APPENDIX 3

AIR QUALITY ASSESSMENT

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**MONCKTON ENERGY LIMITED**

# Monckton Gas Peaking Scheme

## Air Quality Assessment

**September 2016**

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**MONCKTON ENERGY LIMITED**

# Monckton Gas Peaking Scheme

# Air Quality Assessment

**September 2016**

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# 1 INTRODUCTION

1.1.1 Wardell Armstrong has been commissioned to undertake an air quality impact assessment to support the planning application for a proposed gas peaking facility at the Monckton Coke and Chemical Works, Royston, South Yorkshire.

1.1.2 The proposed site for the gas peaking facility is located within the southern part of the Monckton Coke and Chemical Works ('Monckton Works') and would replace the disused biological effluent treatment plant.

1.1.3 The proposed development comprises a total of 5 gas generators and will provide a flexible modular energy supply which could rapidly deliver energy supplies of between 2 and 10 MW. The demand for power and operational time span of the gas peaking plant would be subject to the requirements of the National Grid. The gas peaking plant will directly feed into the National Grid. The purpose of the development is to ensure that there is a contingency power generator in case electricity shortages affect the National Grid.

1.1.4 The requirements for generators would be dependent on the local circumstances and may be used less or more depending on local effects. However, it is anticipated that the generator will run for approximately 800 hours per year as a standby electricity generator when the local area is stressed or suffers a shortage, with peak operational times expected to be between 16:00 to 19:30 Monday to Friday during the months of November to March.

1.1.5 The proposed development is located within the Monckton Works, located approximately 5km to the northeast of Barnsley. The Monckton Works processing area with associated buildings and structures are primarily present to the north with open land to the east and south. The urban area of Royston is present to the south west and west at approximately 200m from the site.

1.1.6 This report details the air dispersion modelling undertaken to assess the potential significance of emissions from the proposed gas peaking plant at the Monckton Works on human health receptors. The pollutants considered in the assessment include oxides of nitrogen ($NO_x$) and carbon monoxide (CO), primary pollutants arising from the combustion of natural gas.

# 2 ASSESSMENT METHODOLOGY

## 2.1 Overview

2.1.1 This assessment has been carried out in accordance with relevant guidance published by the Environment Agency. Guidance on modelling the impact of emissions to air is provided in Environment Agency H1 guidance[1,2]

2.1.2 The air quality assessment methodology comprises air dispersion modelling of the gas generators, using the AERMOD modelling software which takes into account meteorological data, background pollution data, terrain data and emissions data. The assessment considers potential impacts at nearby residential receptor locations.

## 2.2 Air Dispersion Modelling

2.2.1 Potential emissions to atmosphere have been modelled using AERMOD (Lakes Environmental model version 9.1). This is a proprietary quantitative air dispersion model that is based upon the Gaussian theory of plume dispersion. The model uses all input data, including the characteristics of the release (rate, temperature, velocity, height, location etc.), the terrain, meteorological data and the locations of the buildings adjacent to the proposed emission points, to predict the concentration of the substance of interest at a specified point.

2.2.2 The model uses sequential hourly meteorological data and the locations of the buildings, to predict the concentration of each substance at each point for each hour over the course of a year. This allows the long-term mean and short-term peak ground level concentrations to be estimated over the modelled area as required. The dispersion modelling has been carried out in accordance with the Environment Agency guidance[3].

## 2.3 Prediction of $NO_x$ and CO Concentrations

2.3.1 This air quality assessment predicts the nitrogen dioxide ($NO_2$) and carbon monoxide (CO) concentrations taking into account the Environment Agency H1 guidance[4]. Although it is anticipated that the generators will run for approximately 800 hours per

[1] Environment Agency, Air Dispersion Modelling Report Requirements (For Detailed Air Dispersion Modelling), prepared by the Air Quality Modelling and Assessment Unit (AQMAU)
[2] Environment Agency, Horizontal Guidance Note H1 – Annex F: Air Emissions, December 2011 (v2.2)
[3] Environment Agency (EA) Air dispersion modelling requirements prepared by the Air Quality Modelling and Assessment Unit
[4] Environment Agency Horizontal Guidance Note H1 – Environmental Risk Assessment for Permits, December 2011 (v2.1)

year, a worst case approach considering 24-hour continuous operation of the gas generators for the entire year has been adopted for modelling purposes.

2.3.2 The AERMOD model produces computed concentrations that are the Process Contribution (PC). These can be added to the ambient background concentrations to give a total Predicted Environmental Concentration (PEC) at the representative existing sensitive receptor (ESR) locations assessed (i.e. ESR 1 to 11). The PC and PEC values can then be compared with the relevant Air Quality Objectives (AQOs) and the likelihood of exceedance determined.

## 2.4 Air Quality Objectives

2.4.1 The current Air Quality Standards and Objectives as set out in the Air Quality Standards Regulations 2010, for the pollutants of concern in this assessment, are detailed in Table 1.

**Table 1: Air Quality Standards Regulations 2010. Summary of Current Air Quality Standards and Objectives**

| Pollutant | Averaging Period | Limit Value |
|---|---|---|
| Nitrogen Dioxide | 1 hour | 200µg/m$^3$ not to be exceeded more than 18 times a calendar year |
| | Calendar year | 40µg/m$^3$ |
| Carbon Monoxide | Maximum 8 hour daily mean | 10mg/m$^3$ |

# 3 BASELINE CONDITIONS

## 3.1 Local Air Quality Management

3.1.1 Air Quality Management Areas (AQMAs) are declared on the basis of the risk of exceeding pollutant objectives. The proposed development is located within the administrative area of BMBC, which is responsible for the management of local air quality. BMBC has declared eight Air Quality Management Areas (AQMAs) within the borough for exceedance of the annual mean objective for nitrogen dioxide ($NO_2$). However, the closest AQMA to the proposed development is located over 4km to the south west near to the village of Monk Bretton. Therefore, the proposed development is not located within an AQMA or a known area of concern with regard to poor air quality.

## 3.2 Potentially Sensitive Receptor Locations (Residential Receptors)

3.2.1 The site is predominately surrounded by former industrial land and open land. There are potentially sensitive receptor locations to the west and southeast in Royston and Shafton respectively. Isolated farmhouses are also present to the north of the site.

3.2.2 The following sensitive receptor locations surround the site:

- Royston (village) – located approximately 200m to the west and southwest;
- Common Lane Farm- located approximately 1km to the northwest;
- Harwood Cottage– located approximately 1.8km to the northeast; and
- Shafton (village) – located approximately 1.5km to the southeast.

3.2.3 The existing sensitive receptor locations considered in the air quality assessment are detailed in Table 2 and shown on drawing LE13676/001.

**Table 2: Sensitive Receptor Locations Included in the Dispersion Modelling Assessment**

| Receptor | Address | Receptor Type | Location | | Bearing from Location of Gas Generators | Nearest Distance to Proposed Gas Generators (m) |
|---|---|---|---|---|---|---|
| | | | Easting | Northing | | |
| ESR 1 | Lund Hill Ln, Royston, Barnsley | Residential | 437525 | 412457 | North | 637(Stack 1) |
| ESR 2 | Midland Rd, Royston, Barnsley | Residential | 437313 | 411715 | Southwest | 169(Stack 1) |
| ESR 3 | Midland Rd, Royston, Barnsley | Residential | 437092 | 411715 | West | 366(Stack 1) |
| ESR 4 | Station Terrace, Royston, Barnsley | Residential | 437315 | 411628 | Southwest | 234(Stack 1) |
| ESR 5 | End Cres, Royston, Barnsley | Residential | 437303 | 411451 | Southwest | 394 (Stack 5) |
| ESR 6 | Caldervale, Royston, Barnsley | Residential | 437174 | 411559 | Southwest | 377(Stack 1) |
| ESR 7 | Common Ln, Royston, Barnsley | Residential | 436646 | 412423 | Northwest | 945(Stack 1) |
| ESR 8 | Gable Cottage, Wakefield | Residential | 437421 | 413189 | North | 1364 (Stack 1) |
| ESR 9 | Slack Ln, South Hiendley, Barnsley | Residential | 438530 | 412372 | Northeast | 1201(Stack 5) |
| ESR 10 | Queens Dr, Shafton, Barnsley | Residential | 438711 | 411298 | Southeast | 1342(Stack 5) |

| Table 2: Sensitive Receptor Locations Included in the Dispersion Modelling Assessment | | | | | | |
|---|---|---|---|---|---|---|
| **Receptor** | **Address** | **Receptor Type** | **Location** | | **Bearing from Location of Gas Generators** | **Nearest Distance to Proposed Gas Generators (m)** |
| | | | **Easting** | **Northing** | | |
| ESR 11 | Greenside Estate, Shafton, Barnsley | Residential | 438834 | 411544 | Southeast | 1389(Stack 5) |

