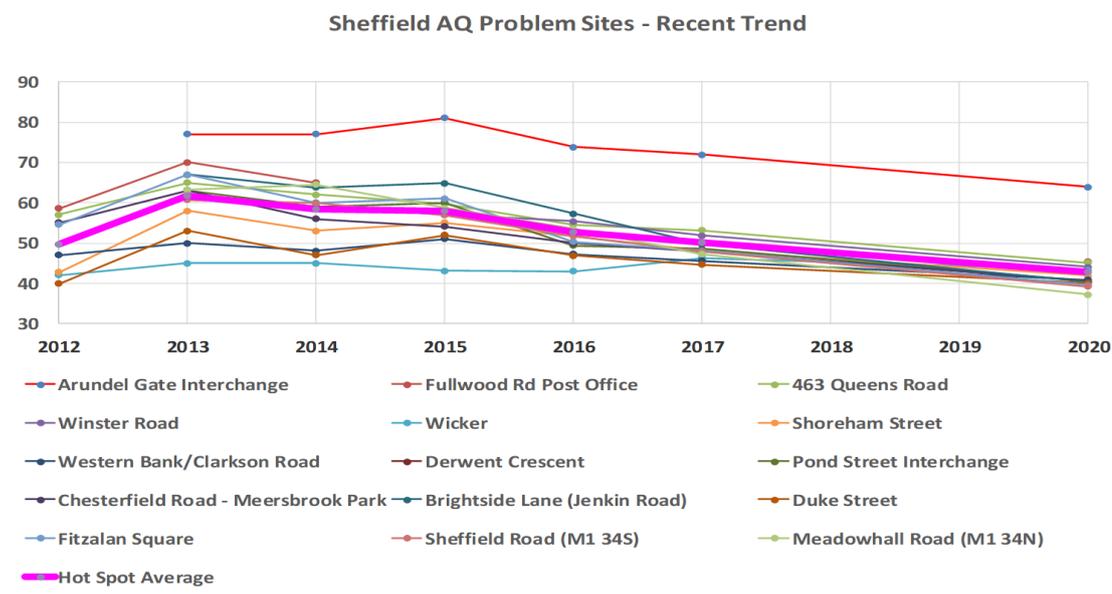
**Figure 1 –AQ Monitoring Sites which exceed 40ug/m3 annual mean NO<sub>2</sub> in Sheffield and Rotherham in 2017**



**Note: not all these monitoring sites are relevant in terms of where the AQD applies (i.e. most are not located at 4m from the kerb etc.)**

2.2.2 The recent trend in this annual average NO<sub>2</sub> concentration at Sheffield’s monitored Air Quality ‘hot-spots’ is illustrated in the figure below.

Figure 2 – Sheffield Air Quality Problem Sites – Recent Trend



- 2.2.3 The charts above suggest that the NO<sub>2</sub>-based air quality is generally improving at most of the hot-spot sites in the region, as would be expected. However, air quality will not improve sufficiently at all locations to meet the AQD. It should be stressed that **The Parkway and Derek Dooley Way (inner ring road), which are dual carriageways with no Local Air Quality Management relevant exposure, had not been monitored until the CAZ Feasibility Study and are not included above.**

### 3. 2017 BASE YEAR AIR QUALITY MODELLING

#### 3.1 Introduction

- 3.1.1 This section describes the results of the Baseline Air Quality Modelling along with the results from that process. It includes how the Base Year Air Quality Model has been validated against the monitored 2017 concentrations in the study area.

#### 3.2 Base Year Air Quality Modelling Results

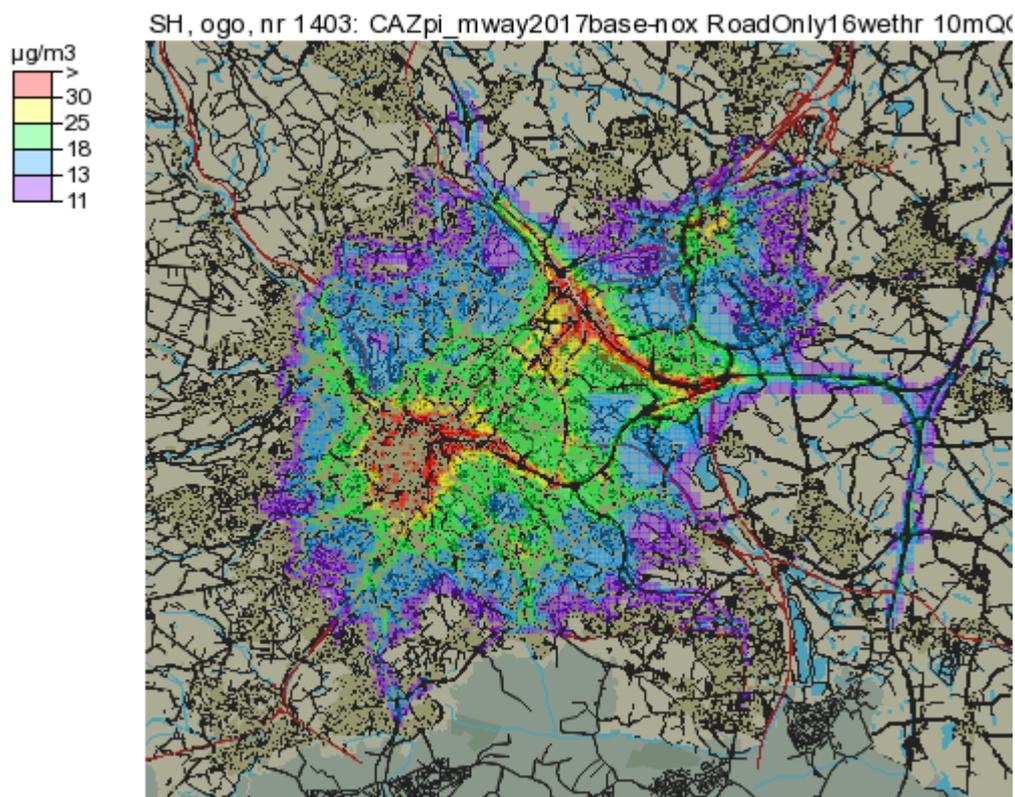
- 3.2.1 For each year modelled a dispersion run for all the point, area and grid sources was undertaken. Another dispersion model run was carried out for the relevant emissions database containing the traffic data.<sup>3</sup>
- 3.2.2 The road NO<sub>x</sub> output was factored after the simulation is complete. The factored road NO<sub>x</sub> was then entered into the Defra NO<sub>x</sub>:NO<sub>2</sub> calculator with relevant background values for the location and locally derived f-NO<sub>2</sub> (calculated for each road link for the Study) for each location. The Defra NO<sub>x</sub> to NO<sub>2</sub> calculator calculates annual mean nitrogen dioxide values for each location.
- 3.2.3 To validate the modelled road NO<sub>x</sub>, the road NO<sub>x</sub> from diffusion tube monitoring data (see Supporting Document SD01), was calculated using the diffusion tube tab in Defra's NO<sub>x</sub> to

<sup>3</sup> The methodology is described in Report AQ2

NO<sub>2</sub> calculator. F-NO<sub>2</sub> for the relevant year and road link were input for each calculation. This methodology is approved by JAQU.

3.2.4 An illustration of the dispersion model output is shown below:

**Figure 3 – An Illustration of the 2017 Road NO<sub>x</sub> Dispersion Model Output**



3.2.5 The model runs are verified by comparing monitored with modelled road NO<sub>x</sub>. The first step is to examine the calculated ratio of monitored road contribution to modelled road contribution NO<sub>x</sub>. This is a useful guide for identifying sites that are performing differently than others. High ratios could suggest the presence of street canyons, sites with a busy bus interchange, a busy taxi rank or sites with steep gradients used by buses and taxis. The next step is to prepare a graph of modelled versus monitored road contribution NO<sub>x</sub> and from the equation of the trend line, the correction factor is obtained. The road NO<sub>x</sub> is then factored.

3.2.6 Sites were considered in terms of zones and some in terms of having similar ratios. The calculated ratio for sites in the Sheffield area ranged between 1.10 to 2.87, with one anomaly at Census\_ID 56863 which has a value of 0.45. This is thought to be due to a rather high Defra Background Map NO<sub>x</sub> value for this site, put into the NO<sub>x</sub> to NO<sub>2</sub> converter. Calculated ratios that ranged between 1.70 to 2.87 and 1.00 to 1.60 were considered separately and graphs from these sites gave correction factors of 1.30 (R<sup>2</sup> of 0.85) and 2.25 (R<sup>2</sup> of 0.82) respectively.

3.2.7 Below are illustration of ratios for various site locations across Sheffield.

**Table 1 – Ratio Range 1.70 to 2.20**

| Census_ID | 4m X   | 4m Y   | Site                                  | 2017 Ratio:<br>Monitored /<br>Modelled |
|-----------|--------|--------|---------------------------------------|--|
| n/a       | 435598 | 387298 | *Arundel Gate Interchange 4m C710     | 2.87                                   |
| 17718     | 438353 | 390191 | Brightside Lane (Forgemaster) A6109   | 1.82                                   |
| 57875     | 436492 | 390149 | Barnsley Road, Fir Vale A6135         | 1.80                                   |
| 17728     | 435839 | 388817 | 73 Burngreave Road A6315              | 1.87                                   |
| 47396     | 434290 | 386197 | Ecclesall Rd/Pear Street A625         | 2.33                                   |
| n/a       | 433332 | 390854 | Fielding Road                         | 2.08                                   |
| 8144      | 433494 | 387010 | Whitham Rd/Moor Oaks Rd A57           | 1.82                                   |
| n/a       | 433413 | 386746 | Glossop Road/Westbourne Road B6547    | 1.88                                   |
| 36588     | 440015 | 386727 | SCC Defra's target deternm Prkway A57 | 1.76                                   |

**Table 2 – Ratio Range 1.00 to 1.60**

|       |        |        |  |      |
|-------|--------|--------|--|------|
| 37441 | 439717 | 390827 | Sheffield Road (M1 34S) A6178          | 1.40 |
| 47826 | 439171 | 391727 | Meadowhall Road (M1 34N) A6109         | 1.49 |
| 17809 | 434808 | 388215 | Penistone Road A61                     | 1.25 |
| 37898 | 435809 | 386349 | Queens Rd / G Casino A61               | 1.10 |
| 17332 | 440115 | 390799 | 98 Bawtry Road A631                    | 1.30 |
| n/a   | 435288 | 387228 | Barkers Pool Taxi Rank n/a             | 1.30 |
| 37898 | 435692 | 385890 | Queens Road - Asda A61                 | 1.55 |
| 47860 | 434401 | 386985 | Upper Hanover Street A61               | 1.54 |
| 17332 | 440199 | 390750 | 109 Bawtry Road A631                   | 1.22 |
| 17718 | 437461 | 389315 | Brightside Lane (Stevenson Road) A6109 | 1.13 |
| 7817  | 437703 | 390079 | Upwell Street A6102                    | 1.15 |
| 60030 | 435802 | 386988 | Sheaf Street Station Side A61          | 1.20 |
| 47855 | 437346 | 387691 | SCC Parkway Layby 1 A57                | 1.50 |
| 56863 | 436322 | 388234 | Attercliffe Road (Tesco) A6109         | 0.45 |

- \*Arundel Gate operates as a busy bus interchange and has a distinctly high ratio, therefore the correction factor of 2.25 for its range has been used.

**Table 3 - Rotherham Road NOx adjustment Factors**

| Zone  | A630 Parkway AQMA1 | A629 AQMA2 | A630 Fitzwilliam Road AQMA3 | A633 Rawmarsh Hill AQMA4 | Average Town Centre/Inner road links | Average Outer road links |
|---|--------------------|------------|-----------------------------|--------------------------|--------------------------------------|--------------------------|
| Modelled road NOx vs monitored roads NOx Factor | 1.540              | 3.297      | 1.645                       | 5.329                    | 1.846                                | 2.822                    |

### Explanation of the Factors

The transport emissions from the transport model do not account for all the monitored roadside NOx at 4m from the kerb (JAQU requirement). Therefore the roadside NOx modelled was factored to verify against monitored roadside NOx values across the domain. For roads where compliance is not currently achieved, it is particularly important to factor the roadside NOx by the correct road link specific factor.

