APPENDIX 6.1 AIR QUALITY POLICY AND LEGISLATION

6.1A.1 The assessment considers the relevant air quality legislation and Local Air Quality Management Technical Guidance. Relevant planning policy is considered at the national, regional and local level.

6.1A.2 Table 6.1-a below summarises key legislation and policy relevant to the protection of air quality.

Table 6.1-a: Relevant air quality legislation

Applicable Law	Description
Environmental Protection Act 1990 Part III	Provides statutory nuisance provisions for nuisance dust
Environment Act 1995, Part IV	Defines requirements for Local Air Quality Management
Air Quality (England) (Amendment) Regulations 2000 / 2002	Legislates for the limit values for pollutants set out in the 2007 Air Quality Strategy
The National Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland, 2007	Updates the 2000 Air Quality Strategy
The Air Quality Standards Regulations 2010, as amended (2016)	Transpose formalised limit values set out in the EU ambient air quality directive 2008/50/EC to UK law

6.1A.3 Directive 2008/50/EC consolidates previous European Directives on ambient air quality and sets legally binding limit values for concentrations of major air pollutants that affect human health. These became law in England through the Air Quality Standards Regulations 2010[1], as amended (2016).

6.1A.4 In order to meet these limit values and in accordance with the requirements under the *Environment Act 1995* the Government produced a national air quality strategy[2]. This strategy sets out Air Quality Objectives (AQOs) and policy options for the UK and recognises that action at national, regional and local level may be needed[3]. Although published in 2007, the Air Quality Strategy is consistent with 2010 Regulations.

6.1A.5 The UK government is responsible to the European Commission (EC) for ensuring that it complies with the provisions of the EU Directives. The UK government and governments of other member states are currently in negotiations with the EC over breaching limit values for PM_{10} (particulate matter with an aerodynamic diameter of less than 10 microns) and nitrogen dioxide (NO_2).

6.1A.6 On the UK government's behalf, the Department for Transport (DfT) and Department for Environment Food and Rural Affairs (Defra) have Public Service Agreements relating to EU limit values.

6.1A.7 Local Authorities have statutory duties for Local Air Quality Management (LAQM), but are not obliged to ensure AQOs are met. Their responsibilities differ to those of the UK Government to the EC regarding compliance with air quality standards. The role of local authorities is discussed in 6.1A.15

Air Quality Strategy for England, Scotland, Wales and Northern Ireland

6.1A.8 The National Air Quality Strategy for England, Scotland, Wales and Northern Ireland (the AQS) establishes AQOs for a number of specific pollutants. The pollutants relevant to this assessment are nitrogen dioxide (NO_2) nitrogen oxides (NO_x), and PM_{10} (see Table 6.1-b). The dates were set out in the AQS, and remain valid.

Table 6.1-b: Air Quality Strategy Objectives (AQOs)

Pollutant	Description		Date to be achieved by
	Concentration	Measured as	
Nitrogen Dioxide (NO_2)	200 µg/m^3 not to be exceeded more than 18 times/yr (99.79th percentile)	1 hour mean	31-12-2005
	40 µg/m^3	Annual mean	31-12-2005
Nitrogen Oxides (NOx)	30 µg/m^3	Annual mean	19-07-2001
Particulate Matter (PM_{10})	50 µg/m3, not to be exceeded more than 35 times/yr (90.41th percentile)	24 hour mean	31-12-2004
	40 µg/m^3	Annual mean	31-12-2004

6.1A.9 For a full description of the terms used in relation to air quality, the science and the legislation, reference should be made to the AQS documents, and to the supporting Defra Local Air Quality Management Technical Guidance[4], referred to hereafter as 'LAQM TG(16)'.

6.1A.10 There are no assessment methods available that can produce robust predictions of short term concentrations from road traffic. Therefore, compliance with the short term AQOs is assessed by following the guidance presented in LAQM TG(16), which provides a relationship between the annual mean concentration and the number of periods per year

[1] Department for Environment Food & Rural Affairs. (2011). *UK and EU Air Quality Policy Context*. EU Level. Accessed on 11 November 2014 from http://uk-air.defra.gov.uk/air-pollution/uk-eu-policy-context

[2] Department for Environment Food and Rural Affairs. (2007). *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*. Crown Copyright, Norwich, July 2007

[3] Department for Environment Food & Rural Affairs. (2011). *UK and EU Air Quality Policy Context*. UK Level: National and Local Authorities. Accessed on 11 November 2014 from http://uk-air.defra.gov.uk/air-pollution/uk-eu-policy-context

[4] Defra (2016) Local Air Quality Management Technical Guidance LAQM.TG(16)

where the short term AQO is likely to be exceeded. These relationships have been derived from examination of monitoring data across the UK.

6.1A.11 The annual mean equivalent concentration for the NO_2 1 hour mean AQO is 60 µg/m^3, whilst the annual mean equivalent concentration for the PM_{10} 24 hour mean AQO is 32 µg/m^3.

6.1A.12 AQOs are health-based standards that are set at a level to provide protection to the whole population.

6.1A.13 Responsibility for determining whether AQOs are complied with lies with Local Authorities within the system of Local Air Quality Management (LAQM). Local Authorities are required to review and assess air quality within their districts, against the AQOs. Where the AQOs are not being met at relevant locations, they must declare Air Quality Management Areas (AQMAs). Within eighteen months of doing so, Local Authorities should publish an Air Quality Action Plan (AQAP) setting out measures to work towards reducing the concentrations of the relevant pollutants to below the relevant AQOs by given dates. The given dates for compliance with the AQOs as described in the National Air Quality Strategy for England, Scotland, Wales and Northern Ireland have all now passed. Local air quality management is an ongoing process beyond these dates, and where exceedances persist, or new exceedances occur, Local Authorities have the same obligations to declare AQMAs and publish/implement AQAPs to bring pollutant concentrations back within compliance.

6.1A.14 Pollutants such as benzene and 1,3 butadiene are associated with the use of fuels for road transport (petrol).

6.1A.15 The AQS and TG(16) introduce measures to control exposure to $PM_{2.5}$ (the fraction of particulate matter with an average aerodynamic diameter less than 2.5 µm). This is intended to be delivered at the national level, so the control of $PM_{2.5}$ concentrations has not been incorporated into LAQM, and authorities have no statutory obligation to review and assess against them. The AQS objective value of 25 µg/m^3 is designed to deliver a minimum level of protection everywhere. Impacts of roads schemes on ambient $PM_{2.5}$ concentrations are typically insignificant, and accordingly DMRB doesn't require the assessment of $PM_{2.5}$.

APPENDIX 6.2 AIR QUALITY ASSESSMENT METHODOLOGY

Assessment approach and method

6.2A.1 The assessment identifies the potential air quality effects by predicting the changes in air quality pollutant concentrations which would result from the combination of background concentrations with the contributions from the roads in the study area, including the Scheme.

6.2A.2 This assessment conforms to the standard practice of environmental impact assessment, whereby the baseline is established, and then the situation with the development in place (Do Something (DS)) is compared with the situation without it (Do Minimum (DM)).

6.2A.3 The potential impacts of the proposed route options have been assessed following HA207/07[5] and the associated Interim Advice Notes[6], and LAQM TG(16). Following the process set out in HA207/07, a detailed assessment has been carried out using the dispersion modelling software, Air Dispersion Model Software (ADMS)-Roads (Version 4.1).

6.2A.4 As explained in Section 5.4, the operational impacts assessment uses the 2021 and 2036 DM and DS traffic models where the future baseline includes the road network and traffic flow changes associated with the Testo's scheme and IAMP One and IAMP Two developments. The construction impact assessment assumes IAMP One has been built (and operational) and the Testo's scheme is under construction when the Scheme starts construction; cumulative construction effects with the IAMP Two development being built at the same time as the Scheme are considered in Chapter 15.

Assessment scenarios

6.2A.5 The assessment covers different geographic scales, as follows:

- Local air quality, focusing only on the headline pollutants NO_2 and PM_{10}; and
- Regional air quality, focusing on NO_x, PM_{10} and carbon dioxide (CO_2) emissions.

