STROMA
BUILT ENVIRONMENT
A PHENNA GROUP COMPANY

**AIR QUALITY ASSESSMENT**

**AT: Huddersfield Bus Station**

**CLIENT: Willmott Dixon Construction**

**DATE: May 2024**

**STROMA PROJECT REF: PRO-092054**

Please find below the link to the online feedback form:

http://www.stroma.com/built-environment/feedback-sheffield/

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# 1 INTRODUCTION

## 1.1 Scope

Stroma Built Environment Ltd has been commissioned to undertake an air quality exposure assessment based on the potential impacts of existing and future traffic levels on a proposed development on adjacent to the A62. The pollutants modelled as part of this assessment are nitrogen oxides (NOx) and particulate matter ($PM_{10}$).

The impacts of vehicle emissions have been assessed using the techniques detailed within the 'LA105 Air Quality' of the Design Manual for Roads and Bridges (DMRB)[1] and the Local Air Quality Management Technical Guidance (LAQM.TG22)[2]. The impact of road traffic emissions will be assessed using the ADMS-Roads air dispersion model. This model has been devised by Cambridge Environmental Research Consultants (CERC) and is described as a "*comprehensive tool for investigating air pollution problems due to small networks of roads*".

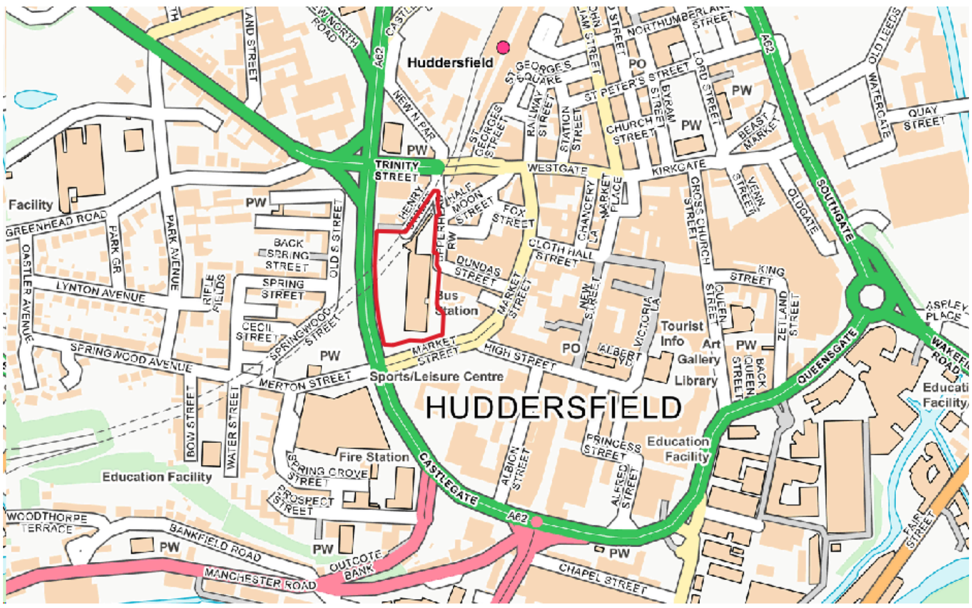
It should be noted that the short-term impacts of $NO_2$ and $PM_{10}$ emissions have not been modelled as dispersion models are inevitably poor at predicting short-term peaks in pollutant concentrations, which are highly variable from year to year, and from site to site. Notwithstanding this, general assumptions have been made about short term concentrations based on the modelled annual mean concentrations.

An assessment on the potential impact on local air quality from demolition and construction activities at the site has not been undertaken as the necessary information was unavailable at the time of reporting.

## 1.2 Site Description

The proposed development site is located at the bus station in Huddersfield, at the junction of the A62 and Market Street. The proposed development is a refurbishment of the current station. A location plan can be found in Figure 1.

**Figure 1 – Site Location Plan**

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1 Design Manual for Roads and Bridges, Sustainability & Environment Appraisal LA 105 Air Quality

2 Part IV of the Environment Act 2021, Local Air Quality Management Technical Guidance (TG22), Defra, August 2022

# 2 POLLUTANTS & LEGISLATION

## 2.1 Pollutant Overview

In most urban areas of the UK, traffic generated pollutants have become the most common pollutants. These are nitrogen dioxide ($NO_2$), fine particulates ($PM_{10}$), carbon monoxide (CO), 1,3-butadiene and benzene, as well as carbon dioxide ($CO_2$). This air quality assessment focuses on $NO_2$ and $PM_{10}$, as these pollutants are least likely to meet their Air Quality Strategy objectives near roads. Table 1 provides an overview of $NO_2$ and $PM_{10}$.

**Table 1 – Overview of $NO_2$ and $PM_{10}$**

| Pollutant | Properties | Anthropogenic Sources | Natural Sources | Potential Effects |
|---|---|---|---|---|
| **Particles ($PM_{10}$)** | Tiny particulates of solid or liquid nature suspended in the air | Road transport;<br>Power generation plants;<br>Production processes e.g. windblown dust | Soil erosion;<br>Volcanoes;<br>Forest fires;<br>Sea salt crystals | Asthma;<br>Lung cancer;<br>Cardiovascular problems |
| **Nitrogen Dioxide ($NO_2$)** | Reddish-brown coloured gas with a distinct odour | Road transport;<br>Power generation plants;<br>Fossil fuels – extraction & distribution;<br>Petroleum refining | No natural sources, although nitric oxide (NO) can form in soils | Pulmonary edema;<br>Various environmental impacts e.g. acid rain |

## 2.2 Air Quality Strategy

The UK Government and the devolved administrations published the latest Air Quality Strategy for England on 28 April 2023[3]. The Strategy provides an over-arching strategic framework for air quality management in the UK.

With regards to this assessment, the Air Quality Strategy contains national air quality standards and objectives established by the Government to protect human health. The objectives for nitrogen dioxide and particulates ($PM_{10}$ and $PM_{2.5}$) have been set, along with seven other pollutants (benzene, 1,3-butadiene, carbon monoxide, lead, PAHs, sulphur dioxide and ozone). Those which are limit values required by EU Daughter Directives on Air Quality have been transposed into UK law through the Air Quality Standards Regulations 2016 which came into force on 31st December 2016. Table 2 provides the UK Air Quality Objectives for $NO_2$ and $PM_{10}$.