Rawmarsh Hill has a relatively high road NOx adjustment factor, this is explained by the steep gradient (which is not accounted for in the emissions data from the transport model), acceleration from standing at traffic lights uphill, and the presence of buildings close to the road. Annual mean nitrogen dioxide is predicted for locations which meet JAQU's requirements i.e. >25m from a junction, and 4m from the kerb.

The A629 also has a steep gradient and vehicles accelerating between buildings from a roundabout. This accounts for the relatively high factor necessary to adjust the modelled data.

The Parkway and A630 Fitzwilliam Road are relatively flat roads. The Parkway is a busy dual carriageway and both it and the A630 Fitzwilliam Road experience peak time congestion. The Parkway (A630) in particular experiences congestion during the pm peak period when commuters are leaving Sheffield Centre and heading for M1 J33.

3.2.8 For **Sheffield**, the following table and graph show the results of the Baseline 2017 modelling:

### 3.3 Sheffield Baseline Dispersion Modelling Results

3.3.1 The following table and graphs show the results of the Baseline 2017 modelling.

**Table 4 – Sheffield: Monitored vs Modelled NO<sub>x</sub> and NO<sub>2</sub> 2017 at 4m to the Road**

| Site name                        | Census_ID_(if applicable) | Grid_ref |        | Annual mean NO <sub>x</sub> modelled_2017 | Annual mean NO <sub>x</sub> monitored_2017 | Annual mean NO <sub>2</sub> modelled_2017 | Annual mean NO <sub>2</sub> monitored 2017 |
|----------------------------------|---------------------------|----------|--------|---|--|---|--|
|                                  |                           | X        | Y      |   |  |   |  |
| Arundel Gate Interchange 4m      | C710                      | 435598   | 387298 | 71.3                                      | 204.6                                      | 63.1                                      | <b>72.0</b>                                |
| Sheffield Road (M1 34S)          | 37441                     | 439717   | 390827 | 61.3                                      | 86.0                                       | 45.9                                      | 47.8                                       |
| Meadowhall Road (M1 34N)         | 47826                     | 439171   | 391727 | 49.9                                      | 74.5                                       | 43.9                                      | 47.3                                       |
| Penistone Road                   | 17809                     | 434808   | 388215 | 56.6                                      | 70.5                                       | 47.5                                      | 46.2                                       |
| Brightside Lane (Forgemaster)    | 17718                     | 438353   | 390191 | 33.5                                      | 60.9                                       | 50.7                                      | 45.2                                       |
| Barnsley Road, Fir Vale          | 57875                     | 436492   | 390149 | 36.4                                      | 65.4                                       | 50.1                                      | 43.8                                       |
| Queens Rd / G Casino             | 37898                     | 435809   | 386349 | 56.6                                      | 62.4                                       | 47.5                                      | 43.1                                       |
| 98 Bawtry Road                   | 17332                     | 440115   | 390799 | 46.7                                      | 60.8                                       | 42.6                                      | 42.6                                       |
| 73 Burngreave Road               | 17728                     | 435839   | 388817 | 33.6                                      | 62.7                                       | 46.5                                      | 42.2                                       |
| Barkers Pool Taxi Rank           | n/a                       | 435288   | 387228 | 51.7                                      | 67.5                                       | 41.8                                      | 42.0                                       |
| Queens Road - Asda A61           | 37898                     | 435692   | 385890 | 37.3                                      | 57.7                                       | 36.6                                      | 40.4                                       |
| Ecclesall Rd/Pear Street         | 47396                     | 434290   | 386197 | 26.9                                      | 62.7                                       | 39.5                                      | 40.3                                       |
| Upper Hanover Street             | 47860                     | 434401   | 386985 | 36.1                                      | 55.6                                       | 35.5                                      | 39.2                                       |
| 109 Bawtry Road A631             | 17332                     | 440199   | 390750 | 41.5                                      | 50.5                                       | 39.8                                      | 38.4                                       |
| Brightside Lane (Stevenson Road) | 17718                     | 437461   | 389315 | 30.0                                      | 34.0                                       | 40.4                                      | 38.2                                       |
| Beeley Wood Road                 | n/a                       | 433248   | 391120 | 29.3                                      | 54.6                                       | 42.5                                      | 37.9                                       |
| Fielding Road                    | n/a                       | 433332   | 390854 | 30.6                                      | 63.7                                       | 39.1                                      | 37.7                                       |
| Whitham Rd/Moor Oaks Rd          | 8144                      | 433494   | 387010 | 30.0                                      | 54.5                                       | 41.8                                      | 36.7                                       |
| Glossop Road/Westbourne Road     | n/a                       | 433413   | 386746 | 30.3                                      | 57.0                                       | 40.1                                      | 36.3                                       |
| Upwell Street                    | 7817                      | 437703   | 390079 | 38.1                                      | 43.9                                       | 37.6                                      | 35.3                                       |



**SYSTRA**

|                                     |       |        |        |      |       |      |             |
|-------------------------------------|-------|--------|--------|------|-------|------|-------------|
| Sheaf Street Station Side           | 60030 | 435802 | 386988 | 90.1 | 108.3 | 63.6 | <b>60.5</b> |
| SCC Defra's target determ<br>Prkway | 36588 | 440015 | 386727 | 39.4 | 69.4  | 51.4 | 43.9        |
| SCC Parkway Layby 1                 | 47855 | 437346 | 387691 | 57.3 | 85.8  | 49.6 | 54.0        |
| Attercliffe Road (Tesco)            | 36588 | 436322 | 388234 | 50.4 | 22.8  | 37.4 | 38.3        |

Figure 3 – Sheffield 2017 Observed vs Modelled NO<sub>2</sub>

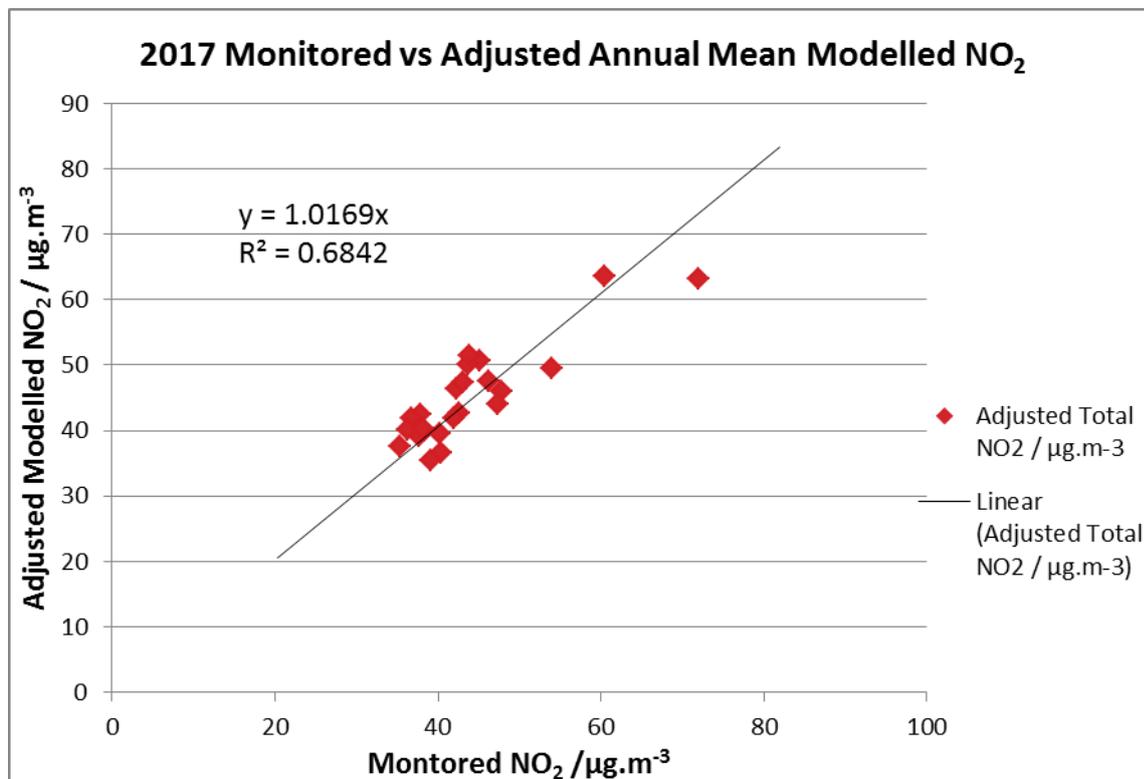
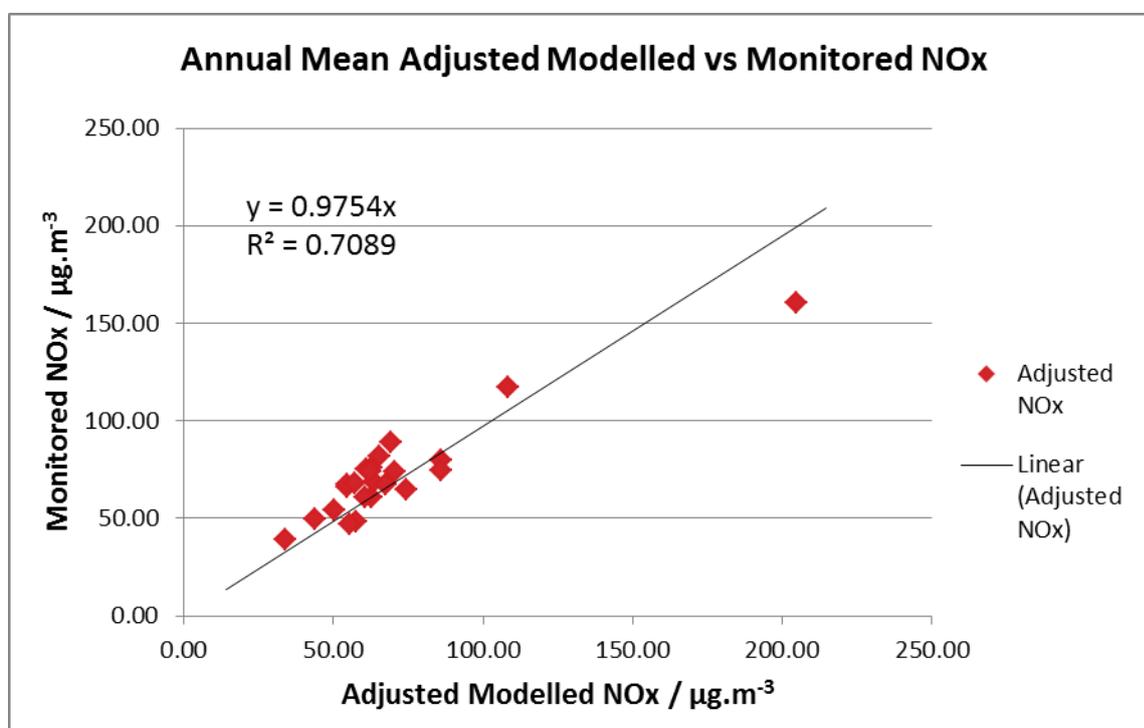


Figure 4 – Sheffield Modelled vs Monitored Road Contribution NO<sub>x</sub> 2017



3.3.2 The f-NO<sub>2</sub> values for input into the NO<sub>x</sub> to NO<sub>2</sub> calculator were derived from the EFT and are shown in the table below for key road links.

