

# Better Barnsley Town Centre

Stage 2  
Air Quality Assessment

Barnsley Metropolitan Borough Council

18 April 2017

## Quality information

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## 1. Introduction

AECOM was commissioned to undertake a local air quality assessment for the proposed redevelopment of the Barnsley town centre as part of the Better Barnsley improvement scheme.

### 1.1 Assessment Approach

A qualitative construction phase assessment has been undertaken in accordance with the Institute of Air Quality Management (IAQM, 2014) 'Guidance on the assessment of dust from demolition and construction' to determine the potential dust and vehicle emission impacts. Taking into consideration the risk of potential impacts, appropriate mitigation measures have been recommended.

A quantitative operational phase assessment has been undertaken in accordance with the Environmental Protection UK (EPUK)/IAQM 'Land Use Planning & Development Control: Planning for Air Quality' (EPUK/IAQM, 2015). Detailed dispersion modelling, using the ADMS Roads software, was undertaken to determine the impact of traffic derived pollutant concentrations at nearby sensitive receptors. The assessment was conducted for the following scenarios:

- 2015 Baseline, existing scenario without the proposed development;
- 2017 and 2022 Do-Minimum, without the proposed development; and
- 2017 and 2022 Do-Something, with the proposed development operational for both Phase 1 and Phase 2 outlined below.

### 1.2 Proposed Scheme

The assessment site represents a large area in the centre of Barnsley, with the proposed redevelopment including commercial and leisure facilities. The proposed scheme will be divided into two phases, which have been appraised separately, whereby Phase 1 will entail demolition and construction work, whilst Phase 2 will also entail road and junction realignments leading to changes in local traffic flow. A site plan showing the application site is provided in Appendix D.

The overall scheme (Phase 1 and Phase 2) includes the following stages:

- Demolition of Central Offices and Carpet World (completed)
- Upgrading the Metropolitan Centre and Markets (reserved matters approved under the outline)
- Redevelopment of the existing TEC building (demolition carried out)
- Construction of a new Central Library (under construction)
- Construction of a new car park on the former CEAG site (completed)
- Improvements to public realm, including a new public square with space for town centre events (approved in outline)

This application includes mixed use development of land adjoining Barnsley Markets following demolition of part of existing market hall and multi-story car park. This will provide new retail / food & drink (Use Classes A1/A3), cinema and leisure use (Use Class D2), and will include a new multi-storey car park and service road with access to / from Lambra Road.

## 2. Legislation and Policy Guidance

### 2.1 European Air Quality Directives

The Air Quality Framework Directive (96/62/EC) on ambient air quality assessment and management defines the policy framework for 12 air pollutants known to have a harmful effect on human health and the environment. Ambient concentration limit values for the specific pollutants are set through a series of Daughter Directives.

Following the Daughter Directives, Council Directive 2008/50/EC on ambient air quality and cleaner air for Europe came into force in 2008, and was transposed into national legislation in 2010 (The Air Quality Standards Regulations 2010 (Defra, 2010)). It consolidated existing air quality legislation and made provisions for Member States to postpone limit value attainment deadlines and allow an exemption from the obligation to limit values for certain pollutants, subject to strict conditions and assessment by the European Commission (EC).

### 2.2 National Air Quality Legislation

The provisions of Part IV of the Environment Act 1995 (H.M. government, 1995) establish a national framework for air quality management, which requires all Local Authorities to conduct local air quality reviews. Section 82(1) of the Act requires these reviews to include an assessment of the current air quality in the area and the predicted air quality in future years. Should the reviews indicate that the objectives prescribed in the UK Air Quality Strategy (AQS) (Defra, 2007) and the Air Quality Standards Regulations 2010 (Defra, 2010) (henceforth referred to as the "Air Quality Regulations") will not be met, the Local Authority is required to designate an Air Quality Management Area (AQMA). Action must then be taken at a local level to ensure that air quality in the area improves.

The UK AQS (AQS) (Defra, 2007) identifies nine ambient air pollutants that have the potential to cause harm to human health. These pollutants are associated with local air quality problems, with the exception of ozone, which is instead considered to be a regional problem. Similarly, the Air Quality Regulations set objectives, but for just seven of the pollutants that are associated with local air quality. These objectives aim to reduce the health effects of the pollutants to negligible levels.

The air quality objectives and limit values currently applicable to the UK can be split into two groups. Each has a different legal status and is therefore handled differently within the framework of UK air quality policy. These are:

- UK air quality objectives set down in regulations for the purposes of local air quality management; and
- European Union (EU) limit values transcribed into UK legislation for which compliance is mandatory.

### 2.3 Pollutants of Concern

#### 2.3.1 Nitrogen Dioxide

The Government and the Devolved Administrations adopted two Air Quality Objectives for nitrogen dioxide (NO<sub>2</sub>) which were to be achieved by the end of 2005. In 2010, mandatory EU air quality limit values on pollutant concentrations were to apply, although it continues to be breached in locations throughout the UK. The EU limit values for NO<sub>2</sub> in relation to human health are the same as the national objectives (Defra, 2007):

- An annual mean concentration of 40 µg/m<sup>3</sup> (micrograms per meter cubed); and
- An hourly mean concentration of 200 µg/m<sup>3</sup>, to be exceeded no more than 18 times per year (99.79<sup>th</sup> percentile).

In practice, meeting the annual mean objective has been and is expected to be considerably more demanding than achieving the 1-hour objective. The annual mean objective of 40 µg/m<sup>3</sup> is currently widely exceeded at roadside sites throughout the UK, with exceedances also reported at urban background locations in major conurbations. Exceedances are associated almost exclusively with road source emissions.

There is considerable year-to-year variation in the number of exceedances of the hourly objective, driven by meteorological conditions which give rise to winter episodes of poor dispersion and summer oxidant episodes. Analysis of the relationship between 1-hour and annual mean NO<sub>2</sub> concentrations at roadside and kerbside monitoring sites indicate that exceedances of the 1-hour objective are unlikely where the annual mean is below 60 µg/m<sup>3</sup> (Defra, 2016).

NO<sub>2</sub> and nitric oxide (NO) are both oxides of nitrogen, and are collectively referred to as NO<sub>x</sub>. All combustion processes produce NO<sub>x</sub> emissions, largely in the form of NO, which is then converted to NO<sub>2</sub>, mainly as a result of its reaction with ozone in the atmosphere. Therefore the ratio of NO<sub>2</sub> to NO is primarily dependent on the concentration of ozone and the distance from the emission source.

### 2.3.2 Particulate Matter

Particulate matter is composed of a wide range of materials arising from a variety of sources. Particulate matter is typically assessed as total suspended particulates or as a mass size fraction.

This assessment considers the annual mean and daily mean air quality objectives, as specified in the AQS for England, Scotland, Wales and Northern Ireland (Defra, 2007). Two objectives have been adopted in England and Wales for PM<sub>10</sub> (fine particulate matter), which were to be achieved by the end of 2004:

- An annual mean concentration of 40 µg/m<sup>3</sup> (gravimetric); and
- A 24-hour mean concentration of 50 µg/m<sup>3</sup> (gravimetric) to be exceeded no more than 35 times per year (90.4<sup>th</sup> percentile).

One objective has been adopted for PM<sub>2.5</sub> in England and Wales which is an annual mean concentration of 25 µg/m<sup>3</sup> (gravimetric).

Both short-term and long-term exposure to ambient levels of particulate matter are consistently associated with respiratory and cardiovascular illness and mortality as well as other ill-health effects. Particles of less than 10 micrograms (µm) in diameter have the greatest likelihood of reaching the thoracic region of the respiratory tract. Here particles may remain resident and therefore have increased likelihood of doing harm.

It is not currently possible to discern a threshold concentration below which there are no effects on the whole population's health. Reviews by World Health Organisation and the Committee on the Medical Effects of Air Pollutants (COMEAP, 1998) have suggested exposure to a finer fraction of particles (PM<sub>2.5</sub>, which typically make up around two thirds of PM<sub>10</sub> emissions and concentrations) give a stronger association with the observed ill health effects, but also warn that there is evidence that the coarse fraction (between PM<sub>10</sub> – PM<sub>2.5</sub>) also has some effects on health.

### 2.3.3 Construction Dust

Dust is defined as all particulate matter up to 75 µm in diameter and comprising both suspended and deposited dust, whereas PM<sub>10</sub> is a mass fraction of airborne particles of diameter of 10 µm or less. The health effects associated with dust include eye, nose and throat irritation in addition to the nuisance caused by deposition on cars, windows and property. Dust and PM<sub>10</sub> emissions arise from a number of sources, so construction activities and emissions from vehicles associated with the development should be considered.

## 2.4 National Planning Policy Framework

The National Planning Policy Framework (NPPF) was published in March 2012 (Department of Communities and Local Government, 2012) and concisely sets out national policies and principles on land use planning. Paragraph 109 of the NPPF states that:

*“The planning system should contribute to and enhance the natural and local environment by preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability...”*

Annex 2 of the NPPF defines ‘Pollution’ as:

*“Anything that affects the quality of land, air, water or soils, which might lead to an adverse impact on human health, the natural environment or general amenity. Pollution can arise from a range of emissions, including smoke, fumes, gases, dust, steam, odour, noise and light”.*

There are both national and local policies for the control of air pollution and local action plans for the management of local air quality. The effect of the proposed development on the achievement of such policies and plans are matters that may be a material consideration by planning authorities, when making decisions for individual planning applications. Paragraph 124 of the NPPF states that:

*“Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan.”*

The Planning Practice Guidance (PPG) was updated in March 2014 (Department of Communities and Local Government, 2014), with specific reference to air quality. The PPG states that the planning system should consider the potential effect of new developments on air quality where relevant limits have been exceeded or are near the limit. Concerns also arise where the development is likely to adversely effect upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife). In addition dust can also be a planning concern, for example, because of the effect on local amenity.

When deciding whether air quality is relevant to a planning application the PPG states that a number of factors should be taken into consideration including if the development will:

- Significantly affect traffic in the immediate vicinity of the site or further afield. This could be by generating or increasing traffic congestion; significantly changing traffic volumes, vehicle speed or both; or significantly altering the traffic composition on local roads. Other matters to consider include whether the proposal results in construction sites that would generate large Heavy Goods Vehicle (HGV) flows over a period of a year or more;
- Expose people to existing sources of air pollutants. This could be by building new homes, workplaces or other development in places with poor air quality; and
- Give rise to potentially unacceptable impacts (such as dust) during construction for nearby sensitive locations.

The PPG states:

*‘The air quality assessment undertaken should be proportionate to the nature and scale of the development proposed and the level of concern about air quality. Mitigation options, where necessary, will depend on the proposed development and should be proportionate to the likely impact. It is important therefore that local planning authorities work with applicants to consider appropriate mitigation so as to ensure the new development is appropriate for its location and unacceptable risks are prevented.’*

## 2.5 Local Policy

### 2.5.1 Barnsley Metropolitan Borough Council Planning Policy

Barnsley MBC has maintained a Core Strategy and Unitary Development Plan, which will be replaced by the Local Plan when it is expected to be published in summer of 2018. The existing Statutory Development Plan incorporates the Core Strategy and the remaining saved policies of the Unitary Development Plan.

The following Core Strategy policies relate to air quality:

CSP 28 Reducing the Impact of Road Travel:

*‘We will reduce the impact of road travel by:*

- *Developing and implementing robust, evidence based air quality action plans to improve air quality;*
- *Working with our sub regional partners, fleet and freight operators to improve the efficiency of vehicles and goods delivery, and reduce exhaust emissions; and*
- *Implementing measures to ensure the current road system is used efficiently.’*

CSP 40 Pollution Control and Protection:

*‘Development will be expected to demonstrate that it is not likely to result, directly or indirectly, in an increase in air, surface water and groundwater, noise, smell, dust, vibration, light or other pollution which would unacceptably affect or cause a nuisance to the natural and built environment or to people.’*

*The Council will not allow development of new housing or other environmentally sensitive development where existing air pollution, noise, smell, dust, vibration, light or other pollution levels are unacceptable and there is no reasonable prospect that these can be mitigated against.*

*Developers will be expected to minimise the effects of any possible pollution and provide mitigation measures where appropriate.'*

CSP 41 Development in Air Quality Management Areas:

*'Development in air quality management areas will be expected to demonstrate that it will not have a harmful effect on the health or living conditions of any future users of the development in terms of air quality (including residents, employees, visitors and customers), or that any such harmful effects can be mitigated against.*

*The Council will only allow residential development in air quality management areas, where the developer provides an assessment that shows living conditions will be acceptable for future residents.*

*The Council will only allow development in air quality management areas which could cause more air pollution, where the developer provides an assessment that shows there will not be a significantly harmful effect on air quality.'*

## 2.5.2 Barnsley Metropolitan Borough Council Air Quality Action Plan

In accordance with the LAQM.TG (16) guidance, Barnsley Metropolitan Borough Council has prepared an air quality action plan (BMBC, 2012) following the declaration of the air quality management areas (AQMA). The AQAP includes 22 measures to improve air quality. These include:

- A low emission strategy package;
- Barnsley MBC Travel Plans
- ECO Stars HDV recognition scheme
- Targeted vehicle emissions testing
- BMBC will continue to ensure that air quality is considered with regards to new development. The Council will look for evidence that developers have taken appropriate steps to mitigate pollution impacts. Where appropriate, the Council will seek to gain air quality improvements using Section 106 agreements;
- BMBC will ensure that all major traffic schemes are assessed for air quality impacts against the NAQS objectives;
- BMBC will continue to work with developers and employers to improve sustainable transport links to new economic and residential developments;
- Encourage uptake of lower emission vehicles and alternative fuels by participating in the LTP funded South Yorkshire 'Low carbon re-fuelling infrastructure' project.

## 2.5.3 Assessment Guidance

The results of the assessment have been followed:

- IAQM (2014) Guidance on the assessment of dust from demolition and construction;
- EPUK/IAQM (2015) Land Use Planning & Development Control: Planning for Air Quality;
- NPPF (2014); and,
- Barnsley Metropolitan Borough Council (2014) Air Quality and Emissions Good Practice Planning Guidance.

### 3. Baseline Conditions

#### 3.1 Local Air Quality Management

The local air quality management review and assessment responsibilities for the area around the proposed development site are undertaken by BMBC.

BMBC have declared seven AQMAs that are currently still in force due to exceedances of the annual mean objective for NO<sub>2</sub>. These AQMAs are:

- AQMA1, M1 Motorway, 100 metres either side of the central reservation within the Barnsley Borough
- AQMA 2A, A628 Dodworth Road
- AQMA 3, Junction of A61 Wakefield Road and Burton Road
- AQMA 4, A61 Harborough Hill Road
- AQMA 5, Junction of A633 Rotherham Road and Burton Road
- AQMA 6, A616 passing through Langsett
- AQMA 7, Junction of A61 Sheffield and A6133 Cemetery Road

AQMA 4 is the closest to the proposed development site, and is located on the southbound carriageway of the A61 Harborough Hill Road from the "PC World" gyratory to the southbound slip road of the A61 near to its junction with Queens Road.

AQMA 7 is to the south, and incorporates the southbound carriageway of the A61 Sheffield Road adjacent to the junction with the A6133 Cemetery Road.