6.2A.6 The assessment method is to quantify the ambient pollution concentrations for a number of road traffic scenarios. Traffic data was utilised for the following scenarios for the local air quality assessment:

- Baseline Year 2012.
- Without Scheme or 'Do Minimum' ('DM'): Opening Year 2021.
- With Scheme or 'Do Something' ('DS'): Opening Year 2021.

6.2A.7 In addition, future scenarios set 15 years after opening are considered for the regional air quality assessment, but not for local air quality[7]:

- Assessment Year 2036 – Without Scheme – Do Minimum.
- Assessment Year 2036 – With Scheme – Do Something.

6.2A.8 Assessment of potential impacts at designated habitat sites would focus on nitrogen deposition and NO_x concentrations, at sites within 200 m of affected roads. However, only sites designated at international or European level are considered in the air quality assessment. There are no sites designated at this level within 200 m of the affected roads. A designated habitats assessment is therefore not required within this air quality assessment, and is not discussed further.

Traffic data

6.2A.9 Traffic data for the modelling scenarios has been provided from the Saturn traffic models. The base year air quality modelling uses traffic data, pollution measurements and meteorological measurements from 2012; this is due to the traffic model using 2012 baseline data, as explained and validated within Sections 2.10 and 5.4 in Chapters 2 and 5 of the ES, respectively. With reference to Chapter 5 of the ES, traffic flow data from traffic models TA1 and ES1 has been used in this assessment to represent the worst case traffic scenario for air quality.

6.2A.10 Interim Advice Note (IAN 185/15) has been published by Highways England (formerly the Highways Agency). The IAN provides supplementary guidance to HA207/07 regarding traffic speeds and the generation of speed-band banding for vehicle emissions.

6.2A.11 For the purposes of this assessment, traffic data which represents the average conditions in specific time periods, with the corresponding speed-band has been utilised for the detailed assessment. These time periods are detailed in Table 6.2-a.

Table 6.2-a: Annual Average Time Periods Used

Traffic Period	Time Period
Annual Average Daily Traffic (AADT)	00:00 – 23:00
Annual Average Weekday Traffic (AAWT) AM Peak (AM)	06:30 – 10:00
AAWT Inter-Peak (IP)	10:00 – 15:00
AAWT PM Peak (PM)	15:00 – 19:00
AAWT Off Peak (OP)	19:00 – 06:30

6.2A.12 For each time period, the following traffic data parameters were provided:

- Total traffic flow, defined as vehicles/hr;
- Percentage heavy duty vehicles (HDV); and
- Vehicle speed (and speed-band).

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5 Highways Agency (2007) DMRB Volume 11 Section 3 Part 1 (HA 207/07) Environmental assessment. Environmental assessment techniques. Air quality.

6 Highways Agency (2015) Interim Advice Note 185/15 Updated traffic, air quality and noise advice on the assessment of link speeds and generation of vehicle data into 'speed-bands' for users of DMRB Volume 11, Section 3, Part 1 'Air Quality' and Volume 11, Section 3. Part 7 'Noise'.

7 DMRB Guidance (DMRB, Vol 11 Section 3, Part 1 HA 207/07) suggests that for local air quality, the assessment should be done on the opening year and possibly a later year if more stringent air quality criteria come into effect at a later date. This is due to local air quality effects being greatest in the earlier years as vehicle emissions are set to decrease in the future due to increasingly stringent vehicle emissions legislation. No such change in air quality criteria was identified, so the future year assessment has not been undertaken for local air quality.

Local air quality assessment methodology

6.2A.13 The ADMS-Roads Software has been developed by Cambridge Environmental Research Consultants Ltd (CERC). It is an atmospheric modelling system that focuses on road traffic as a source of pollutant emissions, and is a recognised tool for carrying out air quality impact assessments and has been comprehensively validated by both the manufacturers and independently.

6.2A.14 The software is used both by regulatory authorities and commercially to assist in decisions related to air quality and traffic management, urban planning and public health in many countries around the world. Version 4.1 (January 2018) was used for this assessment.

6.2A.15 It should be noted that dispersion models provide an estimate of concentrations arising from input emissions and historical meteorological data. The estimates produced, while appropriately representing the complex factors involved in atmospheric dispersion, are subject to uncertainty. Whilst the predictions provided by the models should not be regarded as definitive statements of concentrations that will arise in the future, they are the most reasonable, robust and representative estimates available. The estimates are composed of calculations made at a single point on each residential property.

Meteorological data

6.2A.16 The effect of meteorological conditions on dispersion is given a complex treatment within the model. The most significant factors in the dispersion of emitted pollutants are wind speed and direction. The meteorological data site considered to be most representative of conditions across the study area was Newcastle Airport.

Vehicle emissions

6.2A.17 The modelling system takes into account the emissions produced by Light Duty Vehicles (LDV, less than 3.5 tonnes) and Heavy Duty Vehicles (HDV, greater than 3.5 tonnes) travelling along a section of road over an average hour and predicts the dispersion of these emissions.

6.2A.18 The traffic data was used to calculate the emission rate for each road link. These emissions are vehicle-weighted averaged emissions for the national vehicle fleet. Emissions factors used the values specified in IAN185/15, which are defined by year to represent the predicted vehicle fleet and the range of vehicle types and EURO emissions standards present across the fleet.

Receptors

6.2A.19 Within the study area, two types of receptors have been considered, as follows:

- residential properties and other sensitive receptors (such as schools, nursing homes, etc.); and
- nature conservation sites designated at International, European or national level.

6.2A.20 Building usage was determined using the Ordnance Survey Address Layer dataset, and calculations made at the nearest façade to the busiest road.

6.2A.21 A total of 55 receptors were included in the local air quality assessment, and selected using professional judgement for being:

- representative of the maximum impacts of the Scheme in that region; and
- at risk of exceeding the annual mean NO_2 AQO.

6.2A.22 All locations referred to as 'receptors' are treated as being equally sensitive.

Background concentrations

6.2A.23 'Background' air quality is a concept used to enable assessments of the effects of a specific source of emissions, without also the need of considering all the other sources of emissions in the area individually. For the purposes of this assessment, the background air quality represents the concentrations of pollutants that would be present if there were no emissions from the roads included in the dispersion modelling. The pollution derived from the existing road is added to the background pollution concentrations.

6.2A.24 Defra provides national background maps, which provide estimates of background pollutant concentrations on a 1 km x 1 km grid square resolution; (http://www.laqm.defra.gov.uk). Whilst the most up to date information is held within the base year 2015 data, in order for a comparison with the A19 / A184 Testo's EIA base year 2013 data has been utilised. As the base scenario is 2012, background concentrations for NO_x, NO_2 and PM_{10} have been calculated using data for the period 2013-2017 to allow 2012 data to be factored, in accordance with principals and tools from Highways England.

6.2A.25 The 'in-grid square' contribution from motorway, trunk 'A' road and primary 'A' road sectors have been removed from the background annual mean NO_x and PM_{10} concentration estimates, and background annual mean NO_2 estimates have been corrected using the Defra's Background NO_2 Calculator[8]. Background concentrations that have these trunk roads and motorway contributions removed (known as 'sector removed'). This process has been undertaken to avoid double counting of road traffic emissions which are included in the dispersion model. Where predicted concentrations for specific receptors are presented, the sector-removed background concentrations used are also presented. The predicted background pollutant concentrations in the study area are significantly below the AQOs.

Prediction of environmental concentrations

6.2A.26 The model is used to predict the road traffic contributions to NO_x and PM_{10} concentrations at specified receptors. Adjustments are applied to the model predictions based on a comparison against measured air quality concentrations, in a process known as model verification and adjustment. The model is then used for predicting air quality concentrations in the future years.

6.2A.27 A further adjustment step is undertaken to account for the observed long term trends in ambient roadside NO_x and NO_2. This is predicted using the Gap Analysis methodology, which takes into account the Long Term Trends (LTT_{E6}) for NO_x and NO_2. This approach is considered more conservative and representative of opening year impacts

[8] Defra, NO_2 Background Sector Tool - for Source Apportioned Background NO_x v5.1

than the LAQM TG(16) methodology. The modelling, verification and adjustment processes are discussed in more detail in Appendix 6.4.