[3] Air Quality Strategy: framework for local authority, 28 April 2023

**Table 2 – UK Air Quality Objectives for Nitrogen Dioxide and Particulate Matter**

| Pollutant | Objective | Concentration measured as |
|---|---|---|
| **Nitrogen Dioxide ($NO_2$)** | 200µg/m$^3$ not to be exceeded more than 18 times a year | 1 hour mean |
| | 40µg/m$^3$ | Annual mean |
| **Particles ($PM_{10}$)** | 50µg/m$^3$ not to be exceeded more than 35 times a year | 24 hour mean |
| | 40µg/m$^3$ | Annual mean |
| **Particles ($PM_{2.5}$)** | 25µg/m$^3$ (except Scotland) | Annual Mean |

Objectives for $PM_{2.5}$ were also introduced by the UK Government and the Devolved Administrations in 2010. However, these are not included in Regulations as the Air Quality Strategy has adopted an "exposure reduction" approach for $PM_{2.5}$ in order to seek a more efficient way of achieving further reductions in the health effects of air pollution by providing a driver to improve air quality everywhere in the UK rather than just in a small number of localised hotspot areas.

As defined in Table 4, background $PM_{2.5}$ concentrations are well below the limit value of 25 µg/m$^3$. As such, no further consideration has been given to $PM_{2.5}$ within this assessment.

## 2.3 Local Air Quality Management (LAQM)

At the core of LAQM delivery are three pollutant objectives; these are: nitrogen dioxide ($NO_2$), particulate matter ($PM_{10}$) and sulphur dioxide ($SO_2$). All current Air Quality Management Areas (AQMAs) across the UK are declared for one or more of these pollutants, with $NO_2$ accounting for the majority. It is a statutory requirement for local authorities to regularly review and assess air quality in their area and take action to improve air quality when objectives set out in regulation cannot be met.

### 2.3.1 Kirklees Council

Kirklees Council are a part of the West Yorkshire Low Emission Strategy (WYLES). This document was produced with the view of making tangible progress with regards to tackling air pollution across the whole region. This includes methodology on how to carry out Air Quality Impact assessments and establish mitigation measures such as potential damage costs.

# 3 PLANNING POLICY & GUIDANCE

## 3.1 National Planning Policy & Guidance

### 3.1.1 National Planning Policy Framework

On a national level, air quality can be a material consideration in planning decisions. The National Planning Policy Framework (NPPF)[4] for England, revised and released on 19th December 2023, is considered a key part of the Governments reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth. The NPPF replaces the Planning Policy Statement 23 (PPS23) Planning and Pollution Control[5].

Paragraph 180 within the NPPF states that "planning policies and decisions should contribute to and enhance the natural and local environment" and that developments "should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans"

It goes on to state in paragraph 192 that "planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan".

### 3.1.2 Planning Practise Guidance (PPG)

As defined within section 2, the UK Government has legally binding limits for concentrations of outdoor air pollutants. Development of any size can influence air quality through the construction and in use phases. The PPG for air quality outlines the considerations for developments in relation to air quality and the scenarios to be considered where appropriate.

Furthermore, the PPG outlines that any new or existing development should not adversely affect the natural environment which encompasses air quality. Where there are opportunities to improve air quality or mitigate the impact, these should be identified and considered at the "plan-making stage".

### 3.1.3 Land-Use Planning & Development Control

In January 2017, Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) produced guidance to ensure that air quality is adequately considered in the land-use planning and development control processes[6].

The guidance document is particularly applicable to assessing the effect of changes in exposure of members of the public resulting from residential and mixed-use developments, especially those within urban areas where air quality is poorer. It is also relevant to other

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[4] National Planning Policy Framework, Department for Levelling Up, Housing and Communities, December 2023

[5] Planning Policy Statement 23: Planning and Pollution Control, Office of the Deputy Prime Minister (ODPM), November 2004

[6] Land-Use Planning & Development Control: Planning for Air Quality. Guidance from Environmental Protection UK and the Institute of Air Quality Management for the consideration of air quality within the land-use planning and development control processes. EPUK & IAQM. January 2017

forms of development where a proposal could affect local air quality and for which no other guidance exists.

# 4 ASSESSMENT METHODOLOGY

## 4.1 Construction Phase

The Institute of Air Quality Management (IAQM) has published guidance on the assessment of dust from construction and demolition[7]. Based on this guidance, 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 $PM_{10}$ concentrations, as a result of dust generating activities on site; and
- An increase in concentrations or airborne particles and nitrogen dioxide due to exhaust emissions from diesel powered vehicles and equipment on site.

In relation to the most likely impacts, the guidance states the following:

"*The most common impacts are dust soiling and increased ambient $PM_{10}$ concentrations due to dust arising from activities on the site. Dust soiling will arise from the deposition of particulate matter in all size fractions.*

*Experience of assessing the exhaust emissions from on-site plant (also known as non-road mobile machinery or NRMM) and site traffic suggests that they are unlikely to make a significant impact on local air quality, and in the vast majority of cases they will not need to be quantitatively assessed*".

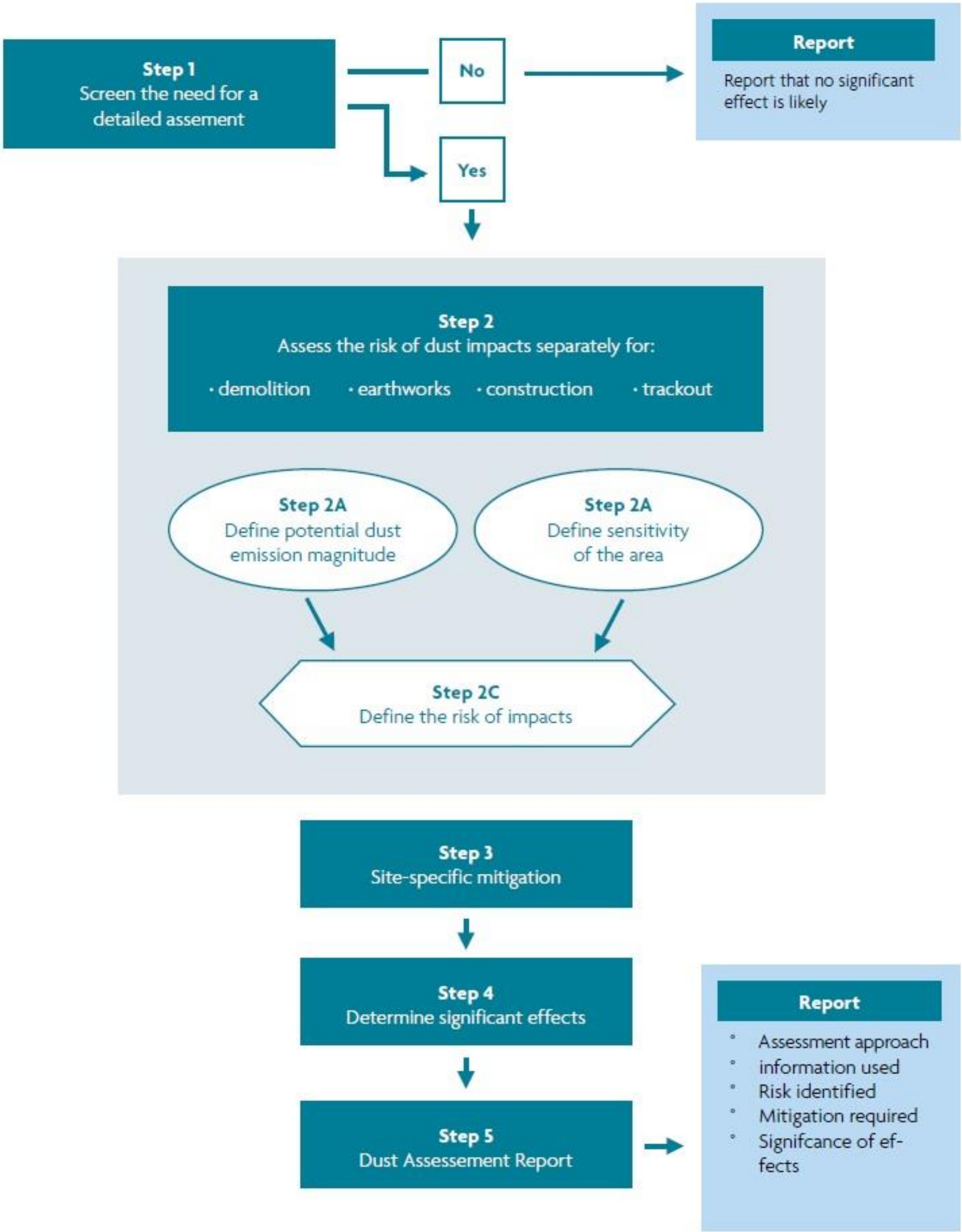
The guidance continues by providing an assessment procedure. This includes sub-dividing construction activities into four types to reflect their different potential impacts. These are as follows:

