

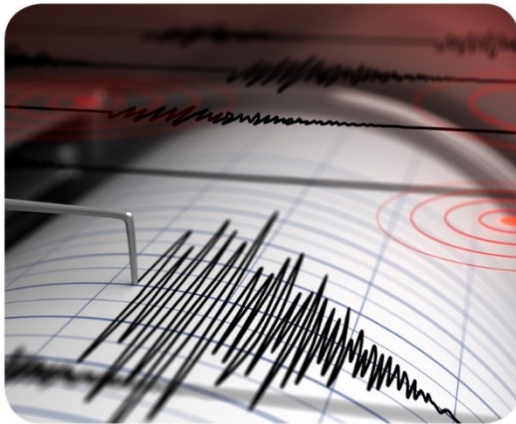


Knowsley Redevelopments Limited

Penrhyn Road, Knowsley Business Park

Air Quality Assessment

January 2022



Knowsley Redevelopments Limited

Penrhyn Road, Knowsley Business Park

Air Quality Assessment

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1 Introduction

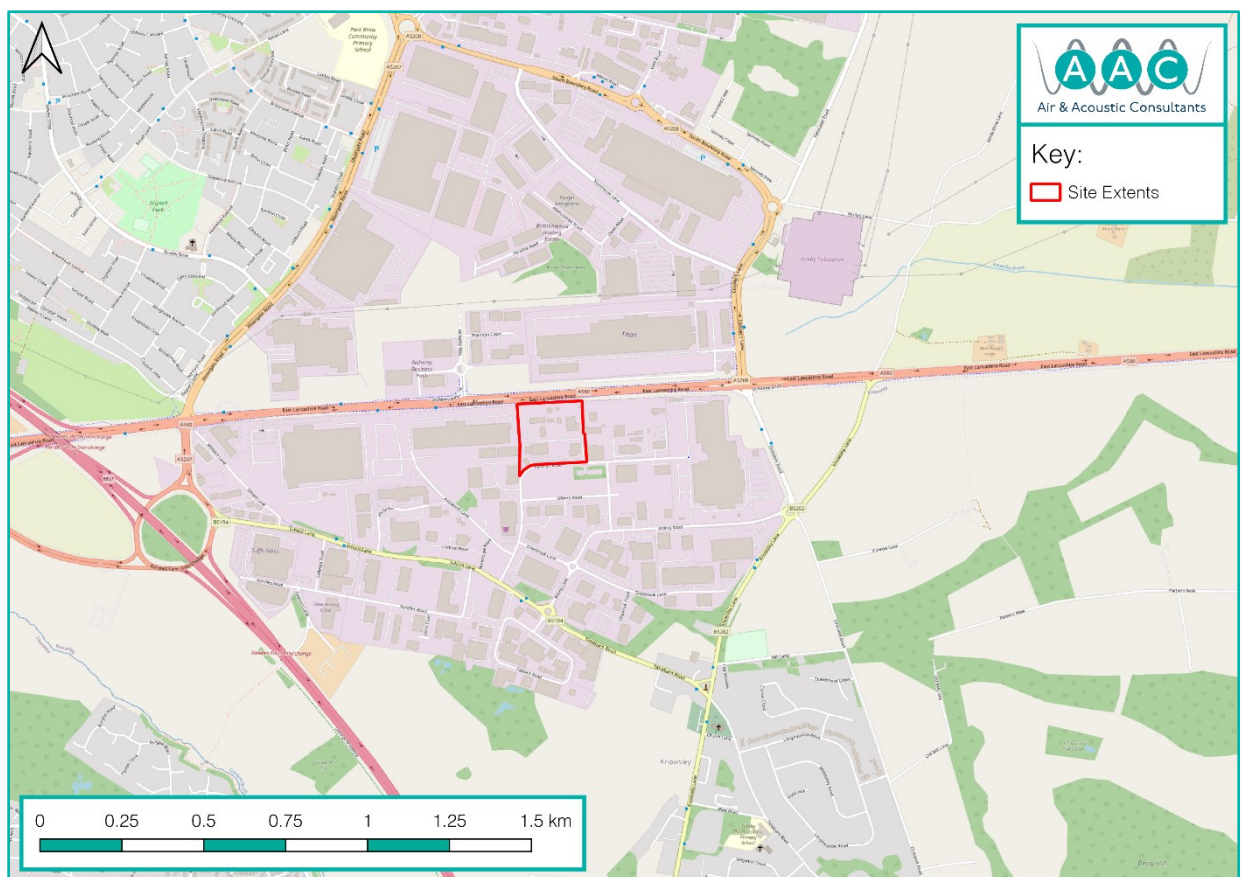
1.1 Brief

- 1.1.1 Air & Acoustic Consultants Limited have been commissioned by Knowsley Redevelopments Limited to undertake an air quality assessment in support of a planning application for a proposed commercial development on land off Penrhyn Road, Knowsley.

1.2 Application Site

- 1.2.1 The proposed is currently unoccupied. The site is bound to the north by the A580 East Lancashire Road, to the east and west by existing commercial premises, and to the south by derelict scrubland.
- 1.2.2 The National Grid Reference for the centre of the site is, SJ 42965 396719 (British National Grid co-ordinates E: **342965**, N: **396719**). The site location and surrounding area are shown in [Figure 1.1](#).

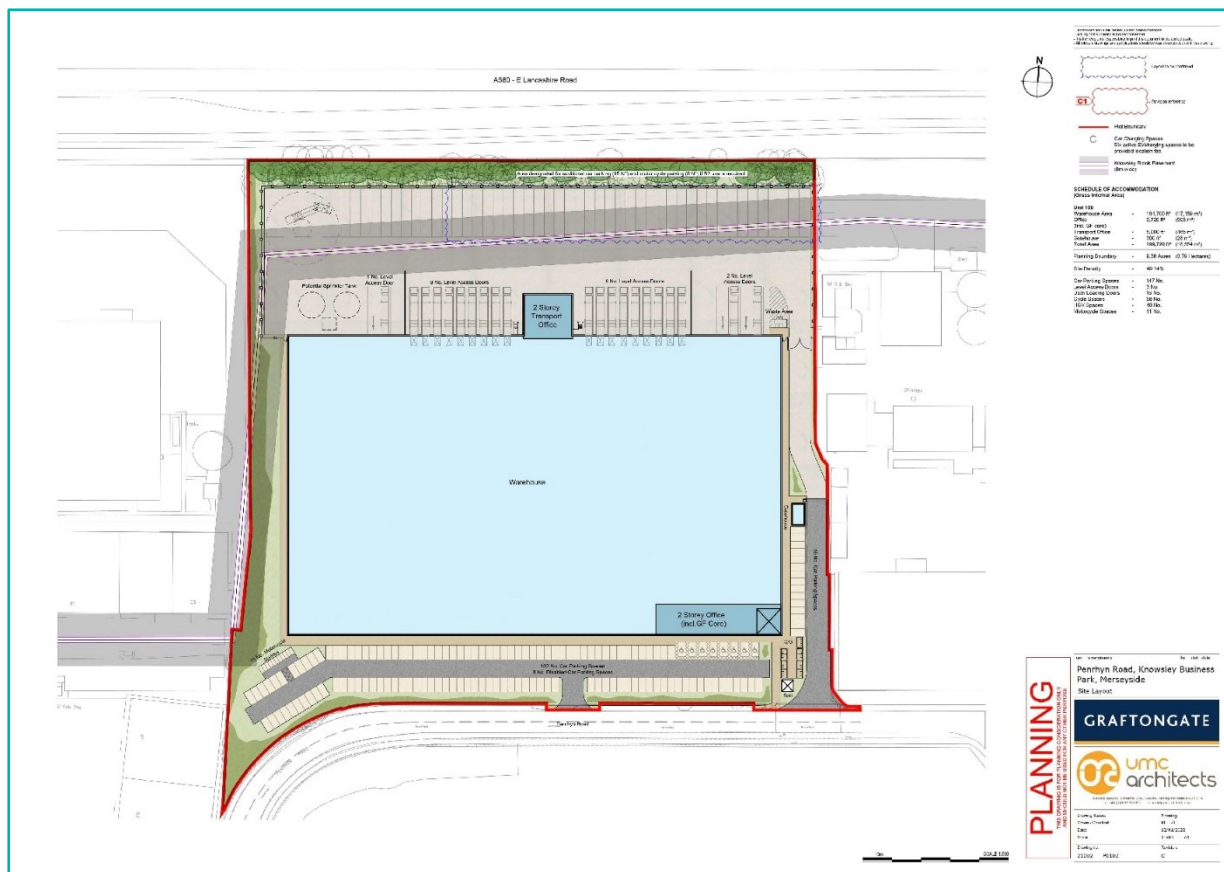
Figure 1.1: Site Location



1.3 Development Proposals

- 1.3.1 The application seeks approval for the erection of a B2/B8 commercial unit. This is illustrated in [Figure 1.2](#).

Figure 1.2: Development Layout



1.4 Assessment Approach

- 1.4.1 This assessment has been undertaken to assess if the proposed scheme is likely to give rise to any significant air quality impacts, and to establish the magnitude and the significance of such impacts caused as a result of the scheme in respect to the prevailing air quality.
- 1.4.2 The report is structured as follows:
- Section 2 sets out an overview of the national and local air quality policy context, in relation to the scheme proposals;
 - Section 3 details the methodology for estimating the air quality impacts;
 - Section 4 describes the baseline conditions;
 - Section 5 considers the construction phase dust impacts;
 - Section 6 considers the operational impacts as a result of the development;
 - Section 7 describes potential mitigation measures for the construction and operational phase(s)
 - (where required); and
 - Section 8 summaries and concludes the assessment.

2 Legislation and Policy Context

2.1 European Legislation

- 2.1.1 The following text is taken from the [legislation.gov.uk](https://www.legislation.gov.uk)¹ website and sets out how EU Legislation will be retained in the United Kingdom after the Brexit transition.

"The UK is no longer a member of the European Union. EU legislation as it applied to the UK on 31 December 2020 is now a part of UK domestic legislation, under the control of the UK's Parliaments and Assemblies, and is published on [legislation.gov.uk](https://www.legislation.gov.uk).

[...]

EU legislation which applied directly or indirectly to the UK before 11.00 p.m. on 31 December 2020 has been retained in UK law as a form of domestic legislation known as 'retained EU legislation'. This is set out in [sections 2 and 3](#) of the European Union (Withdrawal) Act 2018 (c. 16)."

- 2.1.2 Air pollutants at high concentrations can give rise to adverse effects upon the health of both humans and ecosystems. The European Union (EU) legislation on air quality forms the basis for the national UK legislation and policy.
- 2.1.3 The EU Framework Directive 2008/50/EC came into force in May 2008 and sets out legally binding limits for concentrations of the major air pollutants that can impact on public health. This Directive came into force in England in June 2010². Amendments to this Directive was made following amendments to the 2008/50/EC and 1004/107/EC on air quality made by Directive 2015/1480/EC. The updated Directive, The Air Quality Standards (Amendment) Regulations 2016, came into force on 31st December 2016³.

2.2 National Legislation, Policy and Strategy

- 2.2.1 Part IV of the Environment Act 1995⁴ requires local authorities to review and assess the air quality within their boundaries. As a result, the Air Quality Strategy was adopted in 1997⁵, with national health-based standards and objectives set out for the, then, eight key air pollutants including benzene, 1-3 butadiene, carbon monoxide, lead, nitrogen dioxide (NO₂), ozone, particulate matter and sulphur dioxide.
- 2.2.2 The purpose of the Air Quality Strategy was to identify areas where air quality was unlikely to meet the objectives prescribed in the regulations. The strategy was reviewed in 2000 and the amended Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2000) was published. This was followed by an Addendum in February 2003 and in July 2007, when an updated Air Quality Strategy was published⁶.
- 2.2.3 The pollutant standards relate to ambient pollutant concentrations in air, set on the basis of medical and scientific evidence regarding how each pollutant affects human health. Pollutant objectives are the future dates by which each standard is to be achieved, considering economic considerations, practical and technical feasibility.