Construction assessment

6.2A.28 Using available information, and in line with the Institute of Air Quality Management (IAQM) 2014 Guidance, a construction dust assessment has been carried out, providing a qualitative risk-based appraisal with reference to the proposed scheme in relation to sensitive locations, the planned construction process, and the local site characteristics.

Regional assessment

6.2A.29 A HA207/07' regional air quality assessment has been undertaken for the study area. This is an estimate of the change in total emissions of PM_{10}, NO_x, carbon dioxide (CO_2) from all vehicles on the affected roads. The assessment was undertaken using the Defra Emissions Factor Toolkit (v7), using the traffic data provided for each link (and incorporating banded speed data), for each of the route options and for both the modelled year of opening (2021) and design year (2036). Defra Emissions Factor Toolkit (v7) was the most up-to-date version of the tool available when the assessment was carried out.

6.2A.30 The results of the regional assessment were also compared to the include a comparison to the National Atmospheric Emissions Inventory (NAEI) dataset 2016, as a percentage comparison. The NAEI provides emissions data for the UK for set years. Data for road transport emissions for 2016 have been used for the assessment.

TAG assessment

6.2A.31 As part of the HA207/07' guidance, a Transport Analysis Guidance (TAG) assessment (Department for Transport, 2012) has been undertaken. The assessment identifies changes in NO_2 and PM_{10} at properties within the study area.

6.2A.32 The local air quality TAG assessment creates an overall 'score' for the scheme, which is calculated on the basis of the number of residential properties within 200 m of affected roads, and the overall sum of the changes in NO_2 and PM_{10} pollutant concentrations at these properties. There are 431 relevant properties within the area covered by the local air quality TAG assessment for this scheme.

6.2A.33 As part of the TAG assessment, annual mass emissions of NO_x and CO_2 have also been calculated.

6.2A.34 The TAG assessment is discussed in more detail in Appendix 6.7.

Impact assessment and significance

6.2A.35 To convey the level of impact of the Scheme, it is necessary to determine its significance. The 'significance' of an environmental impact relates to the 'sensitivity' of the receptor and the 'scale' of the impact. The model results were used to assess whether there any significant effects as a result of the Scheme.

6.2A.36 Highways England's approach to evaluating significant air quality effects is set out in IANs 174/13[9] and 175/13[10]. These IANs are intended to reflect the change in national planning policy associated with the National Planning Policy Framework 2012 (NPPF). The NPPF was updated in July 2018[11], which strengthens the link between what local authorities are doing in the context of AQMAs and Clean Air Zone (CAZ) in that paragraph 181 states in relation to air quality 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 AQMAs and Clean Air Zones, and the cumulative impacts from individual sites on 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. Planning decisions should ensure that any new development in an AQMA or Clean Air Zone is consistent with the local air quality action plan.'* Therefore, application of these IANs was still appropriate, but extra consideration is necessary where the AQOs are likely to be exceeded.

6.2A.37 Highways England's approach to air quality assessment identifies and assesses sensitive receptors near roads where air quality might be affected. Consequently, areas where national AQOs might be expected to be exceeded are considered, which includes AQMAs. The model results are used to identify those receptors which are in exceedance of AQOs in either the DM or DS scenario. These are the only receptors which are considered in the judgement of significance. The change in predicted concentration is then calculated as the difference between DS and DM model results at these receptors.

6.2A.38 Where the difference in concentrations are less than 1% of the AQO (e.g. less than 0.4 $\mu g/m^3$ for annual average NO_2) then the change at these receptors is considered to be imperceptible and can be scoped out of the judgement on significance.

6.2A.39 Highways England has developed a framework to provide guidance on the number of receptors for each of the magnitude of change categories that might result in a significant effect. A judgement of significant effect is made in relation to the Scheme overall, and considers the aggregate of effect on all residential receptors exposure to exceedances of AQOs, and the risk of exceedance of EU limit values, rather than in relation to individual receptors.

6.2A.40 These are guideline values only and are to be used to inform professional judgement on significant effects of the Scheme. The guideline bands are based on Highways England's considered opinion and are intended to help provide consistency across all Highways England schemes. The significance categories and guideline property numbers are summarised in Table 6.2-b.

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[9] Highways Agency (2013) Interim Advice Note 174/13 Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 'Air Quality' (HA207/07)

[10] Highways Agency (2013) Interim Advice Note 175/13 Updated air quality advice on risk assessment related to compliance with the EU Directive on ambient air quality and on the production of Scheme Air Quality Action Plans for user of DMRB Volume 11, Section 3, Part 1 'Air Quality' (HA207/07)

[11] Department for Communities and Local Government (2018) The National Planning Policy Framework, https://www.gov.uk/government/collections/revised-national-planning-policy-framework, accessed August 2018.

Table 6.2-b: Guideline to Number of Properties Constituting a Significant Effect

Magnitude of Change in NO_2	Number of Receptors with:	
	Worsening of AQO already above objective or creation of a new exceedance	Improvement of an AQO already above objective or the removal of an existing exceedance
Large (>4 μg/m³)	1 to 10	1 to 10
Medium (>2 to 4 μg/m³)	10 to 30	10 to 30
Small (>0.4 to 2 μg/m³)	30 to 60	30 to 60

6.2A.41 The significance of the change is greater the higher above the air quality thresholds the changes are predicted to occur. Where it is predicted that the short-term thresholds are exceeded, then more significance should be attributed to these effects.

6.2A.42 The upper and lower thresholds presented in each cell of Table 6.2b are guidelines and not absolutes. On occasions when the number of properties affected is above the upper guideline threshold, consideration should be given to all the evidence that may support or detract from a conclusion of a significant effect when coming to a concluding view. The further above the upper guideline band the more likely local air quality effects would be significant.

6.2A.43 Where the results reside between the lower and upper guideline thresholds for any of the magnitude criteria, then the Scheme effects could be significant and a judgement is required taking into account the results for all six categories. This judgement is based on the technical knowledge and experience of the air quality professional. To assist this judgement, consideration should be given (but not limited) to the following.

6.2A.44 Scheme effects are more likely to be significant where:

- there are no / few receptors with any improvements;
- PM_{10} annual averages are also affected by small, medium or large deteriorations; &
- short term exceedances may be caused or worsened by the scheme for either NO_2 or PM_{10}.

6.2A.45 Scheme effects are more likely to be not significant where:

- there are receptors with small, medium or large improvements;
- PM_{10} annual averages are not affected by small, medium or large deteriorations; &
- short term exceedances are not caused or worsened by the Scheme for either NO_2 or PM_{10}.

6.2A.46 The establishment of overall air quality significance for the scheme should also consider:

- whether the Scheme detracts or supports measures set out in relevant local authority AQAPs;
- if the scheme represents a low or high compliance risk with the EU directive on air quality; or
- if any designated site(s) are affected, and potential effective mitigation.

6.2A.47 The EU Directive on Ambient Air Quality and Clean Air for Europe (2008/50/EC) sets limit values for a range of pollutants. The purpose of the Directive is to protect human health, and the environment as a whole. Defra reports annually (on behalf of the UK government) on the status of air quality to the European Commission. Highways England's Compliance Risk Assessment Test (IAN 175/13) has been developed to enable decision makers to judge a scheme's likelihood of non-compliance with the EU Directive. The compliance risk assessment test also informs the air quality significance test.

APPENDIX 6.3 AIR QUALITY DISPERSION MODEL SETUP

Introduction

6.3A.1 The ADMS-Roads model has been developed by Cambridge Environmental Research Consultants Ltd (CERC) and is a version of an atmospheric modelling system that focuses on road traffic as a source of pollutant emissions. Version 4.1 (January 2018) has been used for this study.

6.3A.2 The modelling system takes into account the emissions produced by light duty and heavy duty vehicles travelling at a certain speed along a section of road over an average hour and predicts the dispersion of these emissions using appropriate historical meteorological data. The effect of meteorological conditions on dispersion is given a complex treatment within the model. The most significant factors are wind speed and direction, and the boundary layer height which is the calculated mixed depth of the lower atmosphere.