3.2.4 In addition to selected representative existing receptor locations, a uniform Cartesian grid has also been modelled. The parameters of the modelled Cartesian grid are included in Table 3.

| Table 3: Uniform Cartesian Grid Parameters | | |
|---|---|---|
| **Parameter** | X | Y |
| **South West Grid Coordinates** | 436155.85 | 410648.94 |
| **Number of Points** | 80 | 60 |
| **Spacing (m)** | 50 | 50 |
| **Length (m)** | 3950 | 2950 |
| **Total Number of Grid Receptors** | 4800 | |

# 4 AIR QUALITY BACKGROUND POLLUTANT CONCENTRATIONS

## 4.1 Background Pollutant Concentrations

4.1.1 There are no representative $NO_2$ or CO background monitoring locations in the vicinity of the site. Background $NO_2$ and CO concentrations for use in the air quality assessment have therefore been obtained from the default concentration maps provided by Defra.

4.1.2 In the absence of representative background pollutant concentrations being available for the local area, background concentrations have been obtained from the 2013-based default concentration maps provided by Defra on their LAQM webpages[5].

4.1.3 $NO_2$ and CO background concentrations have been obtained for the most appropriate grid squares, for the considered receptor locations, in accordance with guidance

[5] Department for Environment, Food and Rural Affairs, Local Air Quality Management webpages (http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html)

provided in LAQM TG (16). The background CO concentrations have been adjusted to 2015 in accordance with the guidance in LAQM TG(16)[6].

4.1.4 The background pollutant concentrations are shown in Table 4.

**Table 4: 2015 Background Air Pollutant Concentrations Used to Determine the Predicted Environmental Concentrations (PEC). $NO_2$ Concentrations Obtained from 2013-Based Defra Maps. CO Concentrations Obtained from 2001 Defra Maps and Adjusted**

| Grid Reference & Receptor | $NO_2$ (µg/m³) | CO (mg/m³) |
|---|---|---|
| 437500,4125800 - ESR 1 | 15.0 | 0.15 |
| 437500, 411500 – ESR 2, ESR 3, ESR 4, ESR 5 ESR 6 | 16.7 | 0.15 |
| 436500,412500 – ESR 7 | 15.0 | 0.15 |
| 437500,413500 – ESR 8 | 14.6 | 0.15 |
| 438500,412500 – ESR –9 | 15.3 | 0.15 |
| 438500, 411500 – ESR 10, ESR 11 | 15.4 | 0.15 |

4.1.5 These background concentrations have been used when calculating the Predicted Environmental Concentrations (PECs) of $NO_2$ and CO at the existing sensitive receptors considered.

## 4.2 Study Inputs

### *Meteorology*

4.2.1 The meteorological data used in the air dispersion modelling has been obtained from ADM Limited. Meteorological data has been obtained for 2009,2012-2015 from the Emley Moor recording station. This is located approximately 15km from the proposed development and is considered to be the most representative of the conditions at the proposed development, in terms of altitude and location.

4.2.2 Five years of hourly sequential data have been obtained from the Emley Moor recording station for use in the air dispersion modelling. About 70% of the data for 2010-2011 for the record station was missing and therefore data for 2009, 2012-2015 has been obtained. Each year of meteorological data, from 2009, 2012-2015, has been considered separately in the air dispersion model.

[6] Department for Food, Environment and Rural Affairs, Local Air Quality Management Technical Guidance Document LAQM.TG(16), April 2016

***Terrain***

4.2.3 To consider the impact of terrain surrounding the site, on the dispersion of pollutants, x.y.z data for the surrounding terrain has been used in the model.

4.2.4 Terrain data has been purchased for the surrounding area and included in the air dispersion model. On-site topographical information and slab height data has also been included in the dispersion model to consider the terrain of the site and when identifying the ground heights of on-site compound buildings and the emission source.

***Surface Characteristics***

4.2.5 The predominant characteristics of land use in an area provides a measure of the vertical mixing and dilution that takes place in the atmosphere due to factors such as surface roughness and albedo.

4.2.6 Examination of the local setting has shown that the area to the north consists of an industrial site and residential uses. To the east and south the land is mainly rural in nature with occasional scattered agricultural/residential properties. To the west, the area is generally more residential in nature.

4.2.7 Buildings can have a significant influence on the behaviour of the local airflow and "downwash" can occur, and an emission plume can be drawn down in the vicinity of buildings. There are a number of buildings in close proximity to the sources of the emissions; therefore, building effects have been included within the model.

***Emission Parameters – $NO_x$ and CO from the Gas Generators***

4.2.8 The proposed development comprises of 5 gas generators of 2MW each. Each gas generator will have an individual stack and there will be a total of five stacks. Each stack has been included as a point source within the model. The parameters included in the model are shown in Table 5.

**Table 5: Model Parameters for Gas Generator Exhaust Emissions**

| | **Stacks 1-10 (Proposed 2MW generators)** | |
|---|---|---|
| Stack location | Stack 1 - 437443, 411822<br>Stack 2 - 437451, 411817<br>Stack 3 – 437458, 411813 | Stack 4 – 437465, 411809<br>Stack 5 – 437473, 411804 |
| Stack height (m) | 7.1m | |
| Stack diameter (m) | 0.35 | |
| Stack gas flow at exit ($m^3/s$) | 2.29 | |

| Table 5: Model Parameters for Gas Generator Exhaust Emissions | |
|---|---|
| | **Stacks 1-10 (Proposed 2MW generators)** |
| Stack efflux velocity (m/s) | 15.43 |
| Stack gas exit temperature (°C/°K) | 390/663 |

4.2.9 The emission rates included in the AERMOD model are shown in Table 6.

| Table 6: Emission rates from the Gas Generators Stack | |
|---|---|
| **Emitted Substance** | **Stacks 1 -5** |
| **Emission Concentration (mg/Nm$^3$)** | |
| **$NO_X$** | 250 |
| **CO** | 963 |
| **Emission Rate (g/s)** | |
| **$NO_X$** | 0.371* |
| **CO** | 1.787* |
| ** Calculated using normalised stack flow rate (Nm$^3$/s). Normalised flow rate calculated from actual flow rate (i.e. 2.29 m$^3$/s) in accordance with the following formula[7]: Vol. Flow (Nm$^3$/s) = Vol. Flow (Am$^3$/s) x (273/(T + 273) x ((100-%$H_2O$(actual)/100) x ((20.9 - %$0_2$actual)/(20.9 - %$0_2$ ref))* | |

4.2.10 The data Maintenance Utility, Caterpillar, has provided the model input parameters, emission concentration and emission rate information used in the pollutant dispersion modelling.

***Treatment of Buildings and Site Plan***

4.2.11 There are a number of buildings located in close proximity to the proposed gas generators. The buildings associated with the CHP plant of the Monckton Works are currently under demolition and will be demolished by the time the proposed project commences. These buildings have therefore not been included in the model. The buildings included within the AERMOD model are shown in Table 7.