**Table 5 – Locally derived f-NO<sub>2</sub> values – Sheffield**

| Location_Census_ID | Local Authority        | fNO <sub>2</sub> _2017 | fNO <sub>2</sub> _2021_BaU | fNO <sub>2</sub> _2021_C3(S)_C+ | fNO <sub>2</sub> _2021_C3(S)_C+_VDM | fNO <sub>2</sub> _2021_C3(S)_D_VDM | fNO <sub>2</sub> _2021_C2(S)_D | fNO <sub>2</sub> _2021_C1(R+S)_D |
|--------------------|------------------------|------------------------|----------------------------|---------------------------------|-------------------------------------|------------------------------------|--------------------------------|----------------------------------|
| 7355               | Sheffield City Council | 0.220                  | 0.226                      | 0.224                           | 0.225                               | 0.225                              | 0.221                          | 0.226                            |
| 7380               | Sheffield City Council | 0.220                  | 0.224                      | 0.212                           | 0.211                               | 0.210                              | 0.204                          | 0.201                            |
| 7817               | Sheffield City Council | 0.261                  | 0.269                      | 0.245                           | 0.246                               | 0.257                              | 0.250                          | 0.238                            |
| 7818               | Sheffield City Council | 0.303                  | 0.301                      | 0.282                           | 0.283                               | 0.286                              | 0.293                          | 0.292                            |
| 8144               | Sheffield City Council | 0.243                  | 0.251                      | 0.233                           | 0.233                               | 0.202                              | 0.200                          | 0.209                            |
| 8710               | Sheffield City Council | 0.202                  | 0.218                      | 0.220                           | 0.222                               | 0.218                              | 0.206                          | 0.205                            |
| 8744               | Sheffield City Council | 0.246                  | 0.250                      | 0.241                           | 0.240                               | 0.186                              | 0.211                          | 0.188                            |
| 8758               | Sheffield City Council | 0.241                  | 0.241                      | 0.219                           | 0.218                               | 0.159                              | 0.202                          | 0.188                            |
| 16007              | Sheffield City Council | 0.261                  | 0.263                      | 0.270                           | 0.271                               | 0.271                              | 0.255                          | 0.260                            |
| 16580              | Sheffield City Council | 0.277                  | 0.278                      | 0.261                           | 0.261                               | 0.256                              | 0.266                          | 0.264                            |
| 16581              | Sheffield City Council | 0.220                  | 0.226                      | 0.222                           | 0.223                               | 0.205                              | 0.197                          | 0.195                            |
| 17332              | Sheffield City Council | 0.271                  | 0.275                      | 0.258                           | 0.261                               | 0.261                              | 0.252                          | 0.247                            |
| 17718              | Sheffield City Council | 0.256                  | 0.258                      | 0.248                           | 0.249                               | 0.244                              | 0.249                          | 0.247                            |
| 17728              | Sheffield City Council | 0.207                  | 0.212                      | 0.224                           | 0.223                               | 0.237                              | 0.180                          | 0.169                            |
| 17809              | Sheffield City Council | 0.296                  | 0.289                      | 0.274                           | 0.271                               | 0.219                              | 0.272                          | 0.243                            |
| 18546              | Sheffield City Council | 0.271                  | 0.272                      | 0.255                           | 0.255                               | 0.254                              | 0.261                          | 0.263                            |
| 18721              | Sheffield City Council | 0.247                  | 0.251                      | 0.232                           | 0.231                               | 0.234                              | 0.241                          | 0.231                            |
| 27373              | Sheffield City Council | 0.185                  | 0.192                      | 0.191                           | 0.191                               | 0.203                              | 0.178                          | 0.184                            |
| 27381              | Sheffield City Council | 0.229                  | 0.241                      | 0.230                           | 0.230                               | 0.216                              | 0.214                          | 0.214                            |
| 27393              | Sheffield City Council | 0.181                  | 0.188                      | 0.197                           | 0.198                               | 0.212                              | 0.160                          | 0.161                            |
| 27821              | Sheffield City Council | 0.292                  | 0.291                      | 0.264                           | 0.264                               | 0.269                              | 0.276                          | 0.273                            |
| 27822              | Sheffield City Council | 0.291                  | 0.291                      | 0.267                           | 0.268                               | 0.275                              | 0.269                          | 0.261                            |
| 27857              | Sheffield City Council | 0.215                  | 0.218                      | 0.213                           | 0.213                               | 0.193                              | 0.197                          | 0.194                            |
| 28052              | Sheffield City Council | 0.255                  | 0.258                      | 0.265                           | 0.265                               | 0.267                              | 0.249                          | 0.251                            |

|       |                        |       |       |       |       |       |       |       |
|-------|------------------------|-------|-------|-------|-------|-------|-------|-------|
| 28172 | Sheffield City Council | 0.296 | 0.293 | 0.269 | 0.269 | 0.257 | 0.285 | 0.277 |
| 28868 | Sheffield City Council | 0.249 | 0.246 | 0.223 | 0.219 | 0.220 | 0.250 | 0.251 |
| 36588 | Sheffield City Council | 0.276 | 0.279 | 0.266 | 0.269 | 0.262 | 0.266 | 0.256 |
| 37441 | Sheffield City Council | 0.255 | 0.261 | 0.247 | 0.247 | 0.249 | 0.245 | 0.241 |
| 37898 | Sheffield City Council | 0.253 | 0.256 | 0.240 | 0.241 | 0.236 | 0.236 | 0.241 |
| 37902 | Sheffield City Council | 0.274 | 0.276 | 0.261 | 0.261 | 0.266 | 0.266 | 0.260 |
| 37913 | Sheffield City Council | 0.255 | 0.258 | 0.265 | 0.266 | 0.267 | 0.250 | 0.251 |
| 38549 | Sheffield City Council | 0.216 | 0.216 | 0.206 | 0.205 | 0.209 | 0.203 | 0.198 |
| 46619 | Sheffield City Council | 0.262 | 0.260 | 0.245 | 0.244 | 0.231 | 0.248 | 0.243 |
| 46620 | Sheffield City Council | 0.243 | 0.254 | 0.248 | 0.249 | 0.244 | 0.237 | 0.236 |
| 47393 | Sheffield City Council | 0.266 | 0.270 | 0.259 | 0.259 | 0.228 | 0.237 | 0.230 |
| 47396 | Sheffield City Council | 0.255 | 0.263 | 0.254 | 0.255 | 0.247 | 0.243 | 0.242 |
| 47405 | Sheffield City Council | 0.233 | 0.239 | 0.234 | 0.234 | 0.236 | 0.228 | 0.228 |
| 47826 | Sheffield City Council | 0.228 | 0.231 | 0.218 | 0.219 | 0.215 | 0.201 | 0.198 |
| 47855 | Sheffield City Council | 0.293 | 0.292 | 0.290 | 0.290 | 0.264 | 0.277 | 0.266 |
| 47856 | Sheffield City Council | 0.261 | 0.263 | 0.246 | 0.247 | 0.244 | 0.250 | 0.251 |
| 47860 | Sheffield City Council | 0.309 | 0.303 | 0.281 | 0.283 | 0.244 | 0.287 | 0.255 |
| 48531 | Sheffield City Council | 0.272 | 0.274 | 0.264 | 0.265 | 0.266 | 0.262 | 0.261 |
| 48804 | Sheffield City Council | 0.257 | 0.263 | 0.243 | 0.244 | 0.249 | 0.246 | 0.239 |
| 48805 | Sheffield City Council | 0.288 | 0.281 | 0.262 | 0.265 | 0.207 | 0.237 | 0.226 |
| 56608 | Sheffield City Council | 0.276 | 0.281 | 0.262 | 0.263 | 0.214 | 0.244 | 0.231 |
| 56862 | Sheffield City Council | 0.237 | 0.243 | 0.239 | 0.239 | 0.241 | 0.236 | 0.231 |
| 56863 | Sheffield City Council | 0.231 | 0.227 | 0.229 | 0.230 | 0.180 | 0.193 | 0.193 |
| 57330 | Sheffield City Council | 0.220 | 0.224 | 0.209 | 0.208 | 0.209 | 0.219 | 0.227 |
| 57861 | Sheffield City Council | 0.298 | 0.295 | 0.278 | 0.278 | 0.231 | 0.273 | 0.252 |
| 57875 | Sheffield City Council | 0.233 | 0.242 | 0.237 | 0.236 | 0.239 | 0.227 | 0.233 |
| 58427 | Sheffield City Council | 0.269 | 0.271 | 0.257 | 0.254 | 0.257 | 0.260 | 0.253 |

|                    |                        |       |       |       |       |       |       |       |
|--------------------|------------------------|-------|-------|-------|-------|-------|-------|-------|
| 60030              | Sheffield City Council | 0.271 | 0.273 | 0.255 | 0.255 | 0.198 | 0.235 | 0.222 |
| 73909              | Sheffield City Council | 0.273 | 0.274 | 0.281 | 0.281 | 0.282 | 0.263 | 0.264 |
| 75194              | Sheffield City Council | 0.283 | 0.280 | 0.269 | 0.269 | 0.213 | 0.250 | 0.242 |
| 75195              | Sheffield City Council | 0.269 | 0.272 | 0.257 | 0.256 | 0.207 | 0.238 | 0.224 |
| 75196              | Sheffield City Council | 0.268 | 0.270 | 0.256 | 0.255 | 0.205 | 0.244 | 0.224 |
| 75197              | Sheffield City Council | 0.257 | 0.258 | 0.247 | 0.245 | 0.191 | 0.227 | 0.200 |
| 75198              | Sheffield City Council | 0.135 | 0.143 | 0.145 | 0.147 | 0.147 | 0.150 | 0.150 |
| 75199              | Sheffield City Council | 0.277 | 0.278 | 0.271 | 0.271 | 0.224 | 0.266 | 0.260 |
| 76044              | Sheffield City Council | 0.199 | 0.213 | 0.201 | 0.201 | 0.134 | 0.173 | 0.162 |
| 76045              | Sheffield City Council | 0.295 | 0.294 | 0.277 | 0.277 | 0.224 | 0.262 | 0.252 |
| 76046              | Sheffield City Council | 0.307 | 0.304 | 0.278 | 0.279 | 0.233 | 0.282 | 0.264 |
| 77544              | Sheffield City Council | 0.269 | 0.269 | 0.260 | 0.260 | 0.258 | 0.260 | 0.273 |
| 77547              | Sheffield City Council | 0.248 | 0.254 | 0.250 | 0.250 | 0.255 | 0.243 | 0.249 |
| 77551              | Sheffield City Council | 0.235 | 0.248 | 0.243 | 0.243 | 0.239 | 0.228 | 0.225 |
| 77553              | Sheffield City Council | 0.280 | 0.283 | 0.267 | 0.267 | 0.270 | 0.277 | 0.280 |
| 77557              | Sheffield City Council | 0.261 | 0.269 | 0.255 | 0.257 | 0.260 | 0.257 | 0.263 |
| 81155              | Sheffield City Council | 0.215 | 0.225 | 0.222 | 0.221 | 0.200 | 0.190 | 0.183 |
| 81162              | Sheffield City Council | 0.291 | 0.291 | 0.274 | 0.273 | 0.233 | 0.264 | 0.256 |
| 81227              | Sheffield City Council | 0.263 | 0.267 | 0.254 | 0.254 | 0.260 | 0.254 | 0.257 |
| 81228              | Sheffield City Council | 0.281 | 0.283 | 0.264 | 0.264 | 0.269 | 0.275 | 0.280 |
| 81229              | Sheffield City Council | 0.230 | 0.236 | 0.232 | 0.233 | 0.240 | 0.220 | 0.220 |
| 81230              | Sheffield City Council | 0.263 | 0.267 | 0.258 | 0.259 | 0.263 | 0.256 | 0.259 |
| 81236              | Sheffield City Council | 0.290 | 0.284 | 0.273 | 0.274 | 0.228 | 0.266 | 0.254 |
| 81237              | Sheffield City Council | 0.300 | 0.297 | 0.278 | 0.279 | 0.236 | 0.278 | 0.259 |
| 81238              | Sheffield City Council | 0.276 | 0.268 | 0.269 | 0.269 | 0.222 | 0.255 | 0.252 |
| 99303              | Sheffield City Council | 0.297 | 0.297 | 0.293 | 0.293 | 0.277 | 0.280 | 0.267 |
| Arundel Gate, C710 | Sheffield City Council | 0.161 | 0.170 | 0.150 | 0.150 | 0.120 | 0.134 | 0.132 |