¹ EU legislation and UK law. Accessible at: <https://www.legislation.gov.uk/eu-legislation-and-uk-law>

² Statutory Instrument, 2010. *The Air Quality Standards Regulations*, No. 1001. Queen's Printer of Acts of Parliament.

³ Statutory Instrument, 2016. *The Air Quality Standards Regulations*, No. 1184. Queen's Printer of Acts of Parliament.

⁴ Parliament of the United Kingdom, 1990. *Environmental Protection Act*, Chapter 43. Queen's Printer of Acts of Parliament.

⁵ Department for Environment Food and Rural Affairs, 1997. *The United Kingdom National Air Quality Strategy*, Cm 3587.

⁶ Department for Environment Food and Rural Affairs, 2007. *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*, Cm 7169, Department for Environment Food and Rural Affairs.

2.2.4 The air quality objectives are managed through the Local Air Quality Management, (LAQM) regime, which is defined within the Air Quality (England) Regulations 2000, (SI 928), The Air Quality (England) (Amendment) Regulations 2002, (SI 3043). [Table 2.1](#) lists the National Air Quality Objectives that are relevant to this assessment, as set out in the Air Quality Standards (Amendment) Regulations 2016.

Table 2.1: Air Quality Objectives (England)

Pollutant	Air Quality Objective	
	Concentration	Measured as
Nitrogen Dioxide (NO ₂)	200 µg/m ³	1-hour mean not to be exceeded more than 18 times per year
NO ₂	40 µg/m ³	Annual mean
Particulate Matter (PM ₁₀)	50 µg/m ³	24-hour mean not to be exceeded more than 35 times per year
PM ₁₀	40 µg/m ³	Annual mean
Particulate Matter (PM _{2.5})	25 µg/m ³	Annual mean – Stage 1 limit value pre 2020.
PM _{2.5}	20 µg/m ³	Annual mean – Indicative Stage 2 limit value post 2020. 15% reduction in background to be achieved between 2010 & 2020 at Urban Background sites

Statutory Nuisance

2.2.5 Under Part III of the Environmental Protection Act (1990)⁷, it is the duty of the local authorities to take steps as reasonably practical to investigate issues that could be a 'statutory nuisance', which include complains of:

- a) *"any premises in such a state as to be prejudicial to health or a nuisance;*
- b) *smoke emitted from premises so as to be prejudicial to health or a nuisance;*
- c) *fumes or gases emitted from premises so as to be prejudicial to health or a nuisance*
- d) *any dust, steam, smell or other effluvia arising on industrial, trade or business premises and being prejudicial to health or a nuisance;*
- e) *any accumulation or deposit which is prejudicial to health or a nuisance;*

[...]"

2.2.6 The local authority must serve an abatement notice on the person, premises owner or occupier if one of the statutory nuisances above occur and is unreasonably interfering with the use or enjoyment of someone's premises and/or is prejudicial to health. Should the abatement notice not be complied with, penalties such as a fine or prosecution could occur. However, it is considered as a defence if the best practicable means to stop or reduce a nuisance are employed.

⁷ UK Public General Acts, 1990. *Environmental Protection Act 1990, Chapter 43. Queen's Printer of Acts of Parliament.*

- 2.2.7 The most likely cause of stator nuisance associated with this AQA is dust. Dust is the generic term used in the British Standard document BS 6069 (Part Two)⁸, to describe particulate matter in the size range 1–75µm (micrometres) in diameter. This document has been withdrawn and has been replaced with the BS ISO 4225:2020⁹ document. Dust nuisance is the result of the perception of the soiling of surfaces by excessive rates of dust deposition.

National Planning Policy

- 2.2.8 The National Planning Policy Framework (NPPF)¹⁰ (2021) sets out the planning policy for England, to help achieve sustainable development within the planning sector.

- 2.2.9 Paragraph 105 states:

“The planning system should actively manage patterns of growth in support of these objectives. Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions, and improve air quality and public health. However, opportunities to maximise sustainable transport solutions will vary between urban and rural areas, and this should be taken into account in both plan-making and decision-making. However, opportunities to maximise sustainable transport solutions will vary between urban and rural areas, and this should be taken into account in both plan-making and decision-making.”

- 2.2.10 Paragraph 174 states:

“Planning policies and decisions should contribute to and enhance the natural and local environment by:

[...]

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development 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.

[...]”

- 2.2.11 Paragraph 185 states:

“Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.”

- 2.2.12 Paragraph 186 states:

“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

⁸ The British Standards Institution, 1994. BS6069-2:1994 - Characterization of air quality.

⁹ The British Standards Institution, 2020. BS ISO 4225:2020 - Air quality.

¹⁰ Ministry of Housing, Communities & Local Government, 2021. National Planning Policy Framework.

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.”

2.2.13 Paragraph 188 states:

“The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.”

2.2.14 The NPPF also sets out the national planning policy on biodiversity and conservation. This emphasises that the planning system should seek to minimise effects on and provide net gains in biodiversity, wherever possible, as part of the Government’s commitment to halting decline and establishing coherent and resilient ecological networks.

2.2.15 The NPPF is supported by Planning Practice Guidance (NPPG)¹¹ (DCLG, 2021), which sets out the principles on how planning can take account of the impacts of new development on air quality.

2.2.16 Paragraph 001 Reference ID: 32-001-20191101 states:

“The 2008 Ambient Air Quality Directive sets legally binding limits for concentrations in outdoor air of major air pollutants that affect public health such as particulate matter (PM₁₀ and PM_{2.5}) and nitrogen dioxide (NO₂).

The UK also has national emission reduction commitments for overall UK emissions of 5 damaging air pollutants:

- *fine particulate matter (PM_{2.5})*
- *ammonia (NH₃)*
- *nitrogen oxides (NO_x)*
- *sulphur dioxide (SO₂)*
- *non-methane volatile organic compounds (NMVOCs)*

As well as having direct effects on public health, habitats and biodiversity, these pollutants can combine in the atmosphere to form ozone, a harmful air pollutant (and potent greenhouse gas) which can be transported great distances by weather systems. Odour and dust can also be a planning concern, for example, because of the effect on local amenity.”

2.2.17 Paragraph: 005 Reference ID: 32-005-20191101 states:

¹¹ National Planning Practice Guidance web-based resource. Accessible at: <http://planningguidance.planningportal.gov.uk/>

“Whether air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to have an adverse effect on air quality in areas where it is already known to be poor, particularly if it could affect the implementation of air quality strategies and action plans and/or breach legal obligations (including those relating to the conservation of habitats and species). Air quality may also be a material consideration if the proposed development would be particularly sensitive to poor air quality in its vicinity.

Where air quality is a relevant consideration the local planning authority may need to establish:

- *The ‘baseline’ local air quality, including what would happen to air quality in the absence of the development;*
- *whether the proposed development could significantly change air quality during the construction and operational phases (and the consequences of this for public health and biodiversity); and*
- *whether occupiers or users of the development could experience poor living conditions or health due to poor air quality.”*

National Clean Air Strategy

2.2.18 The Clean Air Strategy (CAS)¹² was published in January 2019 and sets out how the government will improve air quality nationally. The document aims to tackle the issue of air quality across all parts of government and society to protect public health and the environment, and identifies what needs to be done to achieve this. The document complements the Industrial Strategy (archived), the Clean Growth Strategy¹³ and the 25 Year Environment Plan¹⁴ and is a key part of delivering the government’s 25 Year Environmental Plan.

2.2.19 The document has adopted international targets to reduce emissions of fine particulate matter, ammonia, nitrogen oxides, sulphur dioxide and non-methane volatile organic compounds by 2020 and 2030. The document proposes tougher goals to cut public exposure to particulate matter pollution, as recommended by the World Health Organisation.

2.2.20 The strategy not only targets the reduction of emissions, but also a reduction in exposure.

Reducing Emissions from Road Transport: Road to Zero Strategy

2.2.21 The *Reducing emissions from road transport: Road to Zero Strategy*¹⁵ (2018) document produced by the Office for Low Emission Vehicles (OLEV), Office for Zero Emission Vehicles (OZEV) and the Department for Transport (DfT) sets out how the government aims to end the sale of new conventional petrol and diesel cars and vans by 2040, with almost every car and van having zero emissions by 2050. Furthermore, the aim of the government is to see at least 50%, and as many as 70%, of new car sales being ultra-low emission by 2030 (and up to 40% of new van sales).

¹² Department for Environment, Food and Rural Affairs, 2019. *Clean Air Strategy 2019*.

¹³ Department for Business, Energy and Industrial Strategy, 2017. *The Clean Growth Strategy*.

¹⁴ Department for Environment, Food and Rural Affairs, 2018. *A Green Future: Our 25 Year Plan to Improve the Environment*.

¹⁵ Department for Transport, Office for Low Emission vehicles and Office for Zero Emission Vehicles, 2018. *Reducing emissions from road transport: Road to Zero Strategy*

- 2.2.22 A number of measures have been set out in the document which outline how the government will support this gradual transition, some of which are consumer incentives, research and development and innovation support based.
- 2.2.23 Since this document was released, the Prime Minister has announced that, as part of the *Ten Point Plan for a Green Industrial Revolution* (2020)¹⁶, the government will end the sale of new petrol and diesel cars and vans from 2030, 10 years earlier than set out in the document above.
- 2.2.24 This ambitious plan will see road traffic-related NO_x emissions to reduce significantly over the coming decades, likely beyond the scale of reductions forecast in air quality tools used to assess air quality impacts.

2.3 Local Legislation, Planning Policy and Strategy

[Knowsley Local Plan](#)

- 2.3.1 The Knowsley Metropolitan Borough Council (KMBC) Local Plan comprises the Knowsley Core Strategy (CS)¹⁷, adopted on the 6th January 2016, and sets out the strategic framework for the growth and development of Knowsley up to 2028 and beyond.
- 2.3.2 A review of the CS shows that a number of policies have been documented that relate to air quality.
- 2.3.3 Policy CS2: Development Principles states:

“1) New development in Knowsley and the preparation of subsequent stages of the Local Plan will be expected to support the following development principles:

[...]

Principle 4: Recognise environmental limits, protect and enhance environmental assets, enhance local character and promote quality of place by:

[...]

e) Mitigating potential negative impacts of traffic growth and road traffic on highway safety, air quality, noise and health;

[...]

j) Minimising negative impact upon flood risk, air quality, water quality, land quality, soil quality, and noise or vibration levels and ensuring any negative impacts are appropriately mitigated.

[...]”

- 2.3.4 Policy CS7: Transport Networks states:

“[...]

Location, Design and Management of New Development

2) New development will be required to be:

[...]

¹⁶ Department for Transport and Office for Zero Emission Vehicles, 2020. *The Ten Point Plan for a Green Industrial Revolution*

¹⁷ Knowsley Borough Council, 2016. *Core Strategy*.

e) Inclusive of measures that will mitigate carbon emissions and improve air quality where appropriate; and

[...]"

2.3.5 Policy CS23: Transport Networks states:

Renewable and Low Carbon Infrastructure

1) The Council will support proposals that will produce and distribute decentralised, low carbon and renewable energy, provided that they do not cause significant harm (in terms of their number, scale, siting or cumulative impacts) to: a) Natural resources, biodiversity, geodiversity, water and air quality and, landscape character;

[...]"

2.4 Air Quality Action Plans

National Air Quality Action Plan

2.4.1 The Department for Environment, Food and Rural Affairs (DEFRA) has produced an Air Quality Plan¹⁸ to tackle roadside NO₂, throughout the United Kingdom. Along with a package of infrastructure, initiatives and grants, the plan requires local authorities to produce local action plans by March 2018, with the aim of reducing the air quality concentrations below the objective as soon as practically possible, should they be predicting exceedances of the air quality objectives beyond 2020.

