BURO HAPPOLD

Dewsbury Riverside

Air Quality Assessment

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Glossary

Term	Definition
AADT	Annual average daily traffic
AQMA	Air quality management area
DMP	Dust Management Plan
HDV	Heavy Duty Vehicles
IAQM	Institute of Air Quality Management
KC	Kirklees Council
LDV	Light Duty Vehicle
LPA	Local planning authority
NO_2	Nitrogen dioxide
NO_X	Nitrogen oxides
NPPF	National Planning Policy Framework
PM	Particulate matter

Executive Summary

Buro Happold has been appointed by Kirklees Council (KC) to undertake an air quality assessment to support a hybrid planning application comprising:

- an outline application for up to 350 dwellings and associated open space, and
- a detailed application for a new junction on Forge Lane.

The proposed development site forms part of the Dewsbury Riverside housing allocation in KC's adopted Local Plan.

This assessment considers the air quality impacts during both the construction phase and the operational phase of the proposed development.

For impacts associated with the construction phase, a qualitative assessment of construction activities (earthworks, construction and trackout) has been undertaken. The assessment indicates that the site represents a high risk in terms of dust soiling during earthworks and construction, and medium risk due to vehicle trackout. There is a low risk with respect to human health impacts. Mitigation measures are proposed which can be implemented within a Construction Management Plan to minimise emissions from construction activities. Mitigation measures have been proposed within the report that are in line with the assessed level of risk.

With respect to construction traffic emissions, the proposed development will lead to an increase of traffic on the local road network during the construction phase. Dispersion modelling has been undertaken to quantitatively assess the impact of construction traffic at existing sensitive receptors (residential properties, care homes, health facilities, etc) during the peak construction year (2023). The modelled results show that the impact from construction traffic emissions is negligible at all modelled receptors.

With respect to operational traffic emissions, the proposed development will lead to an increase of traffic on the local road network. Dispersion modelling has been undertaken to quantitatively assess the impact of operational traffic at existing sensitive receptors (residential properties, care homes, health facilities, etc.) during the opening year (2030). The modelled results show that one receptor, a residential unit adjacent to Forge Lane junction, is experiencing moderate adverse impact. Following sensitivity testing, using less conservative assumptions regarding future air quality improvement, the impact is negligible. It is recommended monitoring should be undertaken near to the junction at Forge Lane, prior to construction up to full build out, to ascertain the impact of the development traffic.

The damage cost calculations also demonstrate the impact of operational traffic, showing the total damage cost for the development to be £126, 753; this is the recommended figure which should be spent on measures to mitigate the impact of the development. Mitigation measures should be confirmed, and agreed with the Local Authority, during the detailed design stage.

1 Introduction

1.1 Proposed development

Buro Happold has been appointed by Kirklees Council to undertake an air quality assessment to support a hybrid planning application for the Dewsbury Riverside development. The site extends 29.41ha and is formed mainly of agricultural land and is located South of Ravensthorpe Road. The proposed development includes up to 350 dwellings and associated amenity, play and community space.

The hybrid planning application comprises the following:

a) Application for full planning permission for engineering works, drainage and utilities connection for the provision of site access from Forge Lane and Ravensthorpe Road including the demolition of the Masjid Abu Bakr Mosque and Lees Hall Playgroup); and,

b) Application for outline planning permission for the erection of up to 350 dwellings and mixed use development (including community facilities) with associated works including the provision of internal estate roads and parking, landscape works (including provision of public open space, tree clearance/replacement/woodland management and ecological management) and sustainable urban drainage works drainage principles.

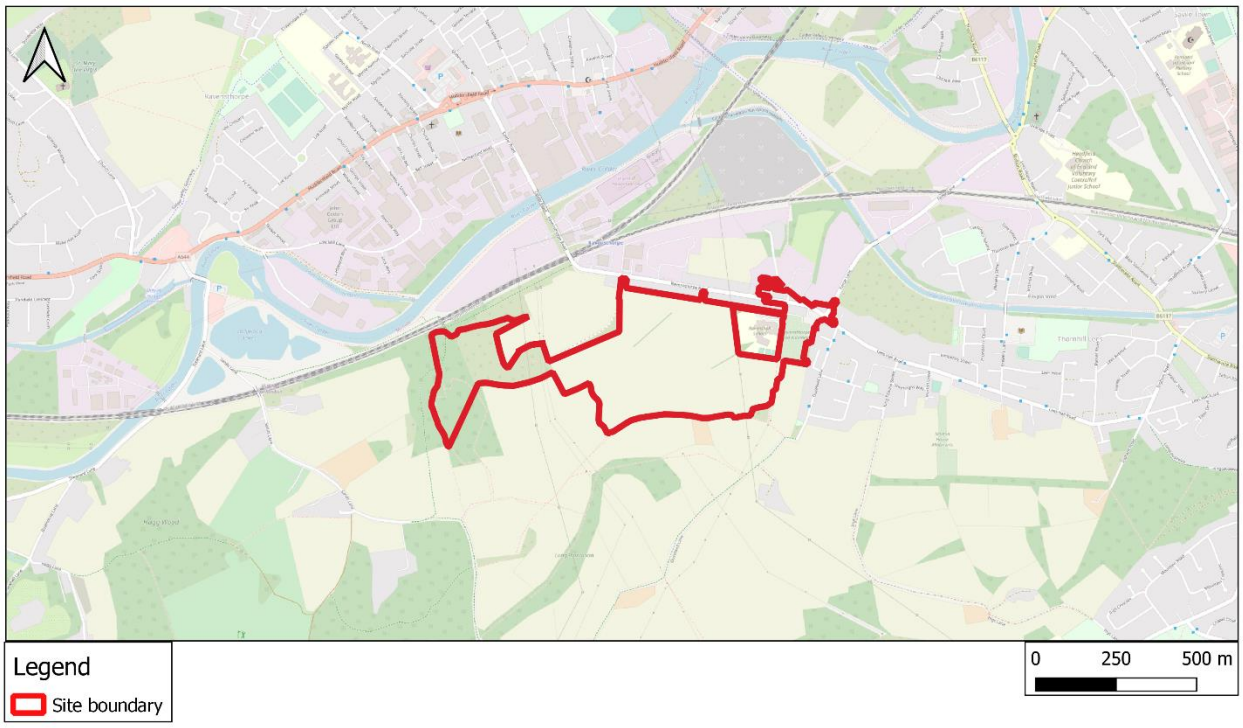


Figure 1-1 Site location

1.2 Scope of assessment

This report assesses the likely environmental effects of the proposed development with respect to air quality. The report also describes the methods used to assess the effects; the baseline conditions currently existing at the site and surrounding area; the mitigation measures required to prevent, reduce or offset any significant adverse effects; and the likely residual effects after these measures have been adopted.

The report takes into account relevant legislation, policy and key technical guidance, in line with industry best practice. A comprehensive review of air quality data from has also been undertaken and, where relevant, considered as part of the baseline sections of the report.

The report assesses the likely impacts and subsequent effects of the proposed development on local air quality through the identification and assessment of direct and indirect emission sources. Likely changes to air quality in the area due to the proposed development are considered in relation to national air quality objectives. Where required, the assessment considers mitigation measures to reduce the effect of the proposals on local air quality.

2 Air Quality Legislation and Policy

2.1 European legislation

The 2008 Ambient Air Quality Directive (2008/50/EC) set legally binding limits for pollutant concentrations. This directive was made law in England through the Air Quality (Standards) Regulations 2010. The Regulations were subsequently updated in 2016 (The Air Quality Standards (Amendment) Regulations 2016).

2.2 UK legislation

Air Quality Standards Regulations (2010)

This UK legislation implements the requirements of the ambient air quality directive and sets legally binding limit values for air quality with respect to human health and vegetation. The regulation transposes Directive 2008/50/EC, which entered into force in Europe on June 2008, it consolidates and replaces previous ambient air quality legislation. The Regulations were subsequently updated in 2016 (The Air Quality Standards (Amendment) Regulations 2016).

Part IV of the Environment Act (1995)

Part IV of the Environment Act 1995 places a duty on the Secretary of State for the Environment to develop, implement and maintain an Air Quality Strategy (AQS) with the aim of reducing atmospheric emissions and improving air quality. The latest AQS for England, Scotland, Wales and Northern Ireland was published in 2007, and provides the framework for ensuring the air quality limit values are complied with based on a combination of international, national and local measures to reduce emissions and improve air quality. This includes the statutory duty, also under Part IV of the Environment Act 1995, for local authorities to undergo a process of Local Air Quality Management (LAQM). This requires local authorities to regularly and systematically review and assess air quality within their boundaries against a series of objectives, and appraise development and transport plans against these assessments.

In areas where air quality objectives are not likely to be met by the relevant target date, local authorities are required to declare an Air Quality Management Area (AQMA) and develop an air quality action plan in pursuit of the air quality objectives.

Air quality objectives

This air quality assessment is carried out to assess compliance with UK air quality objectives. The air quality objectives relevant to this assessment are presented in Table 2-1. It should be noted that air quality objectives are numerically the same as the EU limit values detailed within the Air Quality Standards Regulations, however, differ in terms of compliance dates, locations where the limit values apply, and the legal responsibility for ensuring compliance.

Air quality objectives are applicable at all locations where members of the public might be regularly exposed. This includes building façades of residential properties, schools, hospitals and care homes.

Table 2-1 Air Quality Objectives relevant to this assessment

Pollutant	Concentration (µg/m^3)	Averaging Period	Number allowable exceedances per calendar year
For protection of human health			
Nitrogen dioxide (NO_2)	40	Annual mean	None
	200	Hourly mean	18
Particulates <10µm in diameter (PM_{10})	40	Annual mean	None
	50	Daily mean	35
Particulates <2.5µm in diameter ($PM_{2.5}$)	25	Annual mean	None

2.3 National Planning Policy Framework

The National Planning Policy Framework (NPPF)[1] underlines the importance of local authorities contributing towards improving and protecting the environment. The legislation points towards the need to focus on the enhancement of biodiversity, minimising waste and pollution, and mitigation/adaptation to climate change.

With particular regard to air quality management, Section 9 of the NPPF notes that the environmental impact of transport and traffic should be identified and assessed, whilst mitigating adverse effects to bring about net environmental gains. The guidance states that the planning system should actively manage patterns of growth, offering a choice of transport modes to reduce air pollution:

'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.'

Further to this, Section 15 of the NPPF notes that planning policies 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 (CAZ), and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Additionally, the NPPF states that planning decisions should ensure that any new development in AQMAs and CAZs is consistent with the local air quality action plan.

[1] MHCLG The National Planning Policy Framework, February 2019

2.4 Planning Practice Guidance (2019)

Planning Practice Guidance[2] provides guiding principles on how the planning process can take account of the impact of new development on air quality. Guidance outlines when air quality considerations could be relevant to the development management process. The Planning Practice Guidance states:

'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.'

The guidance also outlines the specific issues that may need to be considered when assessing air quality impacts. Relevant considerations include when a development would:

- Lead to changes (including any potential reductions) in vehicle-related emissions in the immediate vicinity of the proposed development or further afield. This could be through the provision of electric vehicle charging infrastructure; altering the level of traffic congestion; significantly changing traffic volumes, vehicle speeds or both; or significantly altering the traffic composition on local roads. Other matters to consider include whether the proposal involves the development of a bus station, coach or lorry park; could add to turnover in a large car park; or involve construction sites that would generate large Heavy Goods Vehicle flows over a period of a year or more;
- Introduce new point sources of air pollution. This could include furnaces which require prior notification to local authorities; biomass boilers or biomass-fuelled Combined Heat and Power plant; centralised boilers or plant burning other fuels within or close to an air quality management area or introduce relevant combustion within a Smoke Control Area; or extraction systems (including chimneys) which require approval or permits under pollution control legislation;
- Expose people to harmful concentrations of air pollutants, including dust. This could be by building new homes, schools, workplaces or other development in places with poor air quality;
- Give rise to potentially unacceptable impacts (such as dust) during construction for nearby sensitive locations;

[2] MHCLG Planning Practice Guidance, November 2019

- Have a potential adverse effect on biodiversity, especially where it would affect sites designated for their biodiversity value.'

Guidance also provides detail on how air quality impacts can be mitigated, stating that mitigation should be spatially specific, dependent on the proposed development, and proportionate to the likely impact. The following examples of mitigation are given:

- 'Maintaining adequate separation distances between sources of air pollution and receptors;
- Using green infrastructure, in particular trees, where this can create a barrier or maintain separation between sources of pollution and receptors;
- Appropriate means of filtration and ventilation;
- Including infrastructure to promote modes of transport with a low impact on air quality (such as electric vehicle charging points);
- Controlling dust and emissions from construction, operation and demolition; and
- Contributing funding to measures, including those identified in air quality action plans and low emission strategies, designed to offset the impact on air quality arising from new development.'

2.5 Local policy and guidance

The Kirklees Local Plan Strategy and Policies (2019) details the strategic objectives and policies with regards to key planning decisions. The Local Plan includes several policies pertaining to air quality; with consideration to both improving existing areas with poor air quality and ensuring future development do not create new areas of poor air quality.

Policy LP51 - Protection and Improvement of Local Air Quality

> "*Development will be expected to demonstrate that it is not likely to result, directly or indirectly, in an increase in air pollution which would have an unacceptable impact on the natural and built environment or to people.*
>
> *Proposals that have the potential to increase local air pollution either individually or cumulatively must be accompanied by evidence to show that the impact of the development has been assessed in accordance with the relevant guidance. Development which has the potential to cause levels of local air pollution to increase must incorporate sustainable mitigation measures that reduce the level of this impact. If sustainable measures cannot be introduced the development will not be permitted.*
>
> *Where the development introduces new receptors into Air Quality Management Areas or Areas of Concern or near other areas of relatively poor air quality, for example near roads or junctions, the development must incorporate sustainable mitigation measures that protect the new receptors from unacceptable levels of air pollution. Where sustainable mitigation measures cannot be introduced which prevent receptors from being exposed to unsafe levels of air pollution, development will not be permitted.*"

The proposed development will meet the expectations of this policy and ensure any air quality impacts are minimised through a suite of mitigation measures.

Policy LP15 – Residential use in Town Centres

"Proposals for residential uses (including student accommodation) within the defined town centres as set out on the Policies Map will be supported subject to… the protection of the amenity of existing residents and future occupiers of the proposed residential use in accordance with amenity and design policies within the plan, and will in particular consider matters such as privacy, noise and air quality."