|                          |                        |       |       |       |       |       |       |       |
|--------------------------|------------------------|-------|-------|-------|-------|-------|-------|-------|
| Attercliffe Road A6109   | Sheffield City Council | 0.216 | 0.220 | 0.215 | 0.215 | 0.208 | 0.184 | 0.183 |
| Barkers Pool, S1         | Sheffield City Council | 0.168 | 0.174 | 0.165 | 0.166 | 0.137 | 0.138 | 0.137 |
| Barnsley Road A6135      | Sheffield City Council | 0.266 | 0.270 | 0.260 | 0.261 | 0.265 | 0.267 | 0.272 |
| Bawtry Road A631         | Sheffield City Council | 0.262 | 0.267 | 0.253 | 0.257 | 0.257 | 0.243 | 0.227 |
| Beeley Wood Road, S6     | Sheffield City Council | 0.264 | 0.268 | 0.252 | 0.252 | 0.254 | 0.257 | 0.260 |
| Brightside Lane A6109    | Sheffield City Council | 0.261 | 0.263 | 0.254 | 0.254 | 0.250 | 0.253 | 0.251 |
| Burngreave Road A6135    | Sheffield City Council | 0.207 | 0.213 | 0.230 | 0.230 | 0.244 | 0.183 | 0.182 |
| Ecclesall Rd A625        | Sheffield City Council | 0.234 | 0.239 | 0.232 | 0.232 | 0.218 | 0.201 | 0.210 |
| Glossop Road B6547       | Sheffield City Council | 0.194 | 0.213 | 0.193 | 0.194 | 0.167 | 0.167 | 0.168 |
| Meadowhall Road A6109    | Sheffield City Council | 0.228 | 0.231 | 0.218 | 0.219 | 0.215 | 0.201 | 0.198 |
| Penistone Road A61       | Sheffield City Council | 0.279 | 0.279 | 0.264 | 0.265 | 0.244 | 0.263 | 0.258 |
| Queens Road A61          | Sheffield City Council | 0.261 | 0.264 | 0.250 | 0.250 | 0.236 | 0.245 | 0.250 |
| Sheaf Street A61         | Sheffield City Council | 0.271 | 0.272 | 0.253 | 0.254 | 0.196 | 0.233 | 0.219 |
| Sheffield Parkway A57    | Sheffield City Council | 0.293 | 0.293 | 0.291 | 0.292 | 0.259 | 0.277 | 0.267 |
| Sheffield Road A6178     | Sheffield City Council | 0.189 | 0.188 | 0.173 | 0.172 | 0.173 | 0.171 | 0.162 |
| Upper Hanover Street A61 | Sheffield City Council | 0.280 | 0.280 | 0.263 | 0.266 | 0.217 | 0.254 | 0.217 |
| Upwell Street A6102      | Sheffield City Council | 0.244 | 0.247 | 0.219 | 0.220 | 0.230 | 0.222 | 0.213 |
| Whitham Rd A57           | Sheffield City Council | 0.250 | 0.258 | 0.243 | 0.243 | 0.205 | 0.209 | 0.216 |

### 3.4 Rotherham Baseline Dispersion Modelling Results

3.4.1 The following table and graphs show the results of the Baseline 2017 modelling.

**Table 6 – Rotherham: Monitored vs Modelled NO<sub>x</sub> and NO<sub>2</sub> 2017**

| Site name                           | Census id (if applicable) | Grid ref      | Annual mean NO <sub>x</sub> modelled 2017 | Annual mean NO <sub>x</sub> monitored 2017 | Annual mean NO <sub>2</sub> modelled 2017 | Annual mean NO <sub>2</sub> monitored 2017 |
|-------------------------------------|---------------------------|---------------|---|--|---|--|
| Blackburn                           | n/a                       | 438696 392816 | 47.6                                      | 46.7                                       | 27.1                                      | 27.6                                       |
| Howarth School                      | n/a                       | 442524 389134 | 62.5                                      | 62.1                                       | 33.5                                      | 28.9                                       |
| Kirkstead Road                      | n/a                       | 438611 392862 | 75.19                                     | 75.2                                       | 38.3                                      | 47.2                                       |
| Blackburn School Entrance           | n/a                       | 438705 392845 | 46.2                                      | 45.77                                      | 26.1                                      | 26.3                                       |
| Grange Farm Close                   | n/a                       | 442866 389161 | 58.7                                      | 55.6                                       | 31.9                                      | 34.4                                       |
| Doncaster Gate                      | n/a                       | 443039 392855 | 59.2                                      | 56.3                                       | 32.2                                      | 31   |
| Broom Road                          | 27799                     | 443969 392041 | 49.2                                      | 47.1                                       | 27.9                                      | 25.3                                       |
| Wellgate Masonic Hall               | 60031                     | 443072 392668 | 62.2                                      | 61.8                                       | 33.3                                      | 38.2                                       |
| Bradgate A629                       | 77552                     | 441006 393338 | 79.3                                      | 79.3                                       | 48.4                                      | 39.9                                       |
| St Ann's A630                       | 58395                     | 443347 393394 | 73.4                                      | 78.3                                       | 38.2                                      | 39   |
| 152 Fitz Rd                         | 58395                     | 443724 393628 | 64.4                                      | 61.2                                       | 34.3                                      | 41.6                                       |
| Bawtry Rd                           | 73908                     | 441283 390309 | 71.8                                      | 70.5                                       | 37.6                                      | 35.7                                       |
| Brinsworth Rd                       | n/a                       | 442623 388976 | 70.6                                      | 67.1                                       | 36.7                                      | 38.2                                       |
| Catcliffe Chemist                   | n/a                       | 442587 388594 | 57.2                                      | 55.5                                       | 31.3                                      | 31.7                                       |
| 4m to Parkway A630 (tube Rotherham) | 73910                     | 442804 388927 | 104.1                                     | 104.1                                      | 48.4                                      | 46.5                                       |

Figure 5 – Rotherham Observed vs Adjusted Modelled NO<sub>2</sub> 2017

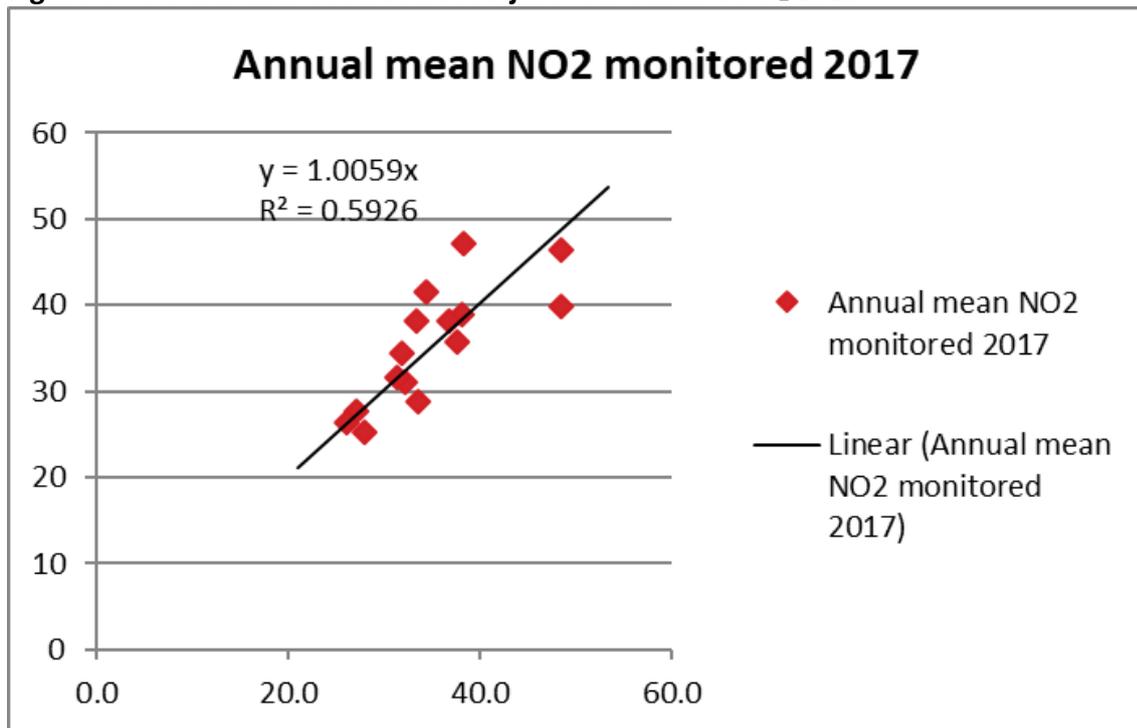
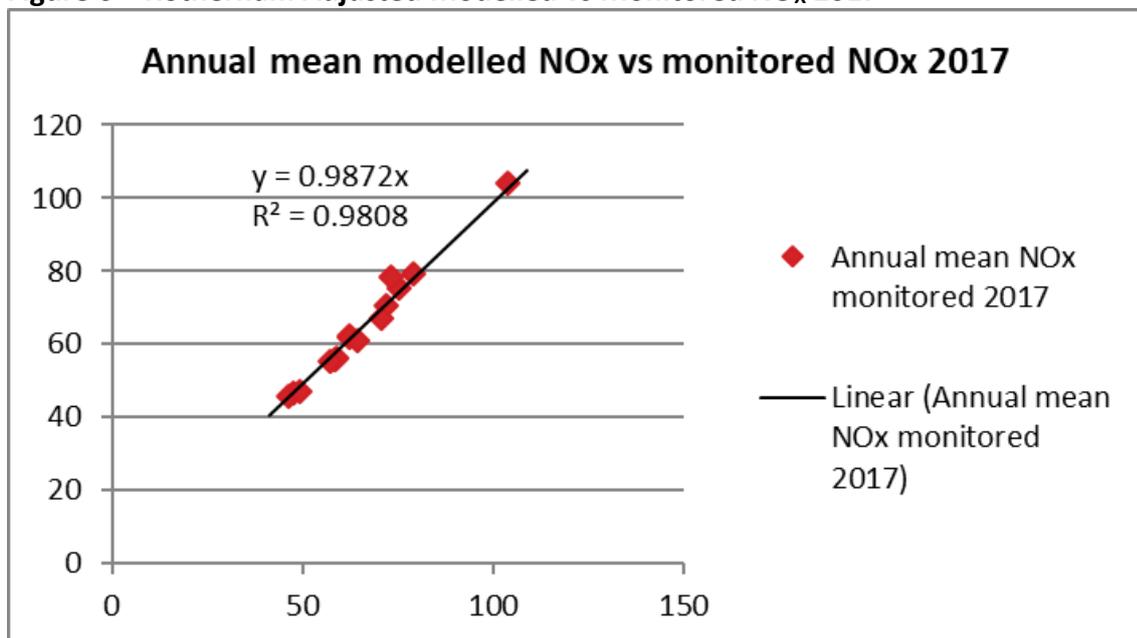


Figure 6 – Rotherham Adjusted Modelled vs Monitored NO<sub>x</sub> 2017



3.4.2 The f-NO<sub>2</sub> values for entering into the NO<sub>x</sub>:NO<sub>2</sub> calculator were derived from the EFT and are shown below for key road links.