AQMA 2A is located to the west and incorporates an area encompassing the A628 from junction 37 of the M1 to Town End roundabout, including part of Summer Lane from Town End roundabout to Wharnccliffe Street.

#### 3.2 Pollutant Monitoring

BMBC has undertaken monitoring using both continuous and passive monitoring techniques. However, only passive monitoring is undertaken in the vicinity of the proposed development site. The results of this monitoring are shown in Table 1. The data have been distance corrected by BMBC to the nearest relevant exposure, whilst the data in brackets in 2015 are the monitored concentrations.

There is no PM<sub>10</sub> or PM<sub>2.5</sub> measurement data gathered in the vicinity of the proposed development site.

**Table 1. BMBC Air Quality Monitoring**

Site ID	Location	Annual Mean NO <sub>2</sub> , mg/m <sup>3</sup>		
		2013	2014	2015
5	Sheffield Road / Park Road	34.3	39.4	37.2
7	Sheffield Road / Cemetery Road	<b>42.9</b>	<b>48.4</b>	(51.4) <b>47.1</b>
8	Sheffield Road / Cemetery Road	33.4	33.1	(49.7) 32.4
19	Summer Lane	31.7	32.4	(38.8) 31.5
20	Dodworth Road	31.7	<b>44.6</b>	(43.9) <b>43.9</b>
21	Dodworth Road	<b>43.8</b>	<b>49.7</b>	(48.5) <b>48.5</b>
22	Traffic Lights Dodworth Road	<b>41.8</b>	<b>45.5</b>	(48.1) <b>43.0</b>
23	Dodworth Rd, adj Shaw Lane	31.7	31.6	(37.0) 31.9
28	Wakefield Rd – app. Burton Rd junction	25.8	24.6	(30.6) 23.5
29	Wakefield Rd – app. Burton Rd junction	-	31.2	(31.2) 29.0
30	Wakefield Road – Burton Road junction	-	28.6	(32.8) 28.0
31	Victoria Rd / Hudds Rd / OML Junction	30.1	30.6	(42.1) 30.4

Site ID	Location	Annual Mean NO <sub>2</sub> , mg/m <sup>3</sup>		
		2013	2014	2015
32	Old Mill Lane / Honeywell Street	32.3	34.3	(41.5) 32.9
33	Old Mill Lane / Eldon Street	28.5	28.9	(34.2) 27.8
34	Burton Road – app Wakefield Rd junction	24.2	23.8	25.6
35	Burton Road – app Wakefield Rd junction	23.1	22.6	(39.7) 34.4
46	Doncaster Road	30.3	31.3	(38.0) 32.2
47	Doncaster Rd J&I School	26.4	29.1	(27.1) 27.1
48	Taylor Row	33.3	33.0	(47.5) 33.6
61	Westway	-	28.7	30.8
63	Pontefract Road / Oakwell Lane	28.9	28.9	(36.4) <b>28.6</b>
66	40 Harborough Hill Road	<b>43.7</b>	-	(67.4) <b>49.0</b>
70	Mottram Street / Eldon Street	34.9	36.8	33.4
71	Harborough Hills Road – near to bakery	<b>48.9</b>	<b>53.7</b>	(65.0) <b>51.5</b>
72	Harborough Hills Road / Meadow Street	32.4	33.6	(34.6) 31.1
73	Harborough Hills Road / Redfearn Street	29.1	30.1	(34.6) 27.8
74	113 Harborough Hills	<b>40.6</b>	<b>42.5</b>	<b>43.0</b>

Source: BMBC, 2016.

### 3.3 Baseline Dust

A background level of dust exists in all urban and rural locations in the UK. Dust can be generated on a local scale from vehicle movements and from the action of wind on exposed soils and surfaces. Dust levels can also be affected by long range transport of dust from distant sources into the local vicinity.

Residents currently experience dust deposition at a rate that is determined by the contributions of local and distant sources. This baseline rate of soiling is considered normal and varies dependent on prevailing climatic conditions. The tolerance of individuals to deposited dust is therefore shaped by their experience of baseline conditions.

Existing local sources of particulate matter includes windblown dust from agricultural land, exhaust emissions from energy plant and road vehicles, break and tyre wear from road vehicles and the long range transport of material from outside the study area.

## 4. Assessment Methodology

### 4.1 Scope of Assessment

The potential for air quality impacts have been assessed for two distinct phases:

- The 'construction' phase: during which the greatest impact is expected to be from dust; and
- The 'operational' phase: when the impacts will be primarily associated with vehicle emissions.

### 4.2 Construction Phase

The impacts associated with the construction phase of the proposed development have been qualitatively assessed with reference to the IAQM published 'Guidance on the assessment of dust from demolition and construction' (IAQM, 2014).

According to the IAQM, the main air quality impacts that may arise during construction activities are:

- Dust deposition, resulting in the soiling of surfaces;
- Visible dust plumes, which are evidence of dust emissions;
- Elevated PM<sub>10</sub> concentrations, as a result of dust generating activities on site; and
- An increase in concentration of airborne particles and NO<sub>2</sub> due to exhaust emissions from diesel powered vehicles and equipment on site and vehicles accessing the site.

Information regarding the number of construction phase Heavy Goods Vehicle (HGV) (>3.5 tonnes) movements associated with the proposed development were unknown at the time of writing. According to the EPUK Guidance (EPUK, 2010) criteria, a quantitative construction phase assessment of potential emissions from vehicles should only be undertaken for, 'large, long term construction sites that would generate large HGV flows (>200 movements per day) over a period of a year or more'. Taking into consideration the scale of the site and the proposed works, it is very unlikely that the EPUK Guidance criteria would be exceeded. Therefore a quantitative assessment is not considered to be required and the impacts due to vehicle emissions during this phase should be considered insignificant.

Activities on construction sites are classified into four types to reflect their different potential impacts:

- Demolition;
- Earthworks;
- Construction; and
- Track-out (The transportation of dust and dirt from the construction site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network).

The following steps, as defined by the IAQM, were followed:

- STEP 1 Screen the requirement for a detailed assessment. Human and ecological receptors were identified and distance to the site and construction routes were determined;
- STEP 2 Assess the risk of dust impacts. The potential risk of dust impacts occurring for each activity was determined, based on the magnitude of the potential dust emissions and the sensitivity of the area;
- STEP 3 Identify the need for site-specific mitigation. Based on the risk of impacts occurring, site specific mitigation measures were determined; and
- STEP 4 Define impacts and their significance. The significance of the potential residual dust impacts (taking mitigation into account) for each activity was determined.

Further details are provided in Appendix A.

### 4.3 Operational Phase

The local air quality assessment has been undertaken in accordance with the BMBC (2014) 'Air Quality and Emissions Good Practice Planning Guidance' as well as the EPUK/IAQM (2015) 'Land-use planning &

development control: planning for air quality' guidance and Defra (2016) Local Air Quality Management Technical Guidance (LAQM.TG(16)).

According to the BMBC guidance document an air quality assessment within the borough should follow a 3 stage process:

- Stage 1: Determining the classification of the development proposal;
- Stage 2: Assessing and quantifying the impact on local air quality; and
- Stage 3: Determining the level of mitigation required by the proposal to meet Local Development Plan requirements.

### 4.3.1 BMBC Development Guidance

#### 4.3.1.1 Stage 1: Development Type Classification

Using criteria adapted by BMBC from the Department for Transport guidance which determines when a Transport Assessment is required, whereby three levels of development type classification are identified (minor, medium or major). The criteria is summarised below:

**Table 2. Criteria for Development Classification**

Land Use	Description	Assessment Required
<b>Trigger Criteria for Minor or Moderate Developments</b>		
Business (B1)	<ul style="list-style-type: none"> <li>a) Offices other than in use within Class A2 (financial and professional)</li> <li>b) Research &amp; Development</li> <li>c) Light Industry</li> </ul>	>2,500 m <sup>2</sup> Gross Floor Area (GFA)
General Industry (B2)	General Industry (other than B1)	>4000 m <sup>2</sup> GFA
Storage or Distribution (B8)	Storage or distribution centres – wholesale warehouses, distribution centres and repositories	>5000m <sup>2</sup> GFA
<b>Other</b>		
Any development generating 30 or more 2-way vehicle movements in any hour		
Any development generating 100 or more 2-way vehicle movements per day		
Any development proposing 100 or more parking spaces		
Any relevant development proposed in a location adjacent to an air quality management area (AQMA)		
<b>Additional Trigger Criteria for Major Developments</b>		
<ul style="list-style-type: none"> <li>- Where the proposed development falls within the Town and Country Planning (EIA) (England and Wales) Regulations 2011 and includes air quality and/or transport as a specific likely impact.</li> <li>- Proposals that include additional HGV movements by more than 10% of total trips.</li> <li>- Where significant demolition and construction works are proposed.</li> </ul>		
<ul style="list-style-type: none"> <li>- Minor Proposal: developments proposals that fall below the above criteria above 1</li> <li>- Medium Proposals: development proposal that meet the criteria above;</li> <li>- Major proposals: Development that meet the criteria above, and the Additional Trigger Criteria.</li> </ul>		

The intended use of the proposed units will be for commercial use and is estimated to be approximately 45,000 m<sup>2</sup> of GFA. This area exceeds the criteria in Table 2, regardless of its specific use.

The proposed development is anticipated to generate a maximum of an additional 1549 movements during weekdays and 2555 movements on weekend days once Phase 1 and 2 are complete. However, it is not anticipated to generate any additional HDV traffic (further details are provided in Section 4.3.5).

With consideration for the overall scale of the proposed development and contribution to the local traffic flow, the Major development triggers have not been met and therefore it is considered that the proposed development should be classified as 'Medium'.

#### 4.3.1.2 Stage 2: Air Quality Impact Assessment

The BMBC guidance states that for Medium classified developments an assessment should be undertaken to determine the likelihood of introducing additional exposure, and to determine the level of mitigation required to make the development acceptable.

Chris Shields, Technical Officer (pollution control) Regulatory Services at BMBC, requested that a quantitative assessment should be undertaken in accordance with the EPUK/IAQM (2015) Guidance to determine the local air quality impacts at existing sensitive receptors (see Section 4.3.6) due to the proposed development. It should be noted that this is not a requirement of a 'Medium' development as defined by the BMBC guidance; however, it does allow for a more thorough assessment of the potential air quality impacts of the development.

As discussed, a detailed level air quality assessment has been undertaken with reference to the EPUK/IAQM (2015) 'Land-Use Planning & Development Control: Planning for Air Quality' guidance. ADMS roads modelling software has been used to predict concentrations of road transport derived pollutants, NO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub>, at selected sensitive receptors. The following scenarios were assessed:

- 2015 Baseline;
- 2017 and 2022 future Do-Minimum (DM) without the proposed scheme going ahead;
- Phase 1 operational in 2017 and 2022; and
- Phase 1 and Phase 2 operational in 2017 and 2022.

This approach is in accordance with the EPUK/IAQM Guidance.

### 4.3.2 EPUK / IAQM Development Guidance

The EPUK/IAQM 2015 Guidance sets out a two-stage approach to determine the need for an operational phase air quality assessment. Stage 1 requires any of the criteria under 'A' coupled with any of the criteria under 'B' to apply (Table 1) before proceeding to Stage 2. If none of the criteria are met then there is no requirement to carry out an air quality assessment and the impacts can be considered to be insignificant.

**Table 3: Stage 1 – Criteria to proceed to Stage 2**

**A) If any of the following apply:**

- 10 or more residential units or a site area of more than 0.5ha
- More than 1000 m<sup>2</sup> of floor space for all other uses or a site area greater than 1ha.

**B) Coupled with any of the following:**

- The development has more than 10 parking spaces
- The development will have a centralised energy facility or other centralised combustion process.

The proposed development exceeds both Criteria A and B, and so has been progressed to Stage 2.

Following the identification of whether an air quality assessment is required or not (Stage 1), Stage 2 is referred to, as set out in Table 2, to determine the detail of the assessment required.

**Table 4: Criteria to undertake a Detailed Air Quality Assessment**

The Development will:	Indicative Criteria to proceed to an Air Quality Assessment
Cause a significant change in Light Duty Vehicle (LDV) traffic flows on local roads with relevant receptors.	A change of Light Duty Vehicles flows of: <ul style="list-style-type: none"> <li>- more than 100 AADT within or adjacent to an AQMA; or</li> <li>- more than 500 AADT elsewhere</li> </ul>
Cause a significant change in Heavy Duty Vehicles (HDV) traffic flows on local roads with relevant receptors.	A change of Heavy Duty Vehicles flows of: <ul style="list-style-type: none"> <li>- more than 25 AADT within or adjacent to an AQMA; or</li> <li>- more than 100 AADT elsewhere</li> </ul>

Realign roads, i.e. changing the proximity of receptors to traffic lanes.	Where the change is 5m or more and the road is within an AQMA.
Introduce a new junction or remove an existing junction near to relevant receptors.	Applies to junctions that cause traffic to significantly change vehicle accelerate/decelerate, e.g. traffic lights, or roundabouts.

The proposed development exceeds some of the criteria at Stage 2 (Table 2), in that the projected development traffic exceeds the change in Light Duty Vehicles (LDV). As such, a dispersion modelling assessment is required.

### 4.3.3 Road Traffic Emissions and Dispersion Modelling

The emission factors applied to the model were derived from the UK Emission Factor Toolkit v7.0. However, due to the uncertainty in the rate of year on year improvements in vehicle emissions technology, the assumption has been made that there are no improvements in vehicle emissions between the 2015 baseline year and the 2017 or 2022 assessment years.

This assessment has used the latest version of dispersion model software 'ADMS-Roads' (v4.0.1.0) to quantify pollution levels at selected receptors. ADMS-Roads is a modern dispersion model that has an extensive published track record of use in the UK for the assessment of local air quality impacts, including model validation and verification studies (CERC, 2014).

### 4.3.4 Conversion of NO<sub>x</sub> to NO<sub>2</sub>

The proportion of NO<sub>2</sub> in NO<sub>x</sub> varies greatly with location and time according to a number of factors including the amount of oxidant available and the distance from the emission source. NO<sub>x</sub> concentrations are expected to decline in future years due to falling emissions, therefore NO<sub>2</sub> concentration will not be limited as much by ozone and consequently it is likely that the NO<sub>2</sub>/NO<sub>x</sub> ratio will in the future increase. In addition, a trend has been noted in recent years whereby roadside NO<sub>2</sub> concentrations have been increasing at certain roadside monitoring sites, despite emissions of NO<sub>x</sub> falling. The direct NO<sub>2</sub> phenomenon is having an increasingly marked effect at many urban locations throughout the UK and must be considered when undertaking modelling studies.

In this study modelled NO<sub>x</sub> values were converted to NO<sub>2</sub> using the 'NO<sub>x</sub> to NO<sub>2</sub>' calculator, released in June 2014, and available at the Air Quality Archive (AQA, 2014). The year and region for which the modelling has been undertaken are specified and local factors, such as an appropriate factor of NO<sub>x</sub> emitted as NO<sub>2</sub>, are used in the calculation.

### 4.3.5 Traffic Data

Traffic data were provided by AECOM Transportation in the form of the 24 hour annual average daily traffic (AADT) flows for affected road links near the proposed development, as well as separate flows for HDVs (vehicles > 3.5t, including buses).