Policy LP20 – Sustainable Travel

"The council will support demand management measures which discourage single occupancy car travel within new development and encourage the use of low emission vehicles to improve areas with low levels of air quality."

Policy LP21 – Highways and Access

"All proposals shall… be accompanied by a supporting Transport Assessment or Transport Statement where the development would generate significant trip generation, providing detail as to the impact on highway safety, air quality, noise and light restrictions"

Policy LP47 - Healthy, Active and Safe Lifestyles

"Healthy, active and safe lifestyles will be enabled by… ensuring that the current air quality in the district is monitored and maintained and, where required, appropriate mitigation measures included as part of new development proposals."

3 Baseline Conditions

3.1 Baseline Assessment Methodology

The baseline air quality for the proposed development presented in this section draws on data from several sources. The focus of the assessment is on key pollutants (NO_2, PM_{10} and $PM_{2.5}$) that could be emitted in potentially significant quantities as a result of the operation and construction of the proposed development.

Baseline data was gathered from the following sources:

- Kirklees Air Quality Annual Status Report 2020[3];
- Defra's national air quality background maps[4];
- Department of Transport (DfT) Traffic Counts[5];

3.2 Local Air Quality Management and Monitoring

Air quality is monitored within Kirklees Council (KC) using automatic and non-automatic monitoring equipment to monitor pollutant concentrations of key pollutants including; NO_2, PM_{10} and $PM_{2.5}$. There are several nearby monitoring locations, located on Huddersfield Road and within Dewsbury town centre. The nearest monitoring sites to the development are located ~600m north of the site boundary.

All nearby monitoring sites are presented in Figure 3-1.

The nearby monitoring locations are predominantly roadside sites adjacent to major roads leading into Dewsbury. Monitoring data from 2019, the most recently published full year of monitoring data, shows one site (K36) exceeds annual mean NO_2 air quality objectives. K35 has reported exceedance for the last 3 reporting years. The site in closest proximity to the site (K5) reported concentrations within 10% of the annual mean air quality objective.

The nearest Particulate Matter (PM_{10}) monitoring site is located in Bradley, 5.3km from the site, however it is stated in the Annual Status Report that due to major breakdowns and loss of data there is no monitored data for the last 5 years.

[3] Kirklees Council (2020) Annual Status Report, 2020.
[4] Defra (2020) Defra mapped background concentrations
[5] Department for Transport (2020) Road Traffic Statistics

Table 3-1 Annual mean NO_2 monitoring results from nearby monitoring sites

Site ID	Location	Distance from Site (km)	Site Type	NO_2 Annual Mean Concentration (µg/m^3)				
				2015	2016	2017	2018	2019
K5	Huddersfield Road/Ravensthorpe Road	0.6	Roadside	**41.5**	35.6	35.8	35.4	36.1
K19	Huddersfield Road Ravensthorpe	1.2	Roadside	39.8	**45.2**	33.0	38.8	31.6
K25/26/27	Leeds Road	0.7	Other (Triplicate)	20.2	-	26.4	30.3	27.3
K36	Huddersfield Road Mirfield 1	2.0	Roadside	**42.5**	38.8	**42.2**	**42.2**	**49.4**
K70	Huddersfield Road - Scouthill - Air station	0.9	Roadside	-	-	38.8	37.0	31.8
K87	Mill St West Dewsbury	1.8	Roadside	-	-	-	37.4	31.2

***Figures in bold indicate an exceedance of the long-term air quality objective. Figures underlined and bold indicate exceedances to the short-term, hourly air quality objective.**

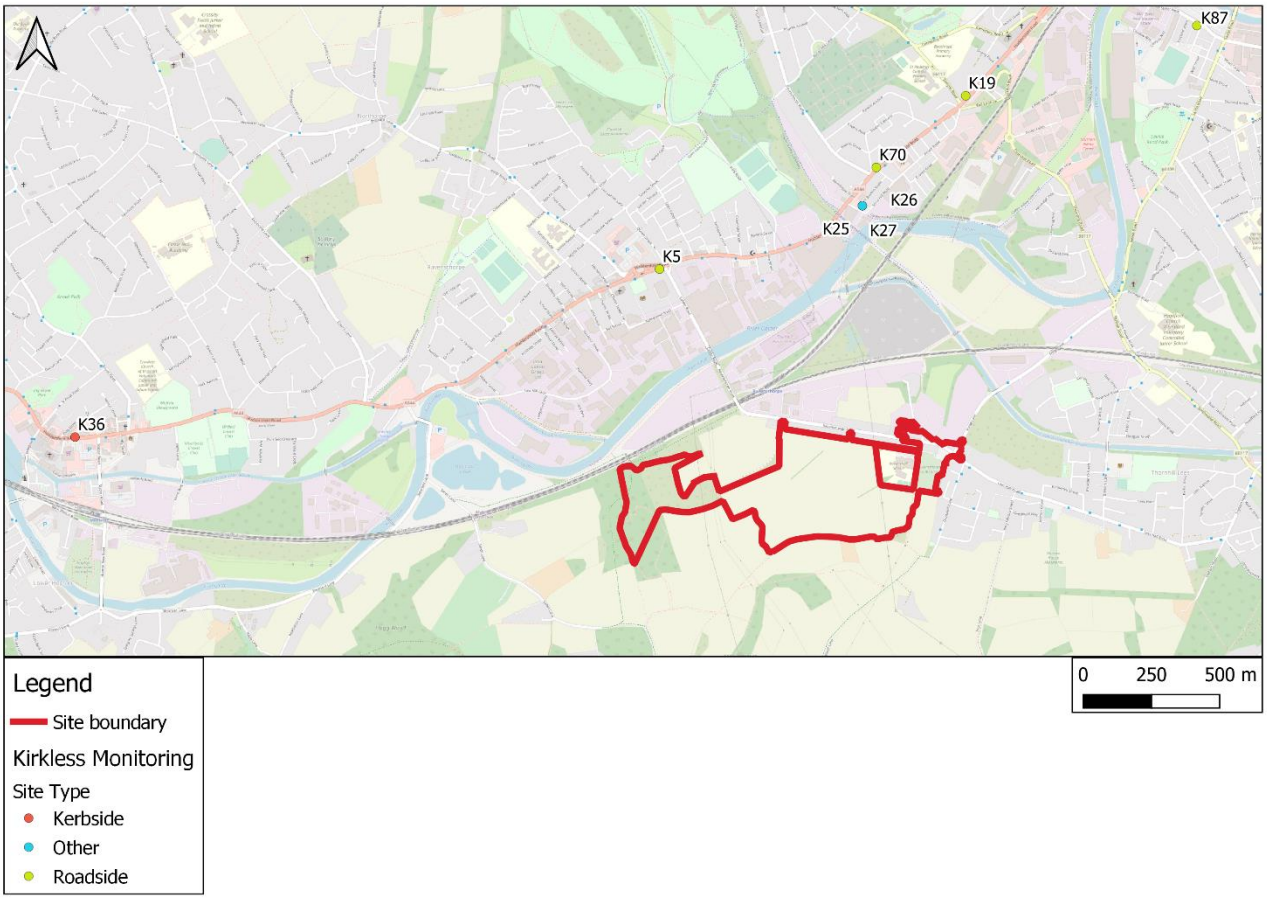


Figure 3-1 Nearby air quality monitoring locations

3.3 Background Air Quality Data

Background concentrations can be identified using two key sources;

- Background monitoring sites, and;
- Defra predicted UK background concentrations (Defra, 2020)[6].

There are no nearby background monitoring sites that are representative of background conditions in proximity to the proposed development.

3.4 Baseline Mapped Background Concentrations

The Defra predicted background pollutant concentrations cover the whole of the UK, with predictions being given within a 1x1 km for years from 2018 until 2030. The Defra predicted background concentrations are presented in Table 3-2 and shown in Figure 3-1.

Table 3-2 Predicted Defra mapped background concentrations of NO_2, and $PM_{2.5}$ and PM_{10} 2019

Pollutant	**2019 Annual mean background concentrations (µg/m3)**
	Defra Background Maps (Grid Square; 423500, 419500)
NO_2	12.9
PM_{10}	11.5
$PM_{2.5}$	7.7

[6] Defra (2018) Air quality background maps, 2018 Reference Year

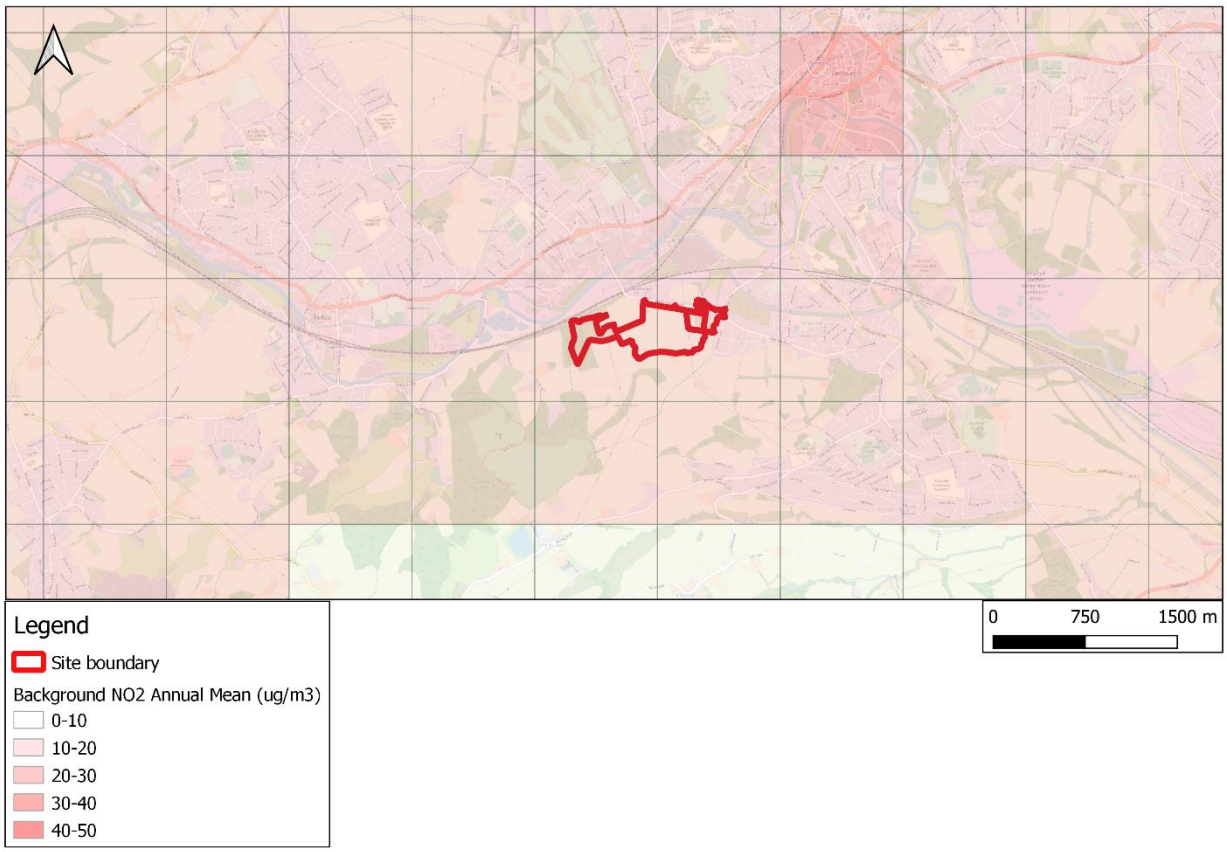


Figure 3-2 Defra mapped background concentrations

3.5 Future Mapped Background Concentrations

Future year projections show pollutant concentrations decreasing, mainly due to improvements in emission abatement technology and policies aimed at improving air quality. The estimated background concentrations during the year of opening (2030) are presented in Table 3-3.

Table 3-3 Future Defra Background Concentrations 2030

Pollutant	Defra Background Maps predicted annual mean background concentrations (µg/m3)
NO_2	11.4
PM_{10}	10.9
$PM_{2.5}$	7.3

4 Construction impacts

4.1 Construction assessment methodology

Potential construction impacts have been assessed in accordance with the Institute of Air Quality Management (IAQM) best practice guidance[7]. This guidance provides a methodology for assessing air quality impacts from demolition, earthworks, construction and trackout[8] activities which may be associated with a development.

The IAQM construction dust assessment methodology involves the following steps:

1. A screening assessment to identify the need for detailed assessment. Detailed assessment will 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).

    IAQM has deliberately made the screening criteria conservative in order to ensure that most, if not all, development schemes will require assessments of their air quality impacts.
2. Assess the risk of dust impacts by: (a) defining the potential dust emission magnitude, (b) defining the sensitivity of the area, and (c) assessing the risk of impacts. Criteria for defining the dust impacts are shown in Appendix A.
3. Determine site-specific mitigation for each of the four possible construction activities; and
4. Examine residual effects to determine whether or not these are significant.

This assessment will focus on earthworks, construction, and trackout. IAQM guidance suggests that the significance of any adverse effects are reported post-mitigation, assuming all actions to avoid or reduce environmental effects are an inherent part of the proposed development.

[7] Holman et al (2014). *IAQM Guidance on the assessment of dust from demolition and construction*, Institute of Air Quality Management, London. www.iaqm/wpcontent/uploads/guidance/dust_assessment.pdf.

[8] Trackout refers to the transport of dust and dirt from the construction site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when heavy duty vehicles (HDVs) leave the construction site with dusty materials, which may then spill onto the road, and/or when HDVs transfer dust and dirt onto the road having travelled over muddy ground on site.

4.2 Construction assessment

The IAQM guidance criteria used to assess the potential impacts from construction activities is detailed in Appendix A. The following steps explain the site-specific assessment in the context of the IAQM criteria.

Step 1: Screen the Need for a Detailed Assessment

In accordance with screening criteria in the IAQM guidance, an assessment is required as sensitive receptors are located within 350m of the site boundary. Receptors include residential properties on Raventhorpe Road and Lees Hall Road.

Step 2A: Define the Potential Dust Emission Magnitude

Dust emission magnitudes for relevant construction activities are shown in Table 4-1.

Table 4-1 Dust emission magnitudes

Activity	Dust emission magnitude
Earthworks	Large (site area >30ha)
Construction	Large (total building volume >100,000m^3)
Trackout	Medium (10-50 maximum HDV outwards movements per day in peak construction year)
Demolition	Medium (demolition of Masjid Abubakr Mosque and Lees Hall Playgroup Building)

The combined site area of the proposed development is 29.4ha, the construction volume is estimated to be >100, 000 m^3. AADT increases in the peak construction year indicate a maximum increase of 64 HGVs on the access road, opposite Forge Lane.