[7] Environmental Protection Act 1990: Technical Guidance Note (Dispersion) D1, June 1993, Her Majesty's Inspectorate of Pollution.

| Table 7: Onsite Buildings Included in Model | | | | | | |
|---|---|---|---|---|---|---|
| Building Number | Building Name in Model | Building Description | Base Elevation (m) | Height of Building (m) | Grid Reference of SW Corner/ Centre Grid Reference | |
| | | | | | X | Y |
| 1 | BLD_1 | Gas Generator 1 | 62 | 3.5 | 437443 | 411825 |
| | BLD_1 | Stack - Gas Generator 1 | 62 | 7.1 | 437443 | 411822 |
| 2 | BLD_2 | Gas Generator 2 | 62 | 3.5 | 437444 | 411810 |
| | BLD_2 | Stack - Gas Generator 2 | 62 | 7.1 | 437451 | 411817 |
| 3 | BLD_3 | Gas Generator 3 | 62 | 3.5 | 437458 | 411816 |
| | BLD_3 | Stack - Gas Generator 3 | 62 | 7.1 | 437458 | 411813 |
| 4 | BLD_4 | Gas Generator 4 | 62.17 | 3.5 | 437465 | 411812 |
| | BLD_4 | Stack - Gas Generator 4 | 62.17 | 7.1 | 437465 | 411809 |
| 5 | BLD_5 | Gas Generator 5 | 62.74 | 3.5 | 437473 | 411808 |
| | BLD_5 | Stack - Gas Generator 5 | 62.74 | 7.1 | 437473 | 411804 |
| 6 | BLD_6 | HV room | 62.38 | 2.9 | 437461 | 411832 |
| 7 | BLD_7 | LV Room | 62.05 | 2.5 | 437452 | 411838 |
| 8 | BLD_8 | Transformer | 62 | 1.5 | 437446 | 411841 |

# 5 PREDICTED EFFECTS AND THEIR SIGNIFICANCE

5.1.1 The modelled process concentrations of nitrogen dioxide ($NO_2$) and carbon monoxide (CO) due to emissions from the gas generators are shown in Appendix A.

5.1.2 The Environment Agency Air Quality Modelling and Assessment Unit (AQMAU) have made recommendations regarding the conversion rates for $NO_x$ to $NO_2$:

- Step 1. Screening/Worst Case Scenario
  - 50% and 100% of the modelled values should be used for short-term and long term average concentrations respectively. If PEC exceeds the relevant air quality objective, then proceed to step 2.
- Step 2. Worst Case Scenario
  - 35% for short term and 70% for long term average concentration should be considered. If PEC exceeds the relevant air quality objective, then proceed to step 3.
- Step 3. Case Specific Scenario

- Operators are asked to justify their use of percentages lower than 35% for short term and 70% for long term in their application reports.

5.1.3 In accordance with these recommendations, the short term (1 hour) and long term (annual mean) concentrations of $NO_2$, for the receptors assessed, have been derived from the predicted $NO_x$ concentrations using the following approach: 50% of $NO_x$ to $NO_2$ for short term and 100% of $NO_x$ to $NO_2$ for long term average concentrations. The 99.79$^{th}$ percentile 1 hour $NO_2$ concentrations and annual mean $NO_2$ concentrations for each considered receptor location are detailed in Appendix A.

5.1.4 The background concentrations of $NO_2$ and CO, detailed in Table 4, have been used to determine the PEC concentrations at each receptor, for each year of meteorological data. The PC and PEC concentrations as a percentage of the relevant air quality objective have then been determined for each receptor, for each year of meteorological data. The highest concentrations/percentages, for the considered receptor locations, are summarised in Table 8.

**Table 8: Maximum Modelled Concentrations at the Receptors Assessed**

| Pollutant | ESR | PC | PEC | PC/AQO | PEC/AQO |
|---|---|---|---|---|---|
| $NO_2$ Annual Mean (µg/m$^3$) | ESR 2 - Midland Rd, Royston, Barnsley | 5.63 (2013) | 22.30 (2013) | 14.07% (2013) | 55.75% (2013) |
| $NO_2$ 99.8$^{th}$ Percentile 1 Hour Mean (µg/m$^3$) | ESR 2 - Midland Rd, Royston, Barnsley | 56.6 (2013) | 90.0 (2013) | 28.3 % (2013) | 45.0% (2013) |
| CO 8 Hour Rolling Average (mg/m$^3$) | ESR 2 - Midland Rd, Royston, Barnsley | 0.558 (2014) | 0.708 (2014) | 5.57% (2014) | 7.07% (2014) |

5.1.5 The results confirm that the PEC concentrations do not exceed the relevant Air Quality Objectives for the existing residential receptors (i.e. ESR 1 to 11) considered in the assessment.

5.1.6 On this basis it is therefore considered that the proposed 7.1m high stacks, on the proposed gas generators, will be sufficient to ensure the adequate dispersion of $NO_2$ and CO and further mitigation will not be required.

5.1.7 The modelled NOx and CO concentrations for the considered receptor locations, along with the Cartesian grid points experiencing the maximum modelled concentrations, are detailed in Appendix A.

# 6 CONCLUSION

6.1.1 Dispersion modelling using AERMOD has been undertaken and the Process Contributions (PC) and Predicted Environmental Concentrations (PEC) of $NO_2$ and CO have been compared against the current Air Quality Objectives for the receptor locations identified. The results indicate that, for the receptor locations assessed, the short and long term predicted concentrations for $NO_2$ and CO lie within the respective Air Quality Objectives.

6.1.2 The results of the assessment indicate that, for the receptor locations assessed, the short and long term predicted concentrations for $NO_2$ and CO lie within the respective air quality objectives and critical levels. This is shown even when a worst case scenario is adopted whereby 24 hours of operation throughout the year has been considered (8760hrs), whereas the actual operation of the gas generators is anticipated to be only 800 hours in a year (less than 10% of the time considered for purposes of modelling).