Assessment scenarios

6.3A.3 In order to quantify the air quality impact of the Scheme, the pollutant concentrations resulting from the emissions from existing road traffic on local roads have been compared to those resulting from predicted traffic emissions with the Scheme in place.

6.3A.4 The following scenarios were modelled:

- base year (2012) existing situation;
- 2021 assessment year 'do minimum' – without the Scheme; and
- 2021 assessment year 'do something' - with the Scheme.

Modelling parameters

Road Parameters

6.3A.5 ADMS Roads requires lengths of road of equal width (and height if specified as a canyon (see 'street canyons' on the next page)) to be input into the model. Road alignment and width were determined using the Ordnance Survey Mastermap base mapping.

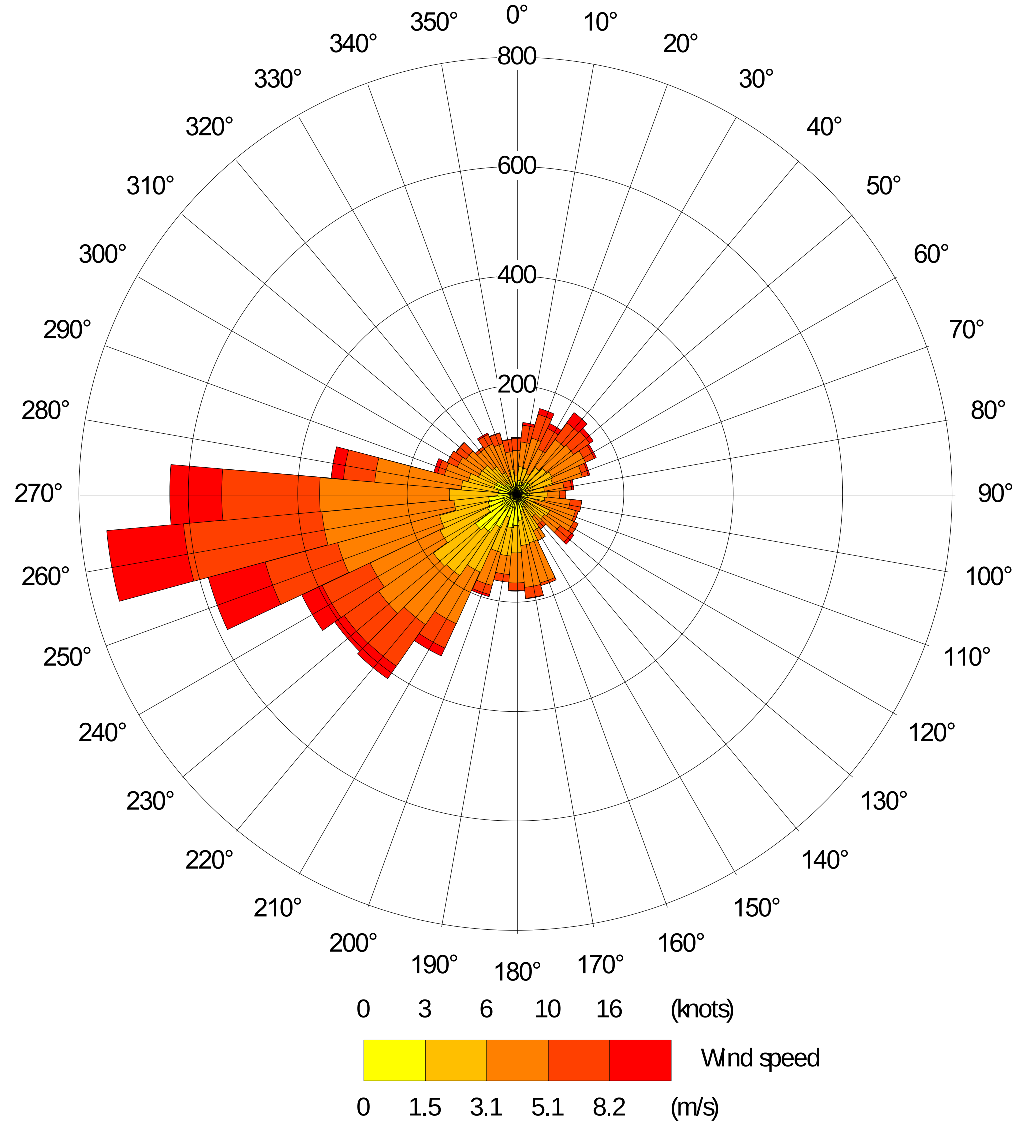
Traffic Emissions

6.3A.6 The traffic flow data for the model was prepared by Arup. Emission rates representing links in the traffic model were calculated based on the traffic flow, HDV composition, banded-speed and road type using IAN185/15[12], which is based on the UK Emission Factor Toolkit v7 produced by Defra.

Meteorological Data

6.3A.7 In order to assess the impact of the development upon local air quality using a dispersion model, it is important to use representative meteorological data. In simple terms, meteorology is the next most significant factor in determining ambient pollutant levels, after emissions.

6.3A.8 Meteorological data for the dispersion modelling assessment was taken from Newcastle Airport which is considered to be the most representative source for the study area. The windrose for 2012 is below[13].



Surface Roughness Length

6.3A.9 The surface roughness length at the meteorological data site, where the wind speed measurements taken at the airports and those across the Scheme areas, were both set to 0.5 m.

[12] Highways Agency (2015) INTERIM ADVICE NOTE 185/15 Updated traffic, air quality and noise advice on the assessment of link speeds and generation of vehicle data into 'speed-bands' for users of DMRB Volume 11, Section 3, Part 1 'Air Quality' and Volume 11, Section 3. Part 7 'Noise'

[13] A wind rose is a graphic tool used by meteorologists to give a succinct view of how wind speed and direction are typically distributed at a particular location. The wind rose shows the frequency of winds blowing *from* particular directions over a specified period. The length of each "spoke" around the circle is related to the frequency that the wind blows from a particular direction per unit time. Each concentric circle represents a different frequency, from zero at the centre to increasing frequencies at the outer circles. Each spoke is broken down into colour-coded bands that show wind speed ranges.

Monin Obukhov Length

6.3A.10 ADMS models use the Monin Obukhov length as a parameter to describe the turbulent length scale which is dependent on meteorological conditions. A minimum length can be used to account for the urban heat island effect, whereby retained heat in cities causes convective turbulence, which prevents the formation of a very shallow boundary layer at night. A minimum Monin Obukhov length of 30 m was set.

Terrain

6.3A.11 The terrain has an effect on the flow field in the air above it. It is recommended that the effect of terrain is incorporated into ADMS-Roads where gradients of greater than 10% exist within the modelled area, or a short way outside of it. These do not occur in the study area and it has not been necessary to include the effect of terrain in the assessment.

Street Canyons

6.3A.12 'Street canyons' in air quality modelling are roads with continuous high buildings on either side. This arrangement tends to impede the dispersion of pollutants from the road, particularly when the wind is at right angles to it, since a vortex is created in the street canyon, retaining the pollution.

6.3A.13 No road links in the study area were identified as being 'street canyons'. This feature was therefore not included within the modelling assessment.

Receptors

6.3A.14 A total of 55 representative receptors were included in the assessment. The building usage was identified using an Ordnance Survey Address Base Layer data within ArcGIS. The grid reference was adjusted to represent the worst-case façade of the property. All representative receptor points were given a height of 1.5 m.

APPENDIX 6.4 MODEL VERIFICATION & ADJUSTMENT

Introduction

6.4A.1 The comparison of modelled concentrations with local monitored concentrations is a process termed 'verification'. Model verification investigates the discrepancies between modelled and measured concentrations, which can arise due to the presence of inaccuracies and/or uncertainties in model input data, modelling and monitoring data assumptions. The following are examples of potential causes of such discrepancy:

- estimates of background pollutant concentrations;
- meteorological data uncertainties;
- traffic data uncertainties;
- model input parameters, such as 'roughness length'; and
- overall limitations of the dispersion model.