Step 2B: Define the sensitivity of the area

The sensitivity of the surrounding area is defined using a number of factors, including receptor sensitivity, number of receptors, distance from the development site, and existing PM_{10} concentrations. The sensitivity of the surrounding area to potential construction impacts is detailed in Table 4-2.

Table 4-2 Area sensitivity

Potential impact	Sensitivity of surrounding area			
	Earthworks	**Construction**	**Trackout**	**Demolition**
Dust soiling	High	High	High	High
Human health	Low	Low	Medium	Low

eThe sensitivity of the area to dust soiling is considered high owing to the proximity of nearby receptors from the site boundary. The site is bordered to the north by Ravensthorpe Road, which has >50 residential properties which are classified as sensitive, and which will be at risk of impact. The sensitivity with respect to human health is low to

medium. The existing PM_{10} concentrations are well below air quality objectives therefore the risk of exceedance of the PM_{10} annual mean limit, and in turn health impact, is unlikely.

Figure 4-1 Construction receptors within 100m from the site

Step 2C: Define the risks of impacts

The risk of dust impacts for relevant construction activities are summarised in Table 4-3. These results take into account both the potential dust emission magnitude and the sensitivity of the area. Results show that the impact is considered high risk, however it is acknowledged these activities are temporary in nature and will be mitigated through implementation of good industry practices, appropriate to the level of risk. Appropriate mitigation measures to ensure the impact from construction activities will not be significant are set out later in this section.

Table 4-3 Summary of risk from dust impacts

Source	Dust soiling	Human health
Earthworks	High Risk	Low Risk
Construction	High Risk	Low Risk
Track-out	Medium Risk	Low Risk
Demolition	Medium Risk	Low Risk

4.3 Construction Traffic Emissions

The appointed transport consultant has supplied traffic data for the peak construction year of the development, 2023, and the maximum AADT increase is 348 on the proposed access road opposite Forge Lane. This increase is above the IAQM criteria presented in Table 5-1 and as such requires detailed assessment. The methodology to assess the impact of construction traffic emissions on existing receptors is the same as set out in the **Traffic Modelling Methodology** section.

4.4 Modelled Results

The impact of construction traffic emissions during the peak construction year is predicted to be negligible at receptors. Concentrations of all pollutants modelled (NO_2, PM_{10} and $PM_{2.5}$) at receptors adjacent to Ravensthorpe Road, a key trackout route, are expected to marginally increase as a result of construction traffic flow; however given the low pollutant concentrations in this area of Dewsbury, the magnitude of increase is below the levels of significant set out in IAQM guidance.

5 Operational Impacts

5.1 Criteria for assessing operational impacts

The EPUK/IAQM has published guidance on consideration of air quality within the planning and development control process. This guidance includes criteria which identify when relevant operational impacts can be screened out as insignificant or require further assessment. Criteria relevant to this assessment are detailed in Table 5-1.

Table 5-1 Indicative criteria for requiring an air quality assessment

The development will:	Indicative criteria to proceed to detailed assessment:
Cause a significant change in Light Duty Vehicle (LDV) traffic flows on local roads with relevant receptors. (LDV = cars and small vans.	A change of LDV flows of: - more than 100 annual average daily traffic (AADT) within or adjacent to an AQMA - more than 500 AADT elsewhere.
Cause a significant change in Heavy Duty Vehicle (HDV) flows on local roads with relevant receptors. (HDV = goods vehicles + buses >3.5t gross vehicle weight).	A change of HDV flows of: - more than 25 AADT within or adjacent to an AQMA - more than 100 AADT elsewhere.
Have one or more substantial combustion processes, where there is a risk of impacts at relevant receptors. NB. this includes combustion plant associated with standby emergency generators (typically associated with centralised energy centres) and shipping.	Typically, any combustion plant where the single or combined NOx emission rate is less than 5 mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion. In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates. Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable.
Have an underground car park with extraction system	The ventilation extract for the car park will be within 20 m of a relevant receptor. Coupled with the car park having more than 100 movements per day (total in and out).

5.2 Combustion plant emissions

As the proposed 350 dwellings are part of the outline element of this applications, the energy strategy is still being finalised. The Dewsbury Riverside Energy Options Appraisal outlines the options available, one of which will be taken forward as part of the reserved matters application. At this stage there are two prevailing options that are being explored:

1. District heat network supplied by a centralised ground source heat pump and peak gas boilers;

2. Decentralised air source heat pumps.

Both options will utilise emission free plant equipment, which will minimise impacts associated with combustion plant equipment; however option 1 will give rise to emissions associated with peak gas boilers. Should option 1 be taken

forward, the impact from the boiler emissions will need to be assessed once sizing and plant specification has been frozen. Given the lack of a frozen energy strategy, and for the purposes of this outline application, a detailed assessment has been scoped out.

5.3 Operational Traffic Emissions

Vehicle emissions from operational traffic associated with the proposed development will have a potential impact on local air quality. The maximum increase of Annual Average Daily Trips (AADT) associated with the operation of the development exceeds the threshold outlined in Table 5-1 and so a detailed assessment of the impact of operational traffic on existing receptors has been scoped into this assessment.

Traffic Modelling Methodology

The impact of emissions from nearby road links has been predicted at existing receptor locations, in proximity to impacted roads, using the dispersion model ADMS-Roads (v5). This model is developed by Cambridge Environmental Research Consultants (CERC) and can be used to assess the impact of vehicle emissions and industrial sources on local air quality. Unlike simpler spreadsheet screening tools, it can include parameters such as variable meteorological conditions, complex road networks (including the combined contribution of multiple road links on single sensitive receptors) and the capability of including the effects of complex terrain, atmospheric chemistry and street-canyon effects. The model is widely used by local authorities in the UK as part of their local air quality management obligations.

The assessment considers existing traffic flows on the road network, future year traffic increases from cumulative schemes and the predicted change in future traffic flows and patterns as a result of the proposed development.

Traffic-related pollutant concentrations (NO_2, PM_{10} and $PM_{2.5}$) are predicted at sensitive receptor locations for the following assessment scenarios:

- 2019 Existing Baseline (to establish existing baseline conditions and for model verification);
- 2023 Peak Construction Year Do Nothing; traffic flows for the peak construction year (including committed development);
- 2023 Peak Construction Year Do Something; traffic flows for the peak construction year (including committed development) with flows associated with the construction vehicles manually assigned to the Do Nothing Scenario by the appointed transport consultant
- 2030 Opening Year Do Nothing; traffic flows for the opening year (including committed development);
- 2030 Opening Year Do Something; traffic flows for the opening year (including committed development) with flows associated with the full operation of the proposed development.

The proposed development flows in the Opening Year Do Something scenario use KC's Wide Area Transport Model to forecast changes in traffic patterns associated with the operation of the proposed development, this model has been used to inform the Local Plan. This includes predicted reductions in traffic flows on some roads in the vicinity of the site. In order to consider a more conservative approach to predicted development traffic flows, a scenario has also been modelled which has manually assigned development flows on the road network in the vicinity of the site, in order to provide a sensitivity analysis. Results from this sensitivity analysis are presented alongside the modelled

results for relevant receptors. Results from receptors impacted by the manually assigned flows are presented in Appendix F.

Vehicle emissions have been calculated based on vehicle flow, composition and speed data using Defra's Emission Factor Toolkit (Version 10.1)[9], which provides projections up to 2030. Emission factors from the relevant scenario year have been used (i.e. the opening year scenario uses 2030 emission factors). Emission factor projections show reductions in pollutant emissions year on year owing to improvements in vehicle emission standards and emission abatement technology.

Hourly sequential meteorological data from Bingley Meteorological Station for 2019 have been used in the traffic emissions modelling.

Surface roughness represents the extent of mechanical turbulence in the atmosphere caused by the roughness of the ground over which the air is passing. A surface roughness length of 0.5 m was used at the study area (representative of typical roughness of open suburbia) and 0.2m (representative of typical roughness of an agricultural area/airport) at the meteorological measurement site.

Background Concentrations

The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra. These cover the whole of the UK on a 1x1 km grid and are published for each year from 2018 until 2030.

In order to consider the uncertainty associated with future improvements in background air quality, the approach to assessment has been to assume no change in background concentrations from the existing baseline year in the first instance. Where this assumption indicates a potentially significant impact, a further scenario will be assessed using Defra's projected background concentrations for the future scenarios for the purpose of sensitivity testing.

Model adjustment, verification, and post processing

The roads within the ADMS model have undergone a detailed adjustment and verification process which followed the methodology set out in Defra's local air quality management technical guidance (LAQM TG(16)) Box 7.14[10].

Each road has been appraised and adjusted following a detailed review of the road layout using satellite imagery and mapping software. The drawn road layout considers;

- Road width;
- Layout and expected slow-down at junctions; and
- Speed adjustment where queuing is expected;

[9] Defra (2020), Emissions Factor Toolkit. https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html
[10] Department of Environment and Rural Affairs (2018) Local Air Quality Management Technical Guidance (TG16), https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf

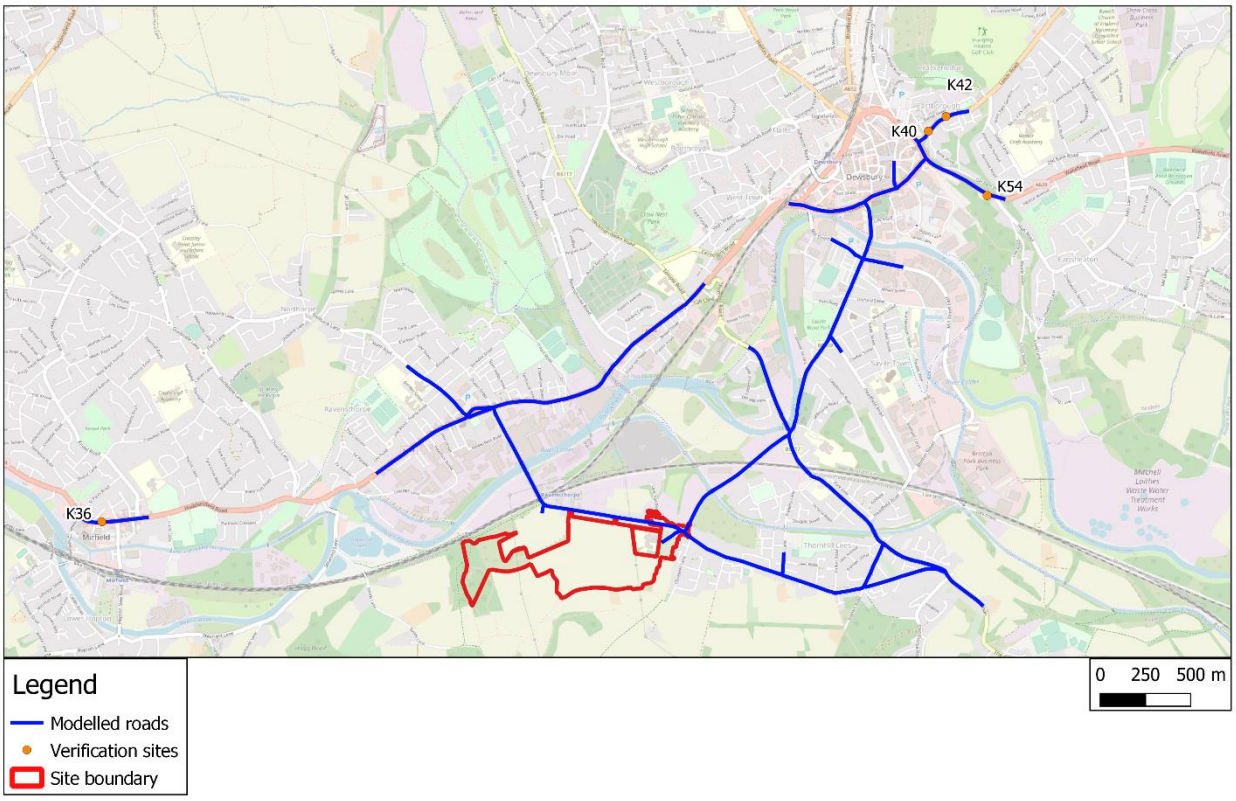


Figure 5-1 Modelled road network and verification sites

Verification is an iterative process that follows the following key steps:

- Identify all roadside monitoring sites within a relevant proximity to road links within the modelled domain;
- Appraise monitoring sites using Google Earth and ensure the location and height given in the Annual Air Quality Status Reports are as accurate as possible;
- Remove sites that are not suitable for model verification (i.e. located in close proximity to a bus stop, inappropriate diffusion tube siting, poor data capture, etc.);
- Compare modelled and monitored NO_x concentrations, identify areas and sites where the differences are similar to identify verification zones; and
- Calculate adjustment factors for each of the identified zones and ensure difference between modelled and monitored NO_2 concentrations are within 25%;

Results indicate that the model under-predicts road NO_x contribution, and therefore it is necessary to apply an adjustment factor. An adjustment factor of 3.4637 has been calculated and has been applied to all modelled NO_x concentrations at receptor locations. Appendix C details the calculations and results from model verification.

The relevant adjustment factor has subsequently been applied to all modelled road NO_x. Owing to the lack of particulate monitoring in the modelled domain, the same adjustment factor has also been applied to modelled PM_{10} and $PM_{2.5}$ results.

Ecological receptors

Nearby ecological receptors have been identified and considered in line with IAQM guidance (IAQM, 2020). Only ecological receptors which are designated nature conservation sites and within 200m of roads predicted to experience an increase in AADT of >1,000 vehicles per day or >200 HDVs per day are to be considered. Relevant designations include;

- Local Nature Sites
- Ancient Woodland;
- Local Wildlife Sites;
- Local Nature Reserves.
- EU/National Designations
- Sites of Special Scientific Interest;
- Special Areas of Conservation;
- RAMSAR Sites.

There are six Ancient Woodlands near the development, shown in Figure 5-2.

Figure 5-2: Nearby ecological receptors

The nearby Ancient Woodland sites are within 1km of the site boundary; however they are not within 200m of roads expected to experience a 1000 AADT increase. As such, an assessment of the impact of traffic emissions on nearby Ecological Receptors has been scoped out.