**Table 7 – Locally derived f-NO<sub>2</sub> values – Rotherham**

| Location_Census_ID | Rotherham                              | fNO <sub>2</sub> _2017 | fNO <sub>2</sub> _2021_BaU | fNO <sub>2</sub> _2021_C3_(S)_C+ | fNO <sub>2</sub> _2021_C3_(S)_C+_VDM | fNO <sub>2</sub> _2021_C3_(S)_D_VDM | fNO <sub>2</sub> _2021_C2_(S)_D | fNO <sub>2</sub> _2021_C1_(R+S)_D |
|--------------------|--|------------------------|----------------------------|----------------------------------|--------------------------------------|-------------------------------------|---------------------------------|-----------------------------------|
| 17339              | Rotherham Metropolitan Borough Council | 0.270                  | 0.273                      | 0.267                            | 0.268                                | 0.268                               | 0.269                           | 0.268                             |
| 17805              | Rotherham Metropolitan Borough Council | 0.287                  | 0.287                      | 0.273                            | 0.274                                | 0.274                               | 0.288                           | 0.264                             |
| 17807              | Rotherham Metropolitan Borough Council | 0.272                  | 0.277                      | 0.276                            | 0.276                                | 0.275                               | 0.261                           | 0.255                             |
| 17808              | Rotherham Metropolitan Borough Council | 0.292                  | 0.291                      | 0.276                            | 0.275                                | 0.275                               | 0.284                           | 0.282                             |
| 18689              | Rotherham Metropolitan Borough Council | 0.263                  | 0.266                      | 0.250                            | 0.252                                | 0.253                               | 0.243                           | 0.244                             |
| 27396              | Rotherham Metropolitan Borough Council | 0.281                  | 0.286                      | 0.276                            | 0.276                                | 0.275                               | 0.271                           | 0.265                             |
| 27401              | Rotherham Metropolitan Borough Council | 0.302                  | 0.299                      | 0.305                            | 0.306                                | 0.306                               | 0.299                           | 0.299                             |
| 27799              | Rotherham Metropolitan Borough Council | 0.264                  | 0.268                      | 0.262                            | 0.262                                | 0.262                               | 0.260                           | 0.258                             |
| 27858              | Rotherham Metropolitan Borough Council | 0.265                  | 0.268                      | 0.260                            | 0.261                                | 0.262                               | 0.262                           | 0.256                             |
| 28002              | Rotherham Metropolitan Borough Council | 0.299                  | 0.298                      | 0.282                            | 0.283                                | 0.283                               | 0.292                           | 0.272                             |
| 36007              | Rotherham Metropolitan Borough Council | 0.271                  | 0.274                      | 0.282                            | 0.282                                | 0.282                               | 0.266                           | 0.268                             |
| 37443              | Rotherham Metropolitan Borough Council | 0.273                  | 0.279                      | 0.268                            | 0.268                                | 0.268                               | 0.270                           | 0.268                             |
| 37868              | Rotherham Metropolitan Borough Council | 0.294                  | 0.294                      | 0.281                            | 0.281                                | 0.281                               | 0.288                           | 0.288                             |
| 38673              | Rotherham Metropolitan Borough Council | 0.275                  | 0.274                      | 0.272                            | 0.272                                | 0.272                               | 0.286                           | 0.233                             |
| 47409              | Rotherham Metropolitan Borough Council | 0.300                  | 0.300                      | 0.287                            | 0.287                                | 0.286                               | 0.290                           | 0.259                             |
| 56055              | Rotherham Metropolitan Borough Council | 0.292                  | 0.292                      | 0.280                            | 0.281                                | 0.280                               | 0.285                           | 0.273                             |
| 57857              | Rotherham Metropolitan Borough Council | 0.272                  | 0.273                      | 0.257                            | 0.258                                | 0.258                               | 0.272                           | 0.252                             |
| 58395              | Rotherham Metropolitan Borough Council | 0.253                  | 0.254                      | 0.244                            | 0.244                                | 0.245                               | 0.269                           | 0.241                             |
| 60031              | Rotherham Metropolitan Borough Council | 0.258                  | 0.260                      | 0.251                            | 0.252                                | 0.252                               | 0.254                           | 0.254                             |
| 60032              | Rotherham Metropolitan Borough Council | 0.219                  | 0.225                      | 0.233                            | 0.233                                | 0.234                               | 0.214                           | 0.220                             |
| 60033              | Rotherham Metropolitan Borough Council | 0.306                  | 0.303                      | 0.289                            | 0.290                                | 0.290                               | 0.295                           | 0.299                             |
| 60034              | Rotherham Metropolitan Borough Council | 0.249                  | 0.256                      | 0.252                            | 0.253                                | 0.254                               | 0.256                           | 0.261                             |
| 73410              | Rotherham Metropolitan Borough Council | 0.215                  | 0.225                      | 0.245                            | 0.246                                | 0.247                               | 0.225                           | 0.215                             |
| 7360               | Rotherham Metropolitan Borough Council | 0.257                  | 0.266                      | 0.264                            | 0.264                                | 0.264                               | 0.251                           | 0.255                             |
| 7382               | Rotherham Metropolitan Borough Council | 0.273                  | 0.279                      | 0.266                            | 0.266                                | 0.266                               | 0.272                           | 0.283                             |
| 7388               | Rotherham Metropolitan Borough Council | 0.293                  | 0.292                      | 0.283                            | 0.283                                | 0.283                               | 0.288                           | 0.287                             |

|                       |  |       |       |       |       |       |       |       |
|-----------------------|--|-------|-------|-------|-------|-------|-------|-------|
| 73907                 | Rotherham Metropolitan Borough Council | 0.249 | 0.251 | 0.242 | 0.242 | 0.243 | 0.245 | 0.235 |
| 73908                 | Rotherham Metropolitan Borough Council | 0.278 | 0.284 | 0.268 | 0.270 | 0.270 | 0.275 | 0.257 |
| 73910                 | Rotherham Metropolitan Borough Council | 0.285 | 0.289 | 0.269 | 0.275 | 0.272 | 0.276 | 0.273 |
| 73911                 | Rotherham Metropolitan Borough Council | 0.285 | 0.286 | 0.274 | 0.274 | 0.275 | 0.284 | 0.289 |
| 77384                 | Rotherham Metropolitan Borough Council | 0.298 | 0.300 | 0.295 | 0.295 | 0.294 | 0.293 | 0.295 |
| 7750                  | Rotherham Metropolitan Borough Council | 0.273 | 0.272 | 0.252 | 0.257 | 0.257 | 0.279 | 0.244 |
| 77542                 | Rotherham Metropolitan Borough Council | 0.278 | 0.280 | 0.273 | 0.274 | 0.274 | 0.271 | 0.273 |
| 77548                 | Rotherham Metropolitan Borough Council | 0.260 | 0.268 | 0.256 | 0.257 | 0.258 | 0.255 | 0.257 |
| 77549                 | Rotherham Metropolitan Borough Council | 0.307 | 0.309 | 0.293 | 0.293 | 0.293 | 0.305 | 0.305 |
| 77552                 | Rotherham Metropolitan Borough Council | 0.262 | 0.263 | 0.275 | 0.272 | 0.273 | 0.293 | 0.252 |
| 77554                 | Rotherham Metropolitan Borough Council | 0.261 | 0.263 | 0.249 | 0.249 | 0.251 | 0.273 | 0.281 |
| 77563                 | Rotherham Metropolitan Borough Council | 0.232 | 0.235 | 0.270 | 0.270 | 0.270 | 0.250 | 0.229 |
| 77615                 | Rotherham Metropolitan Borough Council | 0.253 | 0.256 | 0.271 | 0.271 | 0.272 | 0.255 | 0.252 |
| 77759                 | Rotherham Metropolitan Borough Council | 0.199 | 0.205 | 0.184 | 0.184 | 0.184 | 0.201 | 0.207 |
| 7973                  | Rotherham Metropolitan Borough Council | 0.272 | 0.279 | 0.268 | 0.268 | 0.269 | 0.272 | 0.277 |
| 80807                 | Rotherham Metropolitan Borough Council | 0.275 | 0.275 | 0.265 | 0.266 | 0.266 | 0.272 | 0.279 |
| 8345                  | Rotherham Metropolitan Borough Council | 0.284 | 0.285 | 0.272 | 0.272 | 0.273 | 0.278 | 0.246 |
| 8590                  | Rotherham Metropolitan Borough Council | 0.222 | 0.228 | 0.217 | 0.218 | 0.217 | 0.208 | 0.161 |
| 99965                 | Rotherham Metropolitan Borough Council | 0.232 | 0.235 | 0.270 | 0.270 | 0.270 | 0.250 | 0.229 |
| A629 Wortley Road     | Rotherham Metropolitan Borough Council | 0.266 | 0.266 | 0.270 | 0.268 | 0.270 | 0.294 | 0.222 |
| A630 Fitzwilliam Road | Rotherham Metropolitan Borough Council | 0.260 | 0.261 | 0.250 | 0.250 | 0.250 | 0.273 | 0.251 |
| A630 Parkway          | Rotherham Metropolitan Borough Council | 0.285 | 0.289 | 0.269 | 0.275 | 0.272 | 0.276 | 0.273 |
| A633 Rawmarsh Hill    | Rotherham Metropolitan Borough Council | 0.266 | 0.271 | 0.270 | 0.271 | 0.271 | 0.275 | 0.257 |

### 3.5 NO<sub>x</sub> Emissions for All Road Transport Sources – 2017

3.5.1 The evidence submission is accompanied by an Excel file which lists the estimated annual NO<sub>x</sub> emissions in 2017 and 2021 for every link in the SCRTM3B traffic model, on a link-by-link basis. These are contained in supporting documents SD04 and SD05.

### 3.6 BUSINESS AS USUAL PROJECTIONS - 2021

3.6.1 This section describes the air quality modelling for the 2021 'Business as Usual', including Clean Air Zones and other 'Do Something' measures forecast.

3.6.2 NO<sub>2</sub> concentrations are also presented in this section for the 2017 Business as Usual forecasts. This is presented for validation receptors those where the AQD (Air Quality Directive) is forecast to be non-compliant in 2021, and also for other predicted compliant receptors.

**Table 8 –Sheffield’s modelled annual mean nitrogen dioxide results for the following:**

| Site Name      | Census id | Road ID | x-co-ord | y co-ord | Modelled NO <sub>2</sub> annual mean 2017 BaU | Modelled NO <sub>2</sub> annual mean 2021 BaU | Modelled NO <sub>2</sub> annual mean 2021 Cordon 3 CAZ C+ with additional measures | Modelled NO <sub>2</sub> annual mean 2021 Cordon 3 CAZ D with additional measures | Modelled NO <sub>2</sub> annual mean 2021 Cordon 1 CAZ D with additional measures | Modelled NO <sub>2</sub> annual mean 2021 Cordon 2 CAZ D with additional measures |
|----------------|-----------|---------|----------|----------|---|---|--|---|---|---|
| PCM Link A6135 | 7355      | A6135   | 438506   | 384878   | 33.93   | 28.72   | 25.65  | 26.00   | 28.40   | 27.24   |
| PCM Link A6178 | 7380      | A6178   | 438009   | 388893   | 38.56   | 33.01   | 29.18  | 28.93   | 28.39   | 25.47   |
| PCM Link A6102 | 7817      | A6102   | 437667   | 390107   | 33.66   | 29.03   | 26.86  | 27.73   | 25.74   | 23.52   |
| PCM Link A6102 | 7818      | A6102   | 436003   | 381661   | 28.69   | 24.38   | 22.81  | 23.41   | 23.53   | 22.41   |
| PCM Link A57   | 8144      | A57     | 433584   | 387108   | 38.26   | 27.41   | 23.10  | 22.05   | 26.51   | 24.45   |
| PCM Link A621  | 8710      | A621    | 431992   | 380867   | 18.38   | 16.03   | 15.09  | 15.11   | 15.82   | 15.60   |
| PCM Link A61   | 8744      | A61     | 435362   | 386383   | 55.60   | 47.22   | 34.90  | 28.74   | 40.48   | 37.13   |
| PCM Link A61   | 8758      | A61     | 435742   | 386706   | 56.84   | 47.92   | 34.87  | 29.05   | 41.86   | 38.46   |
| PCM Link M1    | 16007     | M1      | 438018   | 393370   | 43.58   | 36.51   | 35.28  | 35.63   | 34.84   | 33.90   |
| PCM Link A61   | 16580     | A61     | 433563   | 389991   | 34.87   | 29.48   | 26.36  | 26.17   | 29.05   | 27.94   |
| PCM Link A61   | 16581     | A61     | 435009   | 384805   | 29.55   | 24.90   | 21.60  | 21.00   | 24.01   | 22.89   |
| PCM Link A631  | 17332     | A631    | 440115   | 390799   | 41.46   | 35.48   | 32.53  | 32.93   | 31.84   | 30.60   |
| PCM Link A6109 | 17718     | A6109   | 438610   | 390617   | 34.92   | 30.06   | 27.08  | 26.96   | 26.66   | 24.27   |
| PCM Link A6315 | 17728     | A6315   | 435839   | 388817   | 32.96   | 28.09   | 26.48  | 27.57   | 25.81   | 24.60   |
| PCM Link A61   | 17809     | A61     | 434808   | 388215   | 46.36   | 39.28   | 30.84  | 26.83   | 35.27   | 33.10   |
| PCM Link A61   | 18546     | A61     | 433471   | 390523   | 35.48   | 30.00   | 26.90  | 27.06   | 29.66   | 28.60   |
| PCM Link A6102 | 18721     | A6102   | 439374   | 388259   | 36.08   | 30.85   | 28.84  | 28.77   | 26.81   | 24.23   |
| PCM Link A6135 | 27373     | A6135   | 437947   | 385193   | 33.60   | 28.67   | 25.85  | 27.14   | 27.96   | 26.41   |
| PCM Link A621  | 27381     | A621    | 434749   | 385004   | 30.19   | 25.55   | 22.20  | 21.55   | 24.63   | 23.24   |
| PCM Link A6178 | 27393     | A6178   | 437082   | 388345   | 34.78   | 29.80   | 26.83  | 27.14   | 26.36   | 24.28   |
| PCM Link A6101 | 27821     | A6101   | 433358   | 389729   | 34.96   | 29.49   | 26.63  | 27.29   | 29.51   | 28.63   |
| PCM Link A6102 | 27822     | A6102   | 438729   | 386001   | 31.77   | 26.91   | 25.20  | 26.32   | 24.77   | 22.63   |