- Demolition;
- Earthworks;
- Construction; and
- Track out.

With regards to the proposed development the potential for dust emissions is assessed for each activity that is likely to take place. The assessment procedure assumes no mitigation measures are applied. The conditions with no mitigation thus form the baseline or "do-nothing" situation for a construction site. The assessment procedure uses the steps provided in the guidance and summarised in Figure 2.

[7] Guidance on the assessment of dust from demolition and construction, August 2023 (version 2.1)

## Figure 2 – Dust Assessment Procedure



## 4.2 Operational Phase (Traffic Emissions)

### 4.2.1 Modelled Scenarios

A modelled baseline year of 2019 has been used to represent current air quality conditions alongside the future year, 2026, being chosen representing the first full year with the proposed development in place. The following scenarios have been adopted as part of the assessment:

- **Scenario 1** - impact of existing emissions on the proposed development (2019).
- **Scenario 2 –** future impact of traffic emissions on the proposed development i.e. introduction of new exposure (2026).

Predicted concentrations will be compared to the Air Quality Strategy objectives. Background pollutant concentrations and vehicle emission rates for all modelled years are based on the latest data issued by Defra. These background concentrations and emission factors are discussed further in the following sections.

### 4.2.2 ADMS-Roads

Modelling the impact of traffic emissions on the proposed development will be undertaken using the latest version of the ADMS-Roads model[8]. ADMS-Roads is significantly more advanced than that of most other air dispersion models in that it incorporates the latest understanding of the boundary layer structure and goes beyond the simplistic Pasquill-Gifford stability categories method with explicit calculation of important parameters. The model uses advanced algorithms for the height-dependence of wind speed, turbulence and stability to produce improved predictions.

### 4.2.3 Emission Factors

Defra and the Devolved Administrations have provided an updated Emission Factors Toolkit (Version 12.0) which incorporates updated NOx emissions factors and vehicle fleet information[9]. These emission factors have been integrated into the latest ADMS-Roads modelling software. However, in order to undertake a worst-case assessment emission factors for 2019 have been used for all modelled years.

### 4.2.4 Traffic Data

Traffic flow data has been provided by the transport consultant and the DfT website. Projection of traffic data has been undertaken using growth factors specific to Huddersfield and Kirklees Council, obtained from TEMPro. The projected flow rates are provided in Table 3. It is assumed that the percentage HDV and speed will remain unchanged in future years. For the modelled speeds, the figures provided above have been used. However, where a link approaches a junction a speed of 20 kmph has been modelled in order to represent queuing traffic at a junction. This is the approach recommended by the Local Air Quality Management Technical Guidance (LAQM.TG22) for modelling queuing traffic at junctions by way of reducing the modelled vehicle speeds.

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8 Model Version: 4.1.1.0. Interface Version 4.1.1 (18/01/2018)

9 https://laqm.defra.gov.uk/documents/EFT2019_v12.0.xlsb

**Table 3 – Annual Average Daily Traffic Flows, Percentage HDV and Speeds for Modelled Roads**

| Link Name | AADT 2019 | AADT 2026 | HDV (%) | Speed (kmph) |
|---|---|---|---|---|
| **A62** | 38,185 | 40,811 | 4.04 | 48 |
| **A640** | 12,422 | 13,226 | 3.46 | 48 |
| **A629** | 17,765 | 18,914 | 4.99 | 48 |

## 4.3 Background Concentrations

Background NOx, $NO_2$ and $PM_{10}$ concentrations have been obtained from Defra[10]. These 1 km x 1 km grid resolution maps are derived from a base year of 2018 (for NOx, $NO_2$, $PM_{10}$ and $PM_{2.5}$ only), which are then projected to future years up to 2030. Background concentrations of $NO_2$, $PM_{10}$ and $PM_{2.5}$ derived from Defra are provided in Table 4.

**Table 4 – Background NOx, $NO_2$, $PM_{10}$ and $PM_{2.5}$ Concentrations**

| Location | Pollutant | X | Y | 2019 |
|---|---|---|---|---|
| **Proposed Development** | $NO_2$ | 414500 | 416500 | 21.6 |
| | NOx | | | 31.8 |
| | $PM_{10}$ | | | 12.3 |
| | $PM_{2.5}$ | | | 8.4 |

## 4.4 Surface Roughness

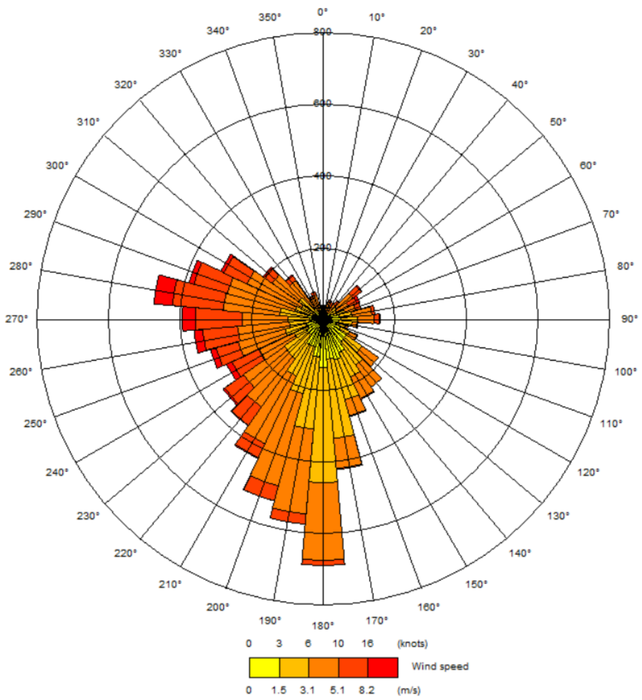
A surface roughness of 1.5 metre has been used in the model. This value is provided by ADMS-Roads as a typical roughness length for large urban areas. This value has been used across the modelled domain.