The baseline scenario was for 2015, with future DM (Do-Minimum) scenarios in 2017 and 2022. The Future DS (Do-Something) scenarios considered the cumulative effects of Phase 1 and Phase 2 of the proposed development.

The traffic model did not include flows on the A61 to the north of Pontefract Road, so data published online by the DfT<sup>1</sup> was used to determine ratio for the baseline traffic to the north and south of this junction.

No traffic flow data were available for the slip roads from Pontefract Road to the A61. Therefore, nominal flows on the slip roads were based on 25% of the flow on the A61 carriageway feeding each slip road, which is considered to be a cautious approach.

Speeds were determined from the speed limits on each link, and adjusted to account for slowing traffic near junctions. In addition, the speeds on the south-bound carriageway of Harborough Hill Road were reduced further to represent the steep gradient.

The emissions from the car park were not appraised, as there were no sensitive receptor locations identified near these car parks that may be affected by such emissions.

<sup>1</sup> <http://www.dft.gov.uk/traffic-counts/cp.php?la=Barnsley>

The traffic data used in the assessment is summarised in Table 5.

**Table 5: Traffic Data**

Road Link	Total Flow (AADT)								HDV %							
	Base		DM		Phase 1		Phase 2		Base		DM		Phase 1		Phase 2	
	2015	2017	2022	2017	2022	2017	2022	2015	2017	2022	2017	2022	2017	2022	2017	2022
Schwabisch Gmund Way	9362	9641	10306	9641	10306	9641	10306	15	15	15	15	15	15	15	15	15
Car Park	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-
Kendray Street (Alhambra to Schwabisch)	1545	1591	1701	1612	1708	1385	1481	0	0	0	0	0	0	0	0	0
Kendray Street (Schwabisch to A61)	13890	14304	15290	14531	15517	14304	15290	10	10	10	10	10	10	10	10	10
Pontefract Road (A61 to Lambra Road)	12634	13011	13908	13278	14176	13112	14010	3	3	3	3	3	3	3	3	3
Pontefract Road (South of Lambra Road)	16795	17296	18488	17764	18963	17852	19051	2	2	2	2	2	2	2	2	2
Alhambra Centre	4910	5056	4413	5435	4791	5056	4413	0	0	0	0	0	0	0	0	0
Better Barnsley MSCP	0	0	0	206	220	1755	1769	-	-	-	0	0	0	0	0	0
A61 to Lambra Road	7323	7542	4732	7844	5041	8639	5836	1	1	1	1	1	1	0	1	1
Lambra Road	6186	6370	6810	6653	7099	7029	7475	1	1	1	1	1	1	1	1	1
A628	34763	35799	38267	35951	38424	36501	38974	1	1	1	1	1	1	1	1	1
A61 (A628 to Pontefract Road)	30184	31084	33227	31162	33306	31287	33431	3	3	3	3	3	3	3	3	3
A61 (North of Pontefract Road)	31149	32077	34289	32157	34370	32287	34500	3	3	3	3	3	3	3	3	3
A61 (A628 to Taylor Row)	34591	35621	38077	35694	38151	35813	38270	4	4	4	4	4	4	4	4	4
A61 (Taylor Row to A6133)	19154	19725	21085	19762	21123	19823	21183	3	3	3	3	3	3	3	3	3
A61 (South of A6133)	18960	19525	20871	19556	20903	19606	20952	3	3	3	3	3	3	3	3	3
Union Street	2247	2314	2473	2317	2476	2322	2481	2	2	2	2	2	2	2	2	2
Taylor Row	16894	17397	18597	17430	18630	17484	18684	6	6	6	6	6	6	6	6	6
A6133 Park Road	11956	12312	13161	12317	13166	12324	13173	2	2	2	2	2	2	2	2	2
A6133 Cemetery Road	8058	8299	8871	8300	8873	8303	8876	1	1	1	1	1	1	1	1	1

#### 4.3.6 Receptors

Receptor locations were selected that were considered to be representative of relevant sensitive exposure, such as residential properties and schools. In addition, a number of receptors were selected near the roads that would be most affected by the proposed scheme, and were considered with regard to the short-term hourly objective for NO<sub>2</sub> due to potential exposure to pedestrians, and have been identified in Table 6.

A number of receptors were also selected to represent potential effects that may occur at AQMAs that are outside the modelled extents.

The receptors that have been selected to represent locations where people are likely to be present are based on Air Quality Objectives that are relevant to public exposure for long and short-term objectives. The Air Quality Objective values have been set at concentrations that provide protection to all members of society, including more vulnerable groups such as the very young, the elderly or people who may be predisposed respiratory conditions. As such the sensitivity of receptors was considered in the definition of the Air Quality Objective values and therefore no additional subdivision of human health receptors on the basis of building or location type is considered to be necessary.

There are no ecological receptors located within 200 m of the Site or roads that are included in the assessment.

Table 6: Modelled Receptors

Receptor ID	Description	Exposure Type	In AQMA?	OS Grid Coordinate	Height, m
1	New Street	Commercial (Hourly NO <sub>2</sub> )		434557 406066	1.5
2	Alhambra, New Street	Commercial (Hourly NO <sub>2</sub> )		434590 406125	1.5
3	John Street	Residential		434597 406029	1.5
4	Alhambra, New Street	Commercial (Hourly NO <sub>2</sub> )		434641 406201	1.5
5	Alhambra	Commercial (Hourly NO <sub>2</sub> )		434683 406111	1.5
6	Burleigh Court	Residential		434691 406064	1.5
7	Alhambra, Wesley Street	Commercial (Hourly NO <sub>2</sub> )		434756 406188	1.5
8	Doncaster Road	Footpath (Hourly NO <sub>2</sub> )		434799 406075	1.5
9	Sheffield Road	Residential		434823 405946	1.5
10	Lambra Road	Footpath (Hourly NO <sub>2</sub> )		434834 406162	1.5
11	Sheffield Road	Residential		434856 405877	1.5
12	Taylor Road	Commercial (Hourly NO <sub>2</sub> )		434873 405933	1.5
13	Queens Road	Residential		434881 406416	1.5
14	Harborough Hill Road	Residential		434887 406372	1.5
15	Harborough Hill Road	Residential	Yes	434887 406507	1.5
16	Bala Street	Residential		434904 406338	1.5
17	Pontefract Road	Residential		434928 406292	1.5
18	Harborough Hill Road	Residential	Yes	434910 406606	1.5
19	King Street	Residential		434894 405906	1.5
20	Pontefract Road	Residential		434998 406117	1.5
21	West Way	Residential		434488 406079	1.5
22	Sheffield Road	Residential		435026 405538	1.5
23	Park Road	Residential		434849 405659	1.5
24	Cemetery Road	Residential		435166 405717	1.5
DT5	Sheffield Road / Park Road	Residential		434958 405672	2.8
DT7	Sheffield Road / Cemetery Road	Residential	Yes	434964 405709	2.7
DT8	Sheffield Road / Cemetery Road	Residential		435016 405692	2.7
DT47	Doncaster Rd J&I School	School		435172 405890	2.8
DT48	Taylor Row	Footpath (Hourly NO <sub>2</sub> )		434916 405930	2.7
DT61	Westway	Footpath (Hourly NO <sub>2</sub> )		434251 406199	10.9
DT63	Pontefract Road / Oakwell Lane	Residential		435261 406052	2.8
DT66	40 Harborough Hill Road	Residential	Yes	434933 406695	2.7
DT71	Harborough Hills Road – near to bakery	Residential	Yes	434955 406769	2.9

#### 4.3.7 Background Pollutant Concentration Data

For any modelling exercise the ideal situation is to estimate emissions from all known sources (road, rail, industry etc). In practice, information will only be available for those sources under the spot light. In this case it's the road traffic component. Under these circumstances all other sources are collectively considered to be a background

element. The concentrations calculated by the model due to vehicle emissions are therefore added to these background concentrations to give the total concentration.

BMBC monitors background NO<sub>2</sub> concentrations at locations across the Borough, including a continuous monitoring unit at Barnsley Gawber (CM3) and diffusion tubes at Moor Lane (DT2), Mexborough Road (DT18) and Lansdowne Crescent (DT62). Of these sites, CM3 is the nearest to the proposed development, and is approximately 2.3 km to the west.

The Council do not operate a background PM<sub>10</sub> monitoring site.

Therefore, the annual mean background pollutant concentration used in this assessment were modelled estimations provided by Defra (Defra, 2013), who provide values for the centre point of each 1 km by 1 km grid square in the UK, for each year between 2013 and 2030. Estimated average background concentrations for the Ordnance Survey grid square containing the proposed development site and modelled receptors considered are provided in Table 7. These data were downloaded in February 2017.

**Table 7: Modelled Annual Mean Background Pollutant Concentrations (µg/m<sup>3</sup>)**

Year	Pollutant	Fraction	OS Grid Centre Coordinate			
			434500, 406500	434500, 405500	435500, 405500	43550, 406500
2015	NO <sub>x</sub>	Total	60.3	31.7	29.5	33.9
		Adjusted	53	28.8	26.4	32.4
	NO <sub>2</sub>	Total	34.2	21.0	19.8	22.1
		Adjusted	30.7	19.3	17.9	21.2
	PM <sub>10</sub>	Total	17.1	16.2	15.7	15.7
		Adjusted	16.3	15.9	15.4	15.5
2017	NO <sub>x</sub>	Total	56.2	28.6	26.4	30.9
		Adjusted	49.9	26.1	23.8	29.6
	NO <sub>2</sub>	Total	32.4	19.3	18.0	20.4
		Adjusted	29.3	17.8	16.4	19.7
	PM <sub>10</sub>	Total	16.7	15.9	15.4	15.3
		Adjusted	16.0	15.6	15.1	15.2
2022	NO <sub>x</sub>	Total	41.2	18.4	16.3	21.4
		Adjusted	43.8	21.2	18.9	24.4
	NO <sub>2</sub>	Total	28.8	15.9	14.5	17.2
		Adjusted	26.6	14.8	13.5	16.7
	PM <sub>10</sub>	Total	16.1	15.4	14.9	14.8
		Adjusted	15.4	15.1	14.6	14.6

#### 4.3.8 Meteorological Data

The meteorological dataset used in the assessment was recorded in 2015 at the meteorological station at Robin Hood airport, Doncaster, located approximately 40 km to the east of the site. The meteorological site is considered to be representative of regional meteorological conditions and sufficient to satisfy the requirements of this assessment.

#### 4.3.9 Model Verification

Modelling results are subject to systematic and random error; systematic error arises due model formulations and random errors to variable factors, such as uncertainty in the traffic data and the composition of the vehicle fleet, and uncertainty in the meteorological dataset. This can be addressed and, if necessary, adjusted for by comparison with monitoring data. The accuracy of the future year modelling results are relative to the accuracy of the base year results, therefore greater confidence can be placed in the future year concentrations if good agreement is found for the base year.

A model adjustment factor of 4.9 was applied to the majority of the results through comparison with local air quality monitoring data. However, one location to the west of the junction of Sheffield Road and Cemetery Road Was very difficult to verify due to queuing traffic on a steep hill, and so receptors in this area were adjusted using a separate, higher, factor of 8.2. The verification calculations are provided in Appendix B.

## 4.4 Significance Criteria

### 4.4.1 Construction Phase

Step 4 of the construction phase assessment methodology defines the significance of the potential residual effect, i.e. after mitigation dust impacts.

According to the IAQM Guidance (IAQM, 2014) the residual effects assessment assumes that all mitigation measures (recommended in Step 3) to avoid or reduce effects will be adhered to, and therefore the residual effects should be considered to be 'not significant'.

However, it is noted that the proposed demolition of the existing multi-storey car park may entail significant, short-term dust effects and so this has been specifically considered in the residual effects and mitigation sections (see Section 6.1).

### 4.4.2 Operational Phase

With regard to road traffic emissions, the change in pollutant concentrations, with respect to the baseline concentrations, has been described at receptors that are representative of exposure to impacts on local air quality within the study area. The absolute magnitude of pollutant concentrations in the modelled scenarios is also described, and this is used to identify the risk of the Air Quality Objective values being exceeded in each scenario.

For consideration of a change in annual mean concentrations of a given magnitude, the EPUK/ IAQM (2015) have jointly published recommendations for describing the effects of such impacts at individual receptors, as set out in Table 8.

The EPUK / IAQM guidance includes seven explanatory notes to accompany the terminology for the effect descriptors. In particular it is noted that the descriptors are for individual receptors only and that overall significance is determined using professional judgement. Additionally, it is noted that it is unwise to ascribe too much accuracy to incremental changes or background concentrations, and this is especially important when total concentrations are close to the objective value. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the objective value, rather than being exactly equal to it.

**Table 8: Effects Descriptors at Individual Receptors – Annual Mean NO<sub>2</sub> and PM<sub>10</sub>**

Annual Mean Pollutant Concentration at Receptor in Assessment Year ( $\mu\text{g}/\text{m}^3$ )	Change in Annual Mean Concentration of NO <sub>2</sub> /PM <sub>10</sub> ( $\mu\text{g}/\text{m}^3$ )				
	< 0.2	0.2 – 0.6	0.6 – 2.2	2.2 - 4	> 4
≤30.2	Negligible	Negligible	Negligible	Slight	Moderate
30.2 – 37.8	Negligible	Negligible	Slight	Moderate	Moderate
37.8 – 41.0	Negligible	Slight	Moderate	Moderate	Substantial
41.0 – 43.8	Negligible	Moderate	Moderate	Substantial	Substantial
≥43.8	Negligible	Moderate	Substantial	Substantial	Substantial

A change in predicted annual mean concentrations of NO<sub>2</sub> or PM<sub>10</sub> of less than 0.5% (0.2  $\mu\text{g}/\text{m}^3$ ) is considered to be so small as to be negligible. A change (impact) that is negligible, given normal bounds of variation, would not be capable of having a direct effect on local air quality that could be considered to be significant.

The EPUK / IAQM guidance indicates that it is the intention of the effect descriptors for smaller changes in pollutant concentrations to capture the potential risk associated with cumulative development. Changes of 1% of a relevant Air Quality Objective could, under the EPUK / IAQM guidance, result in slight to moderate air quality effects at individual receptors. In practice this assessment inherently considers cumulative impacts through the use of traffic data, Defra background concentrations and predictions at committed developments. Additionally, the EPUK / IAQM guidance also includes the potential for slight to substantial air quality effects as a result of changes in pollutant concentrations between 2 and 5% of relevant Air Quality Objectives. For annual average NO<sub>2</sub> concentrations, this relates to changes in concentrations ranging from 0.6 – 2.1µg/m<sup>3</sup>. In practice, changes in concentration of this magnitude, and in particular changes at the lower end of this band are likely to be very difficult to distinguish through any post operational monitoring regime due to the number of sources of NO<sub>2</sub> in an urban environment and the inter annual effects of varying meteorological conditions. Changes in concentration of more than 5% (the two highest bands) are considered to be of a magnitude which is far more likely to be discernible and as such carry additional weight within the overall evaluation of significance for air quality.