Local Air Quality Action Plan

2.4.2 On the basis no Air Quality Management Area's (AQMAs) have been declared by KMBC, an Air Quality Action Plan (AQAP) has not been created. The latest Annual Status Report (ASR)¹⁹ does however list a number of actions the council are conducting to improve air quality. Some of these include:

- Construction of cycle ways / walkways in the borough;
- Road junction improvements at Hall Lane and County Road, Kirkby and the M57 Junction 6; and
- Air Quality Steering Group meetings.

¹⁸ Department for Environment Food & Rural Affairs & Department for Transport, 2017. *UK plan for tackling roadside nitrogen dioxide concentrations*.

¹⁹ Knowsley Metropolitan Borough Council, 2020. *2020 Air Quality Annual Status Report*.

3 Assessment Approach

3.1 Construction Phase

3.1.1 There is currently no formal assessment criterion for dust, therefore, the approach developed and published by the Institute of Air Quality Management (IAQM), in the *Guidance on the Assessment of Dust from Demolition and Construction* (2016)²⁰ document, has been utilised as part of this assessment. The approach consists of a five step processes to assess the potential level of risks, (Large, Medium, Small or Negligible), regarding the four main phases of development, (demolition, earthworks, construction, and trackout). The assessment includes consideration of pre-mitigation, and post-mitigation impacts, based upon the scale and nature of the proposed development.

3.1.2 The main air quality impacts that may arise during demolition and construction activities are:

- Dust deposition, resulting in the soiling of surfaces;
- Visible dust plumes, which are evidence of dust emissions;
- Elevated PM₁₀ and PM_{2.5} concentrations, as a result of dust generating demolition and construction activities; and
- An increase in concentrations of NO₂ due to exhaust emissions from vehicles and equipment.

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

“The most common impacts are dust soiling and increased ambient PM₁₀ 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.”

3.1.4 The approach states that an assessment will normally be required where there are either:

- Human receptors within 350 m of the site boundary, and/or within 50 m of the routes used by construction vehicles on the local highway network and up to 500 m from site entrances; and/or
- Ecological receptors within 50 m of the site boundary, or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

3.1.5 An ecological receptor refers to any sensitive habitat that is susceptible to dust soiling. For locations with a statutory designation, such as Ramsar Conservation Sites, Sites of Specific Scientific Interest (SSSI), Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), consideration should be given as to whether the specific site is sensitive to dust. Some non-statutory sites, (such as local nature reserves) may also have to be considered if appropriate.

²⁰ Institute of Air Quality Management, 2016. *Guidance on the Assessment of Dust from Demolition and Construction.*

- 3.1.6 The degree of risk is then derived from the level of the risk, and the sensitivity of the receptor being considered. To note, not all the criteria for a particular risk class needs to be met for magnitude or significance. It is suggested in IAQM (2016) guidance that other criteria, (such as professional judgement) can be used to justify the assessment.
- 3.1.7 The full Construction Dust Impact Assessment methodology is set out in [Appendix A](#), and the assessment is set out in [Section 5](#).

3.2 Operational Phase

- 3.2.1 The key guidance document which has been used to determine the potential for impacts upon air quality is the Environmental Protection UK (EPUK) & IAQM (2017)²¹ *Land-Use Planning and Development Control: Planning for Air Quality* document.
- 3.2.2 This guidance document provides indicative criteria for the requirements of an Air Quality Impact Assessment. The following criteria, as listed in the guidance, has been considered as part of this assessment:

Local Highway Network

Step 1:

- If any of the following apply to the development:
 - Contains 10 or more residential units or a site area of more than 0.5ha; or
 - Contains more than 1,000 m² of floor space for all other uses or a site area greater than 1ha.
- Coupled with any of the following:
 - The development has more than 10 parking spaces; or
 - The development will have a centralised energy facility or other centralised combustion process.

Step 2:

- A change of cars / LDVs (light duty vehicles) flow of:
 - More than 100 AADT within or adjacent to an Air Quality Management Area (AQMA); or
 - More than 500 AADT elsewhere.
 - A change of HDVs (heavy duty vehicles) flow of:
 - More than 25 AADT within or adjacent to an AQMA; or
 - More than 100 AADT elsewhere
- 3.2.3 Should these criteria not be met, then the guidance document considers air quality impacts associated with a scheme to be 'insignificant' and no further assessment is required.
- 3.2.4 This is further set out in [Section 6](#).

²¹ Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM), 2017. *Land-use Planning & Development Control: Planning for Air Quality*.

3.3 Modelling Parameters

Sensitive Locations

- 3.3.1 The concentrations of NO₂, PM₁₀ and PM_{2.5} have been considered as part of this assessment. While selecting the receptor locations, careful consideration was made to receptors located near key road junctions, where congestion may occur, or where a number of highway links merge.
- 3.3.2 The sensitive locations at which the standards and objectives apply are places where the population is expected to be exposed to the various pollutants over the particular averaging period. Thus, for those objectives to which an annual mean standard applies, the most common sensitive receptor locations used to measure concentrations against the set standards are areas of residential housing, since it is reasonable to expect that people living in their homes could be exposed to pollutants over such a period of time.
- 3.3.3 Schools and children's playgrounds are also often used as sensitive locations for comparison with annual mean objectives due to the increased sensitivity of young people to the effects of pollution (regardless of whether or not their exposure to pollution could be over an annual period). For shorter averaging periods of between 15 minutes, 1 hour or 1 day, the sensitive receptor location can be anywhere where the public could be exposed to the pollutant over these shorter periods of time, such as on public footways or residential amenity areas.
- 3.3.4 DEFRA (2021) Local Air Quality Management Technical Guidance (TG16)²² states:
- "Dispersion models cannot predict short-term concentrations as reliably as annual mean concentrations*
- [...]*
- Previous research carried out on behalf of Defra and the Devolved Administrations identified that exceedances of the NO₂ 1-hour mean are unlikely to occur where the annual mean is below 60 µg/m³. This assumption is still considered valid; therefore local authorities should refer to it."*
- 3.3.5 The receptor locations are outlined in [Table 3.1](#) and illustrated in [Figure 3.1](#).

²² Department for Environment, Food & Rural Affairs, 2021. *Local Air Quality Management. Technical Guidance (TG16)*.

Figure 3.1: Receptor Locations

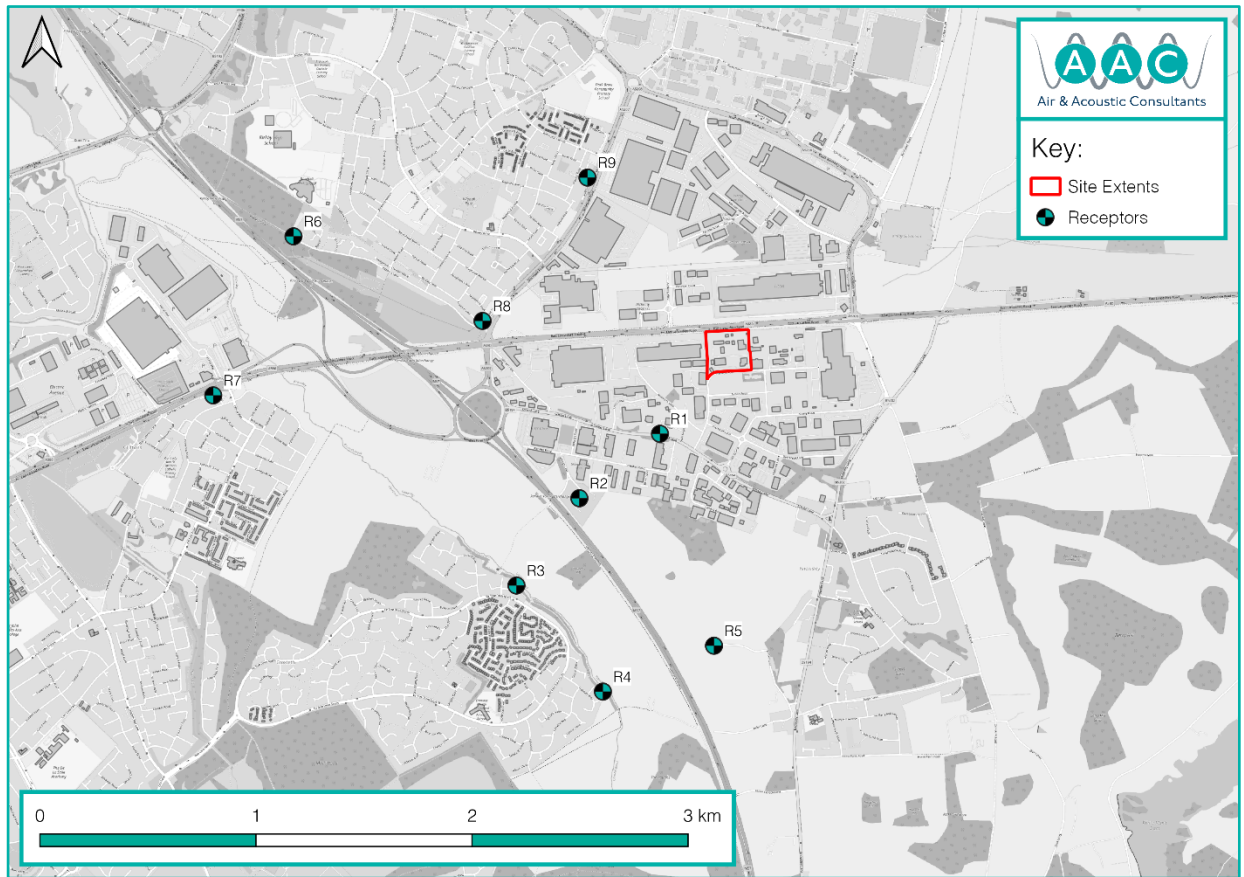


Table 3.1: Receptor Locations

ID	Description	Coordinates (m)		
		X	Y	Z
R1	Existing Residential Receptor	342649	396345	1.5
R2	Existing Residential Receptor	342276	396047	1.5
R3	Existing Residential Receptor	341985	395643	1.5
R4	Existing Residential Receptor	342385	395153	1.5
R5	Existing Residential Receptor	342899	395365	1.5
R6	Existing Residential Receptor	340953	397257	1.5
R7	Existing Residential Receptor	340582	396522	1.5
R8	Existing Residential Receptor	341828	396866	1.5
R9	Existing Residential Receptor	342314	397529	1.5

Assessment Scenarios

3.3.6 The following scenarios have been considered for this assessment:

- 2019 verification baseline;
- 2021 future baseline; and
- 2021 future baseline + proposed development.

3.3.7 The traffic data utilised within this assessment has been provided by the transport consultant, Apex Transport Planning, and is set out in [Appendix B](#) for the 2019 baseline and both the 2021 assessment year scenarios.

Modelling Methodology

3.3.8 The modelling of the release of vehicular emissions, (dispersion), into the air has been carried out using the latest version of the air dispersion model: ADMS-Roads model (v5.0.0.1). The model calculates pollution concentrations and deposition over a specified area and / or at a specified location, based upon the following input information:

- Source parameters: e.g. highway width, average speed of vehicles, the number of vehicles per hour and the diurnal traffic profile;
- Meteorological parameters: e.g. wind speed, direction, precipitation, temperature and atmospheric stability; and
- Topographical factors: e.g. ground levels, gradients, buildings and surface roughness.