## 4.5 Meteorological Data

Hourly sequential meteorological data from the Leeds Bradford Airport meteorological station has been used. Wind speed and direction data from the Leeds Bradford Airport meteorological station has been plotted as a wind rose in Figure 3.

[10] http://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018

**Figure 3 – Wind Speed and Direction Data, Leeds Bradford Airport**




## 4.6 Model Output

### 4.6.1 NOx/$NO_2$ Relationship

Following recent evidence that shows the proportion of primary $NO_2$ in vehicle exhaust has increased[11]. As such, a new NOx to $NO_2$ calculator has been devised[12]. This new calculator has been used to determine $NO_2$ concentrations for this assessment, based on predicted NOx concentrations using ADMS-Roads. Converted $NO_2$ concentrations are initially compared to local monitoring data in order to verify the model output. If the model performance is considered unacceptable then the NOx concentrations are adjusted before conversion to $NO_2$.

### 4.6.2 Predicted Short Term Concentrations

As discussed in the introduction, it has not been possible to model the short-term impacts of $NO_2$ and $PM_{10}$. Research undertaken in 2003[13] has indicated that the hourly $NO_2$ objective is unlikely to be exceeded at a roadside location where the annual mean $NO_2$ concentration is less than 60 µg/m$^3$.

For $PM_{10}$, a relationship between the annual mean and the number of 24-hour mean exceedances has been devised and is as follows:

- No. 24-hour mean exceedances = -18.5 + 0.00145 x annual mean$^3$ + (206/annual mean)

This relationship has been applied to the modelled annual mean concentrations in order to estimate the number of 24-hourly exceedances.

11 Trends in Primary Nitrogen Dioxide in the UK, Air Quality Expert Group, 2007

12 https://laqm.defra.gov.uk/documents/NOx_to_NO2_Calculator_v8.1.xlsm

13 Analysis of Relationship between 1-Hour and Annual Mean Nitrogen Dioxide at UK Roadside and Kerbside Monitoring Sites, Laxen and Marner, 2003

### 4.6.3 Receptor Locations

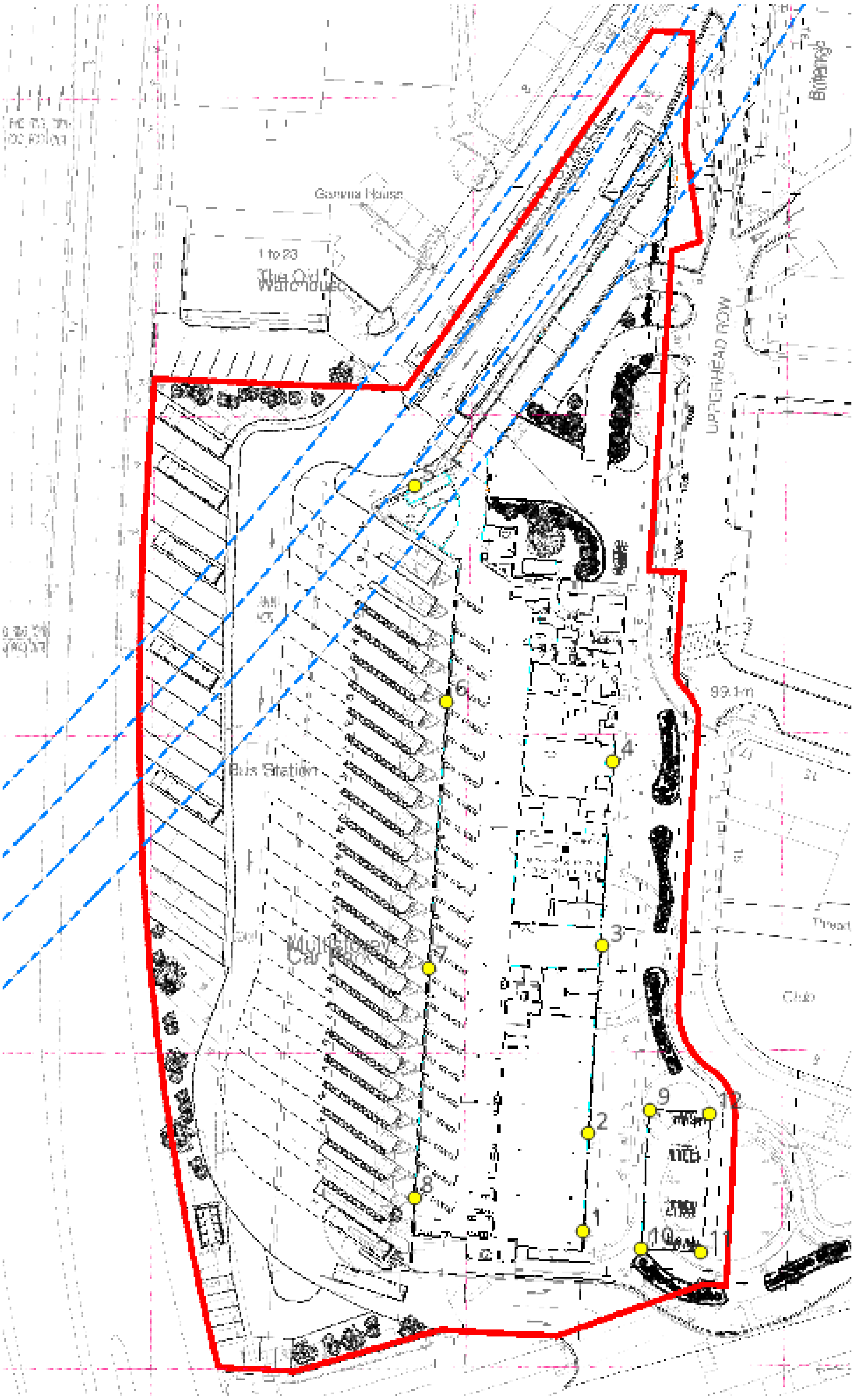
In order to assess the potential impact of the proposed development, selected proposed buildings have been modelled.