## Nitrogen Oxides

### 2009

| RECEPTORS | | | | | SHORT TERM 99.79th PERCENTILE | | | | | LONG TERM | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Receptor ID | Grid Reference X | Grid Reference Y | Receptor Address | Background Concentration | C 99.79th %il $NO_x$ 1 HOUR | PC $NO_2$ 1 HOUR | PEC $NO_2$ 1 HOUR | PC/AQO $NO_2$ 1 HOUR | PEC/AQO $NO_2$ 1 HOUR | PC $NO_x$ ANNUAL | PC $NO_2$ ANNUAL | PEC $NO_2$ ANNUAL | PC/AQO $NO_2$ ANNUAL | PEC/AQO $NO_2$ ANNUAL |
| | | | | µg/m³ | µg/m³ | µg/m³ | µg/m³ | % | % | µg/m³ | µg/m³ | µg/m³ | % | % |
| ESR 1 | 437525 | 412457 | Lund Hill Ln, Royston, Barnsley | 15.0 | 26.2 | 13.1 | 43.1 | 6.6 | 21.5 | 0.82 | 0.82 | 15.79 | 2.04 | 39.47 |
| ESR 2 | 437313 | 411715 | Midland Rd, Royston, Barnsley | 16.7 | 108.7 | 54.4 | 87.7 | 27.2 | 43.9 | 4.64 | 4.64 | 21.31 | 11.60 | 53.28 |
| ESR 3 | 437092 | 411715 | Midland Rd, Royston, Barnsley | 16.7 | 70.3 | 35.2 | 68.5 | 17.6 | 34.3 | 2.04 | 2.04 | 18.71 | 5.10 | 46.78 |
| ESR 4 | 437315 | 411628 | Station Terrace, Royston, Barnsley | 16.7 | 80.7 | 40.4 | 73.7 | 20.2 | 36.9 | 2.97 | 2.97 | 19.64 | 7.42 | 49.11 |
| ESR 5 | 437303 | 411451 | End Cres, Royston, Barnsley | 16.7 | 53.8 | 26.9 | 60.2 | 13.4 | 30.1 | 1.46 | 1.46 | 18.13 | 3.64 | 45.33 |
| ESR 6 | 437174 | 411559 | Caldervale, Royston, Barnsley | 16.7 | 57.8 | 28.9 | 62.2 | 14.4 | 31.1 | 1.62 | 1.62 | 18.29 | 4.05 | 45.73 |
| ESR 7 | 436646 | 412423 | Common Ln, Royston, Barnsley | 15.0 | 33.4 | 16.7 | 46.6 | 8.3 | 23.3 | 0.65 | 0.65 | 15.60 | 1.62 | 39.00 |
| ESR 8 | 437421 | 413189 | Gable Cottage, Wakefield | 14.6 | 25.7 | 12.9 | 42.1 | 6.4 | 21.0 | 0.37 | 0.37 | 14.98 | 0.92 | 37.45 |
| ESR 9 | 438530 | 412372 | Slack Ln, South Hiendley, Barnsley | 15.3 | 16.1 | 8.0 | 38.6 | 4.0 | 19.3 | 0.55 | 0.55 | 15.85 | 1.37 | 39.62 |
| ESR 10 | 438711 | 411298 | Queens Dr, Shafton, Barnsley | 15.4 | 21.0 | 10.5 | 41.3 | 5.2 | 20.6 | 0.57 | 0.57 | 15.97 | 1.42 | 39.92 |
| ESR 11 | 438834 | 411544 | Greenside Estate, Shafton, Barnsley | 15.4 | 20.5 | 10.3 | 41.1 | 5.1 | 20.5 | 0.59 | 0.59 | 16.00 | 1.48 | 39.99 |
| **Short term** | | | | | | | | | | | | | | |
| Maximum | 437456 | 411849 | | 16.7 | 351.0 | 175.5 | 208.9 | 87.8 | 104.5 | | | | | |
| **Long Term** | | | | | | | | | | | | | | |
| **Maximum** | 437506 | 411849 | | 16.7 | | | | | | 53.13 | 53.13 | 69.83 | 132.83 | 174.58 |

### 2012

| RECEPTORS | | | | | SHORT TERM 99.79th PERCENTILE | | | | | LONG TERM | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Receptor ID | Grid Reference X | Grid Reference Y | Receptor Address | Background Concentration | C 99.79th %il $NO_x$ 1 HOUR | PC $NO_2$ 1 HOUR | PEC $NO_2$ 1 HOUR | PC/AQO $NO_2$ 1 HOUR | PEC/AQO $NO_2$ 1 HOUR | PC $NO_x$ ANNUAL | PC $NO_2$ ANNUAL | PEC $NO_2$ ANNUAL | PC/AQO $NO_2$ ANNUAL | PEC/AQO $NO_2$ ANNUAL |
| | | | | µg/m³ | µg/m³ | µg/m³ | µg/m³ | % | % | µg/m³ | µg/m³ | µg/m³ | % | % |
| ESR 1 | 437525 | 412457 | Lund Hill Ln, Royston, Barnsley | 15.0 | 25.9 | 13.0 | 42.9 | 6.5 | 21.5 | 0.52 | 0.52 | 15.49 | 1.30 | 38.72 |
| ESR 2 | 437313 | 411715 | Midland Rd, Royston, Barnsley | 16.7 | 109.3 | 54.7 | 88.0 | 27.3 | 44.0 | 5.10 | 5.10 | 21.78 | 12.75 | 54.44 |
| ESR 3 | 437092 | 411715 | Midland Rd, Royston, Barnsley | 16.7 | 75.2 | 37.6 | 71.0 | 18.8 | 35.5 | 2.40 | 2.40 | 19.07 | 6.00 | 47.68 |
| ESR 4 | 437315 | 411628 | Station Terrace, Royston, Barnsley | 16.7 | 88.6 | 44.3 | 77.7 | 22.2 | 38.8 | 3.70 | 3.70 | 20.37 | 9.24 | 50.92 |
| ESR 5 | 437303 | 411451 | End Cres, Royston, Barnsley | 16.7 | 54.7 | 27.3 | 60.7 | 13.7 | 30.3 | 1.65 | 1.65 | 18.32 | 4.12 | 45.80 |
| ESR 6 | 437174 | 411559 | Caldervale, Royston, Barnsley | 16.7 | 64.0 | 32.0 | 65.3 | 16.0 | 32.7 | 2.00 | 2.00 | 18.67 | 5.00 | 46.68 |
| ESR 7 | 436646 | 412423 | Common Ln, Royston, Barnsley | 15.0 | 35.5 | 17.7 | 47.7 | 8.9 | 23.8 | 0.74 | 0.74 | 15.69 | 1.84 | 39.22 |
| ESR 8 | 437421 | 413189 | Gable Cottage, Wakefield | 14.6 | 16.0 | 8.0 | 37.2 | 4.0 | 18.6 | 0.22 | 0.22 | 14.83 | 0.54 | 37.08 |
| ESR 9 | 438530 | 412372 | Slack Ln, South Hiendley, Barnsley | 15.3 | 12.1 | 6.1 | 36.7 | 3.0 | 18.3 | 0.37 | 0.37 | 15.67 | 0.93 | 39.18 |
| ESR 10 | 438711 | 411298 | Queens Dr, Shafton, Barnsley | 15.4 | 18.8 | 9.4 | 40.2 | 4.7 | 20.1 | 0.55 | 0.55 | 15.95 | 1.38 | 39.88 |
| ESR 11 | 438834 | 411544 | Greenside Estate, Shafton, Barnsley | 15.4 | 18.2 | 9.1 | 39.9 | 4.5 | 19.9 | 0.52 | 0.52 | 15.92 | 1.29 | 39.80 |
| **Short term** | | | | | | | | | | | | | | |
| Maximum | 437456 | 411849 | | 16.7 | 344.0 | 172.0 | 205.4 | 86.0 | 102.7 | | | | | |
| **Long Term** | | | | | | | | | | | | | | |
| **Maximum** | 437506 | 411799 | | 16.7 | | | | | | 67.63 | 67.63 | 84.33 | 169.08 | 210.83 |