#### 4.4.3 Overall Determination of Significance

The significance of all the reported impacts is then considered for the development in overall terms. The potential for the development to contribute to or interfere with the successful implementation of policies and strategies for the management of local air quality are considered if relevant, but the principal focus is any change in the likelihood of future achievement of the Air Quality Objective values for the following pollutants:

- Annual mean nitrogen dioxide (NO<sub>2</sub>) concentration of 40 µg/m<sup>3</sup>;
- 1-hour mean NO<sub>2</sub> concentration of 200 µg/m<sup>3</sup> not to be exceeded on more than 18 times per year;
- Annual mean particulate matter (PM<sub>10</sub>) concentration of 40 µg/m<sup>3</sup>;
- 24-hour mean PM<sub>10</sub> concentration of 50 µg/m<sup>3</sup> not to be exceeded on more than 35 days per year; and
- Annual mean fine particulate matter (PM<sub>2.5</sub>) concentrations of 25 µg/m<sup>3</sup>.

Local Authorities are focused on achieving these AQOs.

In terms of empirical studies undertaken by EPUK/IAQM the statistical significance of the consequences of any adverse impacts, an effect is reported as being either 'not significant' or as being 'significant'. If the overall effect of the development on local air quality or on amenity is found to be 'moderate' or 'substantial' this is deemed to be 'significant'. Effects found to be 'minor' are considered to be 'not significant', although they may be a matter of local concern. 'Negligible' effects are considered to be 'not significant'.

#### 4.5 Consultation

The assessment approach and mitigation plans were discussed with the Technical Officer for air quality (pollution control) at Regulatory Services at BMBC during a meeting on 22 March 2017.

It was agreed that the requirements of the Barnsley MBC Air Quality and Emissions Good Practice Planning Guidance, and the assessment procedures as detailed within Land-Use Planning and Development Control: Planning for Air Quality (EPUK/IAQM, 2015) should be used.

## 5. Assessment Results

### 5.1 Construction Phase

As discussed in the assessment methodology, a four step process was followed to determine the risk of potential effects during the construction phase.

The following assessment considers the effects of all proposed works for the town centre improvements, and not only the areas relevant to this application, due to the potential cumulative effects and specific significant dust-generating activities that are expected to occur.

#### 5.1.1 STEP 1: Screen the Requirement for a more Detailed Assessment

The extent of the proposed development incorporates several large buildings in the centre of Barnsley, and which are adjacent to the inner ring road, bus station and railway station.

The site is surrounded by predominantly commercial properties, although there are residential properties to the south and east. There are also several car parks and garages near the site that may be affected by dust soiling.

Many of these receptors are located directly adjacent or within 20 m of the site boundary.

There are no ecological receptors, as defined by the IAQM Guidance (IAQM, 2014) (Appendix B), located within 50m of the site.

In accordance with the IAQM Guidance (2014), a detailed construction phase assessment is required.

#### 5.1.2 STEP 2: Assess the Risk of Dust Impacts

##### 5.1.2.1 Step 2A – Define the Potential Dust Emission Magnitude

###### *Demolition*

It is proposed that the majority of the existing structures will be demolished.

The potential dust emission classification during the demolition works is dependent on the total building volume, construction material, whether on-site crushing and screening will take place and the types of demolition activities being undertaken.

The existing concrete multi-storey car park is expected to be demolished by blasting, which will likely entail a large, but very short-lived dust event. The remaining rubble is expected to be crushed on site for re-use or removal. However, it should be noted that the demolition of the car park has already been approved under separate authorisation (outline PP and Prior Notification), and is not formally part of this application. However, as it is a potentially significant activity, it has been included due to the potential cumulative effects of the overall town centre scheme.

Although the total volume of the structure to be demolished is approximately 40,000m<sup>3</sup> and therefore according to the IAQM Guidance (2014) the potential dust emission class should be classified as 'medium'. However, the height of the existing building is > 20 m above ground level, and there will be blasting and onsite crushing and screening. Therefore the potential dust emission classification is increased to '**Large**'.

###### *Earthworks*

Earthworks will primarily involve excavating material, haulage, tipping and stockpiling. The potential dust emission classification during the earthworks is dependent on the total site area, the soil type, number of heavy earth moving vehicles and amount of material moved.

The development site is > 10,000 m<sup>2</sup> although it is anticipated that there will be less than 10 heavy earth moving vehicles active at any one time therefore according to the IAQM Guidance (2014) the proposal is considered to have a '**Medium**' magnitude of potential dust emissions during the earthworks.

###### *Construction*

The proposal is for a number of large buildings and associated parking and servicing areas.

The key issues when determining the potential dust emission magnitude during the construction phase includes the size of the building, method of construction, construction materials and duration of build.

The size of the building being constructed is likely to be > 100,000m<sup>3</sup> and may involve piling and concrete batching. Therefore, according to the IAQM Guidance (2014) should be considered to have a '**Large**' dust generating potential.

#### *Track-out*

Factors which determine the dust generating potential during track out are vehicle size, vehicle speed, vehicle numbers, geology and duration. It is anticipated that a construction site of this size would generate < 50 HDV outward movements in any one day and the length of unpaved road would be < 100m, therefore it is the potential dust emission magnitude is considered to be '**Medium**'.

A summary of the dust emission magnitude for each activity is provided in Table 9.

**Table 9. Summary of the Dust Emission Magnitude**

Emission Source	Dust Emission Classification
Demolition	Large
Earthworks	Medium
Construction	Large
Track-out	Medium

#### 5.1.2.2 Step 2B – Define the Sensitivity of the Area

The following were taken into consideration when determining the sensitivity of the area to dust soiling and health effects of PM<sub>10</sub>.

- The site is located in the centre of Barnsley, with residential dwellings located nearby and therefore the receptor sensitivity is considered to be High;
- There are commercial properties within 20m of the site;
- There are also between 10 and 100 residential properties located within approximately 100 m of the site;
- No PM<sub>10</sub> monitoring is undertaken in a background location near to the proposed site; however, the modelled Defra annual mean background concentrations indicated that the values in the vicinity of the site would be <24 µg/m<sup>3</sup>.

Taking the above into consideration the sensitivity of the area to dust soiling effects are consider to be **Medium**, and for human health effects are **Low**.

#### 5.1.2.3 Step 2C – Define Risk of Impacts

Taking into consideration the conclusion from Steps 2A and 2B, the risk of dust effects for each activity are provided in Table 10.

**Table 10. Risk of Unmitigated Dust Impacts**

Emission Source	Dust Soiling	Human Health
Demolition	High	Medium
Earthworks	Medium	Low
Construction	Medium	Low
Track-out	Low	Low

## 5.2 Operational Phase

The operational phase considered the cumulative effects of the proposed scheme during Phase 1 and Phase 2 in both 2017 and 2022.

As discussed in Section 4.3.3, the modelled future scenarios used the vehicle fleet make up and vehicle emission factors derived for year 2015. This was a cautious approach that assumes there would be no further improvements to emissions, although in this was unlikely to occur.

### 5.2.1 NO<sub>2</sub>

The model was used to predict the annual mean concentration of NO<sub>2</sub> at the selected receptor locations presented in Section 4.3.6. The receptors were selected or sensitive to both the annual mean and potential short-term hourly exposure. The results are presented in Table 11.

The annual mean objective was predicted to be exceeded in several locations in the 2015 base year, including 20 locations outside of an AQMA. However, it was recognised that the model may have over-predicted the pollutant concentrations in these locations owing to the conservative level of adjustment to account for systematic and random model error. It's worth noting that for the purposes of LAQM this approach would heighten the concern for examining potential declarations of AQMAs. However, this assessment is concerned with identifying developmental impact for planning application purposes and so the absolute concentration is not considered as important.

The predicted annual mean concentrations in 2017 were broadly the same as in 2015, although in reality they would be expected to decrease marginally with the introduction of more vehicles with improved emission standards.

In the 2017 Phase 1 scenario, the greatest changes of the annual mean NO<sub>2</sub> concentration were predicted to be 0.4 µg/m<sup>3</sup> on Wesley Street, and at the junction of Pontefract Road and Oakwell Lane, which were described as "moderate" effects.

In the 2017 Phase 2 scenario the predicted changes were higher, with a maximum increase of 1.1 µg/m<sup>3</sup> on Wesley Street (Receptor 7), which was described as "substantial adverse". A "substantial adverse" effect was also predicted at Lambra Road (Receptor 10). These were commercial locations and assessed with regard to the hourly objective, and as the concentrations were below 60 µg/m<sup>3</sup> (see Section 2.3.1), it was considered unlikely that that they may exceed the hourly objective for NO<sub>2</sub>.

Two locations on Harborough Hill Road were predicted to have an annual mean concentration greater than 60 µg/m<sup>3</sup>, which indicated that they may exceed the hourly objective for NO<sub>2</sub>. These are also monitoring locations that were used to verify the model, and the modelled concentrations were consistent with the monitored values recorded in 2015.

The most noticeable effects at a location sensitive to changes in annual mean concentrations were predicted to be "moderate"; at the junction of Pontefract Road and Oakwell Lane, near West Way (Receptor 21), and at Burleigh Court. (Receptor 6)

The potential effects on the AQMAs were appraised using the receptors within the AQMA on Harborough Hill Road (Receptors DT66 and DT71), and Receptor 24 to the north of West Way to indicate the potential effects in the Dodworth Road AQMA to the west of West Way:

- The predicted changes on the A61 Harborough Hill Road were considered to be "negligible".
- The effects on West Way were predicted to be "negligible" in Phase 1 and "moderate" in Phase 2. With regard to the effects in the AQMA to the west of the junction with A628 Dodworth Road, the effects of the scheme would be slightly lower due to traffic effects being distributed onto local roads, and so it was expected that the residual effects were unlikely to exceed a "negligible" significance.

Potential means of mitigating the residual effects are presented in Section 6.2

**Table 11. Predicted Annual Mean NO<sub>2</sub> Concentrations, 2015 Baseline and 2017,**

Location	2015		2017		Change		Effect Description	
	Baseline	Do-Min	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
<b>Receptors Sensitive to Annual Mean Objective</b>								
3	41.1	40.5	40.5	40.6	0.0	0.1	Negligible	Negligible
6	54.4	54.4	54.4	54.6	0.1	0.3	Negligible	Moderate
9	39.3	38.8	38.8	38.9	0.0	0.1	Negligible	Negligible
11	37.1	36.4	36.5	36.5	0.0	0.1	Negligible	Negligible
13	46.2	45.6	45.7	45.8	0.1	0.1	Negligible	Negligible
14	49.4	49.0	49.1	49.1	0.1	0.1	Negligible	Negligible

Location	2015		2017		Change		Effect Description	
	Baseline	Do-Min	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
15	45.2	44.5	44.6	44.6	0.1	0.1	Negligible	Negligible
16	50.3	50.0	50.2	50.2	0.2	0.1	Negligible	Negligible
17	46.2	45.6	45.8	45.8	0.2	0.1	Negligible	Negligible
18	58.8	58.8	58.9	59.0	0.1	0.1	Negligible	Negligible
19	47.8	47.7	47.7	47.8	0.0	0.1	Negligible	Negligible
20	39.9	39.3	39.6	39.7	0.3	0.4	Slight	Slight
21	46.8	46.5	46.6	46.8	0.1	0.3	Negligible	Moderate
22	51.8	51.6	51.6	51.7	0.0	0.1	Negligible	Negligible
23	40.1	39.2	39.2	39.2	0.0	0.0	Negligible	Negligible
24	47.1	46.8	46.8	46.8	0.0	0.0	Negligible	Negligible
DT5	39.2	38.6	38.7	38.7	0.0	0.1	Negligible	Negligible
DT7	48.5	48.4	48.4	48.5	0.0	0.1	Negligible	Negligible
DT8	49.7	50.3	50.3	50.3	0.0	0.0	Negligible	Negligible
DT47	34.4	33.7	33.8	33.8	0.0	0.1	Negligible	Negligible
DT63	41.2	40.7	41.1	41.2	0.4	0.4	Moderate	Moderate
DT66	h	63.0	63.1	63.2	0.1	0.2	Negligible	Negligible
DT71	63.5	63.8	63.9	63.9	0.1	0.2	Negligible	Negligible
<b>Receptors Sensitive to Hourly Objective</b>								
1	54.1	54.2	54.3	54.6	0.1	0.4	Negligible	Moderate
2	39.3	38.5	38.5	38.6	0.0	0.1	Negligible	Negligible
4	38.2	37.3	37.4	37.5	0.0	0.1	Negligible	Negligible
5	63.8	64.2	64.3	64.6	0.1	0.4	Negligible	Moderate
7	53.6	53.4	53.8	54.5	0.4	1.1	Moderate	Substantial
8	53.5	53.4	53.5	53.6	0.1	0.2	Negligible	Negligible
10	47.5	47.0	47.3	47.6	0.3	0.6	Moderate	Substantial
11	37.1	36.4	36.5	36.5	0.0	0.1	Negligible	Negligible
12	63.2	64.0	64.0	64.1	0.1	0.1	Negligible	Negligible
DT47	34.4	33.7	33.8	33.8	0.0	0.1	Negligible	Negligible
DT48	50.7	50.8	50.9	50.9	0.0	0.1	Negligible	Negligible
DT61	34.3	33.2	33.2	33.3	0.0	0.1	Negligible	Negligible

The predicted impacts in 2022 are presented in Table 12.

In 2022, the overall concentrations were predicted to be lower than in the 2015 or 2017 due to lower background concentrations. The annual mean objective was predicted to continue to be exceeded at several locations, although it should be recognised that the model over-predicted the total concentrations due to using the emission rates from 2015, and the actual concentrations in 2022 are likely to be much lower. Furthermore, a relatively high model adjustment factor was applied to the model that would effectively increase the overall concentrations and impacts in all scenarios.

Two locations sensitive to the hourly objective were predicted to exceed 60  $\mu\text{g}/\text{m}^3$ ; Receptor 5 outside the Alhambra, and Receptor 12 on Taylor Road. However, this was predicted to occur in all scenarios in 2022.

The highest change in annual mean concentration was predicted to be 1.2  $\mu\text{g}/\text{m}^3$  on Wesley Street in Phase 2, which was predicted to be a “substantial” change. However, this was a commercial locations and assessed with regard to the hourly objective, and as the concentrations were below 60  $\mu\text{g}/\text{m}^3$  (see Section 2.3.1), it was considered unlikely that that they may exceed the hourly objective for  $\text{NO}_2$ .

Moderate impacts were predicted to occur at Burleigh Court (Receptor 6) in Phase 2, which was a residential property on Pontefract road opposite the junction with Lambra Road.

As in the 2017 scenarios, the effects on the AQMAs were appraised with the receptors on Harborough Hill Road (Receptors DT66 and DT71), and Receptor 24 to the north of West Way. The predicted changes on the A61 Harborough Hill Road were considered to be "negligible". The effects on West Way were considered to be Moderate in Phase 2, although as in the 2017 scenario, the effects on the A628 Dodworth Road AQMA would be lower and so the effects in that area would be "negligible".