Model precision

6.4A.2 Residual uncertainty may remain after systematic error or 'model accuracy' has been accounted for in the final predictions. Residual uncertainty may be considered synonymous with the 'precision' of the model predictions, i.e. how wide the scatter or residual variability of the predicted values compare with the monitored true value, once systematic error has been allowed for. The quantification of model precision provides an estimate of how the final predictions may deviate from true (monitored) values at the same location over the same period.

Model performance

6.4A.3 An evaluation of model performance has been undertaken to establish confidence in model results. LAQM.TG(16) identifies a number of statistical procedures that are appropriate to evaluate model performance and assess uncertainty. The statistical parameters used in this assessment are:

- Root mean square error (RMSE);
- Fractional bias (FB); and
- Correlation coefficient (CC).

6.4A.4 A brief for explanation of each statistic is provided in Table 6.4-a, and further details can be found in LAQM.TG(16) Box A7.17.

Table 6.4-a: Model Performance Statistics

Statistical Parameter	Comments	Ideal value
RMSE	RMSE is used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared. If the RMSE values are higher than 25% of the objective being assessed, it is recommended that the model inputs and verification should be revisited in order to make improvements. For example, if the model predictions are for the annual mean NO_2 objective of 40 µg/m3, if an RMSE of 10 µg/m^3 or above is determined for a model it is advised to revisit the model parameters and model verification. Ideally an RMSE within 10% of the air quality objective would be derived, which equates to 4 µg/m^3 for the annual mean NO_2 objective.	0.01
FB	FB is used to identify if the model shows a systematic tendency to over or under predict. FB values vary between +2 and -2 and has an ideal value of zero. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.	0.00
CC	CC is used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship. This statistic can be particularly useful when comparing a large number of model and observed data points.	1.00

6.4A.5 These parameters estimate how the model results agree or diverge from the observations.

6.4A.6 These calculations have been carried out prior to and after adjustment and provide information on the improvement of the model predictions as a result of the application of the verification adjustment factors.

6.4A.7 The verification process involves a review of the modelled pollutant concentrations against corresponding monitoring data to determine how well the air quality model has performed. Depending on the outcome it may be considered that the model has performed adequately and that there is no need to adjust any of the modelled results.

6.4A.8 Alternatively, the model may perform poorly[14] against the monitoring data, in which case there is a need to check all the input data to ensure that it is reasonable and accurately represented by the air quality modelling process. Where all input data, such as traffic data, emissions rates and background concentrations have been checked and considered reasonable, then the modelled results may require adjustment to improve alignment with the monitoring data. This adjustment may be made either by using by a single verification adjustment factor (to be applied to the modelled concentrations across the study area) or a range of different adjustment factors to account for different situations in the study area.

[14] The acceptable limits of model verification performance are set out in Defra's Local Air Quality Management Technical Guidance (2009)

Air quality monitoring data

6.4A.9 The air quality monitoring data collected as part of this assessment is detailed in the Air Quality Chapter, and was reviewed to determine the suitability of each of the monitoring locations for inclusion in the model verification process. The criteria used to determine the suitability of the monitoring data for inclusion into the verification process are:

- Monitoring Location required within the air quality study area.
- Monitoring data capture required to be greater than 75% complete.
- Monitoring data influenced by major road emissions sources (i.e. busy road links) which were not included in the traffic model, and hence could not be included in the dispersion model, was excluded.
- Monitoring Data from Sites where the exact location could not be accurately identified or validated was excluded.

6.4A.10 The monitoring site HA_018 was not included in the verification because of the influence of the elevated background concentration predicted in Defra's mapping, and because it is not representative of relevant exposure.

6.4A.11 The Highways England monitoring located on the Edinburgh Road Monitoring Station (HA_013) was used in preference to the STC data, because it recorded higher concentrations than either the continuous analyser data (which was unratified) or the local authority diffusion tubes.

Verification methodology – NO_x / NO_2

6.4A.12 The verification method followed the process detailed in LAQM TG(16). The first stage of verification was undertaken by comparing the modelled versus monitored Road NO_x. Road NO_x measured at the diffusion tubes were calculated using the latest Defra NO_x to NO_2 calculator, because diffusion tubes only measure NO_2 and do not directly measure NO_x.

6.4A.13 Once the modelled Road NO_x component had been adjusted, this value was used in the Defra NO_x to NO_2 calculator, and the calculated Road NO_2 component was adjusted following comparison with the monitored Road NO_2.

Verification summary – NO_x / NO_2

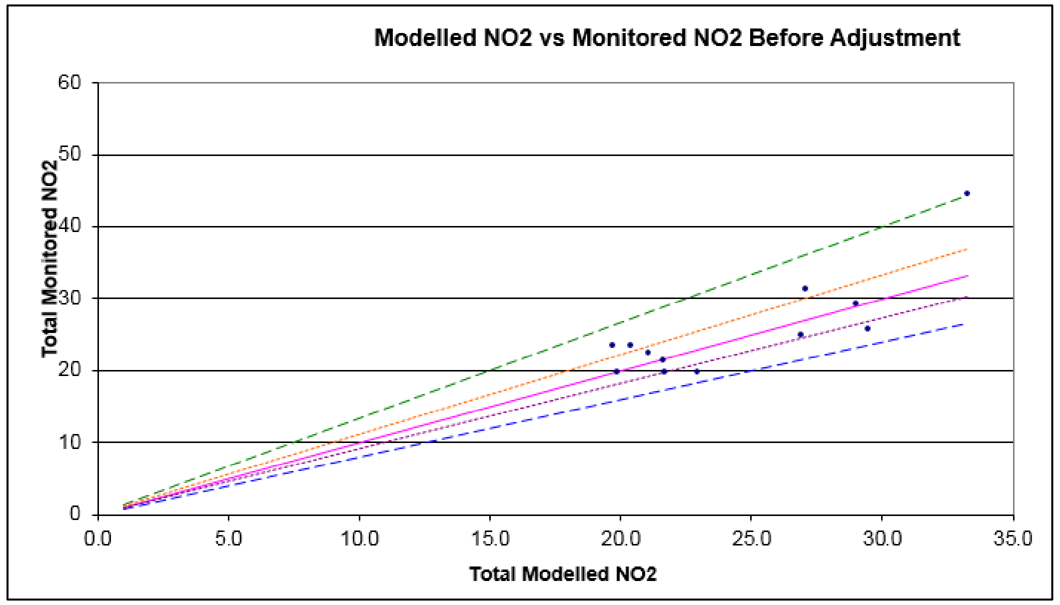
6.4A.14 A review was undertaken of the modelled versus monitoring performance across the whole study area. The summary results and model performance statistics defined in LAQM.TG(16) are provided in Table 6.4-b.

Table 6.4-b: Verification Zone Model Performance – NO_2

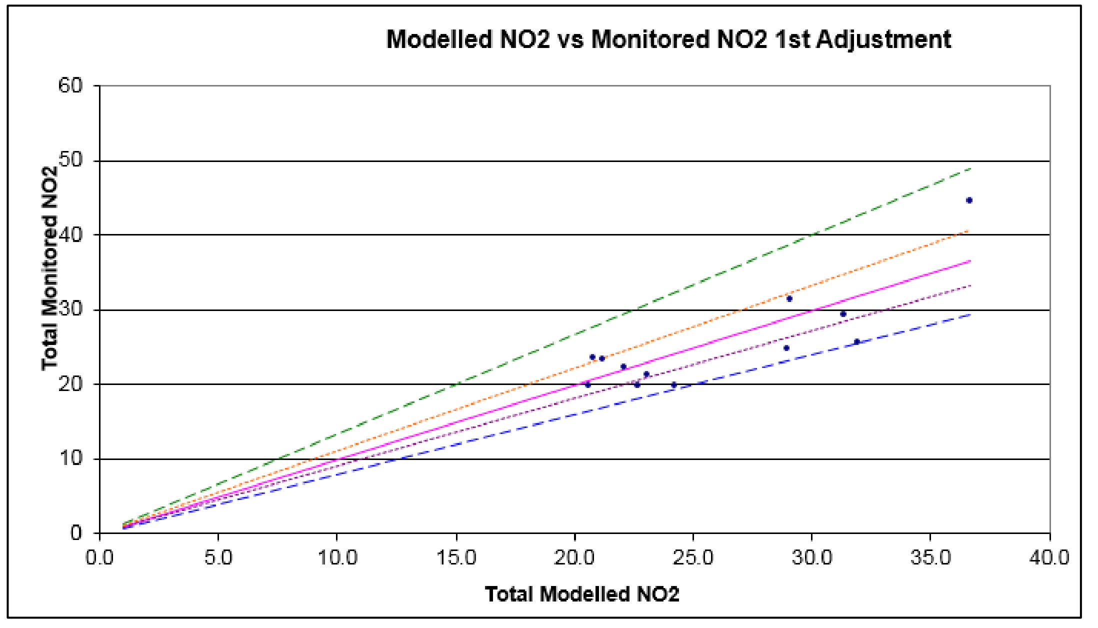
Statistical Parameter	No Adjustment	With NO_x Adjustment
No. of monitoring sites	**12**	**12**
NOx road adjustment factor	N/A	1.225
NO_2 road adjustment factor	N/A	N/A
RMSE	**4.11**	**3.77**
FB	-2.00	-0.020
CC	0.83	0.84
No with +-25% 1-stage	11	12