### 2013

| RECEPTORS | | | | | SHORT TERM 99.79th PERCENTILE | | | | | LONG TERM | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Receptor ID | Grid Reference X | Grid Reference Y | Receptor Address | Background Concentration | C 99.79th %il $NO_x$ 1 HOUR | PC $NO_2$ 1 HOUR | PEC $NO_2$ 1 HOUR | PC/AQO $NO_2$ 1 HOUR | PEC/AQO $NO_2$ 1 HOUR | PC $NO_x$ ANNUAL | PC $NO_2$ ANNUAL | PEC $NO_2$ ANNUAL | PC/AQO $NO_2$ ANNUAL | PEC/AQO $NO_2$ ANNUAL |
| | | | | µg/m³ | µg/m³ | µg/m³ | µg/m³ | % | % | µg/m³ | µg/m³ | µg/m³ | % | % |
| ESR 1 | 437525 | 412457 | Lund Hill Ln, Royston, Barnsley | 15.0 | 26.1 | 13.1 | 43.0 | 6.5 | 21.5 | 0.58 | 0.58 | 15.55 | 1.45 | 38.87 |
| ESR 2 | 437313 | 411715 | Midland Rd, Royston, Barnsley | 16.7 | 113.2 | 56.6 | 90.0 | 28.3 | 45.0 | 5.63 | 5.63 | 22.30 | 14.07 | 55.75 |
| ESR 3 | 437092 | 411715 | Midland Rd, Royston, Barnsley | 16.7 | 81.4 | 40.7 | 74.0 | 20.3 | 37.0 | 3.48 | 3.48 | 20.16 | 8.70 | 50.39 |
| ESR 4 | 437315 | 411628 | Station Terrace, Royston, Barnsley | 16.7 | 95.6 | 47.8 | 81.1 | 23.9 | 40.6 | 3.76 | 3.76 | 20.44 | 9.41 | 51.09 |
| ESR 5 | 437303 | 411451 | End Cres, Royston, Barnsley | 16.7 | 56.8 | 28.4 | 61.7 | 14.2 | 30.9 | 1.69 | 1.69 | 18.36 | 4.22 | 45.91 |
| ESR 6 | 437174 | 411559 | Caldervale, Royston, Barnsley | 16.7 | 62.2 | 31.1 | 64.4 | 15.5 | 32.2 | 2.09 | 2.09 | 18.76 | 5.22 | 46.90 |
| ESR 7 | 436646 | 412423 | Common Ln, Royston, Barnsley | 15.0 | 33.0 | 16.5 | 46.4 | 8.2 | 23.2 | 0.63 | 0.63 | 15.58 | 1.58 | 38.96 |
| ESR 8 | 437421 | 413189 | Gable Cottage, Wakefield | 14.6 | 17.3 | 8.6 | 37.9 | 4.3 | 18.9 | 0.23 | 0.23 | 14.85 | 0.58 | 37.12 |
| ESR 9 | 438530 | 412372 | Slack Ln, South Hiendley, Barnsley | 15.3 | 9.7 | 4.9 | 35.5 | 2.4 | 17.7 | 0.34 | 0.34 | 15.64 | 0.86 | 39.10 |
| ESR 10 | 438711 | 411298 | Queens Dr, Shafton, Barnsley | 15.4 | 12.7 | 6.4 | 37.2 | 3.2 | 18.6 | 0.46 | 0.46 | 15.86 | 1.14 | 39.65 |
| ESR 11 | 438834 | 411544 | Greenside Estate, Shafton, Barnsley | 15.4 | 14.6 | 7.3 | 38.1 | 3.7 | 19.1 | 0.41 | 0.41 | 15.81 | 1.03 | 39.54 |
| **Short term** | | | | | | | | | | | | | | |
| Maximum | 437456 | 411849 | | 16.7 | 350.1 | 175.1 | 208.5 | 87.5 | 104.2 | | | | | |
| **Long Term** | | | | | | | | | | | | | | |
| **Maximum** | 437506 | 411799 | | 16.7 | | | | | | 62.08 | 62.08 | 78.78 | 155.20 | 196.95 |

### 2014

| RECEPTORS | | | | | SHORT TERM 99.79th PERCENTILE | | | | | LONG TERM | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Receptor ID | Grid Reference X | Grid Reference Y | Receptor Address | Background Concentration | C 99.79th %il $NO_x$ 1 HOUR | PC $NO_2$ 1 HOUR | PEC $NO_2$ 1 HOUR | PC/AQO $NO_2$ 1 HOUR | PEC/AQO $NO_2$ 1 HOUR | PC $NO_x$ ANNUAL | PC $NO_2$ ANNUAL | PEC $NO_2$ ANNUAL | PC/AQO $NO_2$ ANNUAL | PEC/AQO $NO_2$ ANNUAL |
| | | | | µg/m³ | µg/m³ | µg/m³ | µg/m³ | % | % | µg/m³ | µg/m³ | µg/m³ | % | % |
| ESR 1 | 437525 | 412457 | Lund Hill Ln, Royston, Barnsley | 15.0 | 25.7 | 12.9 | 42.8 | 6.4 | 21.4 | 0.65 | 0.65 | 15.62 | 1.62 | 39.05 |
| ESR 2 | 437313 | 411715 | Midland Rd, Royston, Barnsley | 16.7 | 103.7 | 51.8 | 85.2 | 25.9 | 42.6 | 5.26 | 5.26 | 21.93 | 13.15 | 54.83 |
| ESR 3 | 437092 | 411715 | Midland Rd, Royston, Barnsley | 16.7 | 78.2 | 39.1 | 72.5 | 19.6 | 36.2 | 2.94 | 2.94 | 19.61 | 7.34 | 49.02 |
| ESR 4 | 437315 | 411628 | Station Terrace, Royston, Barnsley | 16.7 | 82.5 | 41.2 | 74.6 | 20.6 | 37.3 | 3.33 | 3.33 | 20.00 | 8.32 | 50.00 |
| ESR 5 | 437303 | 411451 | End Cres, Royston, Barnsley | 16.7 | 50.3 | 25.2 | 58.5 | 12.6 | 29.3 | 1.43 | 1.43 | 18.10 | 3.58 | 45.26 |
| ESR 6 | 437174 | 411559 | Caldervale, Royston, Barnsley | 16.7 | 59.5 | 29.7 | 63.1 | 14.9 | 31.5 | 1.91 | 1.91 | 18.58 | 4.76 | 46.45 |
| ESR 7 | 436646 | 412423 | Common Ln, Royston, Barnsley | 15.0 | 36.7 | 18.4 | 48.3 | 9.2 | 24.1 | 0.76 | 0.76 | 15.71 | 1.91 | 39.29 |
| ESR 8 | 437421 | 413189 | Gable Cottage, Wakefield | 14.6 | 25.8 | 12.9 | 42.1 | 6.5 | 21.1 | 0.31 | 0.31 | 14.92 | 0.77 | 37.31 |
| ESR 9 | 438530 | 412372 | Slack Ln, South Hiendley, Barnsley | 15.3 | 10.7 | 5.3 | 35.9 | 2.7 | 18.0 | 0.34 | 0.34 | 15.64 | 0.86 | 39.10 |
| ESR 10 | 438711 | 411298 | Queens Dr, Shafton, Barnsley | 15.4 | 18.4 | 9.2 | 40.0 | 4.6 | 20.0 | 0.45 | 0.45 | 15.85 | 1.12 | 39.63 |
| ESR 11 | 438834 | 411544 | Greenside Estate, Shafton, Barnsley | 15.4 | 11.0 | 5.5 | 36.3 | 2.7 | 18.1 | 0.39 | 0.39 | 15.79 | 0.97 | 39.48 |
| **Short term** | | | | | | | | | | | | | | |
| Maximum | 437456 | 411849 | | 16.7 | 350.8 | 175.4 | 208.8 | 87.7 | 104.4 | | | | | |
| **Long Term** | | | | | | | | | | | | | | |
| **Maximum** | 437506 | 411799 | | 16.7 | | | | | | 57.45 | 57.45 | 74.15 | 143.63 | 185.38 |