**Table 12. Predicted Annual Mean NO<sub>2</sub> Concentrations, 2022, Receptors Sensitive to Annual Mean**

Location	2022		Change		Effect Description		
	Do-Min	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
<b>Receptors Sensitive to Annual Mean Objective</b>							
3	38.6	38.6	38.7	0.0	0.1	Negligible	Negligible
6	<b>53.4</b>	<b>53.4</b>	<b>53.6</b>	0.1	0.3	Negligible	Moderate
9	37.4	37.4	37.5	0.0	0.1	Negligible	Negligible
11	34.9	35.0	35.0	0.0	0.1	Negligible	Negligible
13	<b>44.1</b>	<b>44.1</b>	<b>44.2</b>	0.1	0.1	Negligible	Negligible
14	<b>47.6</b>	<b>47.7</b>	<b>47.8</b>	0.1	0.1	Negligible	Negligible
15	<b>42.9</b>	<b>42.9</b>	<b>43.0</b>	0.1	0.1	Negligible	Negligible
16	<b>48.7</b>	<b>48.9</b>	<b>48.8</b>	0.2	0.2	Negligible	Negligible
17	<b>44.1</b>	<b>44.2</b>	<b>44.2</b>	0.2	0.1	Negligible	Negligible
18	<b>58.2</b>	<b>58.2</b>	<b>58.3</b>	0.1	0.2	Negligible	Negligible
19	<b>47.0</b>	<b>47.0</b>	<b>47.1</b>	0.1	0.1	Negligible	Negligible
20	37.8	37.6	38.2	0.3	0.4	Slight	Slight
21	<b>45.1</b>	<b>45.1</b>	<b>45.4</b>	0.1	0.3	Negligible	Moderate
22	<b>50.4</b>	<b>50.4</b>	<b>50.5</b>	0.0	0.1	Negligible	Negligible
23	37.3	37.3	37.3	0.0	0.0	Negligible	Negligible
24	<b>45.3</b>	<b>45.4</b>	<b>45.4</b>	0.0	0.0	Negligible	Negligible
DT5	37.3	37.3	37.3	0.0	0.1	Negligible	Negligible
DT7	<b>47.7</b>	<b>47.7</b>	<b>47.8</b>	0.0	0.1	Negligible	Negligible
DT8	<b>49.6</b>	<b>49.6</b>	<b>49.6</b>	0.0	0.0	Negligible	Negligible
DT47	32.1	32.1	32.2	0.0	0.0	Negligible	Negligible
DT63	39.3	38.7	39.8	0.4	0.4	Slight	Slight
DT66	<b>62.6</b>	<b>62.6</b>	<b>62.7</b>	0.1	0.2	Negligible	Negligible
DT71	<b>63.4</b>	<b>63.4</b>	<b>63.5</b>	0.1	0.2	Negligible	Negligible
<b>Receptors Sensitive to Hourly Objective</b>							
1	<b>53.3</b>	<b>53.4</b>	<b>53.7</b>	0.1	0.4	Negligible	Moderate
2	36.4	36.5	36.6	0.0	0.1	Negligible	Negligible
4	35.1	35.1	35.2	0.1	0.1	Negligible	Negligible
5	<b>63.7</b>	<b>63.8</b>	<b>64.1</b>	0.1	0.4	Negligible	Moderate
7	<b>49.2</b>	<b>49.6</b>	<b>50.4</b>	0.4	1.2	Moderate	Substantial
8	<b>52.3</b>	<b>52.4</b>	<b>52.5</b>	0.1	0.2	Negligible	Negligible
10	<b>45.6</b>	<b>45.8</b>	<b>46.2</b>	0.3	0.6	Moderate	Moderate
11	34.9	35.0	35.0	0.0	0.1	Negligible	Negligible
12	<b>64.2</b>	<b>64.2</b>	<b>64.3</b>	0.1	0.1	Negligible	Negligible
DT47	32.1	32.1	32.2	0.0	0.0	Negligible	Negligible

Location	2022			Change		Effect Description	
	Do-Min	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
DT48	50.3	50.3	50.4	0.0	0.1	Negligible	Negligible
DT61	30.7	30.8	30.8	0.0	0.1	Negligible	Negligible

### 5.2.2 PM<sub>10</sub>

The annual mean concentration of PM<sub>10</sub> was predicted for the Phase 1 and Phase 2 scenarios in both 2017 and 2022. The results for the 2017 scenario are presented in Table 13, and for the 2022 scenario presented in Table 14.

The predicted concentrations were all well below the annual mean objective. The largest increases were predicted to be 0.1 mg/m<sup>3</sup>, which was described as a “negligible impact”.

**Table 13. Predicted PM<sub>10</sub> Concentrations, 2017**

Location	2015		2017		Change		Effect Description	
	Baseline	Do-Min	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
3	18.6	18.4	18.4	18.4	0.0	0.0	Negligible	Negligible
6	20.8	20.7	20.7	20.7	0.0	0.1	Negligible	Negligible
9	19.5	19.3	19.3	19.3	0.0	0.0	Negligible	Negligible
13	19.5	19.2	19.2	19.3	0.0	0.0	Negligible	Negligible
14	20.1	19.9	20.0	20.0	0.0	0.0	Negligible	Negligible
15	19.1	18.9	18.9	18.9	0.0	0.0	Negligible	Negligible
16	20.3	20.1	20.2	20.2	0.0	0.0	Negligible	Negligible
17	19.4	19.2	19.3	19.2	0.0	0.0	Negligible	Negligible
18	21.7	21.6	21.6	21.6	0.0	0.0	Negligible	Negligible
19	20.3	20.2	20.2	20.2	0.0	0.0	Negligible	Negligible
20	19.3	19.1	19.1	19.2	0.1	0.1	Negligible	Negligible
21	20.2	20.0	20.0	20.1	0.0	0.1	Negligible	Negligible
22	20.9	20.7	20.7	20.7	0.0	0.0	Negligible	Negligible
23	18.3	18.0	18.0	18.0	0.0	0.0	Negligible	Negligible
24	19.9	19.7	19.7	19.7	0.0	0.0	Negligible	Negligible
DT5	19.2	19.0	19.0	19.1	0.0	0.0	Negligible	Negligible
DT7	20.9	20.8	20.8	20.8	0.0	0.0	Negligible	Negligible
DT8	20.9	20.8	20.8	20.8	0.0	0.0	Negligible	Negligible
DT63	19.6	19.4	19.5	19.5	0.1	0.1	Negligible	Negligible
DT66	22.6	22.4	22.4	22.5	0.0	0.0	Negligible	Negligible
DT71	22.7	22.5	22.6	22.6	0.0	0.0	Negligible	Negligible

**Table 14. Predicted PM<sub>10</sub> Concentrations, 2022**

Location	2022			Change		Effect Description	
	Do-Min	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
3	18.0	18.0	18.0	0.0	0.0	Negligible	Negligible
6	20.4	20.5	20.5	0.0	0.1	Negligible	Negligible
9	19.0	19.0	19.0	0.0	0.0	Negligible	Negligible
13	18.9	18.9	18.9	0.0	0.0	Negligible	Negligible

Location	2022			Change		Effect Description	
	Do-Min	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
14	19.6	19.7	19.7	0.0	0.0	Negligible	Negligible
15	18.5	18.6	18.6	0.0	0.0	Negligible	Negligible
16	19.9	19.9	19.9	0.0	0.0	Negligible	Negligible
17	18.9	18.9	18.9	0.0	0.0	Negligible	Negligible
18	21.4	21.4	21.4	0.0	0.0	Negligible	Negligible
19	20.0	20.0	20.0	0.0	0.0	Negligible	Negligible
20	18.8	18.9	18.9	0.1	0.1	Negligible	Negligible
21	19.7	19.8	19.8	0.0	0.1	Negligible	Negligible
22	20.5	20.5	20.5	0.0	0.0	Negligible	Negligible
23	17.6	17.6	17.6	0.0	0.0	Negligible	Negligible
24	19.4	19.4	19.4	0.0	0.0	Negligible	Negligible
DT5	18.8	18.8	18.8	0.0	0.0	Negligible	Negligible
DT7	20.6	20.6	20.6	0.0	0.0	Negligible	Negligible
DT8	20.7	20.7	20.7	0.0	0.0	Negligible	Negligible
DT63	19.2	19.3	19.3	0.1	0.1	Negligible	Negligible
DT66	22.3	22.3	22.3	0.0	0.0	Negligible	Negligible
DT71	22.4	22.5	22.5	0.0	0.0	Negligible	Negligible

### 5.2.3 Summary

There were a number of “substantial” changes in annual mean NO<sub>2</sub> near roads most affected by the proposed scheme, although the overall concentrations were sufficiently low that exceedances of the short-term NO<sub>2</sub> objective were not predicted to occur in these locations.

“Moderate” NO<sub>2</sub> effects were predicted at locations sensitive to changes in the annual mean concentration.

The model also predicted potential “moderate adverse” effects on West Way, although the LAQM regime has not identified any exceedances of the annual mean in this area and it is considered likely that the model over predicted the total concentrations, and particularly in the future 2022 scenarios. Therefore, whilst this indicated a potential “moderate” effect in the Dodworth Road AQMA, the actual effects would likely be much lower.

The overall effects due to NO<sub>2</sub> before additional mitigation is applied were predicted to be “moderate” adverse.

The effects due to PM<sub>10</sub> were predicted to be “negligible”.

## 6. Mitigation

### 6.1 Construction Phase

A number of mitigation measures can be adopted to reduce the production and/or dispersal of dust to lessen the nuisance and limit the human health effects. Ideally dust should be controlled at the source as once airborne it is difficult to suppress.

Based on the risk of effects determined in Step 2 for each activity, appropriate site-specific mitigation measures were identified. The recommended mitigation controls that may be used during the construction of the proposed development are provided in Table 15.

Identifying potential dust generating activities and good site planning is essential to prevent unnecessary dust production and should be conducted prior to commencing work. Where appropriate, dust generating activities should be undertaken off-site, however, where this is not possible these activities should be located away from sensitive receptors.

Construction dust usually responds well to appropriate measures as long as a co-ordinated construction environmental management plan (or equivalent) is implemented and the measures should be enforced and adhered to. The IAQM considers that where suitable construction dust mitigation controls are implemented it will ensure that potential adverse effect will not occur and there should be no notable residual effects.

A specific activity that may entail notable residual dust effect is the demolition of the existing concrete multi-storey car park that is expected to take place using blasting. Whilst the demolition of the car park has already been approved under separate authorisation, and is not formally part of this application, the potential cumulative effects may be significant. Therefore, potential dust control methods have been identified in Table 15, although it is expected that elevated (albeit brief) dust effects may still occur during this demolition event.

**Table 15. Potential Site Operations and Methods of Controlling Dust**

Activity	Recommended Dust Control Methods
Communication	<ul style="list-style-type: none"> <li>- Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.</li> <li>- Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary, and the regional office contact information.</li> <li>- Develop and implement a Dust Management Plan (DMP).</li> </ul>
Site Management	<ul style="list-style-type: none"> <li>- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.</li> <li>- Make the complaints log available to the local authority when asked.</li> <li>- Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.</li> </ul>
Monitoring	<ul style="list-style-type: none"> <li>- Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.</li> <li>- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.</li> <li>- Undertake daily on-site and off-site inspection, where receptors are nearby to monitor dust and record inspection results. Carry out regular site inspections to monitor compliance with the DMP and record inspection results.</li> </ul> <p>The following actions are also recommended:</p> <ul style="list-style-type: none"> <li>- Agree dust deposition, dust flux, or real-time PM10 continuous monitoring locations . Where possible commence baseline monitoring at least three months before work commences on site.</li> </ul>
Preparation	<ul style="list-style-type: none"> <li>- Plan site layout so that machinery and dust causing activities should be located away from receptors as far as is possible, although this may not be feasible within the limited space available.</li> <li>- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any permanent stockpiles on site.</li> <li>- Avoid site runoff of water or mud.</li> <li>- Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.</li> <li>- Keep site fencing, barriers and scaffolding clean using wet methods.</li> <li>- Remove materials that have a potential to produce dust from site as soon as possible.</li> </ul>

Activity	Recommended Dust Control Methods
Operating Vehicles	<ul style="list-style-type: none"> <li>- Cover, seed or fence long-term stockpiles to prevent wind whipping.</li> </ul> <hr/> <ul style="list-style-type: none"> <li>- Ensure all vehicles switch off engines when stationary with no idling vehicles.</li> <li>- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.</li> <li>- Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.</li> </ul> <p>Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)</p> <p>The following actions are also recommended:</p> <ul style="list-style-type: none"> <li>- Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas.</li> </ul>
General Operations	<ul style="list-style-type: none"> <li>- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays (where feasible) or local extraction.</li> <li>- Ensure an adequate water supply on the site for effective dust suppression.</li> <li>- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.</li> <li>- Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.</li> <li>- Avoid bonfires and burning of waste materials</li> </ul>
Demolition	<ul style="list-style-type: none"> <li>- Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).</li> <li>- Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.</li> <li>- Bag and remove any biological debris or damp down such material before demolition</li> </ul> <p>The following actions are recommended for blasting works:</p> <ul style="list-style-type: none"> <li>- Avoid dry, windy weather</li> <li>- Use water mists and sprays immediately following the demolition</li> <li>- Switch-off and / or cover building ventilation inlets and ensure windows and doors are closed.</li> <li>- Notify all nearby residents beforehand</li> </ul>
Earthworks	<p>The following actions are recommended:</p> <ul style="list-style-type: none"> <li>- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.</li> <li>- Use Hessian or mulches where it is not possible to re-vegetate or cover with topsoil, as soon as practicable</li> <li>- Only remove the cover in small areas during work and not all at once</li> </ul>
Construction	<ul style="list-style-type: none"> <li>- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.</li> <li>- For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.</li> </ul> <p>The following actions are also recommended:</p> <ul style="list-style-type: none"> <li>- Avoid scabbling (roughening of concrete surfaces) if possible,</li> <li>- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.</li> </ul>
Track-out	<ul style="list-style-type: none"> <li>- Use water-assisted dust sweepers on the access and local roads, to remove, as necessary, any material tracked out of the site.</li> <li>- Avoid dry sweeping of large areas.</li> <li>- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.</li> <li>- Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.</li> <li>- Record all inspections of haul routes and any subsequent action in a site log book.</li> <li>- Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.</li> </ul>

Activity	Recommended Dust Control Methods
	<ul style="list-style-type: none"> <li>- Implement a wheel washing system with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable.</li> <li>- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.</li> <li>- Access gates to be located at least 10m from receptors where possible.</li> </ul>

## 6.2 Operational Phase

The Barnsley MBC Air Quality and Emissions Good Practice Planning Guidance lists possible mitigation controls that may be used to mitigate local air quality effect arising from changes to traffic.

The following mitigation controls are suggested by BMBC, with reference to the scale of the proposed scheme (i.e. “medium”, as discussed in Section 4.3.1.1):

- Provide parking spaces with an electric charging point, using a phased introduction with an initial agreed provision and a remaining allocated at an agreed trigger level. The electric charging points should be located near priority parking areas (e.g. car park pedestrian entrance routes).
- Provision of a Travel Plan, which may include:
  - Strategy to discourage high emission vehicle use
  - Improved pedestrian access to public transport
  - New or improved bus stop infrastructure
  - Site layout to encourage walking and cycling.
- Strategies for reducing emissions by vehicles operated by tenants and promoting the uptake of low-emission technologies should be encouraged by provision of information on accreditation schemes, such as South Yorkshire Eco Stars.

With regard to the commercial site, the following mitigation may be implemented:

- A workplace travel plan should be promoted to all staff.
- A Delivery and Service Planning Toolkit should be adopted to ensure deliveries are efficient and minimise effects on local roads.

## 7. Conclusions and Residual Impacts

AECOM was commissioned to undertake a local air quality assessment for the proposed Better Barnsley Town centre redevelopment. The proposed site is located in the town centre and would comprise commercial and car parking facilities.