Human receptors

Pollutant concentrations (NO_2, PM_{10} and $PM_{2.5}$) have been predicted at worst case existing receptor locations within 200m of roads predicted to experience an increase in Annual Average Daily Traffic (AADT) flows above the IAQM criteria detailed in Table 5-1. The modelled road network and receptor locations are presented in Figure 5-3. All receptors have been modelled at 1.5m, representative of worst-case breathing height.

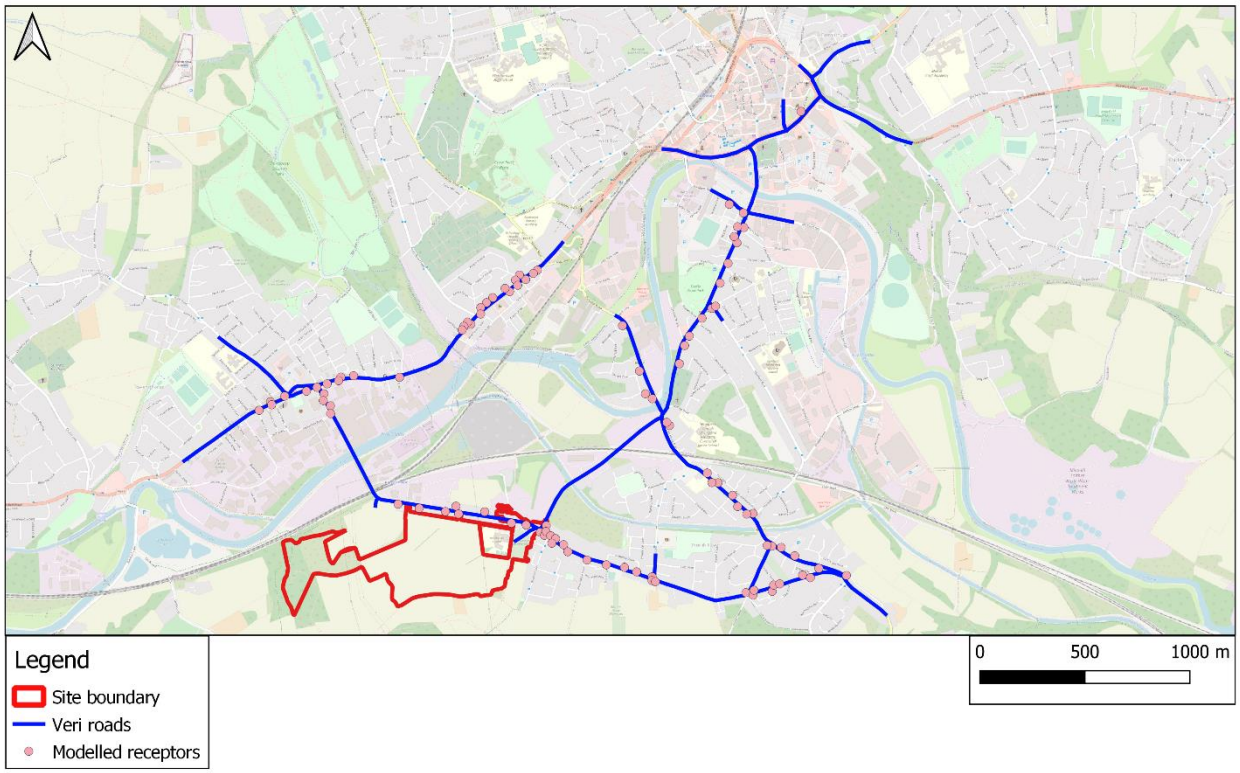


Figure 5-3 Modelled road network and Existing Receptors

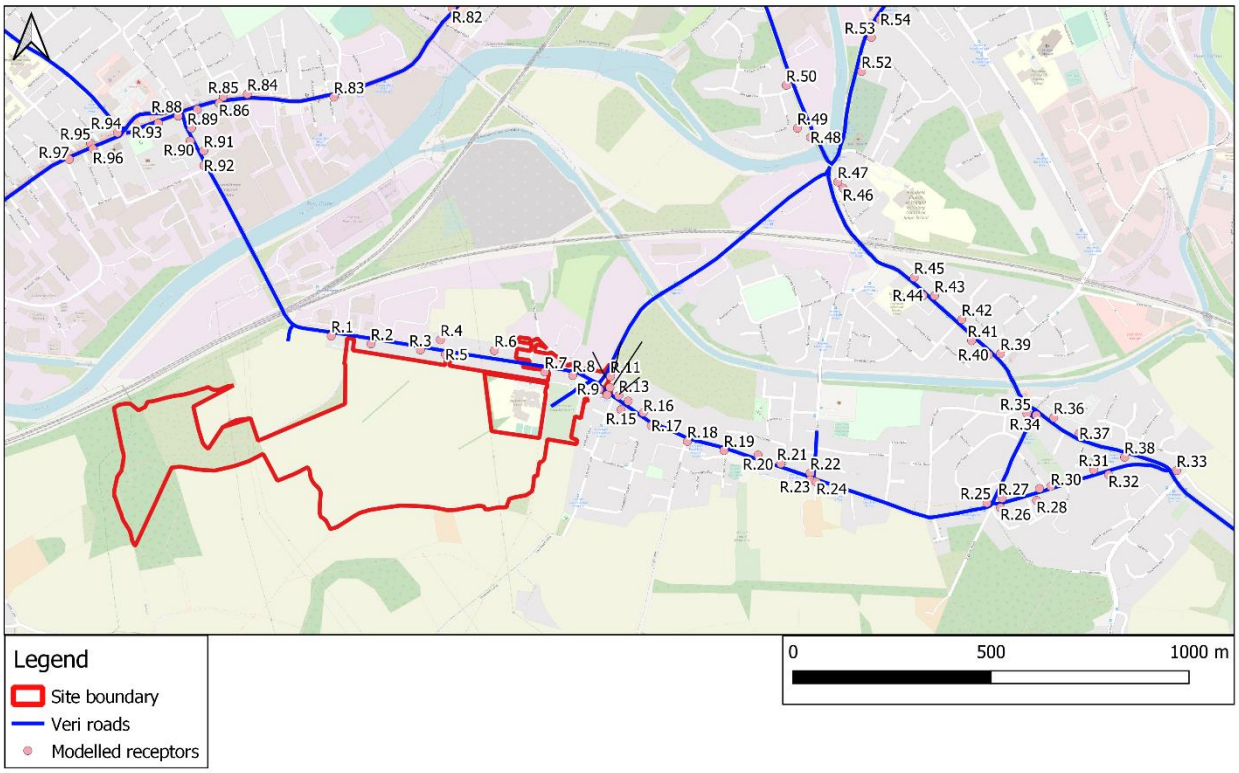


Figure 5-4 Modelled road network and Existing Receptors, with receptor IDs to the south of the modelled domain

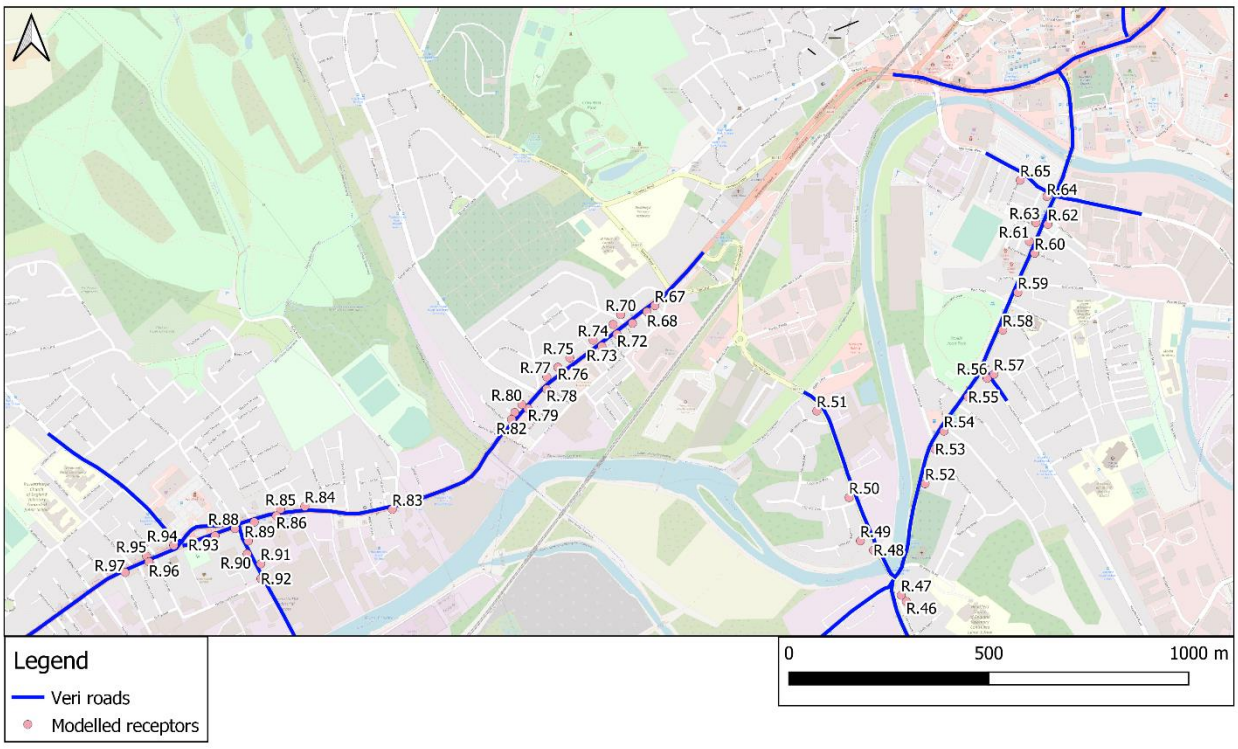


Figure 5-5 Modelled road network and Existing Receptors, with receptor IDs to the north of the modelled domain

Table 5-2 Receptor Locations

Receptor ID	X	Y
R.1	422845.91	419830.91
R.2	422946.31	419811.19
R.3	423071.31	419795.81
R.4	423121.69	419821.31
R.5	423134.19	419784.31
R.6	423258.19	419794.41
R.7	423385.31	419740.31
R.8	423455.91	419731.41
R.9	423522.69	419696.81
R.10	423542.81	419682.69
R.11	423551.31	419729.19
R.12	423549.81	419701
R.13	423572.19	419680.69
R.14	423595.81	419666.81
R.15	423578	419645.19
R.16	423634.19	419637.91
R.17	423654.31	419604.59
R.18	423745.31	419565
R.19	423837.81	419542.19
R.20	423923.91	419530.41
R.21	423981.59	419509.09
R.22	424055.69	419484.91
R.23	424055.5	419467.59
R.24	424071.19	419462.19
R.25	424502.19	419410
R.26	424536.19	419398
R.27	424540.41	419421.31
R.28	424627.31	419416.09
R.29	424634.59	419446.09
R.30	424663.31	419451.59
R.31	424772	419493.41
R.32	424809.31	419481.19
R.33	424981.19	419491.59
R.34	424626.81	419631
R.35	424603	419635.09
R.36	424670.81	419624.91
R.37	424735.19	419585.19
R.38	424849.59	419525.19
R.39	424536.19	419786.31
R.40	424505.91	419783.41
R.41	424463.31	419819.31
R.42	424438.41	419872.81
R.43	424369.69	419932.41

R.44	424340.5	419933.09
R.45	424318	419978.69
R.46	424138.31	420204.09
R.47	424125.41	420219.81
R.48	424056.41	420332.19
R.49	424023.5	420355.5
R.50	423995.31	420463.81
R.51	423914.5	420679.81
R.52	424185.41	420498.41
R.53	424210.19	420584.69
R.54	424232.69	420629.5
R.55	424293.19	420714.69
R.56	424340.5	420761.5
R.57	424357.59	420771.69
R.58	424379.5	420881.69
R.59	424417.31	420975.81
R.60	424459.5	421073.69
R.61	424445.91	421103.19
R.62	424492.59	421146.09
R.63	424462.81	421149.91
R.64	424489.91	421215.59
R.65	424423.41	421256.09
R.66	424764.5	421698.09
R.67	423509.5	420942.81
R.68	423490.09	420927.59
R.69	423453.59	420898.69
R.70	423424.09	420920.31
R.71	423405.19	420896
R.72	423415.09	420871.19
R.73	423377	420841.19
R.74	423355.09	420856.69
R.75	423296.69	420812.59
R.76	423266.91	420788.91
R.77	423239.19	420764.91
R.78	423238.91	420734.5
R.79	423192.09	420686.09
R.80	423176.91	420696.19
R.81	423159.19	420676.09
R.82	423151	420658.81
R.83	422852.81	420434
R.84	422633.91	420441.5
R.85	422573.41	420434.81
R.86	422562.69	420417.81
R.87	422507.69	420402.59
R.88	422459.31	420386.31
R.89	422492.81	420355.41

R.90	422489.81	420323.09
R.91	422523.81	420298.31
R.92	422524.41	420261
R.93	422409.5	420367.91
R.94	422306.09	420344.19
R.95	422238.09	420317.41
R.96	422244.19	420303.31
R.97	422184.31	420276.69

Receptor sensitivity

Operational impacts are considered at receptor locations where there is relevant exposure to national air quality objectives, in line with LAQM TG16. Examples of receptors, dependent on the averaging period for pollutant concentration, are shown in Table 5-3. Air quality objectives are based on standards which are set at a level below the lowest concentration at which more sensitive members of the public have been observed to be affected by pollutant exposure.

As any member of the public could be present at receptors which have relevant exposure, it is considered that all receptors are of equal sensitivity. Therefore, all receptors considered, where there is relevant exposure, will be of high sensitivity.

Table 5-3 Receptor sensitivity principles: operation

Averaging period	Sensitive receptors occur at	Sensitive receptors generally do not occur at
Annual mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
24 hour mean	All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.

Hourly mean	All locations where the annual mean and 24 -hour mean objective apply. Kerbside sites (for example, pavements of busy shopping streets) Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations where members of the public might reasonably expected to spend one hour or longer	Kerbside sites where the public would not be expected to have regular access.

Significance evaluation

EPUK and the IAQM have produced guidance to ensure adequate consideration of air quality matters in the development control process. This guidance provides a framework for describing the degree of impact resulting from a change in air pollutant concentration. Impact is described by expressing the magnitude of incremental change as a proportion of a relevant assessment level and then to examine this change in the context of the new total concentration and its relationship with the assessment criterion (or Air Quality Assessment Level (AQAL)). In this instance, the AQAL by which significance is determined is the UK air quality objective value.