6.4A.15 The statistics support the methodology adopted. The statistics show that the RMSE and FB are improved when an adjustment is applied, when compared to the RMSE and FB for unadjusted results across the whole study area.

Verification Graph 1 (before adjustment)



Verification Graph 2 (with adjustment)



Verification methodology – PM_{10}

6.4A.16 There were no PM_{10} analysers within the study area. Therefore, the NOx Road adjustment factor has been applied to the modelled PM_{10} road contributions, following guidance in LAQM TG(16).

Prediction of environmental concentrations, including adjustment for long-term trends in NO_x and NO_2

6.4A.17 The model is used to predict the road traffic contributions to NO_x and PM_{10} concentrations in future years. A further adjustment step is undertaken to account for the observed trends in ambient roadside NO_x and NO_2.

6.4A.18 In July 2011 Defra published a report (Defra, 2011) examining the long-term air quality trends in NO_x and NO_2 concentrations. This identified that there has been a clear decrease in NO_2 concentrations between 1996 and 2002. Thereafter NO_2 concentrations have stabilised with little to no reduction between 2004 and 2012. The consequence of the conclusions of Defra's advice on long term trends is that there is now a gap between current projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality, which are built into the vehicle emission factors, the projected background maps and the NO_x to NO_2 calculator.

6.4A.19 The Highways England has developed the Gap Analysis methodology to adjust model predictions based on the method in LAQM TG(16) to account for the long term NO_x and NO_2 profiles. This uses the relationship between the Base year vehicle emission rates and the Opening year vehicle emission rates, and the measured trends in roadside air quality concentrations to uplift opening year predicted concentrations to align them better with the long-term trends of NO_x and NO_2.

6.4A.20 The current trends in air quality are based on measurements of emissions from the existing vehicle fleet. New vehicles will need to comply with the more stringent Euro 6/VI emissions standards from September 2014 onwards. If the Euro 6/VI fleet emissions perform as predicted, then this should lead to substantial reductions in predicted future roadside air quality concentrations.

6.4A.21 However, because the likely effects of Euro 6/VI vehicles on air quality are yet to be fully understood, Highways England's advice is that a long-term trend based on the existing fleet is assumed to be linear and continue at this projected rate of decrease into the future. The Euro 6/VI penetration in the UK fleet mix is approximately 35% in the opening year based on the EFT v6.0.2 for a motorway, but because the emission rates are predicted to be lower for Euro 6/VI than earlier Euro standards, the emissions from the Euro 6/VI component would be equivalent to 15% of the total NOx emission rate from the motorway traffic.

6.4A.22 The Gap Analysis methodology (IAN 170/12v3)[15] incorporates the Euro 6/VI improvements. These projection factors are referred to as 'LTT_{E6}'. The LTT_{E6} factors assume that the measured trends from 2004 to 2012 continue to occur for all pre-Euro 6/VI fleet. They also take a precautionary approach to account for uncertainty associated with Euro 6/VI performance and fleet mix in the future, rather than assuming full reductions in emissions occur as predicted by Euro 6/VI, which has not been observed by air quality monitoring trends associated with recent Euro standards. This is implemented into LTT_{E6} by taking the mid-point between the measured trend predictions (which assume no improvement in emissions associated with Euro 6/VI) and predicted Euro 6/VI uptake and emission improvements.

6.4A.23 On this basis, the LTT_{E6} projections are considered by the air quality specialist to be the most reasonable prediction of likely actual future NOx and NO_2 concentrations, and have been used in the calculations for this updated local air quality assessment.

6.4A.24 When forming a judgement on the significance of the effects, both the LAQM TG(16) results and the results adjusted using the Gap Analysis method (to reflect Long Term Trends (LTT_{E6})) should be provided. Predictions for NO_2 using the LAQM TG(16) method, which are lower, are also used in the final assessment to provide context for the uncertainty in model predictions.

6.4A.25 The Gap Analysis method is not applied to PM_{10} predictions, and the results based on the LAQM TG(16) method are the final predicted concentrations throughout the assessment.

[15] Highways England (2013) INTERIM ADVICE NOTE 170/12 v3 Updated air quality advice on the assessment of future NOx and NO_2 projections for users of DMRB Volume 11, Section 3, Part 1 'Air Quality'

APPENDIX 6.5 RECEPTOR RESULTS

A total of 55 receptors were modelled to include for local assessment calculations, and the results for these receptors are provided in Table 6.5-a. The top ten highest concentrations are reported in the ES Chapter.

Table 6.5-a: Receptor Results (including Addresses)