3.3.9 The following information, as set out in LAQM.TG(16) has been utilised as part of this assessment.

“For junctions, common sense, driving experience and local knowledge are helpful to estimate speeds. For example, for a section of road leading up to traffic lights, the aim should be to estimate average speeds over a 50 m section of road:

- *Traffic pulling away from the lights, e.g. 40-50kph;*
- *Traffic approaching the lights when green, e.g. 20-50kph; and*
- *Traffic on the carriageway approaching the lights when red, e.g. 5-20kph, depending on the time of day and how congested the junction is.*

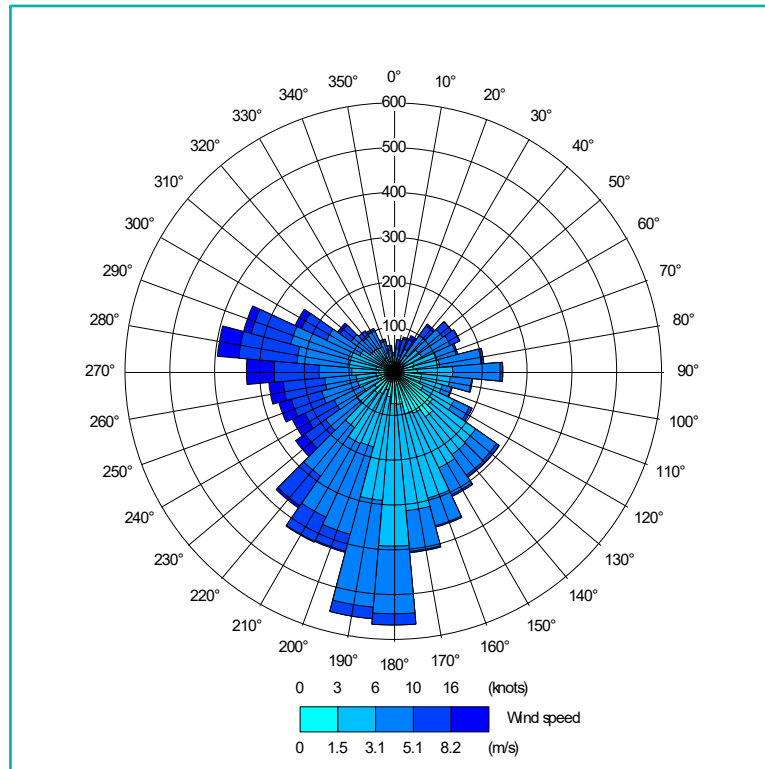
It is considered that the combined effect of these three conditions is likely in most instances to be a two-way average speed for all vehicles of 20 to 40kph. Speeds in similar ranges would also apply at roundabouts, although on sections of large roundabouts, speeds may well average between 40-50kph.

3.3.10 The meteorological data required for the ADMS-Roads model, must be sourced from a representative location to the study site and include a full year of sequential readings. A review of the nearest available meteorological stations indicates Manchester Airport Meteorological Site is the most suitable site with the most complete/representative information. 2019 meteorological data has been utilised for this assessment in line with the verification year.

3.3.11 It is recognised that a minimum data capture of 90% is recommended for representing hourly dispersion conditions within the dispersion model. Missing lines of meteorological data can be interpolated or filled by data for these specific hours from a neighbouring site. The data capture at Manchester Airport

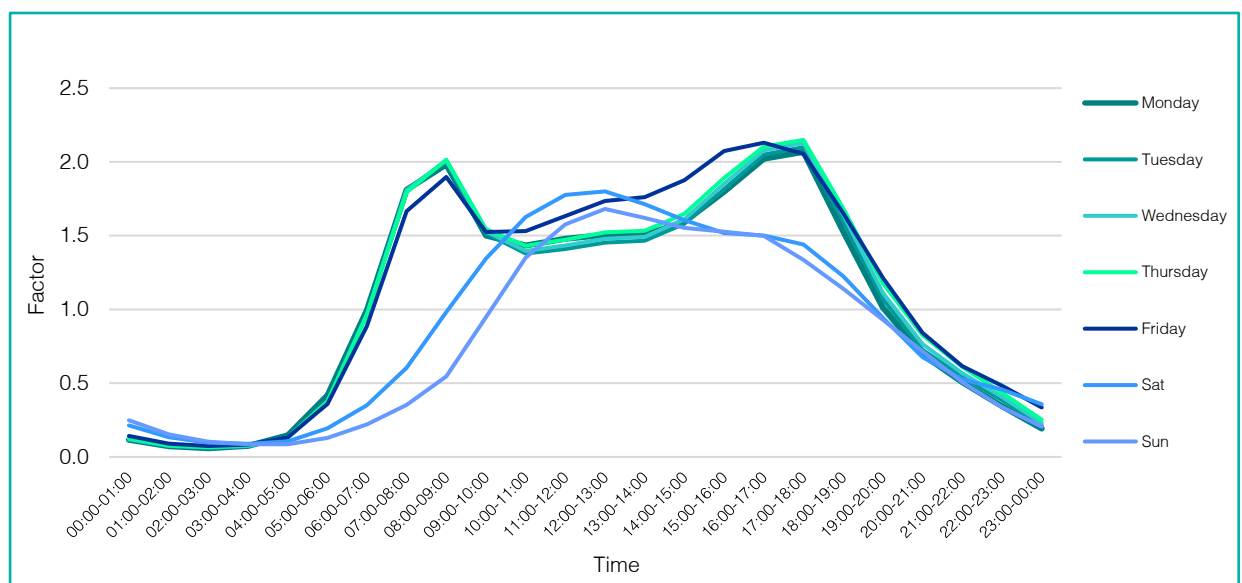
Meteorological Site for 2019 was within an acceptable margin error, for all parameters. The wind rose is illustrated in Figure 3.2.

Figure 3.2: Manchester Airport Meteorological Site (2019)



3.3.12 A standard diurnal profile from the Department of Transport website²³ has been utilised as part of the modelling process for an average 7-day week. The 2019 diurnal profile is illustrated in Figure 3.3.

Figure 3.3: Diurnal Profile (2019)



²³ Department for Transport. Road Traffic Statistics (TRA). Accessible at: <https://www.gov.uk/government/statistical-data-sets/road-traffic-statistics-tra>

Emission Factors

- 3.3.13 There are numerous sources of NO₂, PM₁₀ and PM_{2.5} which include for example, industry and domestic origins. However, the main source is usually road transport. For the purpose of this assessment and due to the absence of other sources in the area, only road traffic emissions have been modelled.
- 3.3.14 The potential impacts have been modelled using the ADMS-Roads model atmospheric dispersion model, with the most recent Emission Factor Toolkit (v10.1) which are built into the ADMS-Roads model.
- 3.3.15 It has been widely known for some time that NO_x/NO₂ levels historically have not reducing as quickly as anticipated, and this was identified by DEFRA in 2011. This was recently reiterated in an IAQM Interim Position Statement (v1.1)²⁴ released in July 2018 recognising that emissions from diesel vehicles have not declined as expected by DEFRA. This document has since been formally withdrawn, stating:

"There is a growing body of evidence to suggest that the latest COPERT vehicle emission factors, which feed into the EFT (v9 and onwards), reflect the real-world NO_x emissions more accurately.

It is judged that an exclusively vehicle emissions-based sensitivity test is no longer necessary.

On this basis, the EFT may be used for future year modelling with greater confidence when considering the per vehicle emission, provided that the assessment is verified against measurements made in the year 2016 or later."

- 3.3.16 On this basis it is anticipated the most up to date EFT at the time the position statement was withdrawn (v10.1) could be relied upon to provide a good representation of the air quality concentrations and impacts, and no sensitivity test has therefore been undertaken. It is noted that EFT v11.0 has been released in November 2021. However, at the time of writing the ADMS-Roads model has not been updated to reflect this release, so this is not possible to currently consider.
- 3.3.17 Vehicles emit NO_x with different proportions of NO₂. Following release into the atmosphere, chemical reactions take place between nitric oxide (NO), NO₂ and Ozone (O₃). In this assessment, the modelling of NO_x emissions has taken place and the resulting NO₂ concentration has been calculated post modelling using the DEFRA NO_x to NO₂ Calculator (v8.1)²⁵.

Verification Process

- 3.3.18 Whilst the ADMS-Roads model is widely accepted for its use in assessments of this nature, it is still important that a model verification process is undertaken to confirm that the model's performance is within an acceptable margin of error. The model verification process is set out in [Appendix C](#).

Modelling Uncertainty

- 3.3.19 There are many uncertainties when considering both measured and predicted pollution concentrations. The model is dependent upon the traffic data provided for the project, and should this be subject to change, so may the resulting pollution concentrations.

²⁴ Institute of Air Quality Management, 2018. *Dealing with Uncertainty in Vehicle NO_x Emissions within Air Quality Assessments*.

²⁵ Department for Environment, Food & Rural Affairs. NO_x to NO₂ Calculator. Accessible at: <https://iaqm.defra.gov.uk/review-and-assessment/tools/background-maps.html>

3.3.20 Due to the ongoing uncertainty regarding 2020 air quality monitoring data as a result of the pandemic, and to ensure a conservative assessment of future exposure and impacts is made, the verification process has used 2019 monitoring data.

3.3.21 The emissions factors within the latest emission factors are based on assumptions which were current before the occurrence of the Covid-19 pandemic. As such, these data will not reflect any changes that have occurred or may occur in the future as a result of behavioural change caused by the pandemic and / or as a result of measures implemented by governing authorities (e.g. lockdowns, travel restrictions etc.).

3.3.22 This is highlighted by a recent statement published by DEFRA, which states:

“Users of the updated LAQM tools should be aware that the projections in the 2018 reference year background maps and associated tools are based on assumptions which were current before the Covid-19 outbreak in the UK. In consequence these tools do not reflect short or longer term impacts on emissions in 2020 and beyond resulting from behavioural change during the national or local lockdowns.”

3.3.23 Furthermore, there is discrepancy between the concentrations mapped by DEFRA and those recorded at local background sites. Therefore, background concentrations should be adjusted based on the ratio between these two measurements.

3.4 Significance Impact Criteria

Construction Impacts

3.4.1 The IAQM (2016) guidance does not provide a method for assessing the significance of effects before mitigation and advises that pre-mitigation significance should not be determined. With appropriate mitigation in place, (as set out in [Section 8](#) and [Appendix D](#) the IAQM (2016) guidance is clear that the residual effect will normally be ‘not significant’.

Operational Impacts

3.4.2 Currently there is no formal guidance on the absolute magnitude and significance criteria for the assessment of air quality impacts. However, the EPUK & IAQM (2017) guidance recommendations for describing the impact at individual receptor locations as set out in [Table 3.2](#), which is utilised to determine the description of any impact.

Table 3.2: Operational Impact Descriptors

Long Term Average Concentration at Receptor in Assessment Year	% Change in concentration relative to Air Quality Action Level (AQAL)				
	< 0.5	1	2 – 5	6 – 10	>10
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Negligible	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial
Notes: Values are rounded to the nearest whole number. When defining the concentration as a percentage of the AQAL, use the 'without scheme' concentration where there is a decrease in pollutant concentration and the 'with scheme' concentration for an increase. AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)'.					

- 3.4.3 The EPUK & IAQM (2017) advice provides guidance on the severity of an impact as a descriptor. However, although the impacts might be considered 'Slight,' 'Moderate' or 'Substantial' at one or more receptor location, the overall effects of a proposed development may not always be judged as being significant.
- 3.4.4 The guidance believes that the assessment of significance should be based on professional judgement, with the overall air quality impact of the scheme described as either significant or not significant. In drawing this conclusion, the following factors should be taken into account:
- Receptor Sensitivity;
 - The existing and future air quality in the absence of the development;
 - The extent of current and future population exposure to the impacts; and
 - The influence and validity of any assumptions adopted when undertaking the prediction of impacts.
- 3.4.5 The judgement of the significance should be made by a competent professional who is suitably qualified.

4 Baseline Conditions

4.1 Air Quality Review and Assessment

- 4.1.1 Under the Air Quality Strategy, there is a duty on all local authorities to consider the air quality within their boundaries and to report annually to DEFRA.
- 4.1.2 Local Air Quality Management (LAQM) has been assessed by KMBC through the national Review and Assessment process and in fulfilment of Part IV of the Environmental Act 1995.
- 4.1.3 At the time of writing KMBC have no AQMAs within its jurisdiction. Therefore, the development site is not located within or adjacent to any AQMAs.