The significance of a potential impact is derived by considering both the total concentration and the magnitude of change at the receptor location, as demonstrated in Table 5-4.

Table 5-4: Long term impact descriptors for individual receptors

Long term average concentration at receptor in assessment year	**% Change in concentration relative to Air Quality Assessment Level (AQAL)**			
	1	**2-5**	**6-10**	**>10**
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

Limitations and assumptions

There are a number of factors that will contribute to uncertainty associated with the modelling predictions, including the traffic and emissions data model inputs which will have inherent uncertainty associated with them.

In order to reduce this uncertainty, model verification has been carried out for the assessment of traffic emissions by comparing modelled and monitored concentrations, which will ensure a good degree of confidence in modelled results for the existing baseline year. For future years there will inevitably be a greater level of uncertainty owing to future trends in air quality conditions, as well as the uptake and performance of more stringent vehicle emission standards within the vehicle fleet.

In order to address the uncertainty in future air quality conditions, a conservative approach has been taken that assumes there will be no improvement in background concentrations from 2019, for all future assessment years. With regards to future vehicle emissions, studies indicate that Defra's emission factor toolkit (v.10) provides an accurate prediction of the most likely future vehicle emissions reductions and may even under-predict the rate of vehicle emissions reduction.

5.4 Modelled Results

The impact of operational traffic emissions associated with the Development is predicted to be negligible at all but one existing receptor locations. Concentrations of all pollutants modelled (NO_2, PM_{10} and $PM_{2.5}$) at all existing receptors are expected to marginally increase as a result of operational traffic flow; however given the low existing concentrations monitored nearby, and Defra background concentrations being well below relevant pollutant limits, the magnitude of change does not constitute a significant impact.

Traffic flows on Forge Lane, Saville Road and Station Road are predicted to increase considerably as a result of the operation of the Development. Given the setback distance between the roads and existing residential receptors and existing low pollutant concentrations, this does not lead to any significant air quality impacts at the majority of locations.

The highest increase in annual mean NO_2 concentrations is predicted at receptor 11 (adjacent to Forge Lane Junction) which increases by 4.91 µg/m3 as a result of the operational traffic. In line with IAQM Guidance, this is indicative of moderate adverse impact.

Sensitivity testing focused on this receptor, and nearby receptor locations, due to the moderate adverse impact predicted with worst case assumptions (no improvement to background concentrations and using the Wide Area Traffic Model). Using the manually assigned traffic flows, moderate adverse impact is still predicted. However using the improved 2030 Defra predicted background concentrations, the impact is expected to be negligible. The actual impact of operational traffic emissions at receptors in close proximity to Forge Lane junction is therefore likely to be between moderate adverse and negligible. The impact experienced at this location, will be dependent on future background concentration improvement and uptake of low emission vehicles.

With regards to short term air quality objectives as a result of the road traffic emissions, in accordance with LAQM TG16, it is considered that because annual mean NO2 concentrations are below 60µg/m3 at all existing receptor locations, the hourly objective will be met.

6 Mitigation measures

6.1 Construction

Site specific mitigation measures

Step 3 of the IAQM guidance sets out a framework for determining appropriate mitigation measures based on the predicted risk (step 2C), and also allowing for a level of professional judgment. The following mitigation measures can be incorporated into the development to ensure that the residual effects from construction are insignificant.

No mitigation measures are required as a result of construction traffic emissions specifically, as all receptor locations experience negligible impact in the peak construction year.

Mitigation measures that will be considered for inclusion into a Construction Environmental Management Plan (CEMP), based on the perceived level of risk, include the following:

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.
- Develop and implement a Dust Management Plan (DMP), which may include measures to control other emission. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in this document.

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 HBC 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; and
- Hold regular liaison meetings with other high risk construction sites within 500m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes.

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 HBC when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m 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 HBC 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; 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[11] on monitoring during demolition, earthworks and construction.

Site preparation and maintenance

- 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;
- Fully enclose site or specific operations where there is a high potential for dust production and the site is actives for an extensive period;
- Avoid site runoff of water or mud;
- Keep site fencing, barriers and scaffolding clean using wet methods;
- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on-site. If they are being re-used on-site cover as described below; 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 HBC, 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

[11] Institute of Air Quality Management (2014), Guidance on the assessment of dust from demolition and construction

- 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

- No bonfires or burning of waste materials.
- Measures specific to demolition
- Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust);
- Ensure effective water suppression is used during demolition operations;
- Bag and remove any biological debris or damp down such material before demolition;
- Measures specific to earthworks
- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable;
- Use hessian, mulches or tackifiers 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.

Measures specific to 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 power materials ensure bags are sealed after use and stored appropriately to prevent dust.

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.
- 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 log book.
- Install hard surfaced haul routes, which 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).
- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
- Access gates to be located at least 10m from receptors where possible.

6.2 Operation

The modelling results show there is a risk of adverse impact at an existing receptor in close proximity to the Forge Lane Junction, where the access road is joining the existing network. The impact is expected to be moderate adverse with worst case assumptions, although this impact is lowered to negligible in an alternative modelling scenario tested (i.e. assumed improved background concentrations by the opening year). It is likely that the actual impact at this receptor will fall between negligible and moderate.

Given impact is only expected at one receptor location, the overall impact of the scheme is deemed insignificant with respect to air quality, however mitigation measures should still be considered.

It is recommended monitoring should take place in close proximity of the Forge Lane junction, prior to construction, with the monitoring programme continuing until full build out. This will ensure the impact at this receptor is appropriately monitored, and interventions can take place should concentrations increase considerably (i.e. >10% of the annual mean NO_2 limit (>4 ug/m3)) once the scheme is operational.

If required, the mitigation measures outlined in section 6.3 below will help to offset the impacts from the scheme.

The appointed transport consultant for the scheme has prepared a travel plan for the proposed development, the table below outlines mitigation measures relevant to air quality. The successful implementation of the below measures will decrease the risk of mitigation; however monitoring is still recommended in the interest of certainty.

Table 6-1 SMART Action Plan from travel Plan

Measures	Objectives
Appoint Travel Plan Coordinator	Oversee and manage the Travel Plan
Undertake initial travel surveys	To refine/ inform the Travel Plan targets
Provide a long-term cycle parking space within the curtilage of each dwelling	To encourage cycling as a long- term travel choice
Offer each dwelling a bus taster ticket	To encourage the uptake of bus use
Agree Mode Split Targets	Ensure SMART objective is realistic
Carry out travel plan monitoring	Establish residents travel patterns and monitor performance
Provision of local cycle map and public transport information/ weblinks	To encourage cyclists and public transport users by raising awareness of travel options
Promote health and financial benefits of walking and cycling within Travel Leaflet	To encourage walking and cycling
Produce Travel Leaflet and display/ distribute in sales office	To raise awareness of travel options
Promote walk and cycle initiatives such as 'The Big Pedal'	To encourage school children to cycle to school
Promote Walkit.com	To encourage walking
Promote car share database	To encourage the use of car sharing
Promote travel websites within the Travel Leaflet	To encourage travel by all sustainable travel modes, including access to the most up to date public transport timetables
Promote Personalised Travel Planning	Influence sustainable journey planning prior to occupation, eg bus usage instead of car ownership
Provide contact details of local licensed taxi operators	Influence journey planning prior to habit being established when moving in
Extend Travel Plan Co-ordinator role by 2 years if targets not met	To deliver additional measures towards the targets

6.3 Emissions mitigation assessment – Damage costs

As requested by KC, a damage costs emissions mitigation assessment has been carried out in order to assess local emissions from the development and determine the appropriate level of mitigation required; the emissions mitigation assessment is detailed in Appendix G.

The total damage cost amount for the development is £126,753. This is the recommended figure which should be spent on measures to mitigate the impact of the development.

Recommended mitigation measures for implementation are detailed below, it is recommended that these measures are confirmed at the detailed design stage:

- EV recharging infrastructure within the development (wall mounted or free standing in-garage or off-street points);
- Use of zero emission heating plant;
- Car club provision or support to local car club/EV car club;

- Designation of parking spaces for zero emission vehicles;
- Differential parking charges depending on vehicle emissions;
- All commercial vehicles should comply with current European Emission Standard;
- Fleet operations should provide a strategy for reducing emissions, low emission fuels and technologies;
- Use of zero emission service vehicles;
- Support local walking and cycling initiatives;
- On-street EV recharging;
- Contribution to low/zero emission vehicle refuelling infrastructure;
- Zero emission bus service provision or waste collection services;
- Bike/e-bike hire schemes;
- Contribution to renewable fuel and energy generation projects; and
- Incentives for the take-up of zero emission technologies and fuels.

7 Conclusions

A detailed assessment of air quality impacts, during both operation and construction phases of the development, has been undertaken that considers the impacts of the scheme on nearby receptors. Sensitive receptor locations include residential units, outdoor amenity spaces, schools, care homes, etc.

Potential impacts during the construction phases of the development may arise from site activities (earthworks, construction, demolition and trackout) as well traffic generated throughout the construction phase. A qualitative assessment of emissions arising from construction and demolition activities will be undertaken following the GLA Construction Dust SPG and IAQM Guidance, with best practice mitigation measures being suggested in line with the level of risk for the proposed development.

Potential impacts during operation of the development include those associated with traffic generated by the development, as well as from any proposed combustion plant introduced. The emissions from these sources has been assessed in line with IAQM planning guidance, with regard to national (NPPF) and local policy.

With respect to construction phase impacts, there is a high risk of dust soiling impact and low risk of human health impact as a result of construction site activities. The assessment proposes best practice mitigation measures that are recommended to be implemented within a Construction Management Plan. Successful implementation of these measures will ensure construction associated emissions are minimised and any residual impact on air quality will be not significant. Traffic generated by the construction phase has been assessed qualitatively using dispersion modelling software, and there are no significant impacts predicted at existing receptor locations, with negligible changes in pollutant concentrations predicted during the peak construction year.

Concentrations of key pollutants have been modelled at worst case onsite sensitive receptor locations for the peak construction year (2023) and the opening year (2030), to quantitively assess impacts of traffic emissions associated with the development.

With respect to construction traffic emissions, the proposed development will lead to an increase of traffic on the local road network during the construction phase. Dispersion modelling has been undertaken to quantitatively assess the impact of construction traffic at existing sensitive receptors (residential properties, care homes, health facilities, etc.) during the peak construction year (2023). The modelled results show that the impact from construction traffic emissions is negligible at all modelled receptors.

With respect to operational traffic emissions, the proposed development will lead to an increase of traffic on the local road network. Dispersion modelling has been undertaken to quantitatively assess the impact of operational traffic at existing sensitive receptors (residential properties, care homes, health facilities, etc.) during the opening year (2030). The modelled results show that one receptor, a residential unit adjacent to Forge Lane junction, is predicted experiencing moderate adverse impact. Following sensitivity testing, using a revised set of assumptions including future air quality improvement, the impact is negligible. It is recommended monitoring should be undertaken near to the junction at Forge Lane, prior to construction up to full build out, to ascertain the real time impact of the development traffic.

The damage cost calculations also demonstrate the impact of operational traffic, showing the total damage cost for the development to be £126, 753. This is the recommended figure which should be spent on measures to mitigate the impact of the development. Mitigation measures should be confirmed, and agreed with the Local Authority, during the detailed design stage.

Appendix A - Construction assessment methodology

Assessing the risk of dust impacts

A) Defining the potential dust emission magnitude

The dust emission magnitude is based on the scale of the anticipated works and should be classified as Small, Medium, or Large.

Demolition: Example definitions for demolition are:

- **Large**: Total building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level;
- **Medium**: Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level; and
- **Small**: Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.
- **Earthworks**: Earthworks will primarily involve excavating material, haulage, tipping and stockpiling. This may also involve levelling the site and landscaping. Example definitions for earthworks are:
- **Large**: Total site area >10,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes;
- **Medium**: Total site area 2,500 m^2 – 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 m - 8 m in height, total material moved 20,000 tonnes – 100,000 tonnes; and
- **Small**: Total site area <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 <20,000 tonnes, earthworks during wetter months.
- **Construction**: The key issues when determining the potential dust emission magnitude during the construction phase include the size of the building(s) / infrastructure, method of construction, construction materials, and duration of build. Example definitions for construction are:
- **Large**: Total building volume >100, 000 m^3, on site concrete batching, sandblasting;
- **Medium**: Total building volume 25,000 m^3 – 100,000 m^3, potentially dusty construction material (e.g. concrete), on site concrete batching; and
- **Small**: Total building volume <25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).
- **Trackout**: Factors which determine the dust emission magnitude are vehicle size, vehicle speed, vehicle numbers, geology and duration. As with all other potential sources, professional judgement must be applied

when classifying trackout into one of the dust emission magnitude categories. Example definitions for trackout are:

- **Large**: >50 HDV (>3.5t) outward movements[12] in any one day[13], potentially dusty surface material (e.g. high clay content), unpaved road length >100 m;
- **Medium**: 10-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m; and
- **Small**: <10 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 m.
- These numbers are for vehicles that leave the site after moving over unpaved ground, where they will accumulate mud and dirt that can be tracked out onto the public highway.

B) Defining the sensitivity of the area

- The sensitivity of the area takes account of a number of factors:
- The specific sensitivities of receptors in the area;
- The proximity and number of those receptors;
- In the case of PM_{10}, the local background concentration; and
- Site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.
- Examples of sensitivities of various receptors to dust soiling, elevated PM_{10} and ecological effects are shown in Table A1.

For the sensitivity of people and their property to soiling, the IAQM recommends that the air quality practitioner uses professional judgement to identify where on the spectrum between high and low sensitivity a receptor lies, taking into account the general principles in the table below.

For the sensitivity of people to the health effects of PM_{10}, the IAQM recommends that the air quality practitioner assumes that there are three sensitivities based on whether or not the receptor is likely to be exposed to elevated concentrations over a 24-hour period, consistent with the Defra's advice for local air quality management.

With regards to ecological effects, it is advised to seek the advice of an ecologist to determine the need for an assessment of dust impacts on sensitive habitats and plants. Professional judgement is required to identify where on the spectrum between high and low sensitivity a receptor lies, taking into account the likely effect and the value of the ecological asset. A habitat may be highly valuable but not sensitive, alternatively it may be less valuable but more sensitive to dust deposition. Consequently, specialist ecological advice should also be sought to determine the sensitivity of the ecological receptors to dust impacts. In general most receptors will either be of high sensitivity or low sensitivity i.e. either sensitive or not to dust deposition.