Receptor ID	Address	Grid Ref		Background Concentration 2012 (μg/m³)		Modelled Total Concentrations Base 2012 (μg/m³)		Background Concentrations 2021 (μg/m³)		Modelled Total Concentrations LAQM TG(16) Do Minimum (DM) 2021 (μg/m³)		Modelled Total Concentrations LAQM TG (16) Do Something (DS) 2021 (μg/m³)		Modelled Total NO_2 Concentrations with Long Term Trends (2021) (μg/m³)	
		x	y	NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}	DM	DS
DHL_01	3 Baltimore Avenue, Sunderland, SR5 4RG	434717	559189	15.2	16.0	19.0	16.7	12.4	15.3	14.8	16.0	14.8	16.0	14.7	14.7
DHL_02	The Chalet Usworth Cottages, Sunderland, SR5 3HX	433944	559078	15.3	15.3	17.3	15.7	10.9	14.5	12.0	14.8	12.1	14.8	13.2	13.3
DHL_03	5 Usworth Cottages, Sunderland, SR5 3JA	433958	559027	15.3	15.3	16.9	15.6	10.9	14.5	11.8	14.7	11.9	14.7	12.9	12.9
DHL_04	4 Usworth Cottages, Sunderland, SR5 3JA	433962	559020	15.3	15.3	16.8	15.6	10.9	14.5	11.8	14.7	11.9	14.7	12.8	12.9
DHL_05	3 Usworth Cottages, Sunderland, SR5 3JA	433964	559015	15.3	15.3	16.8	15.6	10.9	14.5	11.8	14.7	11.9	14.7	12.8	12.9
DHL_06	2 Usworth Cottages, Sunderland, SR5 3JA	433966	559011	15.3	15.3	16.8	15.6	10.9	14.5	11.8	14.7	11.8	14.7	12.8	12.8
DHL_07	1 Usworth Cottages, Sunderland, SR5 3JA	433968	559005	15.3	15.3	16.7	15.6	10.9	14.5	11.8	14.7	11.8	14.7	12.7	12.8
DHL_08	50 Capetown Road, Sunderland, SR5 3LY	434673	559000	15.2	16.0	19.8	16.8	12.4	15.3	15.5	16.2	15.5	16.2	15.7	15.6
DHL_09	18 Boston Crescent, Sunderland, SR5 4QS	434501	559635	15.2	16.0	18.2	16.6	12.4	15.3	14.3	15.8	14.4	15.8	14.0	14.1
DHL_10	43 Boston Crescent, Sunderland, SR5 4QS	434425	559589	15.2	16.0	20.6	17.0	12.4	15.3	15.8	16.3	15.8	16.2	16.1	16.1
DHL_11	43 Boston Crescent, Sunderland, SR5 4QS	434425	559589	15.2	16.0	20.6	17.0	12.4	15.3	15.8	16.3	15.8	16.2	16.1	16.1
DHL_12	43 Boston Crescent, Sunderland, SR5 4QS	434425	559589	15.2	16.0	20.6	17.0	12.4	15.3	15.8	16.3	15.8	16.2	16.1	16.1
DHL_13	43 Boston Crescent, Sunderland, SR5 4QS	434425	559589	15.2	16.0	20.6	17.0	12.4	15.3	15.8	16.3	15.8	16.2	16.1	16.1
DHL_14	51 Boston Crescent, Sunderland, SR5 4QS	434431	559579	15.2	16.0	20.5	17.0	12.4	15.3	15.8	16.3	15.8	16.2	16.0	16.0
DHL_15	33 Boston Crescent, Sunderland, SR5 4QS	434448	559612	15.2	16.0	19.3	16.8	12.4	15.3	15.0	16.0	15.1	16.0	15.0	15.0
DHL_16	37 Boston Crescent, Sunderland, SR5 4QS	434435	559607	15.2	16.0	19.8	16.9	12.4	15.3	15.3	16.1	15.3	16.1	15.4	15.4
DHL_17	23 Boston Crescent, Sunderland, SR5 4QS	434462	559618	15.2	16.0	19.0	16.7	12.4	15.3	14.8	16.0	14.8	16.0	14.7	14.7
DHL_18	23 Boston Crescent, Sunderland, SR5 4QS	434462	559618	15.2	16.0	19.0	16.7	12.4	15.3	14.8	16.0	14.8	16.0	14.7	14.7
DHL_19	23 Boston Crescent, Sunderland, SR5 4QS	434462	559618	15.2	16.0	19.0	16.7	12.4	15.3	14.8	16.0	14.8	16.0	14.7	14.7
DHL_20	40 Boston Street, Sunderland, SR5 4QT	434439	559560	15.2	16.0	20.6	17.0	12.4	15.3	15.8	16.3	15.8	16.2	16.1	16.1
DHL_21	152 Baltimore Avenue, Sunderland, SR5 4QU	434453	559543	15.2	16.0	20.3	17.0	12.4	15.3	15.6	16.2	15.6	16.2	15.9	15.9
DHL_22	4 Baltimore Avenue, Sunderland, SR5 4RG	434703	559186	15.2	16.0	19.2	16.8	12.4	15.3	14.9	16.0	14.9	16.0	14.9	14.9
DHL_23	12 Baltimore Avenue, Sunderland, SR5 4RG	434673	559180	15.2	16.0	19.9	16.9	12.4	15.3	15.2	16.1	15.2	16.1	15.3	15.3
DHL_24	8 Baltimore Avenue, Sunderland, SR5 4RG	434688	559183	15.2	16.0	19.5	16.8	12.4	15.3	15.0	16.1	15.0	16.1	15.1	15.1
DHL_25	4 Baltimore Square, Sunderland, SR5 4RH	434753	559194	15.2	16.0	18.8	16.7	12.4	15.3	14.6	15.9	14.6	15.9	14.4	14.5
DHL_26	16 Baltimore Avenue, Sunderland, SR5 4RG	434658	559176	15.2	16.0	20.3	17.0	12.4	15.3	15.4	16.2	15.4	16.2	15.7	15.7
DHL_27	11 Ferryboat Lane, Sunderland, SR5 3RB	434658	559078	15.2	16.0	19.9	16.9	12.4	15.3	15.5	16.2	15.5	16.2	15.7	15.7
DHL_28	9 Ferryboat Lane, Sunderland, SR5 3RB	434657	559084	15.2	16.0	19.9	16.9	12.4	15.3	15.5	16.2	15.5	16.2	15.7	15.7
DHL_29	157 Washington Road, Sunderland, SR5 3RA	434666	559128	15.2	16.0	20.1	16.9	12.4	15.3	15.6	16.2	15.6	16.2	15.8	15.8
DHL_30	3 Ferryboat Lane, Sunderland, SR5 3RB	434654	559113	15.2	16.0	20.1	16.9	12.4	15.3	15.6	16.2	15.6	16.2	15.8	15.8
DHL_31	1 Ferryboat Lane, Sunderland, SR5 3RB	434654	559120	15.2	16.0	20.3	16.9	12.4	15.3	15.7	16.2	15.7	16.2	16.0	16.0
DHL_32	141 Washington Road, Sunderland, SR5 3LL	434807	559153	15.2	16.0	18.9	16.7	12.4	15.3	14.6	15.9	14.7	15.9	14.6	14.6
DHL_33	145 Washington Road, Sunderland, SR5 3LL	434790	559151	15.2	16.0	19.0	16.7	12.4	15.3	14.7	16.0	14.7	16.0	14.6	14.6
DHL_34	153 Washington Road, Sunderland, SR5 3LL	434757	559145	15.2	16.0	19.1	16.7	12.4	15.3	14.8	16.0	14.8	16.0	14.8	14.8
DHL_35	149 Washington Road, Sunderland, SR5 3LL	434774	559148	15.2	16.0	19.1	16.7	12.4	15.3	14.7	16.0	14.8	16.0	14.7	14.7
DHL_36	100 Baltimore Avenue, Sunderland, SR5 4QX	434520	559404	15.2	16.0	20.2	17.0	12.4	15.3	15.6	16.2	15.7	16.2	15.8	15.9
DHL_37	104 Baltimore Avenue, Sunderland, SR5 4QX	434509	559428	15.2	16.0	20.3	17.0	12.4	15.3	15.6	16.2	15.7	16.2	15.9	15.9
DHL_38	114 Baltimore Avenue, Sunderland, SR5 4QX	434496	559447	15.2	16.0	20.5	17.0	12.4	15.3	15.8	16.3	15.8	16.2	16.0	16.0