The location of these model points, together with their height above ground level is provided in Table 5 and represented in Figure 4.

**Table 5 – Modelled Receptor Locations**

| Air Quality Assessment ID | X | Y | Height (m) |
|---|---|---|---|
| **D1** | 414219 | 416522 | 1.5 |
| **D2** | 414220 | 416537 | 1.5 |
| **D3** | 414222 | 416567 | 1.5 |
| **D4** | 414224 | 416596 | 1.5 |
| **D5** | 414192 | 416639 | 1.5 |
| **D6** | 414197 | 416605 | 1.5 |
| **D7** | 414194 | 416563 | 1.5 |
| **D8** | 414192 | 416527 | 1.5 |
| **D9** | 414229 | 416541 | 1.5 |
| **D10** | 414228 | 416519 | 1.5 |
| **D11** | 414237 | 416518 | 1.5 |
| **D12** | 414239 | 416540 | 1.5 |

## Figure 4 – Modelled receptor points



## 4.7 Significance Criteria

### 4.7.1 Construction Phase

The risk of dust arising in sufficient quantities to cause annoyance and/or health and/or ecological impacts should be determined using four risk categories: negligible, low, medium and high risk. A development is allocated to a risk category based on two factors:

- the scale and nature of the works, which determines the potential dust emission magnitude as small, medium or large (see Table 6); and
- the sensitivity of the area to dust impacts, which is defined as low, medium or high sensitivity.

These two factors are combined to determine the risk of dust impacts with no mitigation applied (see Table 7). The risk category assigned to the development can be different for each of the four potential activities (demolition, earthworks, construction and trackout).

**Table 6 – Dust Emission Magnitude**

| Activity | Dust Emission Class | | |
|---|---|---|---|
| | **Large** | **Medium** | **Small** |
| **Demolition** | Total building volume >75,000 $m^3$, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >12 m above ground level | Total building volume 12,000 – 75,000$m^3$, potentially dusty construction material, demolition activities 6-12 m above ground level | Total building volume <12,000 $m^3$, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <6m above ground, demolition during wetter months |
| **Earthworks** | Total site area >110,000 $m^2$, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >6 m in height | Total site area 18,000 – 110,000 $m^2$, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 3 m - 6 m in height | Total site area <18,000 $m^2$, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4 m in height |
| **Construction** | Total building volume >75,000 $m^3$, piling, on site concrete batching; sandblasting | Total building volume 12,000 $m^3$ – 75,000 $m^3$, potentially dusty construction material (e.g. concrete), piling, on site concrete batching | Total building volume <12,000 $m^3$, construction material with low potential for dust release (e.g. metal cladding or timber) |
| **Track out** | >50 HDV (>3.5t) trips in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m | 20 – 50 HDV (>3.5t) trips in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50m – 100 m; | <20 HDV (>3.5t) trips in any one day, surface material with low potential for dust release, unpaved road length <50 m. |

**Table 7 – Risk of Dust Impacts**

| Construction Activity | Sensitivity of Area | Dust Emission Magnitude | | |
|---|---|---|---|---|
| | | Large | Medium | Small |
| **Demolition** | High | High Risk | Medium Risk | Medium Risk |
| | Medium | High Risk | Medium Risk | Low Risk |
| | Low | Medium Risk | Low Risk | Negligible |
| **Earthworks** | High | High Risk | Medium Risk | Low Risk |
| | Medium | Medium Risk | Medium Risk | Low Risk |
| | Low | Low Risk | Low Risk | Negligible |
| **Construction** | High | High Risk | Medium Risk | Low Risk |
| | Medium | Medium Risk | Medium Risk | Low Risk |
| | Low | Low Risk | Low Risk | Negligible |
| **Track out** | High | High Risk | Low Risk | Low Risk |
| | Medium | Medium Risk | Low Risk | Negligible |
| | Low | Low Risk | Low Risk | Negligible |

### 4.7.2 Operational Phase

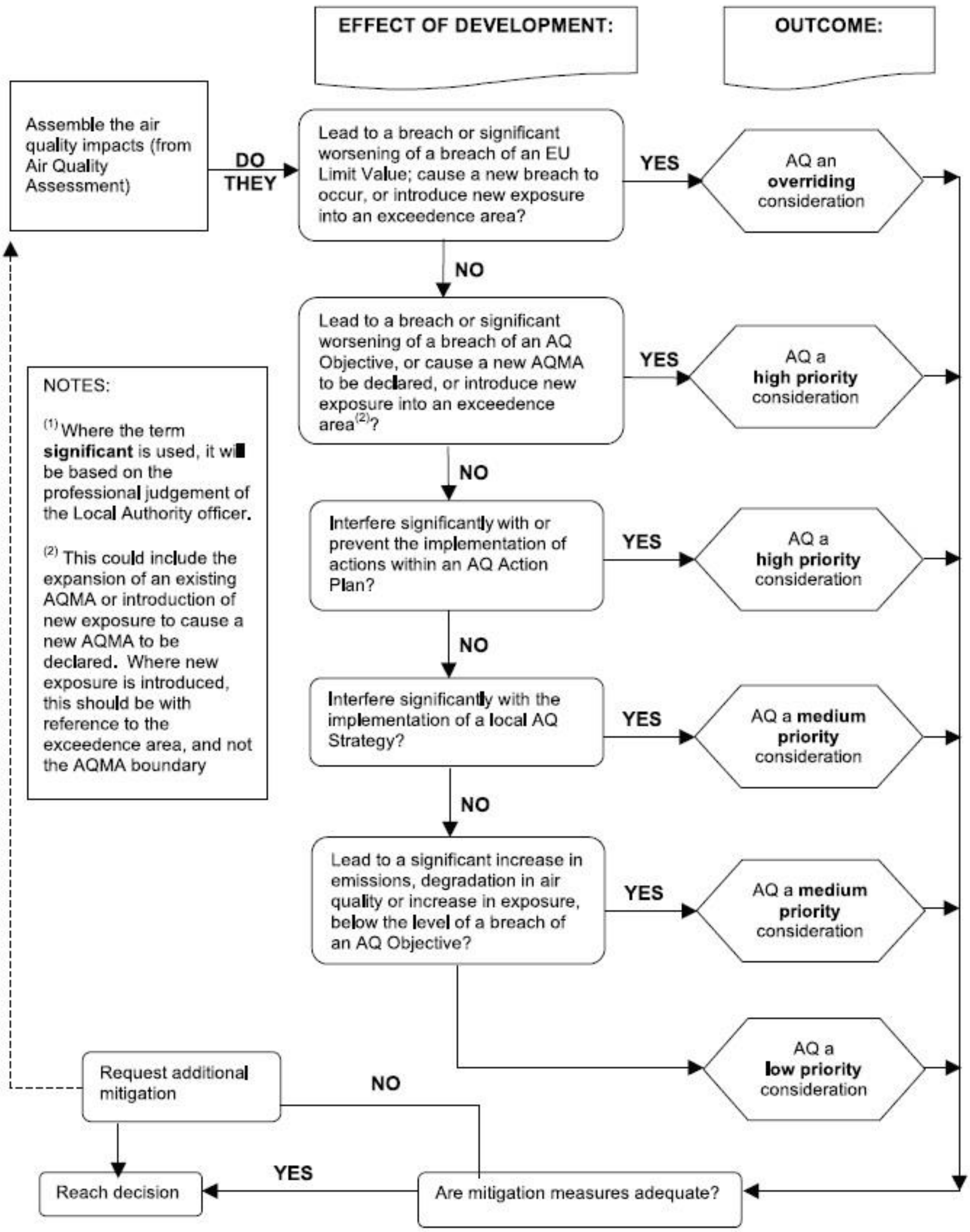
The significance of emissions will be determined by comparing the predicted results to the Air Pollution Exposure Criteria (APEC) detailed in the Air Quality and Planning Guidance written by the London Air Pollution Planning and the Local Environment (APPLE) working group[14]. The Air Pollution Exposure Criteria is considered appropriate to describe the significance of the impacts predicted, together with an indication as to the level of mitigation required in order for the development to be approved. The APEC Table 8 is provided below.