A qualitative construction phase assessment has been undertaken in accordance with the Institute of Air Quality Management (IAQM, 2014) 'Guidance on the assessment of dust from demolition and construction' to determine the potential dust and vehicle emission impacts. Taking into consideration the risk of potential impacts, appropriate mitigation measures were recommended.

A quantitative operational phase assessment has been undertaken in accordance with the EPUK/IAQM 'Land Use Planning & Development Control: Planning for Air Quality' (EPUK/IAQM, 2015) and the Barnsley Metropolitan Borough Council 'Air Quality and Emissions Good Practice Planning Guidance' (BMBC, 2014). Detailed dispersion modelling, using the ADMS Roads software, was undertaken to determine the impact of traffic derived pollutant concentrations at nearby sensitive receptors.

With consideration for the overall scale of the proposed development and contribution to the local traffic flow, it was considered that the proposed development should be classified as 'Medium' in accordance with the BMBC Good Practice Planning Guidance.

### 7.1 Construction Phase

Determining the residual effects corresponds to Step 4 of the assessment methodology.

The effects associated with the construction phase of the proposed development have been qualitatively assessed with reference to the Institute of Air Quality Management (IAQM) published draft 'Guidance on the assessment of dust from demolition and construction' (IAQM, 2014).

The IAQM guidance states that *'in the case of demolition / construction it is assumed that mitigation (secured by planning conditions, legal requirements or required by regulations) will ensure that a potential significant adverse effect will not occur, so the residual effect will normally be "not significant"'*.

Potentially, large dust effects may occur during the blast demolition of the existing concrete multi-storey car park. Potential dust control methods have been identified, although it is expected that a brief, and noticeable dust effect may still occur during this demolition event.

However it is considered that the overall effects during the construction phase will be of "negligible" significance.

### 7.2 Operational Phase

With regard to potential impacts during the operational phase, the assessment concludes the following:

- The annual mean background pollutant concentrations at the proposal site are well below the annual mean objectives for both NO<sub>2</sub> and PM<sub>10</sub>, although they varied across the study area.
- Several locations were predicted to exceed the annual mean concentrations in the 2015 base year, including 20 locations outside an AQMA. It was recognised that the model may have over-predicted the pollutant concentrations in these locations, although a cautious approach was considered and reflected the application of significance criteria.
- There were a number of locations that would experience "moderate" NO<sub>2</sub> due to changes of the annual mean concentration.
- The predicted effects at other locations sensitive to the annual mean objective were considered to be "negligible".
- Annual mean NO<sub>2</sub> impacts described as "moderate adverse" were predicted at West Way, due to the magnitude of change in concentration at this receptor associated with the proposed development and the overall concentration. However, the predicted change in pollutant concentration was very close to being described as "negligible", and based on nearby monitoring results it is considered likely that the model approach has resulted in an overestimation of concentrations at this location.
- "Negligible" impacts were predicted at the majority of receptors with regards to the 1-hour NO<sub>2</sub> objective, except for locations on Harborough Hill Road where monitoring has also indicated that the hourly objective

may be exceeded. Also two commercial locations in 2022, although in places where pedestrians were considered unlikely to regularly spend more than 1-hour.

- “Negligible” impacts were predicted at all receptors with regards to the annual mean PM<sub>10</sub> objective in all modelled scenarios.
- “Negligible” impacts were predicted at all receptors with regards to the daily mean PM<sub>10</sub> objective in all modelled scenarios.

Therefore, it is recommended that mitigation controls should be used to further reduce the local air quality effects of the proposed scheme.

Overall, it is considered that the proposed development will not have an adverse impact on AQ and is in accordance with the local planning policy considerations.

## 8. References

- Air Quality Archive (2017) <http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.htm#NOxNO2calc> (accessed March 2017)
- Air Quality Framework Directive (96/62/EC) *on ambient air quality assessment and management*
- Barnsley Metropolitan Borough Council (2014) *Air quality and Emissions Good Practice Planning Guidance*
- Barnsley Metropolitan Borough Council (2011) *Core Strategy*
- Barnsley Metropolitan Borough Council (2012) *Air Quality Action Plan*
- Barnsley Metropolitan Borough Council (2016) *Local Air Quality Management, Air Quality Status Report*
- CLG (March 2012) *National Planning Policy Framework*
- CLG (March 2014) *Planning Practice Guidance*
- COMEAP (1998). *The Quantification of the Effects of Air Pollution on Health in the United Kingdom*. HMSO, London.
- Council Directive 2008/50/EC *on Ambient Air Quality and Cleaner Air for Europe*.
- Defra (2007) *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*
- Defra (2010) *The Air Quality Standards Regulations 2010 Statutory Instrument 2010 No. 64*
- Defra (2017) <https://uk-air.defra.gov.uk/data/laqm-background-home> (accessed March 2017)
- Defra (2016). *Local Air Quality Management Technical Guidance LAQM.TG(16)*
- Department for Transport (2017) <http://www.dft.gov.uk/traffic-counts/> (accessed March 2017)
- Environmental Protection UK (2010) *Development Control: Planning For Air Quality*.
- Environmental Protection UK and Institute of Air Quality Management (2015) *Land Use Planning & Development Control: Planning for Air Quality*
- Institute of Air Quality Management (IAQM) (2014) *Guidance on the assessment of dust from demolition and construction*

## Appendix A Construction Dust Assessment Methodology

The effects associated with the construction phase of the proposed development have been qualitatively assessed with reference to the IAQM published 'Guidance on the Assessment of Dust from Demolition and Construction' (IAQM, 2014).

According to the IAQM, the main air quality effects that may arise during construction activities are:

- Dust deposition, resulting in the soiling of surfaces;
- Visible dust plumes, which are evidence of dust emissions;
- Elevated PM<sub>10</sub> concentrations, as a result of dust generating activities on site; and
- An increase in concentration of airborne particles and NO<sub>2</sub> due to exhaust emissions from diesel powered vehicles and equipment on site and vehicles accessing the site.

According to the EPUK Guidance (2010) a quantitative air quality assessment should be undertaken for, 'large, long term construction sites that would generate large Heavy Goods Vehicle (HGV) flows (> 200 movements per day) over a period of a year or more'. If this criterion is not exceeded then the potential effects should be considered insignificant. Taking into consideration the scale of the proposed site, it is very unlikely that the number of construction phase HGV movements will exceed the criterion. Therefore, a quantitative assessment is not required and the potential effects from vehicle emissions are considered to be insignificant.

Activities on construction sites are classified into four types to reflect their different potential effects:

- Demolition;
- Earthworks;
- Construction; and
- Track out (the transportation of dust and dirt from the construction site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network).

The following steps, as defined by the IAQM, were followed:

- STEP 1 Screen the requirement for a detailed assessment. Human and ecological receptors were identified and distance to the site and construction routes were determined;
- STEP 2 Assess the risk of dust impacts. The potential risk of dust impacts occurring for each activity was determined, based on the magnitude of the potential dust emissions and the sensitivity of the area;
- STEP 3 Identify the need for site-specific mitigation. Based on the risk of impacts occurring, site specific mitigation measures were determined; and
- STEP 4 Define impacts and their significance. The significance of the potential residual dust impacts (taking mitigation into account) for each activity was determined.

### 8.1.1 STEP 1: Screen the Requirement for a Detailed Assessment

Sensitive receptors were identified and the distance to the site and construction routes were determined according to the examples of sensitivity shown in Table 16. According to the IAQM, an assessment will normally be required where there are sensitive receptors within 350 metres (m) of the boundary of a site and/or within 50 m of route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance. A human receptor, as considered within the IAQM guidance, is any location where a person or property may experience:

- The annoyance effects of airborne dust or dust soiling e.g. dwellings, industrial or commercial premises such as a vehicle showroom, food manufacturers, electronics manufacturers, amenity areas and horticultural operations; or
- Exposure to PM<sub>10</sub> over a period relevant to the air quality objectives.

Ecological receptors within 50 m of the boundary of the site or routes used by construction vehicles on the public highway, up to 500 m from the site entrance, also need to be identified.

**Table 16. Examples of Dust Sensitive Receptors**

Receptor Sensitivity	Dust Soiling	Human Health	Ecological
High	<ul style="list-style-type: none"> <li>- Dwellings,</li> <li>- Museum and other culturally important collections,</li> <li>- Medium and long term car parks</li> <li>- Car showrooms.</li> </ul>	<ul style="list-style-type: none"> <li>- Residential properties.</li> <li>- Hospitals,</li> <li>- Schools</li> <li>- Residential care homes</li> </ul>	<ul style="list-style-type: none"> <li>- Locations with an international or national designation (e.g. SAC) and the designated features may be affected</li> </ul>

Receptor Sensitivity	Dust Soiling	Human Health	Ecological
			by dust soiling
Medium	<ul style="list-style-type: none"> <li>- Parks</li> <li>- Places of work.</li> </ul>	<ul style="list-style-type: none"> <li>- Office and shop workers, but will generally not include workers occupationally exposed to PM<sub>10</sub>, as protection is covered by Health and Safety at Work legislation.</li> </ul>	<ul style="list-style-type: none"> <li>- Locations with a national designation (e.g. SSSI) where the features may be affected by dust deposition</li> </ul>
Low	<ul style="list-style-type: none"> <li>- Playing fields</li> <li>- Farmland (unless commercially-sensitive horticultural),</li> <li>- Footpaths,</li> <li>- Short term car parks</li> <li>- Roads</li> </ul>	<ul style="list-style-type: none"> <li>- Public footpaths,</li> <li>- Playing fields,</li> <li>- Parks</li> <li>- Shopping streets.</li> </ul>	<ul style="list-style-type: none"> <li>- Locations with a local designation where the features may be affected by dust deposition local Nature Reserve with dust sensitive features.</li> </ul>

SAC: Special Area of Conservation; SSSI: Site of Special Scientific Interest

### 8.1.2 STEP 2: Assess the Risk of Dust Impacts

The risk of dust arising in sufficient quantities to cause annoyance and/or health effects was determined for each activity (demolition, earthworks, construction works and track out), taking account of:

- The scale and nature of the works, which determines the potential dust emission magnitude (small, medium or large) (Step 2A); and
- The sensitivity of the area (low, medium or high) (Step 2B).

These factors were then combined to give the risk of dust effects with no mitigation applied, as Negligible, Low, Medium or High.

It should be noted that where detailed information was not available to inform the risk category, professional judgement and experience was used and a cautious approach adopted, in accordance with the guidance.

#### 8.1.2.1 Step 2A – Define the Potential Dust Emission Magnitude

##### *Demolition*

The classifications in Table 17 are based on examples of suitable criteria, although factors such as seasonality, building type, duration and scale were also taken into consideration, where possible.

**Table 17. Potential Demolition Dust Emission Classification**

Potential Dust Emission Classes	Criteria
Large	<ul style="list-style-type: none"> <li>- Total Building Area: &gt; 50,000 m<sup>3</sup></li> <li>- Potentially dusty construction material (e.g. concrete)</li> <li>- On-site crushing and screening</li> <li>- Demolition activities: &gt; 20 m above ground level</li> </ul>
Medium	<ul style="list-style-type: none"> <li>- Total Building Area: 20,000 - 50,000 m<sup>3</sup></li> <li>- Potentially dusty construction material</li> <li>- Demolition activities: 10 - 20 m above ground level</li> </ul>
Small	<ul style="list-style-type: none"> <li>- Total Building Area: &lt; 20,000 m<sup>3</sup></li> <li>- construction material with low potential for dust release</li> <li>- Demolition activities: &lt; 10 m above ground level,</li> <li>- Demolition occurring in wetter months</li> </ul>

##### *Earthworks*

Earthworks will primarily involve excavating material, haulage, tipping and stockpiling. The classifications in Table 18 are based on examples of suitable criteria. Factors such as existing land use, topography, seasonality, duration and scale were also taken into consideration, where possible.

**Table 18. Potential Earthworks Dust Emission Classification**

Potential Dust Emission Classes	Criteria
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Potential Dust Emission Classes	Criteria
Large	<ul style="list-style-type: none"> <li>- Total site area: &gt;10,000 m<sup>2</sup></li> <li>- Potentially dusty soil type (e.g. clay)</li> <li>- &gt;10 heavy earth moving vehicle active at any one time</li> <li>- Formation of bunds &gt;8 m in height</li> <li>- Total material moved &gt;100,000 tonnes</li> </ul>
Medium	<ul style="list-style-type: none"> <li>- Total site area: 2,500 - 10,000 m<sup>2</sup></li> <li>- Moderately dusty soil type (e.g. silt)</li> <li>- 5 -10 heavy earth moving vehicle active at any one time</li> <li>- Formation of bunds 4 - 8 m in height</li> <li>- Total material moved 20,000 – 100,000 tonnes</li> </ul>
Small	<ul style="list-style-type: none"> <li>- Total site area: &lt;2,500 m<sup>2</sup></li> <li>- Soil type with large grain size (e.g. sand)</li> <li>- &lt; 5 heavy earth moving vehicle active at any one time</li> <li>- Formation of bunds &lt; 4 m in height</li> <li>- Total material moved &lt;20,000 tonnes</li> <li>- Earthworks during wetter months</li> </ul>

### Construction

The key issues when determining the potential dust emission magnitude during the construction phase include the size of the building(s)/infrastructure, method of construction, construction materials and duration of build. The classifications in Table 19 are based on examples of suitable criteria. Factors such as seasonality, building type, duration and scale were also taken into consideration, where possible.

**Table 19. Potential Construction Dust Emission Classification**

Potential Dust Emission Classes	Criteria
Large	<ul style="list-style-type: none"> <li>- Total building volume &gt;100,000m<sup>3</sup></li> <li>- Piling, on site concrete batching, sandblasting</li> </ul>
Medium	<ul style="list-style-type: none"> <li>- Total building volume 25,000 – 100,000m<sup>3</sup></li> <li>- Potentially dusty construction material (e.g. concrete)</li> <li>- On-site concrete batching</li> </ul>
Small	<ul style="list-style-type: none"> <li>- Total building volume &lt;25,000m<sup>3</sup></li> <li>- Construction material with low potential for dust release (e.g. metal cladding or timber)</li> </ul>

### Track-out

Track-out is the transport of dust and dirt from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the local road network. The classifications in Table 20 are based on examples of suitable criteria. Factors such as vehicle size, speed, numbers, geology and duration were also taken into consideration, where possible.

**Table 20. Potential Track-out Dust Emission Classification**

Potential Dust Emission Classes	Criteria
Large	<ul style="list-style-type: none"> <li>- 50 HGV (&gt;3.5t) outward movements in any one day</li> <li>- Potentially dusty surface material</li> <li>- Unpaved road length &gt; 100 m</li> </ul>
Medium	<ul style="list-style-type: none"> <li>- 10 – 50 HGV (&gt;3.5t) outward movements in any one day</li> <li>- Moderately dusty surface material</li> <li>- Unpaved road length 50 – 100 m</li> </ul>
Small	<ul style="list-style-type: none"> <li>- &lt; 10 HGV (&gt;3.5t) outward movements in any one day</li> <li>- Surface material with low potential for dust release</li> <li>- Unpaved road length &lt; 50m</li> </ul>

8.1.2.2 Step 2B – Define the Sensitivity of the Area

The sensitivity of the area takes account of the following factors:

- The specific sensitivities of receptors in the area;
- The proximity and number of those receptors;
- In the case of PM<sub>10</sub>, the local background concentrations; and
- Site specific factors, such as whether there are natural shelters, such as trees to reduce the risk of wind-blown dust.