Receptor ID	Address	Grid Ref		Background Concentration 2012 (µg/m³)		Modelled Total Concentrations Base 2012 (µg/m³)		Background Concentrations 2021 (µg/m³)		Modelled Total Concentrations LAQM TG(16) Do Minimum (DM) 2021 (µg/m³)		Modelled Total Concentrations LAQM TG (16) Do Something (DS) 2021 (µg/m³)		Modelled Total NO_2 Concentrations with Long Term Trends (2021) (µg/m³)	
		x	y	NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}	DM	DS
DHL_39	9 Benfleet Avenue, Sunderland, SR5 4RB	434539	559359	15.2	16.0	20.3	17.0	12.4	15.3	15.7	16.2	15.7	16.2	15.9	15.9
DHL_40	82 Baltimore Avenue, Sunderland, SR5 4QY	434547	559344	15.2	16.0	20.2	16.9	12.4	15.3	15.6	16.2	15.6	16.2	15.8	15.8
DHL_41	60 Baltimore Avenue, Sunderland, SR5 4QY	434577	559279	15.2	16.0	20.1	16.9	12.4	15.3	15.6	16.2	15.5	16.2	15.7	15.7
DHL_42	66 Baltimore Avenue, Sunderland, SR5 4QY	434569	559296	15.2	16.0	20.1	16.9	12.4	15.3	15.6	16.2	15.5	16.2	15.8	15.7
DHL_43	74 Baltimore Avenue, Sunderland, SR5 4QY	434560	559317	15.2	16.0	20.1	16.9	12.4	15.3	15.6	16.2	15.6	16.2	15.8	15.8
DHL_44	20 Baltimore Avenue, Sunderland, SR5 4RG	434644	559173	15.2	16.0	20.9	17.1	12.4	15.3	15.7	16.2	15.7	16.2	16.0	16.0
DHL_45	24 Baltimore Avenue, Sunderland, SR5 4RG	434627	559169	15.2	16.0	21.9	17.3	12.4	15.3	16.1	16.4	16.1	16.4	16.7	16.7
DHL_46	26 Baltimore Avenue, Sunderland, SR5 4RG	434622	559186	15.2	16.0	20.7	17.1	12.4	15.3	15.7	16.3	15.7	16.3	16.1	16.1
DHL_47	42 Baltimore Avenue, Sunderland, SR5 4RG	434607	559215	15.2	16.0	20.2	16.9	12.4	15.3	15.5	16.2	15.5	16.2	15.7	15.7
DHL_48	46 Baltimore Avenue, Sunderland, SR5 4RG	434599	559230	15.2	16.0	20.1	16.9	12.4	15.3	15.5	16.2	15.5	16.2	15.7	15.7
DHL_49	1 Barking Crescent, Sunderland, SR5 4QZ	434589	559250	15.2	16.0	20.1	16.9	12.4	15.3	15.5	16.2	15.5	16.2	15.7	15.7
DHL_50	33 Ferryboat Lane, Sunderland, SR5 3RB	434665	559010	15.2	16.0	20.2	16.9	12.4	15.3	15.8	16.3	15.8	16.3	16.0	16.0
DHL_51	27 Ferryboat Lane, Sunderland, SR5 3RB	434663	559035	15.2	16.0	20.0	16.9	12.4	15.3	15.7	16.2	15.7	16.2	15.9	15.8
DHL_52	128 Baltimore Avenue, Sunderland, SR5 4QX	434479	559484	15.2	16.0	20.4	17.0	12.4	15.3	15.7	16.3	15.7	16.2	16.0	16.0
DHL_53 (A19)	Make Me Rich Farm Downhill Lane, South Tyneside, NE36 0BA	433923	560078	12.2	15.7	14.7	16.1	10.3	14.9	11.9	15.2	11.9	15.3	11.3	11.4
DHL_54	Enterprise Rent A Car Newcastle Road, South Tyneside, NE36 0BG	433697	560993	12.2	15.7	19.1	16.7	10.3	14.9	14.8	15.8	14.9	15.8	15.4	15.4
DHL_55	Make Me Rich Farm (Access Road), Downhill Lane, South Tyneside, NE36 0BA	433919	560055	12.2	15.7	14.5	16.0	10.3	14.9	11.8	15.2	11.8	15.2	11.2	11.2

APPENDIX 6.6 MITIGATION MEASURES FOR CONSTRUCTION IMPACTS

Introduction

6.6A.1 In order to minimise any potential emissions of fugitive dust during the construction phase (and hence minimise potential impacts), the Construction Environmental Management Plan (CEMP) would adopt best practice measures to control fugitive dust.

6.6A.2 Appropriate construction dust mitigation measures, based on those outlined by the Institute for Air Quality Management[16], are detailed within this Appendix 6.6 and the CEMP. These are based on a Low risk site for on-site construction activities, and a High risk site for track-out associated with construction vehicle traffic.

6.6A.3 It is considered that with an appropriate CEMP implemented, there would be no significant effects on air quality during the construction phase of the scheme.

Communications

- Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be an environmental manager/engineer or site manager.

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.
- Record any exceptional incidents that cause dust and/or air emissions, either on- or off-site, 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 the site boundary, with cleaning to be provided if necessary.
- Carry out regular site inspections to monitor compliance with the dust management plan, record inspection results, and make an inspection log available to the local authority when asked.
- 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.

Preparing and maintaining the site

- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as practicable.
- Where practicable, erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
- Where practicable, fully enclose the 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.

Construction operations

- Provide 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.

Measures specific to track-out

- 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.
- Make sure 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 log book.
- Install hard surfaced haul routes, where reasonably practicable, that are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site, where reasonably practicable).
- Provide an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
- Access gates to be located at least 10 m from receptors, where possible.

6.6A.4 No mitigation measures are required for the operational phase of the Proposed Scheme.

[16] Institute for Air Quality Management (2014) *Guidance on the assessment of dust from* demolition and construction.

APPENDIX 6.7 TAG ASSESSMENT

6.7A Local Air Quality

6.7A.1 The local air quality TAG assessment creates an overall 'score' for the Scheme, which is calculated on the basis of the number of residential properties within 200 m of affected roads and the overall sum of the changes in annual mean pollutant concentrations at these properties. For the 2021, there are 431 relevant properties within the area covered by the local air quality TAG assessment.

6.7A.2 TAG works by adding up the change in annual mean air pollution concentrations caused by the scheme at the nearest road link for each property within 200 m of the affected roads. If there was only one property, and pollution concentrations there decreased by 1µg/m^3 with the Scheme, the scheme would have an aggregate score of -1.

6.7A.3 The results of the generalised local air quality assessment indicate exposure to a net deterioration in air quality with the scheme in place in 2021. The TAG air quality assessment summary results are presented in Table A6.7-1 and A6.7-2 for the 2021 scenario.

Table 6.7-1: Worksheet 1b Environment: Local AQ Workbook- Plan Level Summary Table – NO_2

NO_2, SUMMARY OF ROUTES: THE AGGREGATED TABLE	0-50m (i)	50-100m (ii)	100-150m (iii)	150-200m (iv)	0-200m (v=i+ii+iii+iv)
Total properties across all routes (min)	10	132	162	127	431
Total properties across all routes (some)	10	132	162	127	431
Do-minimum NO_2 assessment *across all routes*	156.91	2003.23	2313.99	1769.67	Total assessment NO_2 (I): 6244
Do-something NO_2 assessment *across all routes*	156.93	2004.05	2315.95	1771.27	Total assessment NO_2 (II): 6248
Net total assessment for NO_2, all routes (II-I)					4.41
Number of properties with an improvement					*0*
Number of properties with no change					*0*
Number of properties with a deterioration					*431*

Table 6.7-2-2: Worksheet 1b Environment: Local AQ Workbook- Plan Level Summary Table – PM_{10}

PM10, SUMMARY OF ROUTES: THE AGGREGATED TABLE	0-50m (i)	50-100m (ii)	100-150m (iii)	150-200m (iv)	0-200m (v=i+ii+iii+iv)
Total properties across all routes (min)	10	132	162	127	431
Total properties across all routes (some)	10	132	162	127	431
Do-minimum PM10 assessment across all routes	160.30	2101.70	2557.30	2011.80	Total assessment PM10 (I): 6831
Do-something PM10 assessment across all routes	160.30	2099.90	2554.90	2011.70	Total assessment PM10 (II): 6827
Net total assessment for PM10, all routes (II-I)					-4.30
Number of properties with an improvement					*422*
Number of properties with no change					*1*
Number of properties with a deterioration					*8*

6.7B Regional Air Quality

6.7B.1 The TAG regional assessment results are detailed in the Chapter 6 (Air Quality) of the ES.

6.7C Greenhouse Emissions

6.7C.1 The greenhouse TAG assessment calculates the total change in CO_2 emissions from the traffic study area over the first 60 years after scheme opening.

6.7C.2 The TAG greenhouse gases assessment summary results are presented in Table A6.7-3.

Table 6.7-3: TAG Valuation Assessment Summary

Greenhouse Gases Workbook - Worksheet 1

Scheme Name:	A19 Downhill Lane Junction
Present Value Base Year	2010
Current Year	2018
Proposal Opening year:	2021
Project (Road/Rail or Road and	road

Overall Assessment Score:

Net Present Value of carbon dioxide equivalent emissions of proposal (£):	-£1,150,370

Quantitative Assessment:

Change in carbon dioxide equivalent emissions over 60 year appraisal period (tonnes): (between 'with scheme' and 'without scheme' scenarios)	25,684
Of which Traded	0
Change in carbon dioxide equivalent emissions in opening year (tonnes): (between 'with scheme' and 'without scheme' scenarios)	513
Net Present Value of traded sector carbon dioxide equivalent emissions of proposal (£): (N.B. this is not additional to the appraisal value in cell I17, as the cost of traded sector emissions is assumed to be internalised into market prices. See TAG Unit A3 for further details)	£0

Change in carbon dioxide equivalent emissions by carbon budget period:

	Carbon Budget 1	Carbon Budget 2	Carbon Budget 3	Carbon Budget 4
Traded sector	0	0	0	0
Non-traded secto	0	0	1020.243199	2435.726274