**Table 8 – Modelled Air Pollution Exposure Criteria (APEC)**

| APEC Category | $NO_2$ | $PM_{10}$ | Recommendations |
|---|---|---|---|
| **A** | >5% below national annual mean objective | >5% below national annual mean objective<br>>1-day less than national 24-hour objective | No air quality grounds for refusal; however mitigation of any emissions should be considered. |
| **B** | Between 5% below or above national annual mean objective | Between 5% above or below national annual mean objective<br>Between 1-day above or below national 24-hour objective | May not be sufficient air quality grounds for refusal, however appropriate mitigation must be considered |
| **C** | >5% above national annual mean objective | >5% above national annual mean objective<br>>1-day more than national 24-hour objective | Refusal on air quality grounds should be anticipated, unless the Local Authority has a specific policy enabling such land use and ensure best endeavours to reduce exposure are incorporated |

[14] Air Quality and Planning Guidance, written by the London Air Pollution Planning and the Local Environment (APPLE) working group, January 2007

## Figure 5 – Flowchart for Air Quality Management



# 5 AIR QUALITY ASSESSMENT

## 5.1 Impact from Construction Activities

The assessment of construction activities has focused on demolition, earthworks, construction and track out activities at the site. Using the criteria provided in Table 6 the dust emission magnitude for each activity is as follows:

- Demolition = Small;
- Earthworks = Small;
- Construction = Small; and
- Track out = Small.

Based on the IAQM guidance the sensitivity of the surrounding area is summarised in Table 9.

**Table 9 – Modelled Sensitivity of the Surrounding Area**

| Potential Impact | Sensitivity of the Surrounding Area | | | |
|---|---|---|---|---|
| | Demolition | Earthworks | Construction | Trackout |
| **Dust Soiling** | Medium | Medium | Medium | Medium |
| **Human Health** | Low | Low | Low | Low |

The dust emission magnitudes and sensitivity of the surrounding area are combined to determine the risk of dust impacts with no mitigation applied. These are summarised in Table 10.

**Table 10 – Summary of Dust Risk**

| Potential Impact | Risk | | | |
|---|---|---|---|---|
| | Demolition | Earthworks | Construction | Trackout |
| **Dust Soiling** | Low | Low | Low | Low |
| **Human Health** | Negligible | Negligible | Negligible | Negligible |

It should also be noted that the likelihood of an adverse impact occurring is correlated to wind speed and wind direction. As such, unfavourable wind speeds and wind directions must occur at the same time as a dust generating activity in order to generate an adverse impact. The overall impacts also assume that the dust generating activities are occurring over the entirety of the site meaning that as an activity moves further away from a potential receptor the magnitude and significance of the impact will be further reduced.

## 5.2 Impact of Vehicle Emissions

### 5.2.1 Model Verification

Using the guidance provided within the Local Air Quality Management Technical Guidance TG(22), the modelled output has been verified against the monitoring data obtained from the site listed in Table 11. The following tables provide a summary of the model verification process for $NOx/NO_2$ and $PM_{10}$ concentrations.

**Table 11 – Comparison of Modelled and Monitored $NO_2$ Concentrations ($\mu g/m^3$)**

| Verification Location | Modelled Concentration | Monitored Concentration | Difference [(modelled - monitored)/ monitored] x100 |
|---|---|---|---|
| **K3** | 23.3 | 42.7 | -45.5% |
| **K8** | 25.1 | 36.0 | -30.4% |
| **K11** | 29.2 | 35.0 | -16.5% |
| **K28** | 28.3 | 46.4 | -38.9% |
| **K31** | 22.6 | 30.5 | -25.8% |
| **K45** | 23.6 | 36.4 | -35.2% |
| **K56** | 24.9 | 34.9 | -28.6% |
| **K86** | 23.8 | 29.1 | -18.2% |

As described in the Technical Guidance (LAQM.TG22), in order to provide more confidence in the model predictions and the decisions based on these, the majority of results should be within ±25% (ideally ±10%) of the monitored concentrations. In order to improve the confidence in modelled concentrations across the modelled domain the model output has been adjusted. This is described further in the next section.

### 5.2.2 Model Adjustment

In order to undertake model adjustment, it is first necessary to derive the monitored and modelled road contributions of NOx (excluding background). The modelled road contribution NOx is taken directly from the ADMS-Roads output before it has been converted to $NO_2$ using the NOx to $NO_2$ calculator described in Section 4.6.1. The NOx to $NO_2$ calculator can also be used to derive monitored road contributions of NOx from $NO_2$ diffusion tube results. A summary of these calculations is provided in Table 12.

**Table 12 – Monitored NOx and $NO_2$ concentrations**

| Verification Location | Monitored Total $NO_2$ | Defra Background $NO_2$ | Monitored road contribution $NO_2$ (total – background) | Monitored road contribution NOx (total – background) | Modelled road contribution NOx (excludes background) | Ratio of monitored road contribution NOx / modelled road contribution NOx |
|---|---|---|---|---|---|---|
| K3 | 42.7 | 14.8 | 27.9 | 59.1 | 16.2 | 3.64 |
| K8 | 36.0 | 19.7 | 16.3 | 33.3 | 10.3 | 3.22 |
| K11 | 35.0 | 21.6 | 13.4 | 27.2 | 15.0 | 1.81 |
| K28 | 46.4 | 21.6 | 24.8 | 53.5 | 13.3 | 4.03 |
| K31 | 30.5 | 14.8 | 15.6 | 31.2 | 15.0 | 2.09 |
| K45 | 36.4 | 19.7 | 16.7 | 34.3 | 7.5 | 4.60 |
| K56 | 34.9 | 18.6 | 16.3 | 33.1 | 12.2 | 2.72 |
| K86 | 29.1 | 18.6 | 10.5 | 20.7 | 10.0 | 2.07 |

Once the monitored and modelled road contributions of NOx (excluding background) have been derived the contributions of NOx are compared and a ratio derived. In this case it is 2.890 and is used to adjust the modelled road contribution of NOx. This is shown in Table 13.