4.2 Local Air Quality Monitoring

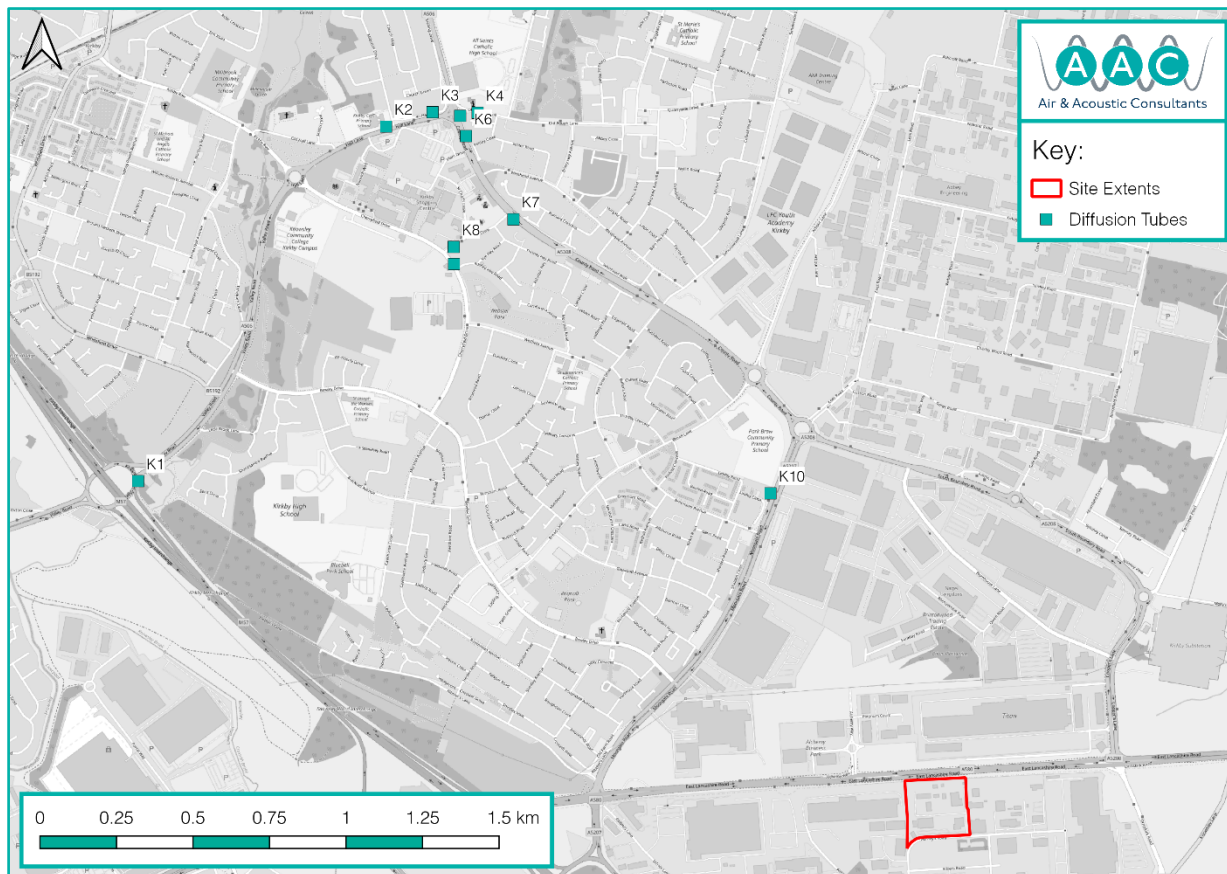
- 4.2.1 KMBC have a number of automatic monitoring locations that have recorded concentrations of NO₂, PM₁₀ and PM_{2.5} for the past 5 years. To support the automatic monitoring, KMBC have a network of non-automatic NO₂ diffusion tubes, located across the jurisdiction.
- 4.2.2 A review of the available data submitted in the latest Annual Status Report (ASR)²⁶ indicates that diffusion tube monitoring was undertaken close to the development site from 2019 only, as illustrated in [Figure 4.1](#). [Table 4.1](#) sets out the NO₂ monitoring data collected in 2019, for these closest monitoring sites.

²⁶ Knowsley Metropolitan Borough Council 2020. 2020 *Air Quality Annual Status Report (ASR)*.

Table 4.1: Summary of NO₂ Diffusion Tube Monitoring (2019)

ID	Type	Location	Annual Mean (µg/m ³)
K1	Roadside	LC056A Junction of M57 and Valley Road.	45.4
K2	Roadside	LC006 Outside Kirkby C of E School, Hall Lane	26.9
K3	Roadside	LC005 outside 12 Hall Drive	25.3
K4	Roadside	LC021 to rear of 12 Brakenhurst Grove	27.1
K5	Roadside	LC091 Junction of Old Rough Lane and County Road	32.1
K6	Roadside	LC085 On County Road near 18 Kelday Close	35.3
K7	Roadside	LC067 Corner of County Road and Webster	29.6
K8	Roadside	LC002 Outside Webster Drive	32.4
K9	Roadside	LC 017 on Cherryfield Drive	29.4
K10	Roadside	Outside 19 Moorgate Road (A5207)	29.4
Objective			40
Notes: Bold indicates exceedances of the NO ₂ annual mean objective. <u>Bold and underlined</u> indicates exceedances of 60 µg/m ³ (which is an indication the hourly mean objective could be being breached).			

Figure 4.1: Monitoring Locations



- 4.2.3 The diffusion tube monitoring carried out closest to the development site shows a mixture of compliance and non-compliance of the NO₂ annual mean objective during 2019. When non-compliance is concerned, the tube is located near to the M57 motorway junction with the A506 Valley Road, both of which are heavily trafficked.

4.3 Mapped Background Concentrations

Defra Background Concentrations

- 4.3.1 The Defra website includes estimated background air pollution data for NO_x, NO₂, PM₁₀ and PM_{2.5} for each 1km-by-1km OS grid square²⁷. Background pollutant concentrations are modelled from the base year of 2018 and based on ambient monitoring, meteorological data from 2018 and then projected for future years. Projected pollutant concentrations for the baseline years (2019 and 2021), covering the closest OS grid square to the chosen receptor locations, are provided in Table 4.2 and have been utilised as part of this assessment.

²⁷ Department for Environmental Food and Rural Affairs. Accessible at: <https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018>
airandacoustics.co.uk | January 2022

Table 4.2: Estimated Annual Mean Background Pollutant Concentrations ($\mu\text{g}/\text{m}^3$)

Pollutant	2021
NO ₂	12.6 – 18.1
PM ₁₀	16.0 – 19.8
PM _{2.5}	8.4 – 10.4

4.3.2 Annual mean concentrations are within the relevant objective limits for NO₂ and PM₁₀. There are no ambient air quality limits for PM_{2.5}.

4.3.3 Background NO₂, PM₁₀ and PM_{2.5} concentrations have been calibrated against data measured in 2019 at the Speke automatic monitoring site, as no background monitoring locations are located near to the Site. Measured annual mean NO₂, PM₁₀ and PM_{2.5} concentrations at these have been compared against the annual mean concentration predicted by DEFRA's background maps to find a calibration factor. A calibration factor has then been calculated in order to provide an overall combined background NO₂, PM₁₀ and PM_{2.5} calibration factor. The calibration factor has been applied to the background concentrations.

4.3.4 The Background Calibration Factor is set out in [Table 4.3](#).

Table 4.3: Background Calibration Factor

	NO ₂
Measured Concentration	19
Mapped Concentration	19.1
Calibration Factor	1.0
	PM ₁₀
Measured Concentration	17
Mapped Concentration	12.8
Calibration Factor	1.3
	PM _{2.5}
Measured Concentration	9
Mapped Concentration	8.8
Calibration Factor	1.0

5 Construction Dust Impact Assessment

5.1 Introduction

- 5.1.1 The assessment of construction activities has focused on demolition, earthworks, construction and trackout activities at the site, in line with the IAQM (2016) guidance methodology (as set out in [Appendix A](#)). A summary of the assessment is provided below.

5.2 Screening for a Full Assessment

- 5.2.1 Having reviewed the site location, it is evident that the site has a large number of human receptors within 350 m of the site boundary, therefore a detailed dust impact assessment is required.
- 5.2.2 A review of the Defra Magic website²⁸ indicates that no ecological site is present within the immediate surrounding area. As per box 1 of the IAQM (2016) guidance, therefore, an assessment of the impact of the construction phase on ecological receptor has been scoped out.

5.3 Potential Dust Emission Magnitude

Demolition

- 5.3.1 A review of the site indicates that any demolition will be negligible as the historical structure have already been removed, and therefore it has been scoped out of this assessment.

Earthworks

- 5.3.2 The total area where earthworks will occur is greater than 10,000m². Furthermore, it is anticipated that the soil existing in the ground has a largely 'sandy and loamy'²⁹ texture. Therefore, in line with [Table A1](#) as set out in [Appendix A](#), the magnitude of potential dust release from earthworks activities is classified as **Large**.

Construction

- 5.3.3 The total building volume to be constructed is unknown. However, when considering the potential dusty material and size of the development and the square footage of the proposed development area, in line with [Table A1](#) as set out in [Appendix A](#) and professional judgement, the magnitude of potential dust release from construction activities is classified as **Medium**.

Trackout

- 5.3.4 The number of daily HGV vehicles movements which may trackout dust and dirt for the construction phase of the development is unknown, but it is considered that there would be between 10 – 50 HGV movements per day. Therefore, in line with [Table A1](#) as set out in [Appendix A](#), the magnitude of potential dust release from trackout activities is classified as **Medium**.

Summary

- 5.3.5 [Table 5.1](#) summarises the dust emission magnitude for the proposed development.

²⁸ Natural England. MAGIC. Accessible at: <https://magic.defra.gov.uk/>

²⁹ Cranfield Soil and Agrifood Institute. Soilscales. Accessible at: <http://www.landis.org.uk/soilscales/>

Table 5.1: Summary of Dust Emission Magnitude

Activity	Dust Emission Magnitude
Demolition	N/A
Earthworks	Large
Construction	Medium
Trackout	Medium

5.4 Sensitivity of Area

- 5.4.1 Step 2B considers the number and the sensitivity of the receptors. A consideration is also made for the background PM₁₀ concentrations when looking at human health impacts. Buffer zones are set out in [Figure 5.1](#) and [Figure 5.2](#) to illustrate the number of receptors in proximity to the site that could be impacted by dust as a result of construction works and trackout.

Effects of Dust Soiling

- 5.4.2 The presence of more than 1 'Medium' sensitivity human (place of work) receptor within approximately 20 m of the site boundary, indicates that the area around the construction site has a '**Medium**' sensitivity (Based upon [Table A3](#) in [Appendix A](#)) for earthworks and construction activities.
- 5.4.3 The routing of construction vehicles is expected to be down Penrhyn Road, therefore receptors have been considered along this road and adjoining roads up to 200 m west of the proposed site access. For trackout, there is more than 1 'Medium' sensitivity human (place of work) receptor within 20 m of where trackout may occur (for a distance of up to 200 m from the site entrance). This would be considered a '**Medium**' sensitivity (Based upon [Table A3](#) in [Appendix A](#)).

Effects on Human Health

- 5.4.4 The presence of over 10 'Medium' sensitivity human (place of work) receptors within approximately 20 m of the site boundary, and the background PM₁₀ concentrations being below 24 (µg/m³), as set out in [Table 4.2](#), would indicate the area would have a '**Low**' sensitivity for earthworks and construction activities (Based upon [Table A4](#) in [Appendix A](#)).
- 5.4.5 The routing of construction vehicles is expected to be down Penrhyn Road, therefore receptors have been considered along this road and adjoining roads up to 200 m west of the proposed site access. For trackout, there are over 10 'Medium' sensitivity human (place of work) receptors within approximately 20 m where trackout may occur (for a distance of up to 200 m from the site entrance). Along with the background PM₁₀ concentrations being below 24 (µg/m³), as set out in [Table 4.2](#), it would indicate that the area would have a '**Low**' sensitivity (Based upon [Table A4](#) in [Appendix A](#)).