[12] A vehicle movement is a one way journey. i.e. from A to B, and excludes the return journey.
[13] HDV movements during a construction project vary over its lifetime, and the number of movements is the maximum not the average.

Table A1 Examples of receptor sensitivities for various construction effects

Receptor sensitivity	Effects		
	Dust soiling	**Elevated PM_{10}**	**Ecological**
High	Users can reasonably expect a enjoyment of a high level of amenity The appearance, aesthetics or value of their property would be diminished by soiling; and the people or property would reasonably be expected a to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Indicative examples include dwellings, museum and other culturally important collections, medium and long term car parks and car showrooms.	locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.	Locations with an international or national designation and the designated features may be affected by dust soiling; or location where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List For Great Britain an indicative example is a Special Area of Conservation (SAC) designated for acid heathlands adjacent to the demolition of a large site containing concrete (alkali) buildings or for the presence of lichen.
Medium	Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or the appearance, aesthetics or value of their property could be diminished by soiling; or the people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. indicative examples include parks and places of work.	locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). indicative examples may include office and shop workers, but will generally not include workers occupationally exposed to PM_{10}, as protection is covered by Health and Safety at Work legislation.	Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or Locations with a national designation where the features may be affected by dust deposition. Indicative examples include a Site of Special Scientific Interest (SSSI) with dust sensitive features.
Low	the enjoyment of amenity would not reasonably be expected; or there is property that would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or there is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land.	Locations where human exposure is transient. indicative examples public footpaths, playing fields, parks and shopping streets.	Locations with a local designation where the features may be affected by dust deposition. Indicative example is a local Nature Reserve with dust sensitive features.

Receptor sensitivity	Effects		
	Dust soiling	**Elevated PM_{10}**	**Ecological**
	indicative examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.		

Additional factors to consider when determining the sensitivity of the area include the following

- Any history of dust generating activities in the area;
- The likelihood of concurrent dust generating activity on nearby sites;
- Any pre-existing screening between the source and the receptors;
- Any conclusions drawn from analysing local meteorological data which accurately represent the area; and if relevant the season during which the works will take place;
- Any conclusions drawn from local topography;
- Duration of the potential impact, as a receptor may become more sensitive over time; and
- Any known specific receptor sensitivities which are considered go beyond the classifications given.
- The following tables show how the sensitivity of an area can be determined for the various potential impacts. For each potential impact the highest level of sensitivity should be recorded.

Table A2 Sensitivity of the area to dust soiling effects on people and property

Receptor sensitivity	Number of receptors	Distance from the source (m)			
		<20	**<50**	**<100**	**<350**
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table A3 Sensitivity of the area to human health impacts

Receptor sensitivity	Annual mean PM_{10} concentration	Number of receptors	Distance from the source (m)				
			<20	**<50**	**<100**	**<200**	**<350**
High	>32 µg/m^3	>100	High	High	High	Medium	Low

Receptor sensitivity	Annual mean PM_{10} concentration	Number of receptors	Distance from the source (m)				
			<20	<50	<100	<200	<350
	(>18 µg/m^3 in Scotland)	10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m^3 (16-18 µg/m^3 in Scotland)	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m^3 (14-16 µg/m^3 in Scotland)	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m^3 (<14 µg/m^3 in Scotland)	>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 A4 Sensitivity of the area to ecological impacts

Receptor sensitivity	Distance from the source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

C) Defining the risks of impacts

Dust emission magnitude determined at step A) should be combined with the sensitivity of the area determined at step B) in order to determine the risk of impacts with no mitigation applied. The following matrices provide a method of assigning the level of risk for each activity. For those cases where the risk category is 'negligible', no mitigation measures beyond those required by legislation will be required.

Table A5 Risk of dust impacts – demolition

Sensitivity of area	Dust emission magnitude		
	Large	Medium	Small
High	High risk	Medium risk	Medium risk
Medium	High risk	Medium risk	Low risk
Low	Medium risk	Low risk	Negligible

Table A6 Risk of dust impacts – earthworks

Sensitivity of area	Dust emission magnitude		
	Large	Medium	Small
High	High risk	Medium risk	Low risk
Medium	Medium risk	Medium risk	Low risk
Low	Low risk	Low risk	Negligible

Table A7 Risk of dust impacts – construction

Sensitivity of area	Dust emission magnitude		
	Large	Medium	Small
High	High risk	Medium risk	Low risk
Medium	Medium risk	Medium risk	Low risk
Low	Low risk	Low risk	Negligible

Table A8 Risk of dust impacts – trackout

Sensitivity of area	Dust emission magnitude		
	Large	**Medium**	**Small**
High	High risk	Medium risk	Low risk
Medium	Medium risk	Low risk	Negligible
Low	Low risk	Low risk	Negligible

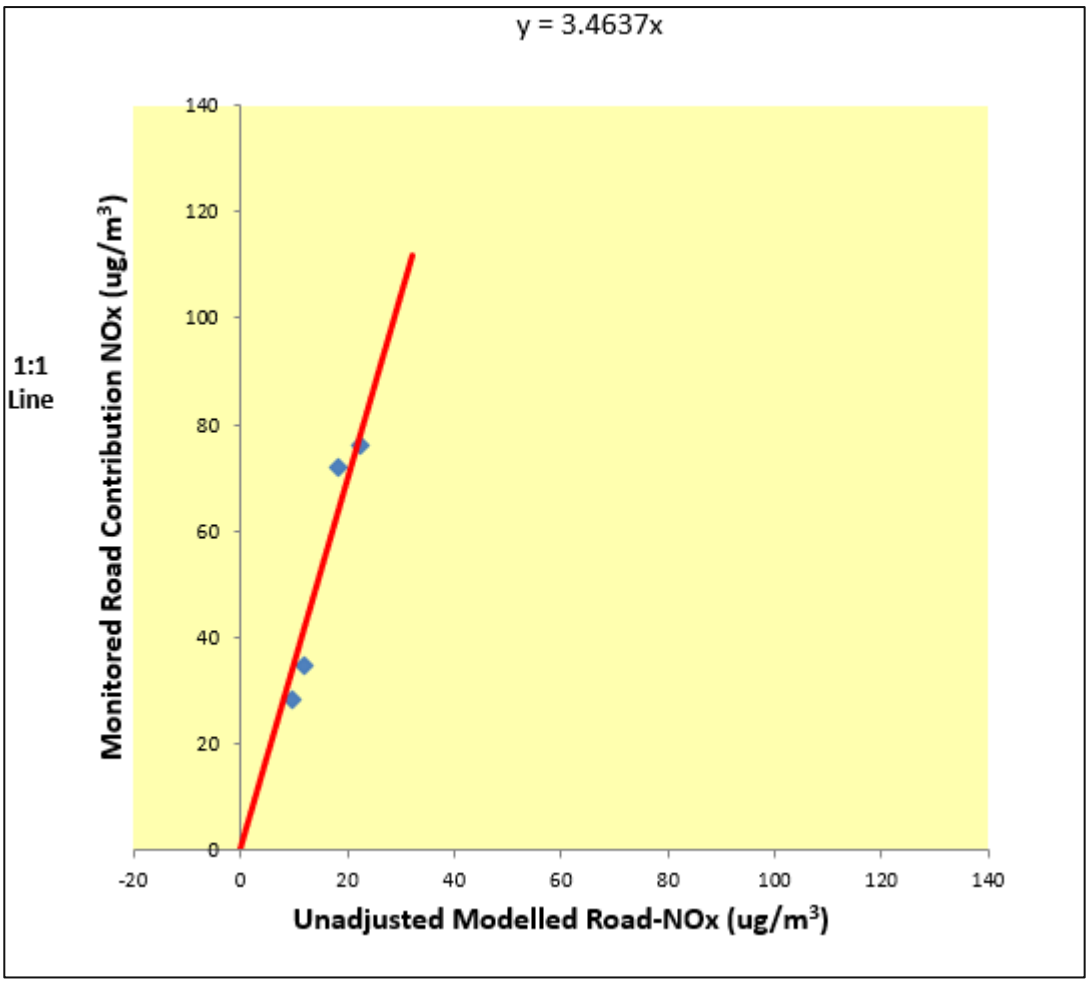
Appendix B - Supplied Traffic Data

Table B1 – Traffic data provided by the Transport Consultant which sets out the Annual Average Daily Traffic (AADT), Heavy Duty Vehicle percentage (HDV%) on key link roads for baseline, peak construction year and opening year scenarios

Link Name	Baseline (2019)		Peak Construction Year Baseline (without construction traffic) (2023)		Peak Construction Year Do Something (with construction traffic) (2023)		Full opening Year Baseline (without operational traffic) (2030)		Full opening Year Baseline (with operational traffic) (2030) *KC Wide Area Traffic Model*		Full opening Year Baseline (without operational traffic) (2030) *Manually assigned traffic data*	
	AADT	HDV %	AADT	HDV %	AADT	HDV %	AADT	HDV %	AADT	HDV %	AADT	HDV %
Site 37372	12706	5.8%	-	-	-	-	-	-	-	-		
Site 57698	14552	4.9%	-	-	-	-	-	-	-	-		
Site 56879	14386	3.0%	-	-	-	-	-	-	-	-		
Site 56879	14386	3.0%	-	-	-	-	-	-	-	-		
Site 56879	14386	3.0%	-	-	-	-	-	-	-	-		
Site 7395	26516	5.5%	-	-	-	-	-	-	-	-		
Gyratory(B)	-	-	19954	5	20024	5	21522	5	21967	5	21522	5
Gyratory(C)	-	-	4994	3	5168	4	7739	3	8041	3	7739	3
Gyratory(D)	-	-	15857	6	15927	6	18348	6	18475	6	18915	6
Gyratory(E)	-	-	7854	3	7889	3	10060	3	10313	3	10060	3
Gyratory(F)	-	-	644	1	644	1	688	1	704	1	688	1
Forge Lane(A)	-	-	12997	3	13171	3	15791	3	15659	3	16358	3
Forge Lane(B)	-	-	7579	3	7725	3	10797	3	12788	3	11563	3
Forge Lane(C)	-	-	5462	3	5490	3	7513	3	7964	3	7937	3
Forge Lane(D)	-	-	-	-	353	20	5	0	2200	0	1763	0
Thornhill(A)	-	-	13602	5	13637	5	15098	5	15202	5	15789	5
Thornhill(B)	-	-	18266	5	18377	5	18200	5	17336	5	18200	5
Thornhill(C)	-	-	9345	5	9345	5	10791	5	12782	5	11557	5
Thornhill(D)	-	-	12744	1	12890	1	14531	3	14322	3	14606	3
Aldmans(A)	-	-	26637	5	26692	5	30030	5	30327	5	30030	5

Link Name	Baseline (2019)		Peak Construction Year Baseline (without construction traffic) (2023)		Peak Construction Year Do Something (with construction traffic) (2023)		Full opening Year Baseline (without operational traffic) (2030)		Full opening Year Baseline (with operational traffic) (2030) *KC Wide Area Traffic Model*		Full opening Year Baseline (without operational traffic) (2030) *Manually assigned traffic data*	
	AADT	HDV %	AADT	HDV %	AADT	HDV %	AADT	HDV %	AADT	HDV %	AADT	HDV %
Aldmans(B)	-	-	16033	5	16123	5	17611	5	17204	5	17611	5
Aldmans(C)	-	-	11935	3	11970	3	13849	3	14564	3	13849	3
Vicarge(A)	-	-	3779	5	3796	5	4939	5	4906	5	4939	5
Vicarge(B)	-	-	26494	5	26532	5	29739	5	30047	5	29739	5
Vicarge(C)	-	-	27489	5	27544	5	31345	5	31620	5	31345	5
Veolia(A)	-	-	10043	3	10217	3	12150	3	12474	3	12717	3
Veolia(B)	-	-	10043	3	10217	3	12150	3	12045	3	12717	3
Veolia(C)	-	-	-	-	10	100	5	3	671	3	5	3
Park Road(A)	-	-	16500	5	16590	5	16038	5	16319	5	16038	5
Park Road(B)	-	-	9141	5	9155	5	9790	5	10087	5	9790	5
Park Road(C)	-	-	17798	5	17902	5	18453	5	18799	5	18453	5
Park Road(D)	-	-	10879	5	10879	5	13382	5	13327	5	13382	5
Headfield(A)	-	-	15202	5	15313	5	16170	5	16412	5	16170	5
Headfield(B)	-	-	6771	5	6771	5	8613	5	8558	5	8613	5
Headfield(C)	-	-	14284	5	14395	5	15290	5	15532	5	15290	5
Brewery(A)	-	-	4499	3	4499	3	4934	3	5203	3	5026	3
Brewery(B)	-	-	5478	3	5478	3	6743	3	6468	3	7075	3
Brewery(C)	-	-	4642	3	4642	3	6078	3	6644	3	6502	3
Ingham(A)	-	-	2459	3	2459	3	3564	3	3894	3	3564	3
Ingham(B)	-	-	2206	3	2206	3	2481	3	2673	3	2481	3
Ingham(C)	-	-	4103	3	4103	3	5440	3	5940	3	5440	3
Slaithwaite(A)	-	-	17683	3	17683	3	19151	3	18524	3	19151	3
Slaithwaite(B)	-	-	17083	3	17083	3	18876	3	18893	3	18876	3
Slaithwaite(C)	-	-	2679	3	2679	3	3806	3	4098	3	3806	3
Common(A)	-	-	17078	3	17078	3	18865	3	18882	3	18865	3

Link Name	**Baseline (2019)**		**Peak Construction Year Baseline (without construction traffic) (2023)**		**Peak Construction Year Do Something (with construction traffic) (2023)**		**Full opening Year Baseline (without operational traffic) (2030)**		**Full opening Year Baseline (with operational traffic) (2030) *KC Wide Area Traffic Model***		**Full opening Year Baseline (without operational traffic) (2030) *Manually assigned traffic data***	
	AADT	**HDV %**	**AADT**	**HDV %**	**AADT**	**HDV %**	**AADT**	**HDV %**	**AADT**	**HDV %**	**AADT**	**HDV %**
Common(B)	-	-	19151	3	19151	3	21214	3	21423	3	21214	3
Common(C)	-	-	2074	3	2074	3	2349	3	2541	3	2349	3



Appendix C - Model verification and adjustment

Modelled results have been verified against known monitored values in close proximity of the site. The verification process has followed the methodology set out in Defra (2018) LAQM TG(16).

The verification sites used in the assessment and the modelled road network are presented in Figure C1 below. Annual mean concentrations from 2019 were used in the absence of the 2020 Annual Status Report at the time writing this report.