| 2015 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RECEPTORS | | | | | SHORT TERM 99.79th PERCENTILE | | | | | LONG TERM | | | | |
| Receptor ID | Grid Reference | | Receptor Address | Background Concentration | C 99.79th %il $NO_x$ 1 HOUR | PC $NO_2$ 1 HOU | PEC $NO_2$ 1 HOU | PC/AQO $NO_2$ 1 HOU | PEC/AQO $NO_2$ 1 HOU | PC $NO_x$ ANNUA | PC $NO_2$ ANNUA | PEC $NO_2$ ANNUA | PC/AQO $NO_2$ ANNUA | PEC/AQO $NO_2$ ANNUAL |
| | X | Y | | µg/m³ | µg/m³ | µg/m³ | µg/m³ | % | % | µg/m³ | µg/m³ | µg/m³ | % | % |
| ESR 1 | 437525 | 412457 | Lund Hill Ln, Royston, Barnsley | 15.0 | 26.4 | 13.2 | 43.1 | 6.6 | 21.6 | 0.57 | 0.57 | 15.54 | 1.43 | 38.86 |
| ESR 2 | 437313 | 411715 | Midland Rd, Royston, Barnsley | 16.7 | 68.6 | 34.3 | 67.6 | 17.1 | 33.8 | 4.09 | 4.09 | 20.77 | 10.24 | 51.92 |
| ESR 3 | 437092 | 411715 | Midland Rd, Royston, Barnsley | 16.7 | 76.2 | 38.1 | 71.5 | 19.1 | 35.7 | 2.11 | 2.11 | 18.79 | 5.28 | 46.96 |
| ESR 4 | 437315 | 411628 | Station Terrace, Royston, Barnsley | 16.7 | 49.8 | 24.9 | 58.3 | 12.5 | 29.1 | 2.54 | 2.54 | 19.21 | 6.35 | 48.04 |
| ESR 5 | 437303 | 411451 | End Cres, Royston, Barnsley | 16.7 | 45.3 | 22.7 | 56.0 | 11.3 | 28.0 | 1.29 | 1.29 | 17.96 | 3.22 | 44.90 |
| ESR 6 | 437174 | 411559 | Caldervale, Royston, Barnsley | 16.7 | 42.0 | 21.0 | 54.4 | 10.5 | 27.2 | 1.26 | 1.26 | 17.94 | 3.16 | 44.84 |
| ESR 7 | 436646 | 412423 | Common Ln, Royston, Barnsley | 15.0 | 30.1 | 15.1 | 45.0 | 7.5 | 22.5 | 0.56 | 0.56 | 15.51 | 1.40 | 38.78 |
| ESR 8 | 437421 | 413189 | Gable Cottage, Wakefield | 14.6 | 18.5 | 9.3 | 38.5 | 4.6 | 19.2 | 0.25 | 0.25 | 14.87 | 0.64 | 37.17 |
| ESR 9 | 438530 | 412372 | Slack Ln, South Hiendley, Barnsley | 15.3 | 12.9 | 6.5 | 37.1 | 3.2 | 18.5 | 0.40 | 0.40 | 15.70 | 1.01 | 39.26 |
| ESR 10 | 438711 | 411298 | Queens Dr, Shafton, Barnsley | 15.4 | 17.8 | 8.9 | 39.7 | 4.4 | 19.8 | 0.49 | 0.49 | 15.89 | 1.23 | 39.73 |
| ESR 11 | 438834 | 411544 | Greenside Estate, Shafton, Barnsley | 15.4 | 13.8 | 6.9 | 37.7 | 3.5 | 18.9 | 0.44 | 0.44 | 15.84 | 1.09 | 39.60 |
| **Short term** | | | | | | | | | | | | | | |
| Maximum | 437456 | 411849 | | 16.7 | 348.3 | 174.2 | 207.6 | 87.1 | 103.8 | | | | | |
| **Long Term** | | | | | | | | | | | | | | |
| **Maximum** | 437506 | 411799 | | 16.7 | | | | | | 70.21 | 70.21 | 86.91 | 175.53 | 217.28 |

The maximum concentrations obtained within the uniform cartesian grid modelled considering a worst case scenario of 24 hours continuous operation throughout the year exceed the Air Quality Objectives. This is due to the overestimation considered in the model for the worst case which asssumes 8760 hours of operation against the anticipated 800 hours of operation . An iteration of the model for 2009 and 2015, the years in which maximum short -term and long -term concentrations were obtained, has been carried out to evaluate the impacts based on the anticipated hours of operation for the five gas generators within the modelled grid. The results are presented below:

**Results for Actual Hours of Operation**

| 2009 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RECEPTORS | | | | | SHORT TERM 99.79th PERCENTILE | | | | | LONG TERM | | | | |
| Receptor ID | Grid Reference | | Receptor Address | Background Concentration | C 99.79th %il $NO_x$ 1 HOUR | PC $NO_2$ 1 HOU | PEC $NO_2$ 1 HOU | PC/AQO $NO_2$ 1 HOU | PEC/AQO $NO_2$ 1 HOU | PC $NO_x$ ANNUA | PC $NO_2$ ANNUA | PEC $NO_2$ ANNUA | PC/AQO $NO_2$ ANNUA | PEC/AQO $NO_2$ ANNUAL |
| | X | Y | | µg/m³ | µg/m³ | µg/m³ | µg/m³ | % | % | µg/m³ | µg/m³ | µg/m³ | % | % |
| ESR 1 | 437525 | 412457 | Lund Hill Ln, Royston, Barnsley | 15.0 | 4.33 | 2.2 | 32.1 | 1.1 | 16.1 | 0.04 | 0.04 | 15.01 | 0.09 | 37.52 |
| ESR 2 | 437313 | 411715 | Midland Rd, Royston, Barnsley | 16.7 | 6.62 | 3.3 | 36.7 | 1.7 | 18.3 | 0.25 | 0.25 | 16.93 | 0.63 | 42.31 |
| ESR 3 | 437092 | 411715 | Midland Rd, Royston, Barnsley | 16.7 | 1.99 | 1.0 | 34.3 | 0.5 | 17.2 | 0.10 | 0.10 | 16.78 | 0.26 | 41.94 |
| ESR 4 | 437315 | 411628 | Station Terrace, Royston, Barnsley | 16.7 | 4.37 | 2.2 | 35.5 | 1.1 | 17.8 | 0.15 | 0.15 | 16.82 | 0.37 | 42.05 |
| ESR 5 | 437303 | 411451 | End Cres, Royston, Barnsley | 16.7 | 2.24 | 1.1 | 34.5 | 0.6 | 17.2 | 0.07 | 0.07 | 16.75 | 0.18 | 41.87 |
| ESR 6 | 437174 | 411559 | Caldervale, Royston, Barnsley | 16.7 | 2.64 | 1.3 | 34.7 | 0.7 | 17.3 | 0.10 | 0.10 | 16.78 | 0.26 | 41.95 |
| ESR 7 | 436646 | 412423 | Common Ln, Royston, Barnsley | 15.0 | 2.04 | 1.0 | 30.9 | 0.5 | 15.5 | 0.03 | 0.03 | 14.98 | 0.07 | 37.46 |
| ESR 8 | 437421 | 413189 | Gable Cottage, Wakefield | 14.6 | 0.77 | 0.4 | 29.6 | 0.2 | 14.8 | 0.01 | 0.01 | 14.62 | 0.03 | 36.56 |
| ESR 9 | 438530 | 412372 | Slack Ln, South Hiendley, Barnsley | 15.3 | 2.21 | 1.1 | 31.7 | 0.6 | 15.9 | 0.02 | 0.02 | 15.32 | 0.06 | 38.31 |
| ESR 10 | 438711 | 411298 | Queens Dr, Shafton, Barnsley | 15.4 | 3.50 | 1.8 | 32.6 | 0.9 | 16.3 | 0.03 | 0.03 | 15.43 | 0.07 | 38.58 |
| ESR 11 | 438834 | 411544 | Greenside Estate, Shafton, Barnsley | 15.4 | 3.32 | 1.7 | 32.5 | 0.8 | 16.2 | 0.04 | 0.04 | 15.44 | 0.09 | 38.60 |
| **Short term** | | | | | | | | | | | | | | |
| Maximum | 437506 | 411799 | | 16.7 | 258.5 | 129.3 | 162.7 | 64.6 | 81.3 | | | | | |
| **Long Term** | | | | | | | | | | | | | | |
| **Maximum** | 437506 | 411799 | | 16.7 | | | | | | 3.43 | 3.43 | 20.13 | 8.57 | 50.32 |