Figure 5.1: Construction Dust Risk Buffers

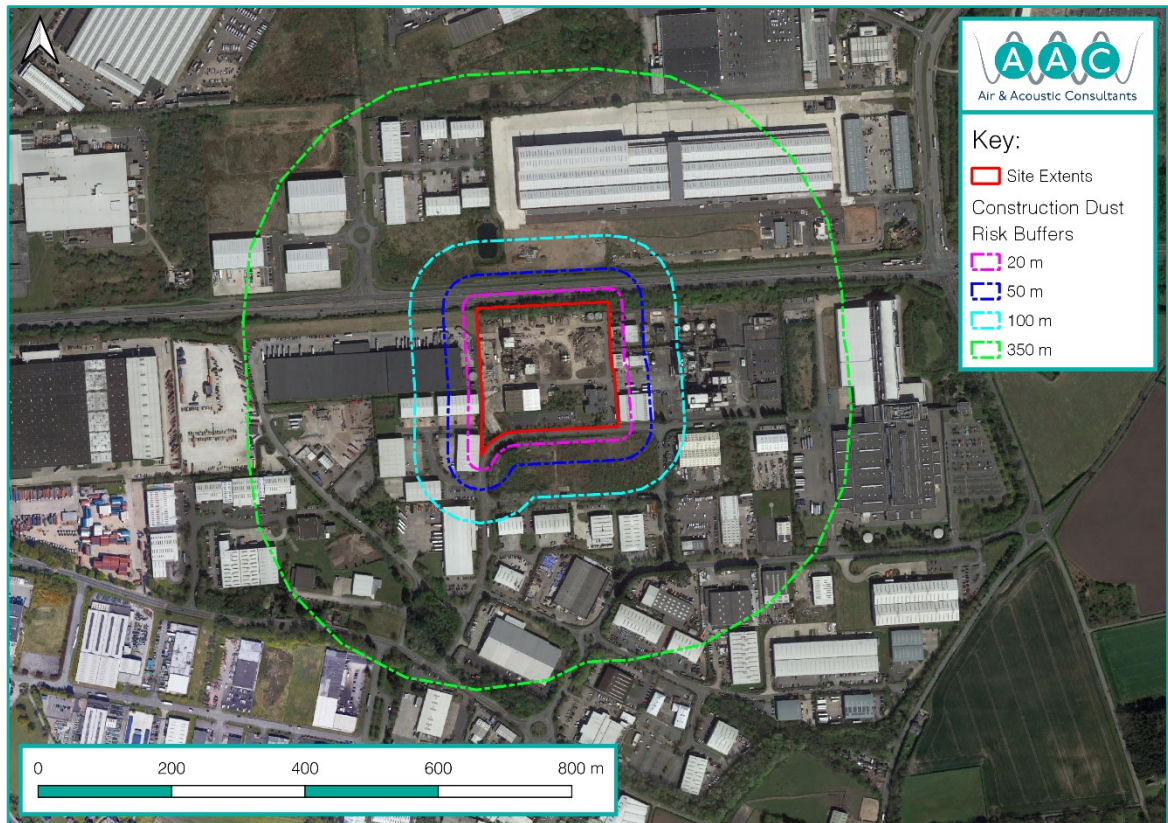
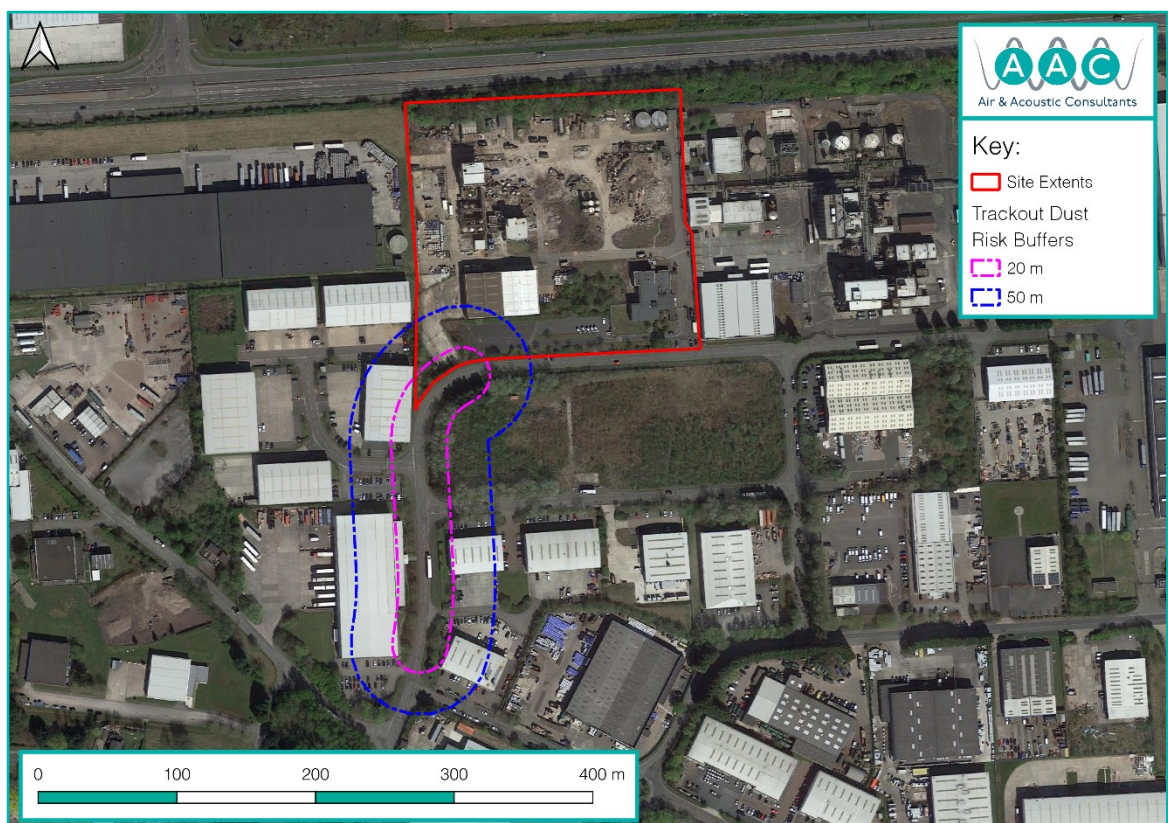


Figure 5.2: Trackout Dust Risk Buffers



Effects on Ecological Receptors

- 5.4.6 As discussed earlier in [paragraph 5.2.2](#), the ecological sites element of the assessment has been scoped out based on the screening criteria in box 1 of the IAQM (2016) guidance.

5.5 Risk and Significance

- 5.5.1 The dust emission magnitude described in the sections above, is combined with the sensitivity of the area assessment set out in the assessment matrix, ([Table A6](#) of [Appendix A](#)). The resulting risk categories for the four construction activities, without mitigation, are set out in [Table 5.2](#).

Table 5.2: Summary of Dust Risk to Define Site-Specific Mitigation

Activity	Demolition	Earthworks	Construction	Trackout
Dust Soiling	N/A	Medium Risk	Medium Risk	Low Risk
Human Health	N/A	Low Risk	Low Risk	Low Risk
Ecological	N/A	N/A	N/A	N/A

- 5.5.2 The IAQM (2016) guidance does not provide a method for assessing the significance of effects before mitigation and advises that pre-mitigation significance should not be determined. With appropriate mitigation in place, (as set out in [Section 7](#) and [Appendix B](#)) the IAQM (2016) guidance is clear that the residual effect will normally be 'not significant'.

6 Operational Impacts Assessment

6.1 Traffic Emissions

- 6.1.1 As development will see more than 1000 m² of floor space created, and car parking exceeds 10 spaces, the Step 1 criteria (as set out in [Section 3](#)) is exceeded and the proposals need to be considered against Step 2.
- 6.1.2 The project transport consultant has provided a vehicular trip comparison of the extant planning permission for the Site against the proposals for the 12-hour period of 7am to 7pm, as set out in Table 6.1.

Table 6.1: Net Change in Two-Way Vehicle Generation (7am-7pm)

Time Period	Existing	Proposed	Net Change
12 Hour	407	414	7

- 6.1.3 Assuming worst case that the 12 hour period was doubled and all net increase movements were HGV's (which in reality neither would not be the case) the proposals would be looking at a net increase of 14 two way movements which in line the EPUK & IAQM (2017) would not trigger a new impact assessment for a site either inside or outside an Air Quality Management Area, and on this basis the impacts would be considered to the 'insignificant.'
- 6.1.4 However, EPUK & IAQM, (2017) recommends that
- "impacts be assessed for the new permission sought against the current baseline for the site."*
- 6.1.5 On the basis the site is not operational and has not been for a substantial period of time, the current baseline position in terms of air quality baseline position would be that the Site has no historical land use.
- 6.1.6 Therefore, the proposed traffic impacts disregarding the extant planning permission(as set out in Table 6.1) have been rescreened against Step 2 of the EPUK & IAQM (2017) criteria, as set out below.

Table 6.2: Proposed Development Traffic Generation

Time Period	Total Vehicles	HGV
AADT	714	307

- 6.1.7 Based on the tale above, the traffic generated as a result of the development will exceed both the LDV and HGV criteria for a development situated outside an AQMA. Therefore, on this basis an assessment on the air quality impacts on existing sensitive receptors in the local area is required.

Existing Receptors Impacts

- 6.1.8 The '2021 future baseline' NO₂, PM₁₀ and PM_{2.5} concentrations at the previously specified receptor locations, as set out in [Table 3.1](#) and illustrated in [Figure 3.1](#), have been compared to the '2021 future baseline + proposed development' concentrations and the results are set out in [Table 6.3](#), [Table 6.4](#) and [Table 6.5](#). The tables also set out the impact descriptor at each location in line with the assessment matrix set out in [Table 3.2](#).

Table 6.3: Predicted NO₂ Impacts at Specified Receptors

Calculated NO ₂ Annual Mean (µg/m ³)				
Receptor	2021 Baseline	2021 Baseline + Scheme	% Change of Objective	Impact Descriptor
R1	26.1	26.8	2%	Negligible
R2	32.8	32.8	0%	Negligible
R3	14.8	14.8	0%	Negligible
R4	18.3	18.3	0%	Negligible
R5	22.9	22.9	0%	Negligible
R6	26.5	26.5	0%	Negligible
R7	21.7	21.7	0%	Negligible
R8	28.7	28.7	0%	Negligible
R9	24.9	24.9	0%	Negligible

Table 6.4: Predicted PM₁₀ Impacts at Specified Receptors

Calculated PM ₁₀ Annual Mean (µg/m ³)				
Receptor	2021 Baseline	2021 Baseline + Scheme	% Change of Objective	Impact Descriptor
R1	19.9	20.2	1%	Negligible
R2	19.8	19.8	0%	Negligible
R3	16.2	16.2	0%	Negligible
R4	18.9	18.9	0%	Negligible
R5	19.4	19.4	0%	Negligible
R6	19.2	19.2	0%	Negligible
R7	18.0	18.0	0%	Negligible
R8	21.4	21.4	0%	Negligible
R9	20.6	20.6	0%	Negligible

Table 6.5: Predicted PM_{2.5} Impacts at Specified Receptors

Calculated PM _{2.5} Annual Mean (µg/m ³)				
Receptor	2021 Baseline	2021 Baseline + Scheme	% Change of Objective	Impact Descriptor
R1	10.0	10.1	1%	Negligible
R2	10.0	10.0	0%	Negligible
R3	8.6	8.6	0%	Negligible
R4	9.2	9.2	0%	Negligible
R5	9.5	9.5	0%	Negligible
R6	10.0	10.0	0%	Negligible
R7	9.5	9.5	0%	Negligible
R8	10.6	10.6	0%	Negligible
R9	11.3	11.3	0%	Negligible

NO₂

- 6.1.9 The modelled NO₂ concentrations in Table 6.3 show that NO₂ concentration at all specified receptor locations are below the annual mean objective (40 µg/m³). Using the matrix in Table 3.2, it can be seen that the impacts are anticipated to be **negligible**.
- 6.1.10 Based on the annual average mean concentration at all reports being below 60 µg/m³, it is unlikely that any receptor identified would experience an exceedance of the 1-hour mean objective.