The sensitivity of the area is determined separately for dust soiling impacts on people and properties (Table 21), human health impacts (Table 22).

**Table 21. Sensitivity of the Area to Dust Soiling Impacts on People and Property**

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		< 20	< 50	< 100	< 350
High	>100	High	High	Medium	Low
	10 – 100	High	Medium	Low	Low
	1 -10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

**Table 22. Sensitivity of the Area to Human Health Impacts**

Receptor Sensitivity	Annual Mean PM <sub>10</sub> Concentration	Number of Receptors	Distance from the Source (m)				
			< 20	< 50	< 100	< 200	< 350
High	>32 µg/m <sup>3</sup>	>100	High	High	High	Medium	Low
		10 – 100	High	High	Medium	Low	Low
		1 - 10	High	Medium	Low	Low	Low
	28 - 32 µg/m <sup>3</sup>	>100	High	High	Medium	Low	Low
		10 – 100	High	Medium	Low	Low	Low
		1 - 10	High	Medium	Low	Low	Low
	24 - 28 µg/m <sup>3</sup>	>100	High	Medium	Low	Low	Low
		10 – 100	High	Medium	Low	Low	Low
		1 - 10	Medium	Low	Low	Low	Low
	<24 µg/m <sup>3</sup>	>100	Medium	Low	Low	Low	Low
		10 – 100	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

8.1.2.3 Step 2C - Define the Risk of Impacts

The dust emission magnitude determined at Step 2A should be combined with the sensitivity of the area determined at Step 2B to determine the risk of effects with no mitigation applied (Table 23 to 26). This Step is undertaken for each activity undertaken on site.

**Table 23. Risk of Dust Impacts - Demolition**

Sensitivity of Area	Dust Emission Classification		
	Large	Medium	Small

Sensitivity of Area	Dust Emission Classification		
	Large	Medium	Small
High	High	Medium	Medium
Medium	High	Medium	Low
Low	Medium	Low	Negligible

**Table 24. Risk of Dust Impacts - Earthworks**

Sensitivity of Area	Dust Emission Classification		
	Large	Medium	Small
High	High	Medium	Low
Medium	Medium	Medium	Low
Low	Low	Low	Negligible

**Table 25. Risk of Dust Impacts - Construction**

Sensitivity of Area	Dust Emission Classification		
	Large	Medium	Small
High	High	Medium	Low
Medium	Medium	Medium	Low
Low	Low	Low	Negligible

**Table 26. Risk of Dust Impacts – Track-out**

Sensitivity of Area	Dust Emission Classification		
	Large	Medium	Small
High	High	Medium	Medium
Medium	Medium	Low	Negligible
Low	Low	Low	Negligible

### 8.1.3 STEP 3: Identify the need for Site-Specific Mitigation

Based on the risk of effects determined in Step 2C for each activity, appropriate site-specific mitigation measures were recommended. Appropriate mitigation measures are set out in the IAQM Guidance (2014) and summarised in Section 6.1.

### 8.1.4 STEP 4: Define impacts and their significance

Finally the significance of the potential residual dust impacts, i.e. after mitigation, was determined. According to the IAQM Guidance (2014) the residual impacts assumes that all mitigation measures (recommended in Step 3) to avoid or reduce impacts are adhered to, and therefore the residual impacts should be considered to be 'not significant'.

## Appendix B Model Verification

The model was verified by comparison with NO<sub>2</sub> diffusion tubes operated by Barnsley Metropolitan Borough Council (BMBC) in 2015. The model under-estimated concentrations when compared to the monitoring data and so the modelled results for NO<sub>2</sub> and PM<sub>10</sub> were adjusted in accordance with the procedure detailed in technical guidance LAQM.TG(16).

**Table 27. Comparison of Modelled and Monitored NO<sub>2</sub> Concentrations, 2015**

Monitoring Site	Monitor Type	Background NO <sub>2</sub>	Monitored Total NO <sub>X</sub>	Modelled Total NO <sub>2</sub>	% Difference [(modelled-monitored)/monitored]
DT5	DT	19.3	37.2	23.7	-36%
DT7	DT	19.3	51.4	26.0	-49%
DT8	DT	17.9	49.7	22.4	-55%
DT47	DT	17.9	27.1	21.5	-21%
DT48	DT	19.3	47.5	26.6	-44%
DT61	DT	30.7	30.8	31.4	2%
DT63	DT	21.2	36.4	25.7	-30%
DT66	DT	30.7	67.4	38.2	-43%
DT71	DT	30.7	65.0	38.4	-41%

An adjustment factors were calculated as follows:

$$\text{NO}_X \text{ [monitored, traffic contribution]} = \text{NO}_X \text{ [monitored]} - \text{NO}_X \text{ [background]}$$

$$\text{NO}_X \text{ [modelled, traffic contribution]} = \text{NO}_X \text{ [modelled]} - \text{NO}_X \text{ [background]}$$

$$\text{Adjustment Factor} = \text{NO}_X \text{ [monitored, traffic contribution]} / \text{NO}_X \text{ [modelled, traffic contribution]}$$

An adjustment factor of **4.9195** was calculated for the majority of locations. However, due to a poor correlation at site DT8 due to queuing on a steep hill a separate factor of **8.2371** was used in this location.

The adjustment factors were subsequently applied to the modelled NO<sub>X</sub> concentrations, and background NO<sub>X</sub> added to give the adjusted NO<sub>X</sub> concentrations (NO<sub>X</sub> [model adjusted]) (Table 30):

$$\text{NO}_X \text{ [model adjusted, traffic contribution]} = \text{NO}_X \text{ [modelled, traffic contribution]} \times \text{Adjustment Factor}$$

$$\text{NO}_X \text{ [model adjusted]} = \text{NO}_X \text{ [model adjusted, traffic contribution]} + \text{NO}_X \text{ [background]}$$

The adjusted NO<sub>X</sub> concentrations were then converted to NO<sub>2</sub>. using version 4.1 of the 'NO<sub>2</sub> to NO<sub>X</sub>' calculator provided by the Air Quality Archive and in accordance with the technical guidance, LAQM.TG(16).

In the absence of suitable PM<sub>10</sub> data for verification, the road-NO<sub>X</sub> adjustment factor was also applied to the modelled road-PM<sub>10</sub>. This is in accordance with LAQM.TG(16).

**Table 28. Determination of Modelled and Monitored Rd NO<sub>2</sub> and Modelled Rd NO<sub>X</sub>**

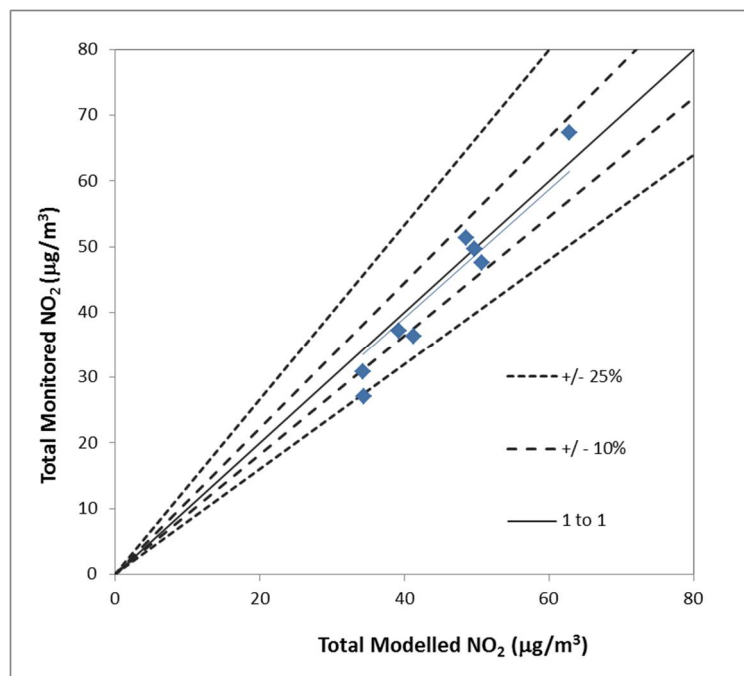
ID	Monitored Total NO <sub>2</sub>	Monitored Road NO <sub>X</sub>	Background NO <sub>2</sub>	Monitored Road Contribution NO <sub>2</sub> (total-background)	Monitored Road Contribution NO <sub>X</sub> (total-background)	Modelled Road Contribution NO <sub>X</sub> (excluding background)
DT5	37.2	38.2	19.3	17.9	38.2	8.7
DT7	51.4	74.2	19.3	32.1	74.2	13.5
DT8	49.7	72.7	17.9	31.8	72.7	8.8
DT47	27.1	18.5	17.9	9.2	18.5	7.0
DT48	47.5	63.8	19.3	28.2	63.8	14.7
DT61	30.8	0.2	30.7	0.1	0.2	1.5

ID	Monitored Total NO2	Monitored Road NOX	Background NO2	Monitored Road Contribution NO2 (total-background)	Monitored Road Contribution NOX (total-background)	Modelled Road Contribution NOX (excluding background)
DT63	36.4	32.2	21.2	15.2	32.2	8.8
DT66	67.4	92.4	30.7	36.7	92.4	16.1
DT71	65.0	85.3	30.7	34.3	85.3	16.5

**Table 29. Determination of the Adjustment Factor and Total Adjusted NO2**

ID	Adjustment Factor for Modelled Road Contribution	Adjusted Modelled Road Contribution NOX	Adjusted Modelled Total NO2	Monitored Total NO2	% Difference [(mod-mon)/mon]
DT5	4.9195	42.9	39.2	37.2	5%
DT7	4.9195	66.5	48.5	51.4	-6%
DT8	8.2371	72.7	49.7	49.7	0%
DT47	4.9195	34.5	34.4	27.1	27%
DT48	4.9195	72.2	50.7	47.5	7%
DT61	4.9195	7.5	34.3	30.8	11%
DT63	4.9195	43.5	41.2	36.4	13%
DT66	4.9195	79.0	62.9	67.4	-7%
DT71	4.9195	81.1	63.6	65.0	-2%

**Figure 1: Adjusted Modelled Versus Monitored Concentrations**



The data in Table 11: Statistical Confidence indicate the statistical confidence attributed to the model. The data show that the verification significantly improves the accuracy of the model, with a resultant RMSE of +/- 3.85 mg/m<sup>3</sup>.

**Table 30. Statistical Confidence**

	Ideal Value	Unadjusted	Adjusted
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	Ideal Value	Unadjusted	Adjusted
Correlation coefficient	1	0.71	0.99
RMSE	0	20.32	3.85
fractional bias	1	0.48	-0.03

## Appendix C Plots and Maps

Figure 2: Baseline Air Quality, 2015

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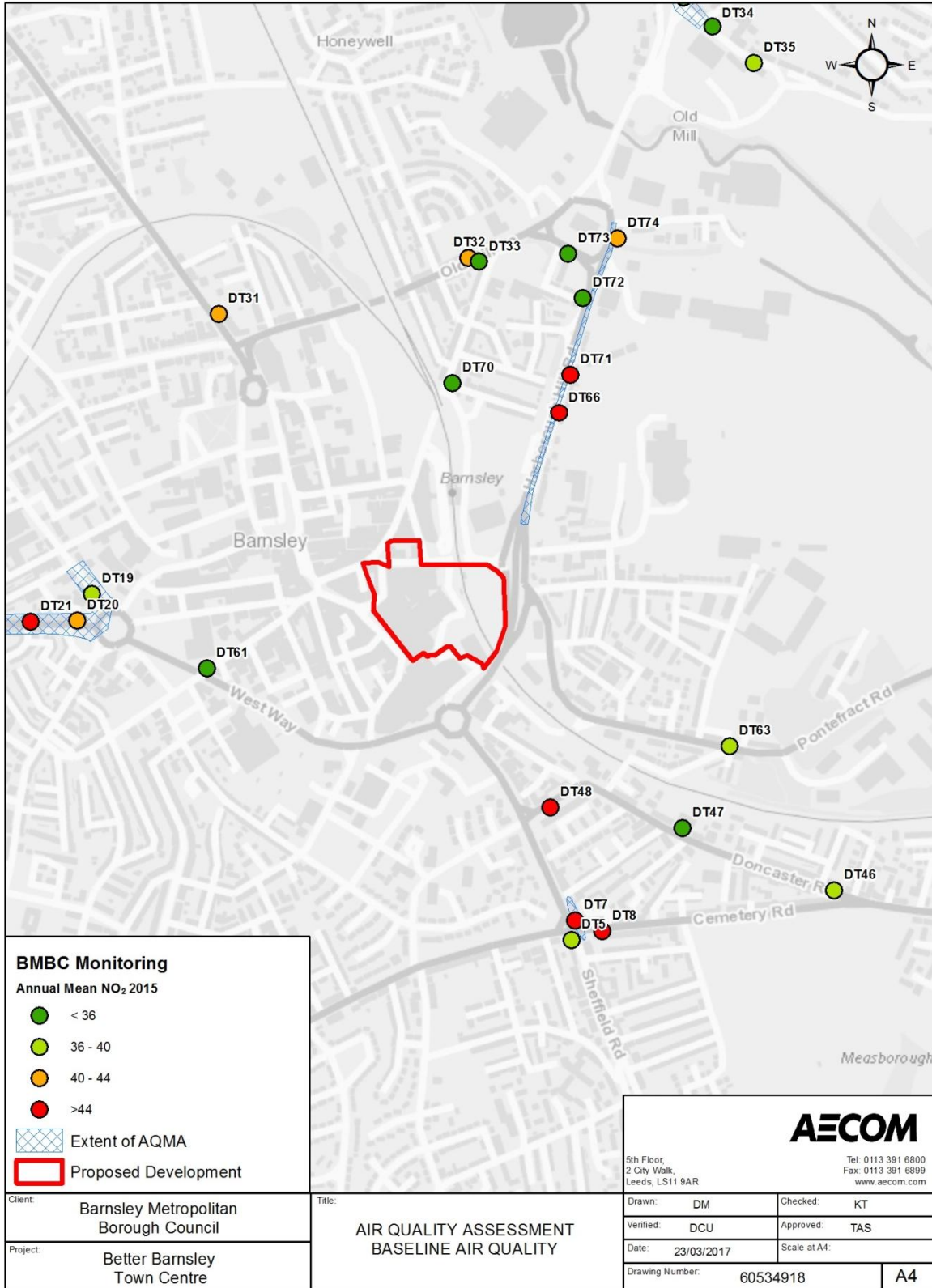