There are two monitoring sites within the modelled domain, the micro siting of the sites has been appraised using satellite and roadside imagery. The automatic site was visible, and therefore there is considerable confidence in the setup of this site in the model, however HR14 could not be located due to fencing and barriers obstructing vision.

Figure C1 Verification Site

Results from model verification are presented Table D1. Results indicate that the model under-predicts road NOx contribution, and therefore it is necessary to apply an adjustment factor of 3.6148 (see Figure D2) in order to give more accurate modelled concentrations (Table D2).

The adjustment factor has subsequently been applied to all modelled road NOx concentrations. Adjusted NOx is presented in Figure C3.

Table C1 Model Verification Results

Monitoring Site ID	Modelled road NOx (µg/m^3)	Monitored road NOx (µg/m^3)	% Difference
K40	18.2	71.9	-74.7
K42	12.0	34.6	-65.2
K54	9.7	28.2	-65.5
K36	22.3	76.1	-70.7

Figure C2 Modelled and monitoring road NO_x

Table C2 Adjusted modelled road NO_x

Monitoring Site ID	Background		Modelled Road NOx (µg/m^3)	Monitored Road NOx (µg/m^3)	Adjusted Modelled Road NOx (µg/m^3)	% Difference after Adjustment	Difference between monitored and adjusted modelled concentrations	RMSE
	NOx	NO_2						
K40	34.8	22.9	18.2	71.9	62.9	-12.5	9.0	3.18
K42	25.2	17.8	12.0	34.6	41.7	20.6	-7.1	
K54	25.2	17.7	9.7	28.2	33.7	19.6	-5.5	
K36	18.6	13.6	22.3	76.1	77.2	1.4	-1.1	

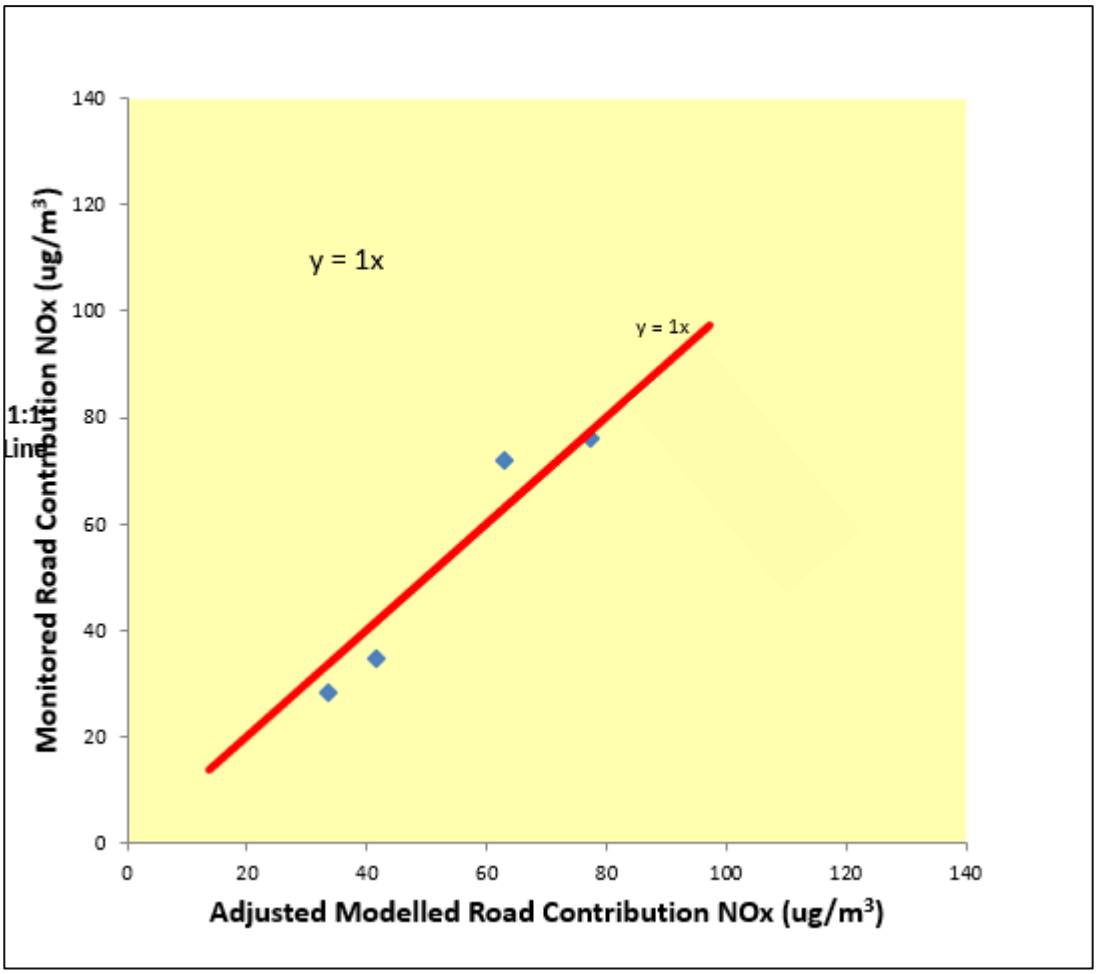


Figure C3 Adjusted modelled road NO_X

Appendix D - Modelled Results at Existing Receptors Peak Construction Year (2023)

Table D1 Modelled NO_2 results at receptors

Receptor ID	X	Y	2019 Background NO_2	Modelled NO_r Annual Mean Concentration (2023) (ug/m^3)		Annual mean as % of Air Quality Annual Limit	Percentage change (%| when compared to AQAL	IAQM Impact Descriptor
				Future Baseline	Peak Construction			
R.1	422846	419831	12.3	17.0	17.1	42.7	0.3	Negligible
R.2	422946	419811	12.3	15.9	15.9	39.9	0.2	Negligible
R.3	423071	419796	11.4	17.0	17.1	42.9	0.3	Negligible
R.4	423122	419821	11.4	15.1	15.2	38.0	0.2	Negligible
R.5	423134	419784	11.4	16.9	17.0	42.6	0.3	Negligible
R.6	423258	419794	11.4	16.9	17.0	42.5	0.3	Negligible
R.7	423385	419740	11.4	16.5	16.6	41.4	0.2	Negligible
R.8	423456	419731	11.4	18.9	19.1	47.7	0.5	Negligible
R.9	423523	419697	11.4	17.2	17.5	43.6	0.5	Negligible
R.10	423543	419683	11.4	16.1	16.2	40.6	0.3	Negligible
R.11	423551	419729	11.4	18.5	18.7	46.8	0.5	Negligible
R.12	423550	419701	11.4	17.6	17.8	44.4	0.4	Negligible
R.13	423572	419681	11.4	16.7	16.8	42.1	0.2	Negligible
R.14	423596	419667	11.4	15.8	15.8	39.6	0.1	Negligible
R.15	423578	419645	11.4	13.3	13.3	33.3	0.1	Negligible
R.16	423634	419638	11.4	16.0	16.0	40.0	0.1	Negligible
R.17	423654	419605	11.4	14.2	14.2	35.6	0.1	Negligible
R.18	423745	419565	11.4	14.3	14.3	35.7	0.0	Negligible
R.19	423838	419542	11.4	14.9	14.9	37.3	0.1	Negligible
R.20	423924	419530	11.4	15.0	15.0	37.6	0.1	Negligible
R.21	423982	419509	11.4	15.6	15.7	39.2	0.0	Negligible
R.22	424056	419485	11.4	17.0	17.0	42.6	0.0	Negligible
R.23	424056	419468	11.4	14.2	14.2	35.4	0.0	Negligible
R.24	424071	419462	11.4	14.6	14.5	36.4	-0.1	Negligible
R.25	424502	419410	11.4	14.5	14.5	36.2	0.0	Negligible
R.26	424536	419398	11.4	13.3	13.3	33.3	0.1	Negligible
R.27	424540	419421	11.4	14.1	14.1	35.2	0.0	Negligible
R.28	424627	419416	11.4	12.4	12.4	31.0	0.0	Negligible
R.29	424635	419446	11.4	13.4	13.4	33.5	0.0	Negligible
R.30	424663	419452	11.4	14.0	14.0	35.0	0.1	Negligible
R.31	424772	419493	11.4	13.7	13.7	34.2	0.0	Negligible
R.32	424809	419481	11.4	13.8	13.8	34.5	0.0	Negligible
R.33	424981	419492	11.4	22.6	22.6	56.4	0.0	Negligible

R.34	424627	419631	11.4	20.9	20.9	52.3	0.0	Negligible
R.35	424603	419635	11.4	16.0	16.0	40.1	0.0	Negligible
R.36	424671	419625	11.4	22.5	22.5	56.3	0.0	Negligible
R.37	424735	419585	11.4	22.0	22.1	55.2	0.0	Negligible
R.38	424850	419525	11.4	19.1	19.1	47.7	0.0	Negligible
R.39	424536	419786	11.4	22.0	22.0	54.9	0.0	Negligible
R.40	424506	419783	11.4	19.4	19.4	48.6	0.1	Negligible
R.41	424463	419819	11.4	18.6	18.7	46.6	0.0	Negligible
R.42	424438	419873	11.4	22.8	22.8	57.0	0.0	Negligible
R.43	424370	419932	11.4	24.3	24.3	60.6	0.0	Negligible
R.44	424341	419933	11.4	21.2	21.2	52.9	0.0	Negligible
R.45	424318	419979	11.4	24.7	24.7	61.9	0.0	Negligible
R.46	424138	420204	14.7	19.5	19.5	48.8	0.0	Negligible
R.47	424125	420220	14.7	22.2	22.3	55.7	0.2	Negligible
R.48	424056	420332	14.7	20.9	21.0	52.4	0.1	Negligible
R.49	424024	420356	14.7	17.5	17.5	43.8	0.0	Negligible
R.50	423995	420464	14.9	18.9	18.9	47.3	0.1	Negligible
R.51	423915	420680	14.9	18.6	18.7	46.7	0.1	Negligible
R.52	424185	420498	14.7	25.4	25.4	63.6	0.2	Negligible
R.53	424210	420585	14.7	25.0	25.0	62.6	0.2	Negligible
R.54	424233	420630	14.7	26.9	27.1	67.6	0.3	Negligible
R.55	424293	420715	14.7	25.5	25.6	64.0	0.2	Negligible
R.56	424341	420762	14.7	22.6	22.7	56.7	0.1	Negligible
R.57	424358	420772	14.7	22.6	22.6	56.6	0.1	Negligible
R.58	424380	420882	14.7	24.0	24.1	60.2	0.2	Negligible
R.59	424417	420976	14.7	28.5	28.7	71.7	0.4	Negligible
R.60	424460	421074	20.3	32.3	32.4	80.9	0.2	Negligible
R.61	424446	421103	20.3	27.0	27.0	67.6	0.1	Negligible
R.62	424493	421146	20.3	31.1	31.2	78.0	0.1	Negligible
R.63	424463	421150	20.3	26.7	26.7	66.7	0.1	Negligible
R.64	424490	421216	20.3	34.0	34.1	85.2	0.1	Negligible
R.65	424423	421256	20.3	16.0	16.1	40.1	0.0	Negligible
R.67	423510	420943	14.9	25.9	25.9	64.9	0.1	Negligible
R.68	423490	420928	14.9	24.8	24.9	62.2	0.1	Negligible
R.69	423454	420899	14.9	24.2	24.3	60.8	0.1	Negligible
R.70	423424	420920	14.9	15.3	15.4	38.4	0.0	Negligible
R.71	423405	420896	14.9	17.4	17.5	43.6	0.0	Negligible
R.72	423415	420871	14.9	26.5	26.6	66.4	0.1	Negligible
R.73	423377	420841	14.9	25.2	25.3	63.3	0.1	Negligible
R.74	423355	420857	14.9	17.8	17.9	44.7	0.0	Negligible
R.75	423297	420813	14.9	17.8	17.9	44.7	0.0	Negligible
R.76	423267	420789	14.9	18.4	18.4	46.0	0.0	Negligible
R.77	423239	420765	14.9	20.5	20.5	51.3	0.0	Negligible
R.78	423239	420735	14.9	31.2	31.3	78.2	0.1	Negligible

R.79	423192	420686	14.9	30.3	30.3	75.8	0.1	Negligible
R.80	423177	420696	14.9	19.9	19.9	49.8	0.0	Negligible
R.81	423159	420676	14.9	19.7	19.8	49.4	0.0	Negligible
R.82	423151	420659	14.9	24.1	24.2	60.4	0.1	Negligible
R.83	422853	420434	17.3	24.0	24.1	60.3	0.1	Negligible
R.84	422634	420442	17.3	24.7	24.7	61.9	0.1	Negligible
R.85	422573	420435	17.3	25.1	25.2	63.0	0.1	Negligible
R.86	422563	420418	17.3	27.1	27.2	68.0	0.1	Negligible
R.87	422508	420403	17.3	25.8	25.9	64.8	0.1	Negligible
R.88	422459	420386	17.3	33.1	33.3	83.2	0.1	Negligible
R.89	422493	420355	17.3	16.8	17.0	42.6	0.1	Negligible
R.90	422490	420323	17.3	14.2	14.3	35.8	0.1	Negligible
R.91	422524	420298	17.3	14.3	14.5	36.3	0.1	Negligible
R.92	422524	420261	17.3	13.5	13.7	34.3	0.1	Negligible
R.93	422410	420368	17.3	32.0	32.1	80.3	0.1	Negligible
R.94	422306	420344	17.3	23.4	23.5	58.8	0.1	Negligible
R.95	422238	420317	17.3	20.1	20.2	50.4	0.0	Negligible
R.96	422244	420303	17.3	26.4	26.5	66.3	0.1	Negligible
R.97	422184	420277	17.3	25.6	25.7	64.2	0.1	Negligible