|                |       |       |        |        |       |       |       |       |       |       |
|----------------|-------|-------|--------|--------|-------|-------|-------|-------|-------|-------|
| PCM Link A61   | 27857 | A61   | 435758 | 385993 | 37.87 | 32.30 | 26.94 | 25.26 | 30.57 | 27.91 |
| PCM Link M1    | 28052 | M1    | 439531 | 391348 | 48.83 | 41.58 | 39.77 | 40.15 | 38.10 | 37.58 |
| PCM Link A6102 | 28172 | A6102 | 433243 | 390478 | 33.33 | 28.15 | 24.39 | 23.89 | 27.30 | 26.46 |
| PCM Link A631  | 28868 | A631  | 439676 | 389992 | 35.00 | 29.38 | 26.62 | 26.52 | 26.32 | 24.40 |
| PCM Link 630   | 36588 | A630  | 440015 | 386727 | 37.82 | 32.26 | 28.17 | 27.76 | 28.17 | 24.71 |
| PCM Link A6178 | 37441 | A6178 | 439717 | 390829 | 48.16 | 41.86 | 37.81 | 38.33 | 36.96 | 33.68 |
| PCM Link A61   | 37898 | A61   | 435809 | 386349 | 45.49 | 38.43 | 29.10 | 25.43 | 34.85 | 31.00 |
| PCM Link A6102 | 37902 | A6102 | 438286 | 389811 | 34.41 | 29.33 | 26.99 | 27.36 | 25.93 | 23.75 |
| PCM Link A631  | 37913 | A631  | 439519 | 391480 | 49.06 | 41.73 | 39.97 | 40.35 | 38.35 | 37.96 |
| PCM Link A6178 | 38549 | A6178 | 438601 | 389692 | 41.66 | 35.82 | 32.76 | 32.99 | 30.57 | 27.82 |
| PCM Link A61   | 46619 | A61   | 433978 | 389419 | 35.51 | 29.99 | 26.07 | 24.85 | 28.55 | 27.25 |
| PCM Link A61   | 46620 | A61   | 434987 | 381693 | 27.25 | 23.08 | 20.50 | 20.53 | 22.61 | 22.03 |
| PCM Link A621  | 47393 | A621  | 435240 | 386002 | 40.81 | 34.69 | 28.22 | 25.82 | 32.31 | 29.15 |
| PCM Link A625  | 47396 | A625  | 434290 | 386197 | 30.52 | 25.97 | 23.38 | 23.43 | 27.26 | 25.07 |
| PCM Link A629  | 47405 | A629  | 435534 | 396240 | 25.43 | 21.75 | 19.74 | 19.93 | 21.19 | 20.95 |
| PCM Link A6109 | 47826 | A6109 | 439171 | 391727 | 41.29 | 35.35 | 32.85 | 32.82 | 31.01 | 29.90 |
| PCM Link A57   | 47855 | A57   | 437766 | 387454 | 49.74 | 42.07 | 33.71 | 28.14 | 36.65 | 32.15 |
| PCM Link A61   | 47856 | A61   | 433380 | 390693 | 31.30 | 26.62 | 23.83 | 23.80 | 26.32 | 25.45 |
| PCM Link A61   | 47860 | A61   | 434401 | 386985 | 36.93 | 30.91 | 24.95 | 22.27 | 28.44 | 26.43 |
| PCM Link A61   | 48531 | A61   | 435191 | 381000 | 28.71 | 24.08 | 21.85 | 22.11 | 23.46 | 22.80 |
| PCM Link A6102 | 48804 | A6102 | 439088 | 389152 | 37.45 | 31.67 | 28.28 | 28.66 | 27.99 | 25.39 |
| PCM Link A61   | 48805 | A61   | 435531 | 386560 | 51.72 | 42.96 | 32.25 | 27.06 | 37.87 | 33.87 |
| PCM Link A61   | 56608 | A61   | 435009 | 388014 | 46.17 | 39.27 | 30.42 | 25.83 | 34.80 | 31.55 |
| PCM Link A629  | 56862 | A629  | 436006 | 395739 | 22.27 | 19.06 | 17.97 | 18.06 | 18.45 | 18.20 |
| PCM Link A6109 | 56863 | A6109 | 436322 | 388234 | 41.64 | 35.17 | 29.42 | 27.39 | 31.08 | 28.24 |
| PCM Link A6178 | 57330 | A6178 | 440015 | 391185 | 36.40 | 30.88 | 28.76 | 28.86 | 27.45 | 26.99 |
| PCM Link A61   | 57861 | A61   | 435003 | 386381 | 60.87 | 51.69 | 38.58 | 30.78 | 45.24 | 39.87 |
| PCM Link A6135 | 57875 | A6135 | 436492 | 390149 | 35.03 | 29.85 | 25.89 | 26.03 | 28.59 | 27.29 |
| PCM Link A6102 | 58427 | A6102 | 439171 | 386995 | 35.32 | 29.98 | 27.79 | 27.39 | 26.76 | 24.10 |
| PCM Link A61   | 60030 | A61   | 435809 | 387001 | 61.06 | 50.91 | 36.77 | 30.18 | 44.91 | 40.97 |
| PCM Link M1    | 73909 | M1    | 440833 | 389848 | 49.00 | 41.19 | 39.37 | 39.99 | 39.33 | 37.86 |
| PCM Link A61   | 75194 | A61   | 435548 | 386632 | 50.85 | 42.56 | 32.03 | 26.89 | 38.17 | 33.98 |
| PCM Link A61   | 75195 | A61   | 435810 | 386626 | 57.43 | 48.18 | 34.80 | 28.92 | 41.83 | 37.98 |
| PCM Link A61   | 75196 | A61   | 435753 | 386520 | 56.87 | 47.79 | 34.88 | 28.57 | 41.30 | 37.60 |
| PCM Link A61   | 75197 | A61   | 435573 | 386464 | 51.97 | 43.52 | 32.58 | 27.24 | 37.64 | 34.78 |
| PCM Link A61   | 75198 | A61   | 435737 | 386648 | 44.43 | 38.76 | 30.21 | 26.68 | 36.37 | 32.82 |

|                             |       |                                 |        |        |       |       |       |       |       |       |
|-----------------------------|-------|---------------------------------|--------|--------|-------|-------|-------|-------|-------|-------|
| <b>PCM Link A61</b>         | 75199 | A61                             | 435592 | 386538 | 49.79 | 41.76 | 31.46 | 26.64 | 37.91 | 33.87 |
| <b>PCM Link A6135</b>       | 76044 | A6135                           | 435936 | 388031 | 48.47 | 42.33 | 32.34 | 27.07 | 37.26 | 33.99 |
| <b>PCM Link A61</b>         | 76045 | A61                             | 436210 | 387645 | 50.40 | 42.78 | 32.83 | 27.13 | 37.88 | 33.50 |
| <b>PCM Link A61</b>         | 76046 | A61                             | 436246 | 387844 | 47.68 | 40.47 | 31.27 | 26.17 | 35.64 | 31.93 |
| <b>PCM Link A57</b>         | 77544 | A57                             | 431994 | 387127 | 24.28 | 20.65 | 18.90 | 18.94 | 20.49 | 19.59 |
| <b>PCM Link A6101</b>       | 77547 | A6101                           | 433005 | 389489 | 34.14 | 28.92 | 25.45 | 25.98 | 28.55 | 27.78 |
| <b>PCM Link A6102</b>       | 77551 | A6102                           | 432723 | 391009 | 24.93 | 21.41 | 19.25 | 19.16 | 20.93 | 20.48 |
| <b>PCM Link A61</b>         | 77553 | A61                             | 433793 | 392251 | 25.17 | 21.44 | 19.82 | 20.03 | 21.36 | 20.83 |
| <b>PCM Link A6135</b>       | 77557 | A6135                           | 435631 | 396500 | 21.03 | 18.17 | 17.09 | 17.26 | 17.97 | 17.75 |
| <b>PCM Link A6135</b>       | 81155 | A6135                           | 436829 | 386425 | 30.65 | 26.11 | 22.59 | 21.75 | 24.54 | 22.97 |
| <b>PCM Link A61</b>         | 81162 | A61                             | 435402 | 388018 | 52.09 | 44.84 | 34.25 | 28.32 | 39.53 | 34.58 |
| <b>PCM Link A6102</b>       | 81227 | A6102                           | 435013 | 390701 | 30.78 | 26.21 | 24.03 | 24.70 | 25.19 | 24.33 |
| <b>PCM Link A6102</b>       | 81228 | A6102                           | 433571 | 390669 | 30.31 | 25.71 | 23.49 | 23.97 | 25.37 | 24.58 |
| <b>PCM Link A6102</b>       | 81229 | A6102                           | 433482 | 390875 | 28.77 | 24.57 | 22.45 | 22.82 | 24.09 | 23.42 |
| <b>PCM Link A6102</b>       | 81230 | A6102                           | 433152 | 390852 | 29.88 | 25.38 | 22.88 | 23.24 | 25.04 | 24.41 |
| <b>PCM Link A61</b>         | 81236 | A61                             | 435658 | 388179 | 57.89 | 51.03 | 38.09 | 30.66 | 43.85 | 38.63 |
| <b>PCM Link A61</b>         | 81237 | A61                             | 435810 | 388040 | 51.77 | 43.96 | 33.08 | 28.04 | 38.84 | 35.29 |
| <b>PCM Link A6109</b>       | 81238 | A6109                           | 435861 | 388168 | 46.90 | 37.40 | 29.49 | 25.68 | 33.82 | 30.44 |
| <b>PCM Link A57</b>         | 99303 | A57                             | 439254 | 386597 | 44.51 | 37.79 | 33.27 | 31.98 | 32.64 | 28.35 |
| <b>Arundel Gate</b>         | n/a   | C710                            | 435601 | 387255 | 46.61 | 40.58 | 30.64 | 27.91 | 37.37 | 35.16 |
|                             | n/a   | Barkers<br>Pool<br>Taxi<br>Rank | 435288 | 387228 | 35.1  | 29.5  | 26.19 | 24.05 | 31.03 | 28.92 |
| <b>Beeley Wood<br/>Road</b> | n/a   | Beeley<br>Wood<br>Road          | 433248 | 391120 | 32.03 | 27.28 | 24.36 | 24.62 | 27.15 | 26.35 |
| <b>Glossop Road</b>         | n/a   | B6547                           | 433413 | 386746 | 31.05 | 26.73 | 23.98 | 23.81 | 26.97 | 25.63 |

*Note: if Cordon 1 CAZ D option is taken forward some sites will require additional mitigation measures as there are some remaining non-compliances along stretches of the A61.*

3.6.3 Sheffield has a city wide Air Quality Management Area, which mainly covers the urban area except the Peak District. In terms of compliance with the AQD, the significant locations for Sheffield are:

- The A630 Parkway (Census ID 76045, 47855, 99309), which was also identified by Defra's modelling and one of the sites which led to the Council being mandated
- A61 Sheaf Street (Census ID 36588) close to Sheffield train station and a link on the east side of the inner ring road
- A61 St Mary's Gate (Census ID 57861) and A61 St Mary's Road (Census ID 75196) both links on the west side of the inner ring road
- A61 Suffolk Road (Census IDs 75195, 8757) which are links close to the train station and on the southeast side of the inner ring road
- A6178 Sheffield Road (Census ID 37441) is close to J34S M1 Motorway
- A61 Derek Dooley Way an inner ring road link (Census IDs 81236, 81237, 81238), which was also identified by Defra's modelling and one of the sites which led to the Council being mandated
- The following links are locations within the city centre: A61 Shoreham Street (Census IDs 48805, 75194), A61 Fornham Street (Census ID 75198), A61 Matilda Street (Census ID 75199) and Arundel Gate (C710), which does not have a Census ID
- A61 Shalesmoor (Census ID 81162), A61 Hoyle Street (Census ID 17809) and A61 Morfields (Census ID 56608), which are on the north side of the inner ring road
- A6135 The Wicker (Census ID 76044) is a link to the north of the city centre and just outside the inner ring road
- A6109 Savile Street (Census ID 81238), A6178 Attercliffe Common (Census ID 38549) and A6109 Meadowhall Road (Census ID 47826) are links to the northeast and form part of the arterial route into and out of the city
- A621 Bramall Lane (Census ID 47393) and A61 Queens Road are links south of the city centre and just outside the inner ring road, and form part of the arterial route into and out of the city
- The M1 (Census IDs 73909, 16007, 28052) and A631 Tinsley Viaduct (Census ID 37913) are also links to the northeast. However, they are the responsibility of Highways England to deal with their compliance

The above identified locations are likely to have non-compliant (or close to non-compliant) annual average NO<sub>2</sub> concentrations in 2021, under 'Business as Usual' assumptions.