**Results for Actual Hours of Operation**

| 2015 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RECEPTORS | | | | | SHORT TERM 99.79th PERCENTILE | | | | | LONG TERM | | | | |
| Receptor ID | Grid Reference | | Receptor Address | Background Concentration | C 99.79th %il $NO_x$ 1 HOUR | PC $NO_2$ 1 HOU | PEC $NO_2$ 1 HOU | PC/AQO $NO_2$ 1 HOU | PEC/AQO $NO_2$ 1 HOU | PC $NO_x$ ANNUA | PC $NO_2$ ANNUA | PEC $NO_2$ ANNUA | PC/AQO $NO_2$ ANNUA | PEC/AQO $NO_2$ ANNUAL |
| | X | Y | | µg/m³ | µg/m³ | µg/m³ | µg/m³ | % | % | µg/m³ | µg/m³ | µg/m³ | % | % |
| ESR 1 | 437525 | 412457 | Lund Hill Ln, Royston, Barnsley | 15.0 | 4.06 | 2.0 | 32.0 | 1.0 | 16.0 | 0.04 | 0.04 | 15.01 | 0.09 | 37.52 |
| ESR 2 | 437313 | 411715 | Midland Rd, Royston, Barnsley | 16.7 | 6.55 | 3.3 | 36.6 | 1.6 | 18.3 | 0.21 | 0.21 | 16.89 | 0.53 | 42.21 |
| ESR 3 | 437092 | 411715 | Midland Rd, Royston, Barnsley | 16.7 | 1.74 | 0.9 | 34.2 | 0.4 | 17.1 | 0.10 | 0.10 | 16.77 | 0.24 | 41.92 |
| ESR 4 | 437315 | 411628 | Station Terrace, Royston, Barnsley | 16.7 | 3.97 | 2.0 | 35.3 | 1.0 | 17.7 | 0.12 | 0.12 | 16.80 | 0.31 | 41.99 |
| ESR 5 | 437303 | 411451 | End Cres, Royston, Barnsley | 16.7 | 1.54 | 0.8 | 34.1 | 0.4 | 17.1 | 0.05 | 0.05 | 16.73 | 0.13 | 41.82 |
| ESR 6 | 437174 | 411559 | Caldervale, Royston, Barnsley | 16.7 | 1.72 | 0.9 | 34.2 | 0.4 | 17.1 | 0.05 | 0.05 | 16.73 | 0.13 | 41.81 |
| ESR 7 | 436646 | 412423 | Common Ln, Royston, Barnsley | 15.0 | 2.85 | 1.4 | 31.3 | 0.7 | 15.7 | 0.03 | 0.03 | 14.98 | 0.07 | 37.45 |
| ESR 8 | 437421 | 413189 | Gable Cottage, Wakefield | 14.6 | 1.38 | 0.7 | 29.9 | 0.3 | 15.0 | 0.02 | 0.02 | 14.63 | 0.05 | 36.58 |
| ESR 9 | 438530 | 412372 | Slack Ln, South Hiendley, Barnsley | 15.3 | 1.18 | 0.6 | 31.2 | 0.3 | 15.6 | 0.02 | 0.02 | 15.32 | 0.05 | 38.30 |
| ESR 10 | 438711 | 411298 | Queens Dr, Shafton, Barnsley | 15.4 | 1.20 | 0.6 | 31.4 | 0.3 | 15.7 | 0.02 | 0.02 | 15.42 | 0.05 | 38.56 |
| ESR 11 | 438834 | 411544 | Greenside Estate, Shafton, Barnsley | 15.4 | 1.02 | 0.5 | 31.3 | 0.3 | 15.7 | 0.02 | 0.02 | 15.42 | 0.05 | 38.56 |
| **Short term** | | | | | | | | | | | | | | |
| Maximum | 437456 | 411849 | | 16.7 | 249.6 | 124.8 | 158.2 | 62.4 | 79.1 | | | | | |
| **Long Term** | | | | | | | | | | | | | | |
| **Maximum** | 437506 | 411799 | | 16.7 | | | | | | 4.27 | 4.27 | 20.97 | 10.67 | 52.42 |

## Carbon Monoxide

### 2009

| RECEPTORS | | | | | SHORT TERM 8 -Hour | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Receptor ID | Grid Reference | | Receptor Address | Background Concentration | PC CO | PC CO | PEC CO | PC/AQO CO | PEC/AQO CO |
| | X | Y | | µg/m³ | µg/m³ | mg/m³ | mg/m³ | % | % |
| ESR 1 | 437525 | 412457 | Lund Hill Ln, Royston, Barnsley | 0.15 | 84.55 | 0.085 | 0.235 | 0.845 | 2.345 |
| ESR 2 | 437313 | 411715 | Midland Rd, Royston, Barnsley | 0.15 | 511.39 | 0.511 | 0.661 | 5.114 | 6.614 |
| ESR 3 | 437092 | 411715 | Midland Rd, Royston, Barnsley | 0.15 | 273.80 | 0.274 | 0.424 | 2.738 | 4.238 |
| ESR 4 | 437315 | 411628 | Station Terrace, Royston, Barnsley | 0.15 | 314.35 | 0.314 | 0.464 | 3.143 | 4.643 |
| ESR 5 | 437303 | 411451 | End Cres, Royston, Barnsley | 0.15 | 188.37 | 0.188 | 0.338 | 1.884 | 3.384 |
| ESR 6 | 437174 | 411559 | Caldervale, Royston, Barnsley | 0.15 | 223.44 | 0.223 | 0.373 | 2.234 | 3.734 |
| ESR 7 | 436646 | 412423 | Common Ln, Royston, Barnsley | 0.15 | 117.02 | 0.117 | 0.267 | 1.170 | 2.670 |
| ESR 8 | 437421 | 413189 | Gable Cottage, Wakefield | 0.15 | 63.24 | 0.063 | 0.213 | 0.632 | 2.132 |
| ESR 9 | 438530 | 412372 | Slack Ln, South Hiendley, Barnsley | 0.15 | 40.83 | 0.041 | 0.191 | 0.408 | 1.908 |
| ESR 10 | 438711 | 411298 | Queens Dr, Shafton, Barnsley | 0.15 | 68.67 | 0.069 | 0.219 | 0.687 | 2.187 |
| ESR 11 | 438834 | 411544 | Greenside Estate, Shafton, Barnsley | 0.15 | 75.27 | 0.075 | 0.225 | 0.753 | 2.253 |
| Maximum | 437455.9 | 411848.9 | | 0.15 | 1471.0 | 1.471 | 1.621 | 14.710 | 16.210 |

### 2012

| RECEPTORS | | | | | SHORT TERM 8 -Hour | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Receptor ID | Grid Reference | | Receptor Address | Background Concentration | PC CO | PC CO | PEC CO | PC/AQO CO | PEC/AQO CO |
| | X | Y | | µg/m³ | µg/m³ | mg/m³ | mg/m³ | % | % |
| ESR 1 | 437525 | 412457 | Lund Hill Ln, Royston, Barnsley | 0.15 | 49.34 | 0.049 | 0.199 | 0.493 | 1.993 |
| ESR 2 | 437313 | 411715 | Midland Rd, Royston, Barnsley | 0.15 | 472.22 | 0.472 | 0.622 | 4.722 | 6.222 |
| ESR 3 | 437092 | 411715 | Midland Rd, Royston, Barnsley | 0.15 | 322.16 | 0.322 | 0.472 | 3.222 | 4.722 |
| ESR 4 | 437315 | 411628 | Station Terrace, Royston, Barnsley | 0.15 | 417.82 | 0.418 | 0.568 | 4.178 | 5.678 |
| ESR 5 | 437303 | 411451 | End Cres, Royston, Barnsley | 0.15 | 199.47 | 0.199 | 0.349 | 1.995 | 3.495 |
| ESR 6 | 437174 | 411559 | Caldervale, Royston, Barnsley | 0.15 | 276.98 | 0.277 | 0.427 | 2.770 | 4.270 |
| ESR 7 | 436646 | 412423 | Common Ln, Royston, Barnsley | 0.15 | 124.01 | 0.124 | 0.274 | 1.240 | 2.740 |
| ESR 8 | 437421 | 413189 | Gable Cottage, Wakefield | 0.15 | 55.53 | 0.056 | 0.206 | 0.555 | 2.055 |
| ESR 9 | 438530 | 412372 | Slack Ln, South Hiendley, Barnsley | 0.15 | 29.45 | 0.029 | 0.179 | 0.295 | 1.795 |
| ESR 10 | 438711 | 411298 | Queens Dr, Shafton, Barnsley | 0.15 | 52.19 | 0.052 | 0.202 | 0.522 | 2.022 |
| ESR 11 | 438834 | 411544 | Greenside Estate, Shafton, Barnsley | 0.15 | 64.02 | 0.064 | 0.214 | 0.640 | 2.140 |
| Maximum | 437456 | 411849 | | 0.15 | 1448.1 | 1.448 | 1.598 | 14.481 | 15.981 |