**Figure 6 – Linear Regression of Modelled and Monitored $NO_2$**

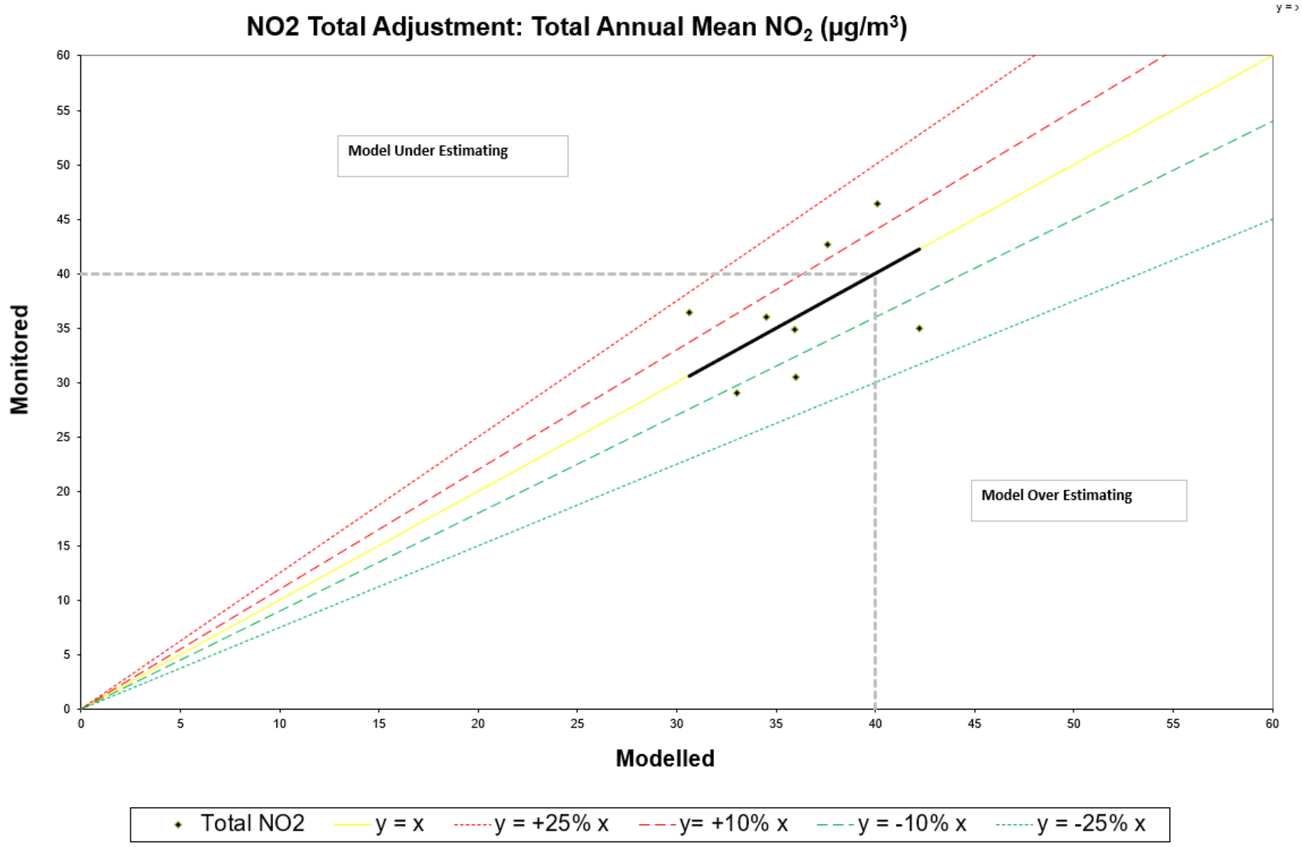



**Table 13 – Adjustment of Modelled NOx Contributions**

| Verification Location | Adjustment factor for modelled road contribution | Adjusted modelled road contribution NOx | Modelled total $NO_2$ (based on empirical NOx/$NO_2$ relationship) | Monitored total $NO_2$ | % Difference [(modelled – monitored) / monitored] x 100 |
|---|---|---|---|---|---|
| **K3** | **2.890** | 46.9 | 37.5 | 42.7 | -12.1% |
| **K8** | **2.890** | 29.9 | 34.4 | 36.0 | -4.4% |
| **K11** | **2.890** | 43.4 | 42.1 | 35.0 | 20.5% |
| **K28** | **2.890** | 38.4 | 40.0 | 46.4 | -13.8% |
| **K31** | **2.890** | 43.2 | 35.9 | 30.5 | 17.9% |
| **K45** | **2.890** | 21.5 | 30.5 | 36.4 | -16.2% |
| **K56** | **2.890** | 35.2 | 35.8 | 34.9 | 2.8% |
| **K86** | **2.890** | 28.8 | 32.9 | 29.1 | 13.2% |

Following adjustment of the modelled NOx concentrations by a factor of 2.890 the total $NO_2$ concentration at the model verification location has been calculated using the method described in Section 4.6.1. The revised $NO_2$ concentration, shown in Table 13, indicates a more acceptable model performance when compared against the monitored $NO_2$ concentrations. As such, an adjustment factor of 2.890 has been applied to all modelled NOx concentrations across the model domain before conversion to $NO_2$.

### 5.2.3 Nitrogen Dioxide

Predicted annual mean concentrations for $NO_2$ at the proposed development in 2019 and 2026 are provided in Table 14. As mentioned in Section 4.6.1, $NO_2$ concentrations have been calculated from the predicted NOx concentrations using the latest NOx-$NO_2$ conversion spreadsheet available from the Air Quality Archive.