PM₁₀

- 6.1.11 The modelled PM₁₀ concentrations in Table 6.4 do not predict any exceedances of the annual mean objective (40 µg/m³) at any of the specified receptor locations. Using the matrix in Table 3.2, it can be seen that the impacts are anticipated to be **negligible**.
- 6.1.12 For PM₁₀, the following equation can be used to derive the number of days that the 24-hour mean objective (50 µg/m³) is likely to be exceeded.

$$\text{No. 24 hour exceedances} = -18.5 + 0.00145 \times \text{annual mean}^3 + \left(\frac{206}{\text{annual mean}} \right)$$

- 6.1.13 The highest annual mean PM₁₀ concentration in Table 6.5 is 21.4 µg/m³ at Receptor R8. Based on the formula above, this predicts 5.4 exceedance days, which is below the 35-days annual limit. It is therefore thought that none of the receptors would be exposed to any material impact from the short-term concentrations of PM₁₀.

PM_{2.5}

- 6.1.14 The modelled PM_{2.5} concentrations in [Table 6.5](#) do not predict any exceedances of the Stage 2 Post 2020 annual mean objective (20 µg/m³) at any of the specified receptor locations. Using the matrix in [Table 3.2](#), it can be seen that the impacts are anticipated to be **negligible**.

Significance of Impacts

- 6.1.15 As set out above, the impacts on the receptors associated with the proposed development are anticipated to be 'negligible' for NO₂, PM₁₀ and PM_{2.5} concentrations. The concentrations do not exceed the relevant nation objectives as set out in [Table 2.1](#). Based on this, and in accordance with the IAQM (2017) guidance and professional judgement, the impacts can be considered 'not significant'.

6.2 Plant Emissions

- 6.2.1 At this stage, it has not been possible to undertake a quantitative assessment of any operational plant, as it is unknown if any will be proposed.

7 Mitigation Measures

7.1 Construction

- 7.1.1 A construction dust assessment has been undertaken in [Section 5](#) and the outcome of which has been utilised within this section to advise upon the adequate level of mitigation that will be required.
- 7.1.2 A range of measures are suggested, which could be utilised during the construction phases are set out below. These have been outlined in the IAQM (2016) document, and should be used to reduce the impacts of the construction phases on the local sensitive receptors.
- 7.1.3 Further general guidance on potential mitigation measures can be found in [Appendix D](#).

Earthworks

- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable;
- Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable; and
- Only remove the cover in small areas during work and not all at once.

Construction

- Avoid scabbling (roughening of concrete surfaces) if possible;
- 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;
- 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; and
- For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.

Trackout

- Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use;
- Avoid dry sweeping of large areas;
- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport;
- Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable;
- Record all inspections of haul routes and any subsequent action in a site logbook; and
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).

7.2 Operational

Operational Mitigation

- 7.2.1 The results of the air quality assessment demonstrated that the air quality concentrations at existing receptors, on the development site and modelled diffusion tube locations are not anticipated to be at a level that would adversely impact sensitive receptors and would fall within the NO₂ (40 µg/m³), PM₁₀ (40 µg/m³) and PM_{2.5} (20 µg/m³) annual mean objectives.
- 7.2.2 It should be noted that the proposed scheme is anticipated to be having a **negligible** adverse impact, and 'not significant.' Any mitigation measures to aid in reducing impacts should be proportionate to the impact of the scheme. This is highlighted in the EPUK & IAQM (2017) guidance, which reiterates the PPG, stating:
- "Mitigation options where necessary, will depend on the proposed development and should be proportionate to the likely impact"*
- 7.2.3 Therefore, specific measures are not considered necessary to mitigate the impact on the existing receptors. Notwithstanding this the following inherent mitigation is being provided within the scheme:
- 42 cycle spaces; and
 - 5 % of parking spaces will have electric vehicle charging facilities.

8 Summary & Conclusions

8.1 Baseline

- 8.1.1 The proposed scheme is not situated within an AQMA. The closest NO₂ monitoring locations to the site carried out by KMBC show a mixture of compliance and non-compliance of the NO₂ annual mean objective in 2019. Where non-compliance is concerned, it has been demonstrated that the location is not representative of concentrations at the proposed development site. The DEFRA background concentrations set out in [Table 4.2](#) indicates that the objectives, as set out in [Table 2.1](#), are not being exceeded on site.

8.2 Construction Phase

- 8.2.1 A construction dust assessment has been undertaken for the construction phase associated with the proposed development, in accordance with IAQM (2016) and guidance, as set out in [Appendix A](#).
- 8.2.2 Following the successful implementation of the suggested mitigation measures, as set out in [Section 7](#) and [Appendix D](#), the residual effects of construction dust and emissions from demolition and construction activities upon the local area and sensitive receptors, although adverse, will be temporary and **'not significant'**.

8.3 Operational Phase

- 8.3.1 The air quality modelling exercise indicates that the scheme will result in a **negligible** adverse impact on baseline air quality concentrations at the specified receptor locations, with concentrations remaining within the relevant objectives set out in [Table 2.1](#), and are therefore considered to be **'not significant.'**
- 8.3.2 It can, therefore, be concluded that the proposed development is not considered to conflict with national and local planning guidance referenced in this assessment.

APPENDICES

APPENDIX A – CONSTRUCTION DUST RISK ASSESSMENT METHODOLOGY

The effects associated with the site preparation, earthworks and construction phase of the Proposed Scheme have been determined qualitatively using criteria provided in the IAQM guidance and professional judgement.

The significance of effects associated with the site preparation, earthworks and construction phase of the Proposed Development has been determined qualitatively and involved the following tasks:

- Evaluation of the proposed Site layout, to evaluate size of the Site and possible site construction activities that could generate dust and PM₁₀, their likely location and duration. No information on the precise construction plan was available at the time of undertaking the current assessment and hence assumptions were made;
- Collection and appraisal of meteorological data related to wind speed, direction and frequency, and precipitation for the local and wider area;
- Identification of any natural shelters, such as trees, likely to reduce the risk of wind-blown dust;
- In the case of PM₁₀, mapping of local background concentrations;
- Assessing the potential distance which the construction traffic will travel across unpaved roads on the construction Site, prior to accessing the local road network (referred to as 'trackout');
- Identification of the location and type of sensitive receptors within 350m of the boundary of the Site and/or within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the Site entrance(s) (at-risk receptors);
- Indication of the number of receptors and sensitivity types at different distances from the Site boundary (or dust generating activities wherever known);
- Assessment of the risk of dust and PM₁₀ effects arising using three risk categories: low risk, medium risk, and high risk. The Site was allocated to a risk category based on two factors:
 - The scale and nature of the works, which determined the magnitude of potential dust emissions classed as: small, medium or large; and
 - The type and proximity of receptors, considered separately for human and ecological receptors, which determined the sensitivity of the area.

The criteria developed by IAQM is divides the activities on construction sites into four different types to assess their different level of impacts upon receptors. These are:

- Demolition;
- Earthworks;
- Construction; and
- Trackout.

The assessment procedure includes four steps summarised below:

STEP 1 - SCREENING THE NEED FOR A FULL ASSESSMENT

The following screening criterion has been applied to the assessment: An assessment will normally be required where there is:

- A 'human' receptor within:
 - 350m of the Site boundary; or
 - 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).
- An 'ecological' receptor within:
 - 50m of the Site boundary; or
 - 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).

Should this criterion not be met it can be concluded that the level of risk upon receptors is negligible and therefore the effects are not significant, and therefore no mitigation measures will be required.

STEP 2 - ASSESS THE RISK OF DUST ARISING

The Site is given a risk classification based upon the following two factors:

- The scale and nature of the construction works, to provide the potential dust emission magnitude (Step 2A); and
- The sensitivity of the area / receptors to the dust impacts (Step 2B).

These two factors are combined in Step 2C, which is to determine the risk of dust impacts with no mitigation applied. The risk categories assigned to the site may be different for each of the four potential sources of dust (demolition, earthworks, construction and trackout).

STEP 2A - DEFINE THE POTENTIAL DUST EMISSION MAGNITUDE

The dust magnitude is categorised by the following:

- Small;
- Medium; or
- Large.

The IAQM provide a brief description upon what could apply for each classification (as set out in [Table A1](#)) and should be based upon professional judgement.

Table A1: Dust Magnitude Classification

Magnitude Class	Demolition
Large	Total building volume >50,000m ³ , potentially dusty material, on-site crushing and screening, activities >20m above ground level.
Medium	Total building volume 20,000-50,000m ³ , potentially dusty construction material, demolition activities 10-20m above ground level.
Small	Total building volume <20,000m ³ , construction material with low potential for dust release, demolition activities <10m above ground, works during wetter months.
	Earthworks
Large	Total site area over 10,000 m ² , potentially dusty soil type (e.g. clay), >10 heavy earth moving vehicles active at any one time, formation of bunds > 8 m in height, total material moved > 100,000 tonnes.
Medium	Total site area between 2,500 to 10,000 m ² , moderately dusty soil type (e.g. silt), 5 – 10 heavy earth moving vehicles active at any one time, formation of bunds 4 - 8 m in height, total material moved 20,000 to 100,000 tonnes.
Small	Total site area less than 2,500 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, total material moved < 10,000 tonnes earthworks during winter months.
	Construction

Large	Total building volume over 100,000 m ³ , activities include piling, on-site concrete batching, and sand blasting. Period of activities more than two years.
Medium	Total building volume between 25,000 and 100,000 m ³ , use of construction materials with high potential for dust release (e.g. concrete), activities include piling, on-site concrete batching. Period of construction activities between one and two years.
Small	Total building volume below 25,000m ³ , use of construction materials with low potential for dust release (e.g. metal cladding or timber). Period of construction activities less than one year.
Trackout	
Large	> 50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100m. (Trackout may occur up to 500m from the site entrance).
Medium	10-50 HDV (>3.5t) outwards movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50m – 100m. (Trackout may occur up to 200m from the site entrance).
Small	<10HDV (>3,5t) outward movements in any one day. (Trackout may occur up to 50m from the site entrance).

STEP 2B - DEFINE THE SENSITIVITY OF THE AREA

The sensitivity of the area / receptor is defined by taking account of the following factors and the criteria set out in [Tables\(s\) A2 to A5](#):

- The type of receptors in the area;
- The distance and number of receptors; and
- Background PM10 concentrations.