### 2013

| RECEPTORS | | | | | SHORT TERM 8 -Hour | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Receptor ID | Grid Reference | | Receptor Address | Background Concentration | PC CO | PC CO | PEC CO | PC/AQO CO | PEC/AQO CO |
| | X | Y | | µg/m³ | µg/m³ | mg/m³ | mg/m³ | % | % |
| ESR 1 | 437525 | 412457 | Lund Hill Ln, Royston, Barnsley | 0.15 | 69.7 | 0.070 | 0.220 | 0.697 | 2.197 |
| ESR 2 | 437313 | 411715 | Midland Rd, Royston, Barnsley | 0.15 | 475.9 | 0.476 | 0.626 | 4.759 | 6.259 |
| ESR 3 | 437092 | 411715 | Midland Rd, Royston, Barnsley | 0.15 | 361.5 | 0.362 | 0.512 | 3.615 | 5.115 |
| ESR 4 | 437315 | 411628 | Station Terrace, Royston, Barnsley | 0.15 | 420.7 | 0.421 | 0.571 | 4.207 | 5.707 |
| ESR 5 | 437303 | 411451 | End Cres, Royston, Barnsley | 0.15 | 207.6 | 0.208 | 0.358 | 2.076 | 3.576 |
| ESR 6 | 437174 | 411559 | Caldervale, Royston, Barnsley | 0.15 | 276.8 | 0.277 | 0.427 | 2.768 | 4.268 |
| ESR 7 | 436646 | 412423 | Common Ln, Royston, Barnsley | 0.15 | 104.8 | 0.105 | 0.255 | 1.048 | 2.548 |
| ESR 8 | 437421 | 413189 | Gable Cottage, Wakefield | 0.15 | 43.6 | 0.044 | 0.194 | 0.436 | 1.936 |
| ESR 9 | 438530 | 412372 | Slack Ln, South Hiendley, Barnsley | 0.15 | 27.3 | 0.027 | 0.177 | 0.273 | 1.773 |
| ESR 10 | 438711 | 411298 | Queens Dr, Shafton, Barnsley | 0.15 | 51.1 | 0.051 | 0.201 | 0.511 | 2.011 |
| ESR 11 | 438834 | 411544 | Greenside Estate, Shafton, Barnsley | 0.15 | 46.4 | 0.046 | 0.196 | 0.464 | 1.964 |
| Maximum | 437456 | 411849 | | 0.15 | 1553.1 | 1.553 | 1.703 | 15.531 | 17.031 |

### 2014

| RECEPTORS | | | | | SHORT TERM 8 -Hour | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Receptor ID | Grid Reference | | Receptor Address | Background Concentration | PC CO | PC CO | PEC CO | PC/AQO CO | PEC/AQO CO |
| | X | Y | | µg/m³ | µg/m³ | mg/m³ | mg/m³ | % | % |
| ESR 1 | 437525 | 412457 | Lund Hill Ln, Royston, Barnsley | 0.15 | 63.9 | 0.064 | 0.214 | 0.639 | 2.139 |
| ESR 2 | 437313 | 411715 | Midland Rd, Royston, Barnsley | 0.15 | 557.7 | 0.558 | 0.708 | 5.577 | 7.077 |
| ESR 3 | 437092 | 411715 | Midland Rd, Royston, Barnsley | 0.15 | 294.0 | 0.294 | 0.444 | 2.940 | 4.440 |
| ESR 4 | 437315 | 411628 | Station Terrace, Royston, Barnsley | 0.15 | 396.1 | 0.396 | 0.546 | 3.961 | 5.461 |
| ESR 5 | 437303 | 411451 | End Cres, Royston, Barnsley | 0.15 | 153.6 | 0.154 | 0.304 | 1.536 | 3.036 |
| ESR 6 | 437174 | 411559 | Caldervale, Royston, Barnsley | 0.15 | 226.1 | 0.226 | 0.376 | 2.261 | 3.761 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ESR 7 | 436646 | 412423 | Common Ln, Royston, Barnsley | 0.15 | 103.1 | 0.103 | 0.253 | 1.031 | 2.531 |
| ESR 8 | 437421 | 413189 | Gable Cottage, Wakefield | 0.15 | 50.8 | 0.051 | 0.201 | 0.508 | 2.008 |
| ESR 9 | 438530 | 412372 | Slack Ln, South Hiendley, Barnsley | 0.15 | 31.9 | 0.032 | 0.182 | 0.319 | 1.819 |
| ESR 10 | 438711 | 411298 | Queens Dr, Shafton, Barnsley | 0.15 | 50.7 | 0.051 | 0.201 | 0.507 | 2.007 |
| ESR 11 | 438834 | 411544 | Greenside Estate, Shafton, Barnsley | 0.15 | 42.2 | 0.042 | 0.192 | 0.422 | 1.922 |
| Maximum | 437456 | 411849 | | 0.15 | 1669.5 | 1.669 | 1.819 | 16.695 | 18.195 |

| 2015 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| RECEPTORS | | | | | SHORT TERM 8 -Hour | | | | |
| Receptor ID | Grid Reference | | Receptor Address | Background Concentration | PC CO | PC CO | PEC CO | PC/AQO CO | PEC/AQO CO |
| | X | Y | | µg/m$^3$ | µg/m$^3$ | mg/m$^3$ | mg/m$^3$ | % | % |
| ESR 1 | 437525 | 412457 | Lund Hill Ln, Royston, Barnsley | 0.15 | 64.4 | 0.064 | 0.214 | 0.644 | 2.144 |
| ESR 2 | 437313 | 411715 | Midland Rd, Royston, Barnsley | 0.15 | 476.5 | 0.477 | 0.627 | 4.765 | 6.265 |
| ESR 3 | 437092 | 411715 | Midland Rd, Royston, Barnsley | 0.15 | 324.9 | 0.325 | 0.475 | 3.249 | 4.749 |
| ESR 4 | 437315 | 411628 | Station Terrace, Royston, Barnsley | 0.15 | 214.4 | 0.214 | 0.364 | 2.144 | 3.644 |
| ESR 5 | 437303 | 411451 | End Cres, Royston, Barnsley | 0.15 | 259.9 | 0.260 | 0.410 | 2.599 | 4.099 |
| ESR 6 | 437174 | 411559 | Caldervale, Royston, Barnsley | 0.15 | 263.9 | 0.264 | 0.414 | 2.639 | 4.139 |
| ESR 7 | 436646 | 412423 | Common Ln, Royston, Barnsley | 0.15 | 80.9 | 0.081 | 0.231 | 0.809 | 2.309 |
| ESR 8 | 437421 | 413189 | Gable Cottage, Wakefield | 0.15 | 67.1 | 0.067 | 0.217 | 0.671 | 2.171 |
| ESR 9 | 438530 | 412372 | Slack Ln, South Hiendley, Barnsley | 0.15 | 57.4 | 0.057 | 0.207 | 0.574 | 2.074 |
| ESR 10 | 438711 | 411298 | Queens Dr, Shafton, Barnsley | 0.15 | 50.4 | 0.050 | 0.200 | 0.504 | 2.004 |
| ESR 11 | 438834 | 411544 | Greenside Estate, Shafton, Barnsley | 0.15 | 51.1 | 0.051 | 0.201 | 0.511 | 2.011 |
| Maximum | 437456 | 411849 | | 0.15 | 1606.8 | 1.607 | 1.757 | 16.068 | 17.568 |