**Table 14 – Predicted Annual Mean $NO_2$ Concentrations (µg/m³)**

| Receptor ID | 2019 | 2026 |
|---|---|---|
| **D1** | 27.7 | 28.2 |
| **D2** | 27.4 | 27.9 |
| **D3** | 27.0 | 27.4 |
| **D4** | 26.8 | 27.2 |
| **D5** | 29.5 | 30.1 |
| **D6** | 28.8 | 29.4 |
| **D7** | 29.3 | 29.9 |
| **D8** | 30.4 | 31.1 |
| **D9** | 26.8 | 27.2 |
| **D10** | 27.2 | 27.6 |
| **D11** | 26.6 | 27.1 |
| **D12** | 26.3 | 26.7 |
| **Objective** | **40** | |

The ADMS predictions for annual mean $NO_2$ concentrations in 2019 and 2026 indicate that the annual mean objective (40 µg/m³) would be achieved at the modelled receptor location.

Nitrogen dioxide also has an hourly objective of 200 µg/m³ not to be exceeded more than 18 times in one year. However, the hourly mean concentration has not been calculated directly by ADMS Roads. This is as a result of an evaluation of continuous monitoring data from across the UK that revealed that the relationship between the annual mean and hourly mean $NO_2$ concentrations was very weak. Nonetheless, research undertaken in 2003[15] has indicated that the hourly $NO_2$ objective is unlikely to be exceeded at a roadside location where the annual mean $NO_2$ concentration is less than 60 µg/m³. Given that predicted $NO_2$ concentrations in 2019 and 2026 are well below 60 µg/m³ at the modelled receptor the likelihood of the short-term objective for $NO_2$ being exceeded is considered low.

[15] Analysis of Relationship between 1-Hour and Annual Mean Nitrogen Dioxide at UK Roadside and Kerbside Monitoring Sites, Laxen and Marner, 2003

### 5.2.4 Particulate Matter

Predicted annual mean concentrations for $PM_{10}$ are provided in Table 15.

**Table 15 – Predicted $PM_{10}$ Concentrations, Annual Mean (µg/$m^3$)**

| Receptor ID | 2019 | 2026 |
|---|---|---|
| **D1** | 14.0 | 14.1 |
| **D2** | 13.9 | 14.0 |
| **D3** | 13.8 | 13.9 |
| **D4** | 13.8 | 13.9 |
| **D5** | 14.4 | 14.5 |
| **D6** | 14.2 | 14.3 |
| **D7** | 14.3 | 14.5 |
| **D8** | 14.6 | 14.7 |
| **D9** | 13.8 | 13.9 |
| **D10** | 13.8 | 13.9 |
| **D11** | 13.7 | 13.8 |
| **D12** | 13.7 | 13.7 |
| **Objective** | **40** | |

The ADMS predictions for annual mean $PM_{10}$ concentrations in 2019 and 2026 indicate that the annual mean objective (40 µg/$m^3$) would be achieved at all the modelled receptor locations. In addition, the maximum number of days when $PM_{10}$ concentrations are more than 50 µg/$m^3$ is 1, less than the 35 exceedances allowed in the regulations.

# 6 CONCLUSIONS AND RECOMMENDATIONS

## 6.1 Impact from Construction Activities

A qualitative assessment of dust levels associated with the proposed development has been carried out. The impact of dust soiling and $PM_{10}$ can be reduced to negligible through suggested appropriate mitigation measures, which are listed in Table 13 and are applicable to a low risk site. Implementation of these Best Practice Measures will help reduce the impact of the construction activities.

With these mitigation measures enforced, the likelihood of nuisance dust episodes occurring at those receptors adjacent to the development are considered low to negligible. Notwithstanding this, the developer should take into account the potential impact of air quality and dust on occupational exposure standards (in order to minimise worker exposure) and breaches of air quality objectives that may occur outside the site boundary. Monitoring is not recommended at this stage, however, continuous visual assessment of the site should be undertaken and a complaints log maintained in order to determine the origin of a particular dust nuisance. Keeping an accurate and up to date complaints log will isolate particular site activities to a nuisance dust episode and help prevent it from reoccurring in the future.

## Table 16 – Mitigation of Construction Activities

| Construction Activity | Mitigation Measures |
|---|---|
| **Communications** | Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager. |
| | Display the head or regional office contact information. |
| **Site Management** | 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. |
| | Make a complaints log available to the local authority when asked. |
| | Record any exceptional incidents that cause dust and air quality pollutant emissions, either on or off the site, and the action taken to resolve the situation is recorded in the log book. |
| **Monitoring** | Carry out regular site inspections to monitor compliance with air quality and dust control procedures, record inspection results, and make an inspection log available to the local authority when asked. |
| | Increase the frequency of site inspections by those accountable for dust and air quality pollutant emissions issues when activities with a high potential to produce dust and emissions and dust are being carried out, and during prolonged dry or windy conditions. |
| | Agree dust deposition, dust flux, or real time $PM_{10}$ continuous monitoring locations with he local authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it is a large site, before work on a phase commences. |
| **Preparing and maintaining the site** | Plan site layout: machinery and dust causing activities should be located away from receptors. |
| | Erect solid screens or barriers around dust activities or the site boundary that are, at least, as high as any stockpiles on site. |
| | Fully enclose site or specific operations where there is a high potential for dust production and the site is actives for an extensive period |
| | Avoid site runoff of water or mud. |
| | Keep site fencing, barriers and scaffolding clean using wet methods |
| | Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below. |
| | Cover, seed or fence stockpiles to prevent wind whipping |
| **Operating Vehicle/Machinery and Sustainable Travel** | Ensure all vehicles switch off engines when stationary – no idling vehicles. |
| | Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where possible. |
| **Operations** | Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems. |
| | Ensure an adequate water supply on the site for effective dust/particulate matter mitigation (using recycled water where possible). |
| | Use enclosed chutes, conveyors and covered skips. |
| | Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate |
| **Waste Management** | Reuse and recycle waste to reduce dust from waste materials |
| | Avoid bonfires and burning of waste materials. |
| **Demolition** | Ensure water suppression is used during demolition operations |
| | Avoid explosive blasting, using appropriate manual or mechanical alternatives |
| | Bag and remove any biological debris or damp down such material before demolition |
| **Earthworks** | N/A |
| **Construction** | 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 |
| | For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust |
| **Trackout** | Regularly use a water-assisted dust sweeper on the access and local roads, as necessary, to remove any material tracked out of the site |

| | |
|---|---|
| | Avoid dry sweeping of large areas |
| | Ensure vehicles entering and leaving sites are securely covered to prevent escape of material during transport |
| | Record all inspections of haul routes and any subsequent action in a site log book |
| | Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable) |
| | Apply dust suppressants to locations where a large volume of vehicles enter and exit the construction site |

## 6.2 Impact of Vehicle Emissions

In terms of introducing new exposure, all predicted $NO_2$ and $PM_{10}$ concentrations at the modelled receptor locations are below the relevant air quality objectives and fall within APEC Category A, which states that there are “No air quality grounds for refusal; however, mitigation of any emissions should be considered”. Using the flow chart presented in Figure 5, air quality is a low priority consideration with regards to the impact of the proposed development.