Figure 3: Predicted Change in Annual Mean NO<sub>2</sub>, Phase 1 2017

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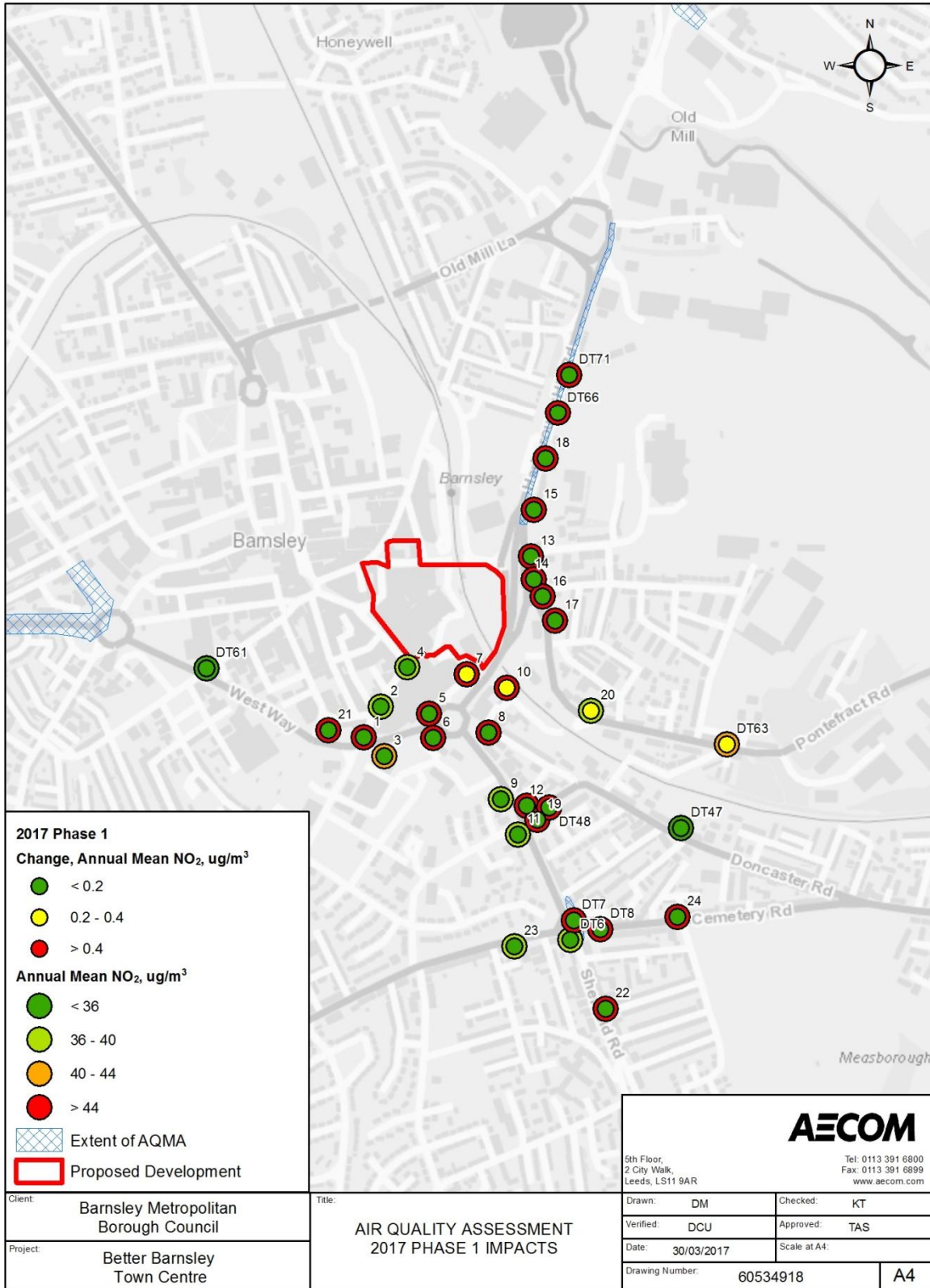
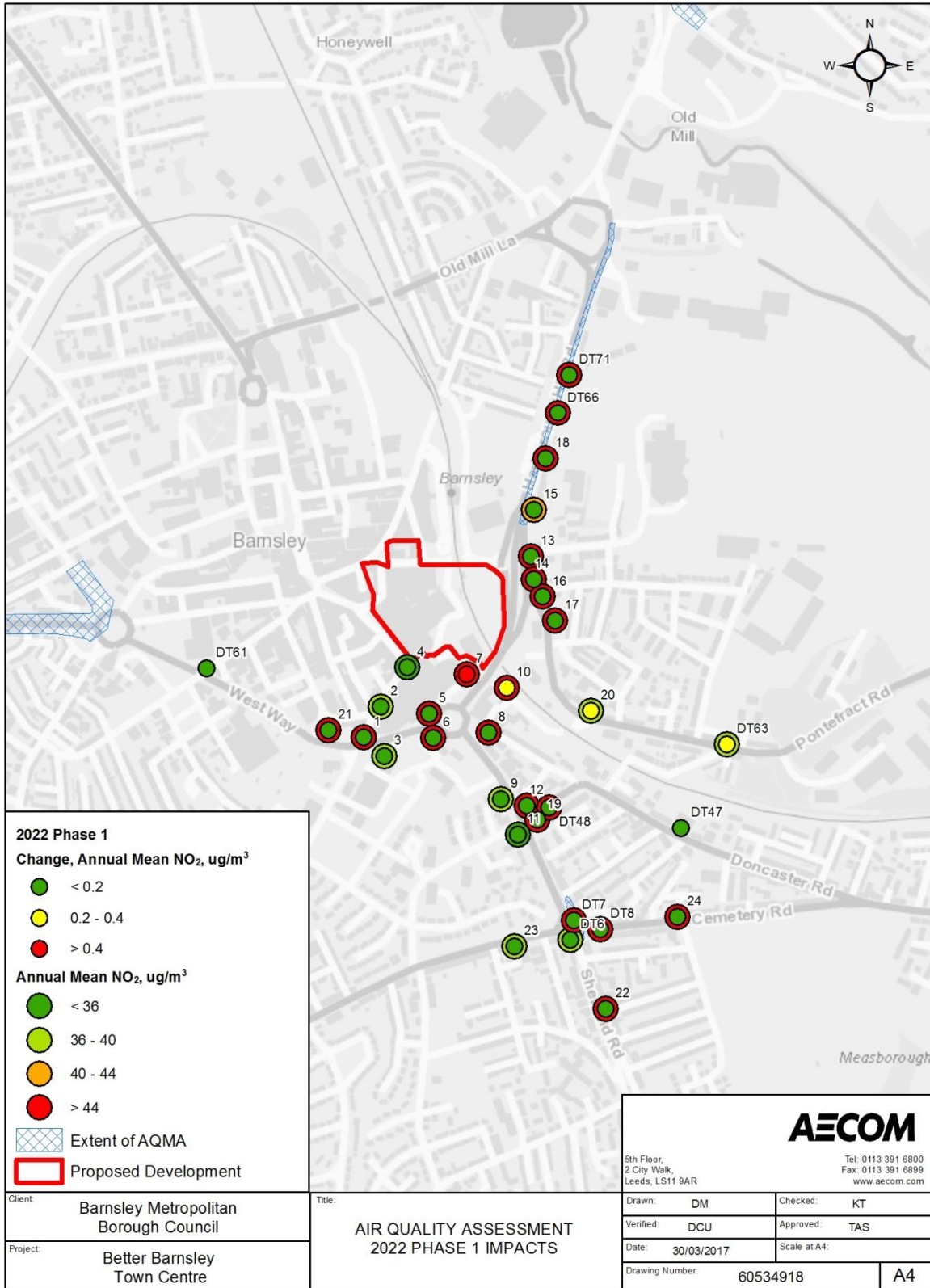


Figure 4: Predicted Change in Annual Mean NO<sub>2</sub>, Phase 1 2022

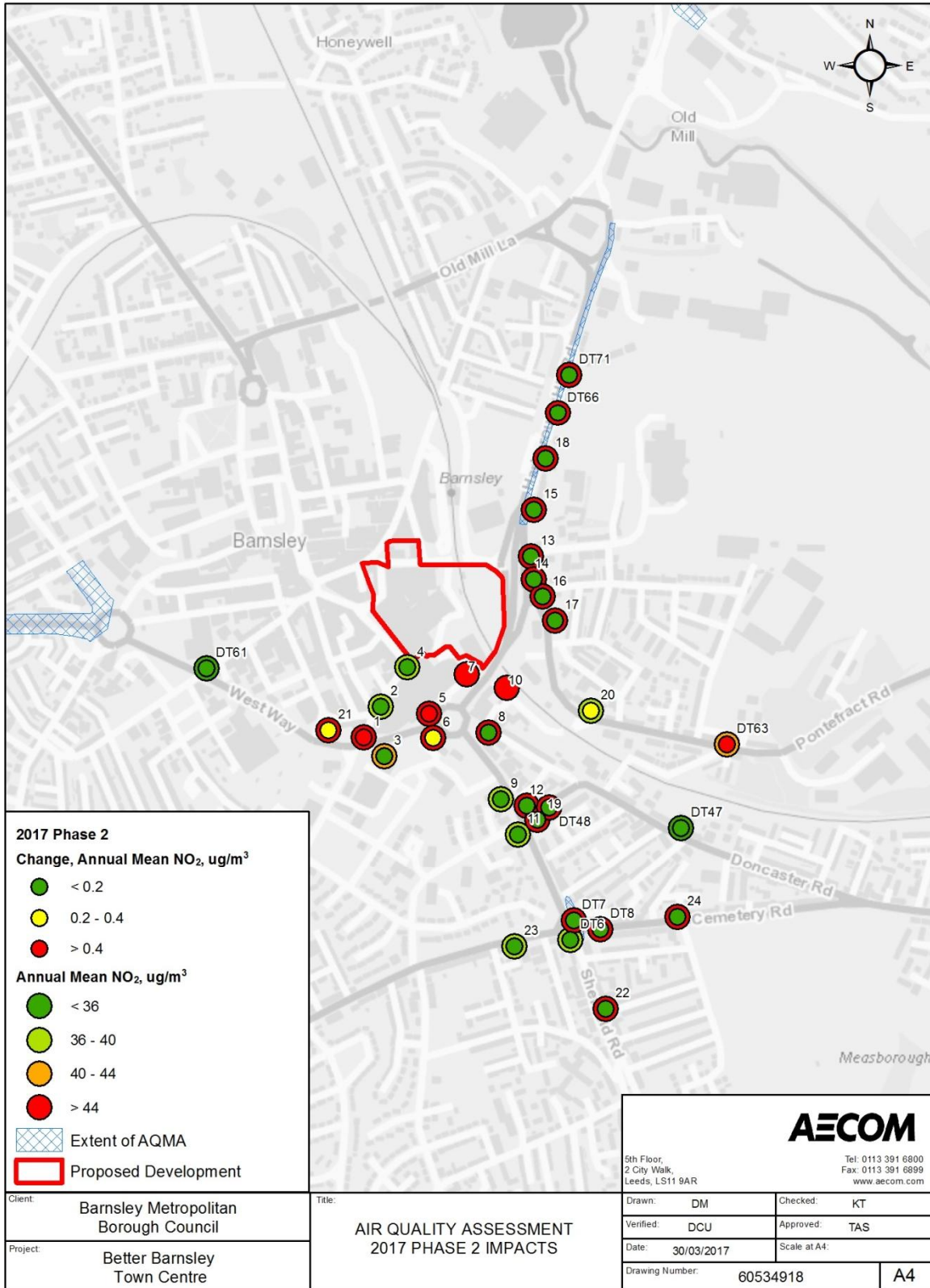
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Figure 5: Predicted Change in Annual Mean NO<sub>2</sub>, Phase 2 2017

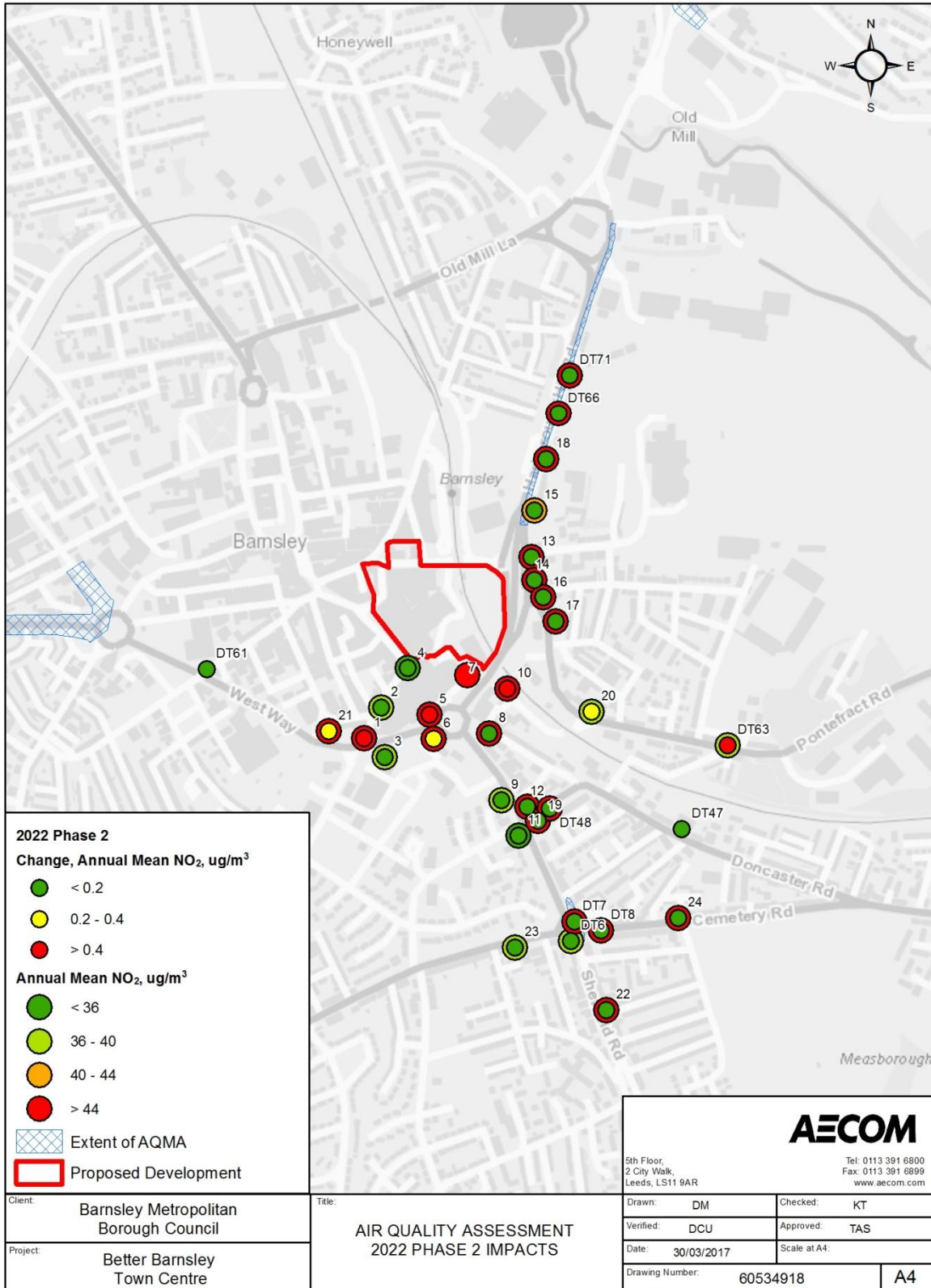
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Figure 6: Predicted Change in Annual Mean NO<sub>2</sub>, Phase 2 2022

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# Appendix D Application Boundary

Figure 7: Phase 2 Site Plan