3.6.4 In particular, Arundel Gate (C710) operates as a busy bus interchange and is exposing a significant number of pedestrians and bus passengers to its non-compliant levels of NO<sub>x</sub> / NO<sub>2</sub> and will therefore need to be treated as a 'special case'.

3.6.5 The locations for target determination in Sheffield are Parkway (A57), Sheaf Street (A61), Sheffield Road (A6178), Derek Dooley Way (A61) and Arundel Gate (C710). Further details are contained in Supporting Document SD02.

3.6.6 Table 9 shows modelled annual mean nitrogen dioxide for the following:

- **2017 BaU**
- **2021 BaU**
- **2021 Cordon 3 CAZ C+ with additional measures**
- **2021 Cordon 3 CAZ D with additional measures**
- **2021 Cordon 1 CAZ D with additional measures**
- **2021 Cordon 2 CAZ D with additional measures**

**Table 9 – Rotherham’s 2017, 2021 BaU and Scenario Annual Mean NO<sub>2</sub> Modelled Results**

| Site Name  | Census id          | Road ID | x-co-ord | y co-ord | Modelled NO <sub>2</sub> annual mean 2017 BaU | Modelled NO <sub>2</sub> annual mean 2021 BaU | Modelled NO <sub>2</sub> annual mean 2021 Cordon 3 CAZ C+ with additional measures | Modelled NO <sub>2</sub> annual mean 2021 Cordon 3 CAZ D with additional measures | Modelled NO <sub>2</sub> annual mean 2021 Cordon 1 CAZ D with additional measures | Modelled NO <sub>2</sub> annual mean 2021 Cordon 2 CAZ D with additional measures |
|--|--------------------|---------|----------|----------|---|---|--|---|---|---|
| Parkway (4m)   | 73910              | A630    | 442410   | 388750   | 48.4  | 43.6  | 39.21  | 39.91   | 38.5  | 36.23   |
| Rawmarsh Hill (4m)   | 17339              | A633    | 443695   | 395454   | 49.3  | 42.2  | 38.08  | 38.19   | 39.1  | 39.4  |
| Wortley Road (4m)  | 77552              | A629    | 441075   | 393332   | 44.9  | 41.3  | 38.56  | 39.25   | 35.8  | 36.2  |
| Fitzwilliam Road (4m)  | 58395              | A630    | 443317   | 393399   | 45  | 40.8  | 39.17  | 39.31   | 39.1  | 39.03   |
| PCM link -A6022 (4m)   | 27858              | A6022   | 445311   | 389216   | 31.13   | 26.12   | 26.04  | 26.21   | 26.29   | 25.52   |
| PCM Link -M1, (4m)Blackburn, Rotherham <b>Highways England</b> | 36007 (location 1) | M1      | 438607   | 392848   | 65.99   | 60.2  | 61.78  | 62.4  | 61.78   | 60.03   |
| PCM link - A631 (4m)   | 37443              | A631    | 444569   | 390295   | 32.26   | 28.09   | 27.24  | 27.33   | 27.96   | 27.23   |
| PCM link -A631 (4m)  | 47409              | A631    | 444315   | 390127   | 32.76   | 28.27   | 23.99  | 23.99   | 27.72   | 26.28   |
| PCM link -A631 (4m)  | 56055              | A631    | 443414   | 389547   | 38.24   | 33.06   | 32.58  | 32.58   | 30.15   | 30.13   |
| PCM link -A6123 (4m)   | 60033              | A6123   | 443026   | 394710   | 31.13   | 25.51   | 25.18  | 23.99   | 26.34   | 25.32   |
| PCM link -A6023 (4m)   | 73410              | A6023   | 443241   | 401486   | 29.06   | 25.22   | 25.01  | 27.68   | 24.52   | 23.51   |
| PCM link -A633 (4m)  | 7388               | A633    | 443599   | 400946   | 31.13   | 27.33   | 27.13  | 27.5  | 24.42   | 23.51   |
| PCM link -A631 (4m)  | 73908              | A631    | 441279   | 390306   | 33.2  | 27.84   | 27   | 27.21   | 27.21   | 26.43   |
| PCM link -A57 (4m)   | 73911              | A57     | 444630   | 384371   | 35.28   | 29.02   | 28.2   | 28.27   | 29.93   | 28.83   |
| PCM link -A618 (4m)  | 77548              | A618    | 443927   | 389895   | 30.09   | 25.02   | 24.73  | 24.83   | 24.83   | 24.24   |

|                              |                    |       |        |        |       |       |       |       |       |       |
|------------------------------|--------------------|-------|--------|--------|-------|-------|-------|-------|-------|-------|
| PCM link -A634 (4m)          | 77549              | A634  | 453402 | 392141 | 21.84 | 19.09 | 18.52 | 18.51 | 18.53 | 18.61 |
| PCM link -A630 (4m)          | 77554              | A630  | 446010 | 394518 | 34.24 | 27.7  | 21.57 | 21.71 | 21.43 | 21.36 |
| PCM link -A633 (4m)          | 77563              | A633  | 443972 | 400994 | 31.13 | 28.5  | 26.7  | 28.27 | 24.5  | 23.51 |
| PCM link -A57 (4m)           | 77759              | A57   | 451754 | 383960 | 30.09 | 21.13 | 23.52 | 24.83 | 24.9  | 23.51 |
| PCM link -A633 (4m)          | 99965              | A633  | 444029 | 401284 | 31.13 | 23.6  | 20.04 | 21.71 | 21.86 | 23.51 |
| PCM link -A630 (4m)          | 17805              | A630  | 442271 | 392395 | 34.24 | 38.5  | 36.68 | 36.68 | 33.75 | 35.38 |
| PCM link -A631 (4m)          | 17807              | A631  | 445708 | 391334 | 37.36 | 32.4  | 36.68 | 30.18 | 30.95 | 30.64 |
| PCM link -A6123 (4m)         | 17808              | A6123 | 445231 | 391301 | 24.93 | 21.66 | 20.73 | 20.78 | 21.12 | 20.78 |
| PCM link -A6109 (4m)         | 18689              | A6109 | 439518 | 391958 | 35.28 | 31.71 | 31.33 | 31.5  | 30.25 | 30.25 |
| PCM link -A631 (4m)          | 27396              | A631  | 444990 | 390817 | 39.45 | 32.61 | 31.71 | 31.71 | 32.53 | 31.71 |
| PCM link -A6021 (4m)         | 27799              | A6021 | 445004 | 391582 | 37.36 | 30.34 | 29.46 | 29.56 | 30.15 | 30.54 |
| PCM link -M1 Brinsworth (4m) | 36007 (location 2) | M1    | 441743 | 389240 | 63    | 60.2  | 61.8  | 62.4  | 65.78 | 63.29 |
| PCM link -A631 (4m)          | 37443              | A631  | 451176 | 392055 | 37.36 | 33.52 | 31.39 | 33.63 | 31.06 | 30.75 |
| PCM link -A6123 (4m)         | 37868              | A6123 | 445026 | 392002 | 24.93 | 20.66 | 21.28 | 20.66 | 29.27 | 31.48 |
| PCM link -A629 (4m)          | 38673              | A629  | 441997 | 393118 | 38.4  | 31.95 | 28.58 | 31.6  | 31.97 | 32.81 |
| PCM link -A631 (4m)          | 47409              | A631  | 443592 | 389965 | 39.45 | 33.07 | 37.45 | 32.59 | 30.14 | 32.03 |
| PCM link -A631 (4m)          | 56055              | A631  | 443009 | 390122 | 39.45 | 31.75 | 32.58 | 31.67 | 30.44 | 32.11 |
| PCM link -A630 (4m)          | 57857              | A630  | 442268 | 392799 | 39.45 | 32.95 | 29.97 | 32.76 | 30.61 | 30.83 |
| PCM link -A6021 (4m)         | 60031              | A6021 | 443354 | 392480 | 37.36 | 31.01 | 29.97 | 28.75 | 30.92 | 30.73 |
| PCM link -A6021 (4m)         | 60032              | A6021 | 443201 | 392992 | 35.28 | 30.62 | 28.81 | 31.67 | 32.13 | 31.15 |
| PCM link -A6023 (4m)         | 60033              | A6123 | 444952 | 394587 | 24.93 | 20.74 | 20.86 | 20.98 | 26.3  | 27.38 |
| PCM link - A633 (4m)         | 60034              | A633  | 443521 | 394689 | 34.24 | 27.8  | 26.26 | 26.35 | 25.03 | 24.65 |
| PCM link -A618 (4m)          | 7360               | A618  | 444009 | 390804 | 30.09 | 24.9  | 25.74 | 24.12 | 23.04 | 23.11 |
| PCM link - A631 (4m)         | 7382               | A631  | 447994 | 391929 | 28.02 | 22.74 | 23.36 | 23.58 | 25.8  | 26.12 |
| PCM link -A6178 (4m)         | 73907              | A6178 | 442004 | 391870 | 34.24 | 27.7  | 27.55 | 27.58 | 27.13 | 27.01 |
| PCM link -A631 (4m)          | 73908              | A631  | 441885 | 390419 | 33.2  | 27.71 | 27.51 | 27.21 | 33.26 | 31.99 |
| PCM link - A57 (4m)          | 73911              | A57   | 444666 | 384363 | 38.4  | 32.19 | 31.14 | 31.33 | 25.59 | 24.8  |
| PCM link -A618 (4m)          | 77384              | A618  | 445591 | 385008 | 30.09 | 25.13 | 27.13 | 24.51 | 30.5  | 32.54 |
| PCM link - A630 (4m)         | 7750               | A630  | 442592 | 393155 | 39.45 | 33.04 | 33.9  | 33.37 | 25.24 | 24.72 |
| PCM link - A618 (4m)         | 77542              | A618  | 445268 | 385995 | 30.09 | 24.91 | 24.3  | 24.4  | 20.67 | 20.76 |
| PCM link - A6021 (4m)        | 7973               | A6021 | 445495 | 391527 | 24.93 | 20.5  | 24.33 | 20.47 | 20.25 | 20.31 |
| PCM link - A6023 (4m)        | 80807              | A6123 | 442713 | 394219 | 24.93 | 20.39 | 20.37 | 20.44 | 24.25 | 24.95 |
| PCM link - A6021 (4m)        | 8345               | A6021 | 442594 | 392182 | 31.13 | 25.17 | 25.21 | 25.28 | 27.02 | 28.36 |