Table A2: Defining Receptor Sensitivity

Receptor Sensitivity	Human	Ecological
High	Very densely populated area, 10-100 dwellings within 20m of site. Annual mean concentrations of PM ₁₀ close to/in exceedence of the national objective (40 µg m ³). Very sensitive receptors (e.g. residential properties, hospitals, schools, care homes).	Internationally or nationally designated site, the designated features may be affected by dust soiling. A location where there is dust sensitive species present.
Medium	Densely populated area, 1-10 dwellings within 20m of site. Annual mean concentrations of PM ₁₀ below the national objective (> 28 µg m ³). Medium sensitivity receptors (e.g. office and shop workers).	Nationally designated site where the features may be affected by dust deposition. A location with a particularly important plant species where its dust sensitivity is unknown.
Low	Sparsely populated area, 1 dwelling	Locally designated site where the

	within 20m of site. Annual mean concentrations well below the national objectives ($< 28 \mu\text{g m}^{-3}$). Low sensitivity receptors (e.g. public footpaths, playing fields, shopping streets).	features may be affected by dust deposition.
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Table A3: Sensitivity of the Area to Effects on People and Property from Dust Soiling

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	Low	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table A4: Sensitivity of the Area to Human Health Effects

Receptor Sensitivity	Annual Mean PM_{10}	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32 $\mu\text{g/m}^3$	>100	High	High	High	Medium	Low
		10 – 100	High	High	Medium	Low	Low
		1 – 10	High	Medium	Low	Low	Low
	28 – 32 $\mu\text{g/m}^3$	>100	High	High	Medium	Low	Low
		10 – 100	High	Medium	Low	Low	Low
		1 – 10	High	Medium	Low	Low	Low
	24 – 28 $\mu\text{g/m}^3$	>100	High	Medium	Low	Low	Low
		10 – 100	High	Medium	Low	Low	Low
		1 – 10	Medium	Low	Low	Low	Low
	<24 $\mu\text{g/m}^3$	>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

Table A5: Sensitivity of the Area to Ecological Effects

Receptor Sensitivity	Distance from the Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

STEP 2C – DEFINE THE RISK OF IMPACTS

The dust emission magnitude determined at Step 2A is combined with the sensitivity of the area determined at Step 2B to determine the risk of impacts with no mitigation applied. The IAQM provides the matrix in Table A6 as a method of assigning the level of risk for each activity.

Table A6: Defining the Risk of Dust Impacts

Sensitivity of the 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
Trackout			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

STEP 3 – IDENTIFY THE NEED FOR SITE SPECIFIC MITIGATION

From the identification of the risk of impacts with no mitigation, it is possible to determine the specific mitigation measures that can be applied in relation to the level of risk associated with the construction activity. The mitigation measures described below are suggested as measures that could be utilised. Specific measures of which are included in [Section 7](#) (and general mitigation measures are set out in [Appendix D](#)) of this report.

STEP 4 – DETERMINE SIGNIFICANT IMPACTS

The IAQM does not provide a method for assessing the significance of effects before mitigation and advises that pre-mitigation significance should not be determined. With appropriate mitigation in place, the IAQM guidance is clear that the residual effect will normally be 'not significant'.

APPENDIX B – TRAFFIC DATA

Verification

Table B.1 – 2019 Verification Traffic Flows

Link	Speed (Kph)	2019 Traffic Flows		
		Total Vehicles	HGV	HGV%
Moorgate Road	64	19257	2118	11%
County Road	48	10181	461	5%

Traffic Scenarios

Table B.2 – 2021 Future Baseline Scenario Traffic Flows

Link	Speed (Kph)	2021 Traffic Flows		
		Total Vehicles	HGV	HGV%
Penrhyn Road - adjacent to site	64	290	14	5%
A580 - East of Knowsley Lane	97	24300	2027	8%
School Lane - east of Penrhyn Road	64	7572	617	8%
School Lane - west of Penrhyn Road	64	7572	617	8%
M57 South of J4	113	102287	8089	8%
A580 - West of J4	64	40464	2223	5%
M57 North of J4	113	66955	7017	10%
Moorgate Road - north of J4	64	19785	2176	11%

Table B.3 – 2021 Future Baseline + Proposed Development Scenario Traffic Flows

Link	Speed (Kph)	2021 Traffic Flows		
		Total Vehicles	HGV	HGV%
Penrhyn Road - adjacent to site	64	1004	321	32%
A580 - East of Knowsley Lane	97	24353	2057	8%
School Lane - east of Penrhyn Road	64	7572	617	8%
School Lane - west of Penrhyn Road	64	8170	894	11%
M57 South of J4	113	102509	8243	8%
A580 - West of J4	64	40630	2269	6%
M57 North of J4	113	67133	7079	11%

Moorgate Road - north of J4	64	19812	2191	11%
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APPENDIX C – VERIFICATION PROCESS

Model verification studies are undertaken in order to check the performance of dispersion models and, where modelled concentrations are significantly different to monitored concentrations, a factor can be established by which the modelled results can be adjusted in order to improve their reliability. The model verification process is detailed in LAQM.TG(16).

According to TG(16), no adjustment factor is necessary where the results of the model all lie within 25% of the monitored concentrations, but ideally within 10%.

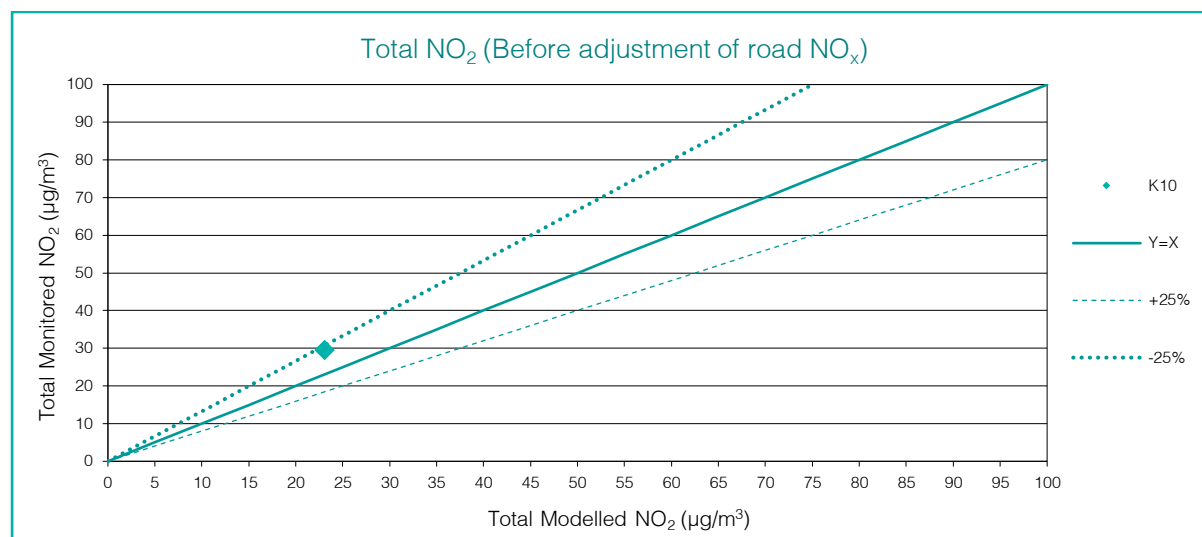
Model verification can only be undertaken where there is sufficient roadside monitoring data in the vicinity of the subject scheme being assessed. TG(16) recommends that a combination of automatic and diffusion tube monitoring data is used; although this may be limited by data availability. For this assessment, one diffusion tube monitoring site was used to verify NO₂ against. The monitoring station is located on County Road in Knowsley. To note, no PM₁₀ or PM_{2.5} monitoring has been close to the site so it has not been possible to verify against these pollutant.

Table C.1 compares the monitored and modelled NO₂ concentrations at the monitoring location, and Figure C.1 illustrates the difference between the monitored and modelled concentrations.

Table C.1: Comparison of Monitored and Modelled NO₂ Concentrations

Site ID	Type	Concentrations (µg/m ³)		
		Monitored	Modelled	% Difference
K10	Diffusion Tube	29.4	23.07	-21.5

Figure C.1: Comparison of Monitored and Modelled Concentrations



The data in Table(s) C.1 shows that the model is under-predicting NO₂ concentrations. This is not unusual and is likely to be the result of local dispersion conditions.

As the difference for NO₂ is greater than +/- 10%, an adjustment factor has been derived to ensure a conservative assessment is undertaken.

As it is primary NO_x rather than secondary NO₂ emissions that are modelled, an adjustment factor must be derived for the road contribution of NO_x. A ratio of the modelled versus monitored NO_x

concentrations using the least squares statistical method has been undertaken to derive an adjustment factor, as set out in [Table C.2](#).

Table C.2: Deriving the NO_x Adjustment Factor

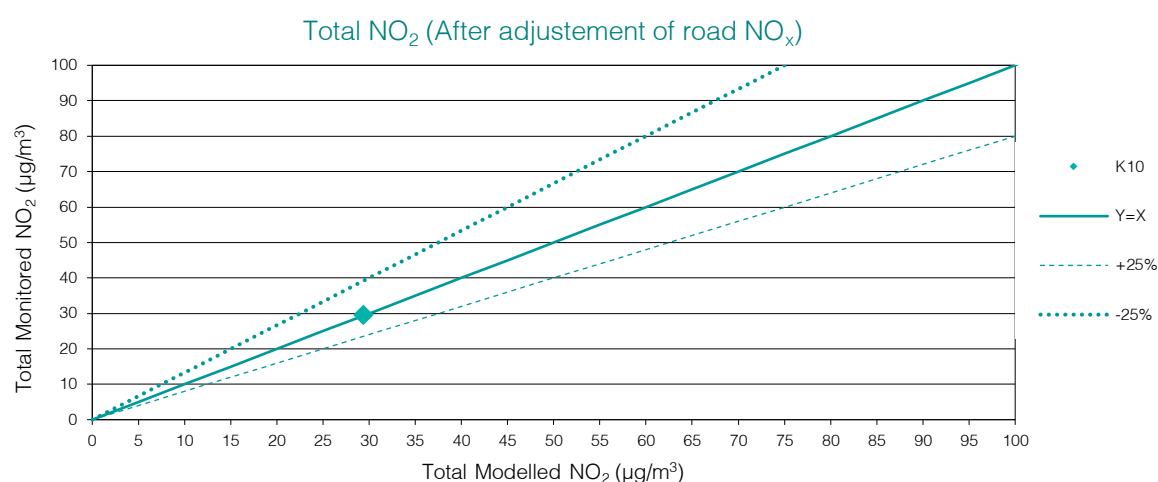
Site	Monitored Road NO _x	Modelled Road NO _x	Ratio
M6 Motorway Junction 9	22.59	10.00	2.260

[Table C.3](#) compares monitored and modelled NO₂ concentrations at the monitoring location after the adjustment factor has been applied. This is also illustrated in [Figure C.2](#).

Table C.3: Comparison of Monitored and Adjusted Modelled NO₂ Concentrations

Site ID	Type	Concentrations (µg/m ³)		
		Monitored	Modelled	% Difference
K10	Diffusion Tube	29.4	29.4	0

Figure C.1: Comparison of Monitored and Modelled Concentrations



The data in [Table C.4](#) shows that the NO₂ concentration in the model are now within 10% of the monitored concentration, indicating that the model is performing acceptably.

A Root Mean Square Error (RMSE) has been calculated in [Table C.4](#) to determine the error within the calculations after Road-NO_x adjustment, based upon the following calculation:

$$RMSE = \sqrt{\frac{1}{N} \sum_{i=1}^N (Obs_i - Pred_i)^2}$$

Table C.4: NO₂ Root Mean Squared Error

Site	Observations	Predictions	RMSE
K10	29.4	29.4	0.0

The calculated RMSEs above for NO₂ is 0.0 µg/m³, which correlates to a 0% error ratio. The RMSE above show that modelled results are acceptable, as they are within the ideal 10% margin of error (as advised in TG(16)).

APPENDIX D – GENERAL MITIGATION MEASURES

COMMUNICATIONS

- Develop and implement a stakeholder communications plan that includes community engagement before work commences on site;
- 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; and
- Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site. In London additional measures may be required to ensure compliance with the Mayor of London's guidance. The DMP may include monitoring of dust deposition, dust flux, realtime PM₁₀ continuous monitoring and/or visual inspections.

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 the complaints log available to the local authority when asked; and
- 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.

MONITORING

- Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of site boundary, with cleaning to be provided if necessary;
- Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked; and
- 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; and
- Agree dust deposition, dust flux, or real-time PM₁₀ continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.

PREPARING AND MAINTAINING THE SITE

- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible;
- Erect solid screens or barriers around dusty 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 active 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 ensure they are kept covered; and
- 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 practicable;
- Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate);
- Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials; and
- Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).

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 suppression/mitigation, using non-potable water where possible and appropriate;
- Use enclosed chutes and 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; and
- 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.

WASTE MANAGEMENT

- Avoid bonfires and burning of waste materials.



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