|   |       |       |        |        |                          |                          |       |       |       |       |
|---|-------|-------|--------|--------|--------------------------|--------------------------|-------|-------|-------|-------|
| PCM link - A6109 (4m)                       | 8590  | A6109 | 441152 | 393010 | 35.28                    | 28.81                    | 25.22 | 28.36 | 24.58 | 24.97 |
| PCM link - A633 (4m)                        | 27401 | A633  | 442509 | 401861 | 29.1                     | 25.42                    | 28.25 | 26.31 | 25.13 | 24.65 |
| PCM link - A630 (4m)                        | 28002 | A630  | 442517 | 391650 | 33.6                     | 27.11                    | 22.29 | 25.28 | 24.23 | 23.75 |
| PCM Link - A631 (4m)                        | 77550 | A631  | n/a    | n/a    | n/a Not in modelled area | n/a Not in modelled area | n/a   | n/a   | n/a   | n/a   |
| Blackburn School (monitoring site)          |       |       | 438696 | 392816 | 27.6                     | 22.89                    | 22.18 | 22.01 | 22.06 | 21.8  |
| Bradgate Lane (monitoring site)             |       |       | 441006 | 393338 | 39.9                     | 32.83                    | 30.54 | 31.14 | 28.78 | 30.54 |
| Brinsworth Howarth School (monitoring site) |       |       | 442524 | 389134 | 28.6                     | 23.99                    | 23.11 | 24    | 23.27 | 22.69 |
| St Ann's Fitzwilliam Road (monitoring site) |       |       | 443347 | 393394 | 41.79                    | 36.28                    | 34.92 | 35.62 | 34.56 | 34.74 |
| Wales School Road (monitoring site)         |       |       | 447368 | 382900 | 41.39                    | 33.14                    | 30.2  | 30.26 | 32.65 | 32.17 |
| Doncaster Gate (monitoring site)            |       |       | 443039 | 392855 | 31                       | 26.2                     | 24.55 | 25.2  | 26.06 | 25.56 |
| 75 Broom Road (monitoring site)             |       |       | 443969 | 392041 | 25.32                    | 21.05                    | 20.21 | 21.01 | 20.44 | 20.55 |
| Broom Avenue (monitoring site)              |       |       | 444565 | 391641 | 26.27                    | 21.73                    | 20.73 | 21.52 | 21.02 | 20.95 |
| 152 Fitzwilliam Road (monitoring site)      |       |       | 443724 | 393628 | 41.61                    | 34.7                     | 32.96 | 33.8  | 31.79 | 32.57 |
| 31 York Road (monitoring site)              |       |       | 443365 | 393357 | 31.17                    | 26.48                    | 25.36 | 26.15 | 25.54 | 25.43 |
| Wellgate, Masonic Hall (monitoring site)    |       |       | 443072 | 392668 | 38.19                    | 32.13                    | 29.48 | 30.21 | 31.79 | 31.21 |
| Kirkstead Road TUBE (monitoring site)       |       |       | 438611 | 392862 | 47.24                    | 39.16                    | 37.55 | 38.48 | 36.97 | 36.51 |
| Moorgate Road (monitoring site)             |       |       | 443764 | 391283 | 31.5                     | 26.11                    | 24.17 | 25.11 | 25.11 | 25.03 |
| Rawmarsh Library (monitoring site)          |       |       | 443699 | 395439 | 38.9                     | 31.64                    | 28.63 | 28.68 | 31.64 | 29.42 |
| 42 Rawmarsh Hill (monitoring site)          |       |       | 443677 | 395545 | 54.2                     | 44.5                     | 39.84 | 39.94 | 41.35 | 41.14 |

|   |  |  |        |        |       |       |       |       |       |       |
|---|--|--|--------|--------|-------|-------|-------|-------|-------|-------|
| 227 Wortley Road<br>(monitoring site)                   |  |  | 441049 | 393331 | 48.07 | 39.66 | 36.62 | 37.19 | 34.21 | 36.76 |
| Blackburn School Building<br>Entrance (monitoring site) |  |  | 438705 | 392845 | 26.34 | 21.85 | 21.15 | 21.99 | 21.08 | 20.84 |
| 169 Bawtry Rd Brinsworth<br>(monitoring site)           |  |  | 441283 | 390309 | 35.66 | 30.67 | 29.01 | 29.87 | 29.18 | 28.55 |
| Derwent Crescent,<br>Brinsworth (monitoring<br>site)    |  |  | 441765 | 389248 | 40.94 | 34.41 | 33.04 | 34.03 | 33.43 | 32.41 |
| Brinsworth Road<br>(monitoring site)                    |  |  | 442623 | 388976 | 38.7  | 32.39 | 30.64 | 31.8  | 30.92 | 29.75 |
| Grange Farm Close<br>(monitoring site)                  |  |  | 442866 | 389161 | 34.4  | 29.39 | 28.1  | 29.07 | 28.4  | 27.52 |
| Catcliffe Rotherham Road<br>(monitoring site)           |  |  | 442587 | 388594 | 31.7  | 26.61 | 24.94 | 25.83 | 24.99 | 24.05 |

- 3.6.7 The key locations in terms of compliance with the AQD are the A629 Wortley Road (Census ID 77552), A633 (Rawmarsh Hill Census ID 17339), A630 Fitzwilliam Road (Census ID 58395) and the A630 Parkway (Census ID 73910), which was also identified by Defra's modelling and the site which led to the Councils being mandated.
- 3.6.8 Two of these roads have significant gradient issues (A629 and A633). Additional Information on the non-compliant road links 2021 follows
- 3.6.9 The A633 census id 17339 Rawmarsh Hill has a steep uphill gradient (which is not accounted for in the emissions data from the transport model), acceleration from standing at traffic lights uphill (it should be stressed that we do not assess compliance within 25m of a junction as per JAQU requirements), and the presence of buildings close to the road. The link which is forecast to be non-compliant in 2021 without measures is in an Air Quality Management Area. The Council has monitored data going back many years. The highest measured nitrogen dioxide roadside annual mean 2017 was 54 ug/m<sup>3</sup>, however, this monitoring location is not the point with the highest level of nitrogen dioxide annual mean along the route. The road is close to a major shopping centre which attracts a significant number of vehicle trips. For 2017, buses have been calculated to contribute 20 % of NOx emissions at roadside.
- 3.6.10 The A629 census 77552 has a steep uphill gradient (which is not accounted for in the emissions data from the transport model), acceleration from a roundabout uphill and is a route used by HGVs to the M1 J35, in spite of signage directing them to J34 (N) being present. The link which is forecast to be non-compliant in 2021 without measures is in an Air Quality Management Area. We have monitored data going back many years. The highest measured nitrogen dioxide roadside annual mean 2017 was 48 ug/m<sup>3</sup>, however, this monitoring location is not the point with the highest level of nitrogen dioxide annual mean along the route.
- 3.6.11 The Parkway (A630) 73910 is the main route from J33 of the M1 to Sheffield City Centre. It has no sensitive receptors in terms of LAQM within 4m of the carriageway. The only possible pedestrian public exposure in the section which goes through Rotherham is a footpath crossing. The speed in that section is currently 70mph. The road experiences congestion, in particular during the pm peak period when drivers are heading for M1 J33 from Sheffield City Centre.
- 3.6.12 A630 Fitzwilliam Rd (census 58395) is on the main route from east to west through Rotherham town centre. The link which is forecast to be non-compliant in 2021 without measures is in an Air Quality Management Area. We have monitored data going back many years showing exceedance of the AQD.
- 3.6.13 Levels of nitrogen dioxide at 4m from M1 (census 36007) are the highest in the borough and much higher than any of the levels at 4m from local roads. In Rotherham we have relevant exposure of resident at distances of around 20m from the carriageway and the Council has declared several Air Quality Management Areas as a result of emissions from the M1.
- 3.6.14 These four sites in Rotherham (A629, A630 (Parkway), A630 (Fitzwilliam Road) and A633 (Rawmarsh Hill) were included in JAQU's target determination process (See Supporting Document SD03). The M1 was also included, however it is the responsibility of Highways England to deal with this issue.

### **3.6.15 Determination of the Preferred Option, Outline Business Case**

- 3.6.16 The preferred option is the Cordon 3 (Sheffield Inner Ring Road) CAZ C+ with additional Rotherham and Sheffield Specific measures to achieve compliance in the most cost effective and timely manner.
- 3.6.17 Our 'preferred option' is to introduce a charging Clean Air Zone (CAZ) Class C in an area covering Sheffield city centre from the inner ring road inwards.
- 3.6.18 Class C charging applies to non-compliant buses, taxis/private hire vehicles, Heavy Goods Vehicles (HGVs) and Light Goods Vehicles (LGVs). It will not apply to private cars.
- 3.6.19 We are proposing that the charge is £50 a day for non-compliant buses and HGVs and £10 a day for non-compliant vans and taxis/private hire vehicles.
- 3.6.20 Our preferred option is for the charging zone to be accompanied by a suite of support packages, to enable owners and drivers to replace older, polluting vehicles more quickly than they otherwise would. We have made clear that we do not want people to pay the CAZ charge, as this would increase their outgoings whilst not delivering the air quality improvements that we need. The charging zone is designed to encourage people to move away from dirty vehicles ('the stick'), while the proposed supporting packages are designed to provide positive incentives to finance, support and enable that change ('the carrot').
- 3.6.21 This will bring significant improvements to the buses, taxis, lorries and vans on Sheffield and Rotherham's roads, reducing emissions and improving the air that our communities breathe across the area (ie. cleaner buses, taxis, vans run across the city, not just within the CAZ).

## **4. NO<sub>x</sub> TO NO<sub>2</sub> CONVERSION**

- 4.1.1 The methodology used was to model the traffic-related NO<sub>x</sub> emissions (on a link-by-link basis), to derive concentrations of road NO<sub>x</sub> annual mean at receptor locations. The road NO<sub>x</sub> was factored (as above) and entered into Defra's NO<sub>x</sub> to NO<sub>2</sub> calculator with the relevant f-NO<sub>2</sub> value for the road link and year, and background (all other sources) NO<sub>x</sub>. The calculator produces annual mean NO<sub>2</sub> for each location. This process is described in other sections of AQ3 and in AQ2.

## **5. SUMMARY**

### **5.1 Introduction**

- 5.1.1 This section provides a summary of the baseline, BaU forecast and scenario testing.
- 5.1.2 Compliance Summary
- 5.1.3 The SRTM3B-based traffic emissions and local Airviro-based air quality modelling has identified a total of eighteen roads, fourteen in Sheffield and four in Rotherham, which are not predicted to be compliant with the AQD for annual average NO<sub>2</sub> levels in 2021, under Business as Usual assumptions.
- 5.1.4 In decreasing order of predicted annual average NO<sub>2</sub> levels in 2021, these eighteen road are:

- M1 from J35 to J31 in Rotherham (60  $\mu\text{g}/\text{m}^3$ )
- St Mary's Gate Sheffield (51.7  $\mu\text{g}/\text{m}^3$ )
- Sheaf Street Sheffield (50.9  $\mu\text{g}/\text{m}^3$ );
- Derek Dooley Way Sheffield (44 – 49.9  $\mu\text{g}/\text{m}^3$ )
- Suffolk Road Sheffield (48 – 48.2  $\mu\text{g}/\text{m}^3$ )
- St Mary's Road (43.5 – 47.8  $\mu\text{g}/\text{m}^3$ )
- Shalesmoor (44.8  $\mu\text{g}/\text{m}^3$ )
- A630 Parkway Rotherham 43.6  $\mu\text{g}/\text{m}^3$ )
- Shoreham Street (42.6 – 43  $\mu\text{g}/\text{m}^3$ )
- A630 Parkway Sheffield (42.1 – 42.8  $\mu\text{g}/\text{m}^3$ )
- M1 from J35 to J31 in Sheffield (41.2 – 41.7  $\mu\text{g}/\text{m}^3$ )
- Arundel Gate Sheffield (42.6  $\mu\text{g}/\text{m}^3$ )
- Rawmarsh Hill Rotherham (42.4  $\mu\text{g}/\text{m}^3$ )
- The Wicker Sheffield (42.3  $\mu\text{g}/\text{m}^3$ )
- Attercliffe Common Sheffield (41.9  $\mu\text{g}/\text{m}^3$ )
- Matilda Street (41.8  $\mu\text{g}/\text{m}^3$ )
- A629 Bradgate - Wortley Road (Rotherham) (41.5 – 41.3  $\mu\text{g}/\text{m}^3$ ) and
- Arundel Gate Sheffield (40.6  $\mu\text{g}/\text{m}^3$ )

## 5.2 Target Determination

- 5.2.1 The required target determination is provided in spreadsheets which go alongside this report. These can be found in Supporting Documents SD02 (for Sheffield) and SD03 (for Rotherham).

## 5.3 Analytical Assurance Statement

- 5.3.1 An updated 'Analytical Assurance Statement' has been provided as a stand-alone document as part of the **Initial Evidence Submission**.