Table D2 Modelled PM_{10} results at receptors

Receptor ID	X	Y	2019 Background PM10	Modelled PM10 Annual Mean Concentration (2023) (ug/m^3)		Annual mean as % of Air Quality Annual Limit	Percentage change (%) when compared to AQAL	IAQM Impact Descriptor
				Future Baseline	Peak Construction			
R.1	422846	419831	10.9	12.5	12.5	31.3	0.1	Negligible
R.2	422946	419811	10.9	12.1	12.2	30.4	0.1	Negligible
R.3	423071	419796	11.0	12.7	12.8	32.0	0.1	Negligible
R.4	423122	419821	11.0	12.2	12.2	30.5	0.1	Negligible
R.5	423134	419784	11.0	12.7	12.7	31.9	0.1	Negligible
R.6	423258	419794	11.0	12.7	12.7	31.8	0.1	Negligible
R.7	423385	419740	11.0	12.6	12.6	31.5	0.1	Negligible
R.8	423456	419731	11.0	13.1	13.2	32.9	0.2	Negligible
R.9	423523	419697	11.0	12.5	12.5	31.3	0.1	Negligible
R.10	423543	419683	11.0	12.4	12.4	31.0	0.1	Negligible
R.11	423551	419729	11.0	12.9	12.9	32.3	0.1	Negligible
R.12	423550	419701	11.0	12.6	12.7	31.7	0.1	Negligible
R.13	423572	419681	11.0	12.6	12.6	31.5	0.1	Negligible
R.14	423596	419667	11.0	12.3	12.4	30.9	0.0	Negligible
R.15	423578	419645	11.0	11.6	11.6	29.1	0.0	Negligible
R.16	423634	419638	11.0	12.4	12.4	31.1	0.0	Negligible

R.17	423654	419605	11.0	11.9	11.9	29.8	0.0	Negligible
R.18	423745	419565	11.0	11.9	11.9	29.8	0.0	Negligible
R.19	423838	419542	11.0	12.1	12.1	30.3	0.0	Negligible
R.20	423924	419530	11.0	12.1	12.1	30.4	0.0	Negligible
R.21	423982	419509	11.0	12.3	12.3	30.8	0.0	Negligible
R.22	424056	419485	10.9	12.4	12.4	30.9	0.0	Negligible
R.23	424056	419468	10.9	11.7	11.7	29.3	0.0	Negligible
R.24	424071	419462	10.9	11.8	11.8	29.5	0.0	Negligible
R.25	424502	419410	10.9	11.9	11.9	29.9	0.0	Negligible
R.26	424536	419398	10.9	11.6	11.6	29.0	0.0	Negligible
R.27	424540	419421	10.9	11.8	11.8	29.5	0.0	Negligible
R.28	424627	419416	10.9	11.4	11.4	28.4	0.0	Negligible
R.29	424635	419446	10.9	11.6	11.6	29.1	0.0	Negligible
R.30	424663	419452	10.9	11.8	11.8	29.5	0.0	Negligible
R.31	424772	419493	10.9	11.7	11.7	29.3	0.0	Negligible
R.32	424809	419481	10.9	11.8	11.8	29.4	0.0	Negligible
R.33	424981	419492	10.9	14.3	14.3	35.9	0.0	Negligible
R.34	424627	419631	10.9	13.8	13.8	34.5	0.0	Negligible
R.35	424603	419635	10.9	12.4	12.4	31.0	0.0	Negligible
R.36	424671	419625	10.9	14.3	14.3	35.9	0.0	Negligible
R.37	424735	419585	10.9	14.2	14.2	35.5	0.0	Negligible
R.38	424850	419525	10.9	13.3	13.3	33.3	0.0	Negligible
R.39	424536	419786	10.9	14.2	14.2	35.4	0.0	Negligible
R.40	424506	419783	10.9	13.4	13.4	33.5	0.0	Negligible
R.41	424463	419819	10.9	13.2	13.2	32.9	0.0	Negligible
R.42	424438	419873	10.9	14.4	14.4	36.1	0.0	Negligible
R.43	424370	419932	10.9	14.7	14.7	36.9	0.0	Negligible
R.44	424341	419933	10.9	13.7	13.7	34.2	0.0	Negligible
R.45	424318	419979	10.9	14.7	14.7	36.7	0.0	Negligible
R.46	424138	420204	11.4	12.9	12.9	32.4	0.0	Negligible
R.47	424125	420220	11.4	13.5	13.5	33.8	0.0	Negligible
R.48	424056	420332	11.4	13.5	13.5	33.7	0.0	Negligible
R.49	424024	420356	11.4	12.5	12.5	31.2	0.0	Negligible
R.50	423995	420464	12.0	13.5	13.5	33.7	0.0	Negligible
R.51	423915	420680	12.0	13.4	13.4	33.5	0.0	Negligible
R.52	424185	420498	11.4	14.9	14.9	37.3	0.1	Negligible
R.53	424210	420585	11.4	14.8	14.8	37.0	0.1	Negligible
R.54	424233	420630	11.4	15.4	15.5	38.6	0.1	Negligible
R.55	424293	420715	11.4	14.9	15.0	37.5	0.1	Negligible
R.56	424341	420762	11.4	14.0	14.0	35.1	0.0	Negligible
R.57	424358	420772	11.4	14.0	14.0	35.0	0.0	Negligible
R.58	424380	420882	11.4	14.5	14.5	36.2	0.1	Negligible
R.59	424417	420976	11.4	14.9	15.0	37.4	0.1	Negligible
R.60	424460	421074	12.3	16.4	16.5	41.2	0.1	Negligible

R.61	424446	421103	12.3	14.7	14.7	36.8	0.0	Negligible
R.62	424493	421146	12.3	16.0	16.0	40.0	0.1	Negligible
R.63	424463	421150	12.3	14.6	14.6	36.4	0.0	Negligible
R.64	424490	421216	12.3	15.9	15.9	39.8	0.0	Negligible
R.65	424423	421256	8.3	14.0	14.0	35.1	0.0	Negligible
R.67	423510	420943	7.9	16.9	16.9	42.3	0.1	Negligible
R.68	423490	420928	7.9	16.7	16.7	41.7	0.1	Negligible
R.69	423454	420899	7.9	16.5	16.6	41.4	0.1	Negligible
R.70	423424	420920	7.9	13.8	13.8	34.5	0.0	Negligible
R.71	423405	420896	7.9	14.4	14.4	36.0	0.0	Negligible
R.72	423415	420871	7.9	17.3	17.3	43.3	0.1	Negligible
R.73	423377	420841	7.9	16.9	16.9	42.2	0.1	Negligible
R.74	423355	420857	7.9	14.5	14.5	36.3	0.0	Negligible
R.75	423297	420813	7.9	14.5	14.5	36.2	0.0	Negligible
R.76	423267	420789	7.9	14.6	14.6	36.4	0.0	Negligible
R.77	423239	420765	7.9	14.8	14.8	37.0	0.0	Negligible
R.78	423239	420735	7.9	17.1	17.1	42.7	0.1	Negligible
R.79	423192	420686	7.9	18.5	18.5	46.2	0.1	Negligible
R.80	423177	420696	7.9	15.1	15.1	37.7	0.0	Negligible
R.81	423159	420676	7.9	15.0	15.1	37.6	0.0	Negligible
R.82	423151	420659	7.9	16.4	16.4	40.9	0.1	Negligible
R.83	422853	420434	8.3	16.6	16.7	41.6	0.1	Negligible
R.84	422634	420442	8.3	16.8	16.8	42.1	0.1	Negligible
R.85	422573	420435	8.3	16.9	17.0	42.4	0.1	Negligible
R.86	422563	420418	8.3	17.6	17.6	44.0	0.1	Negligible
R.87	422508	420403	8.3	17.0	17.0	42.6	0.1	Negligible
R.88	422459	420386	8.3	17.7	17.7	44.3	0.1	Negligible
R.89	422493	420355	8.3	14.1	14.2	35.4	0.1	Negligible
R.90	422490	420323	8.3	13.5	13.5	33.8	0.1	Negligible
R.91	422524	420298	8.3	13.6	13.6	34.1	0.1	Negligible
R.92	422524	420261	8.3	13.4	13.4	33.5	0.1	Negligible
R.93	422410	420368	8.3	17.2	17.3	43.2	0.1	Negligible
R.94	422306	420344	8.3	16.2	16.2	40.6	0.1	Negligible
R.95	422238	420317	8.3	15.4	15.4	38.5	0.0	Negligible
R.96	422244	420303	8.3	17.4	17.4	43.6	0.1	Negligible
R.97	422184	420277	8.3	17.1	17.2	42.9	0.1	Negligible

Table D3 Modelled $PM_{2.5}$ results at receptors

Receptor ID	X	Y	2019 Background PM2.5	Modelled PM10 Annual Mean Concentration (2023) (ug/m^3)		Annual mean as % of Air Quality Annual Limit	Percentage change (%| when compared to AQAL	IAQM Impact Descriptor
				Future Baseline	Peak Construction			
R.1	422846	419831	7.1	8.1	8.1	32.3	0.0	Negligible
R.2	422946	419811	7.1	7.9	7.9	31.4	0.0	Negligible
R.3	423071	419796	7.3	8.5	8.5	33.9	0.0	Negligible
R.4	423122	419821	7.3	8.1	8.1	32.5	0.0	Negligible
R.5	423134	419784	7.3	8.5	8.5	33.9	0.0	Negligible
R.6	423258	419794	7.3	8.5	8.5	33.8	0.0	Negligible
R.7	423385	419740	7.3	8.4	8.4	33.6	0.0	Negligible
R.8	423456	419731	7.3	8.8	8.8	35.2	0.2	Negligible
R.9	423523	419697	7.3	8.4	8.5	34.1	0.5	Negligible
R.10	423543	419683	7.3	8.4	8.4	33.8	0.4	Negligible
R.11	423551	419729	7.3	8.7	8.9	35.8	0.9	Negligible
R.12	423550	419701	7.3	8.6	8.7	34.7	0.5	Negligible
R.13	423572	419681	7.3	8.5	8.6	34.5	0.4	Negligible
R.14	423596	419667	7.3	8.4	8.4	33.7	0.3	Negligible
R.15	423578	419645	7.3	7.8	7.8	31.4	0.1	Negligible
R.16	423634	419638	7.3	8.4	8.5	34.0	0.3	Negligible
R.17	423654	419605	7.3	8.0	8.1	32.3	0.2	Negligible
R.18	423745	419565	7.3	8.1	8.1	32.4	0.2	Negligible
R.19	423838	419542	7.3	8.2	8.2	32.9	0.2	Negligible
R.20	423924	419530	7.3	8.2	8.2	32.9	0.3	Negligible
R.21	423982	419509	7.3	8.3	8.4	33.5	0.3	Negligible
R.22	424056	419485	7.4	8.6	8.4	33.8	0.4	Negligible
R.23	424056	419468	7.4	8.0	8.2	31.9	0.8	Negligible
R.24	424071	419462	7.4	8.0	8.2	32.0	0.8	Negligible
R.25	424502	419410	7.4	8.1	8.2	32.7	0.2	Negligible
R.26	424536	419398	7.4	7.9	7.9	31.5	0.1	Negligible
R.27	424540	419421	7.4	8.0	8.1	32.2	0.2	Negligible
R.28	424627	419416	7.4	7.7	7.7	30.8	0.1	Negligible
R.29	424635	419446	7.4	7.9	7.9	31.6	0.1	Negligible
R.30	424663	419452	7.4	8.0	8.0	32.0	0.1	Negligible
R.31	424772	419493	7.4	7.9	7.9	31.7	0.1	Negligible
R.32	424809	419481	7.4	7.9	7.9	31.8	0.1	Negligible
R.33	424981	419492	7.4	9.5	9.5	38.0	0.1	Negligible
R.34	424627	419631	7.4	9.2	9.2	36.9	0.1	Negligible
R.35	424603	419635	7.4	8.3	8.3	33.3	0.0	Negligible
R.36	424671	419625	7.4	9.5	9.5	37.9	0.0	Negligible

R.37	424735	419585	7.4	9.4	9.4	37.6	0.0	Negligible
R.38	424850	419525	7.4	8.8	8.8	35.4	0.1	Negligible
R.39	424536	419786	7.4	9.3	9.3	37.0	-0.2	Negligible
R.40	424506	419783	7.4	8.9	8.8	35.3	-0.2	Negligible
R.41	424463	419819	7.4	8.7	8.7	34.8	-0.1	Negligible
R.42	424438	419873	7.4	9.5	9.4	37.7	-0.2	Negligible
R.43	424370	419932	7.4	9.7	9.6	38.4	-0.2	Negligible
R.44	424341	419933	7.4	9.0	9.0	35.9	-0.2	Negligible
R.45	424318	419979	7.4	9.6	9.6	38.4	-0.2	Negligible
R.46	424138	420204	7.6	8.5	8.6	34.5	0.3	Negligible
R.47	424125	420220	7.6	8.9	9.0	36.0	0.4	Negligible
R.48	424056	420332	7.6	8.8	8.8	35.2	0.0	Negligible
R.49	424024	420356	7.6	8.2	8.2	32.8	0.0	Negligible
R.50	423995	420464	7.9	8.8	8.8	35.2	0.0	Negligible
R.51	423915	420680	7.9	8.7	8.7	35.0	0.0	Negligible
R.52	424185	420498	7.6	9.4	9.5	37.6	0.3	Negligible
R.53	424210	420585	7.6	9.4	9.5	37.3	0.3	Negligible
R.54	424233	420630	7.6	9.7	9.8	38.6	0.4	Negligible
R.55	424293	420715	7.6	9.6	9.6	38.4	0.0	Negligible
R.56	424341	420762	7.6	9.2	9.2	36.7	0.0	Negligible
R.57	424358	420772	7.6	9.2	9.2	36.7	0.0	Negligible
R.58	424380	420882	7.6	9.3	9.4	37.4	0.1	Negligible
R.59	424417	420976	7.6	9.6	9.6	38.5	0.1	Negligible
R.60	424460	421074	8.3	10.6	10.6	42.5	0.2	Negligible
R.61	424446	421103	8.3	9.6	9.7	38.6	0.1	Negligible
R.62	424493	421146	8.3	10.3	10.4	41.5	0.1	Negligible
R.63	424463	421150	8.3	9.5	9.6	38.2	0.1	Negligible
R.64	424490	421216	8.3	10.4	10.4	41.6	0.1	Negligible
R.65	424423	421256	8.3	9.3	9.3	37.3	0.0	Negligible
R.67	423510	420943	7.9	10.8	10.8	43.3	0.2	Negligible
R.68	423490	420928	7.9	10.6	10.7	42.7	0.2	Negligible
R.69	423454	420899	7.9	10.5	10.6	42.4	0.2	Negligible
R.70	423424	420920	7.9	8.9	9.0	35.9	0.1	Negligible
R.71	423405	420896	7.9	9.3	9.3	37.3	0.1	Negligible
R.72	423415	420871	7.9	11.0	11.1	44.2	0.3	Negligible
R.73	423377	420841	7.9	10.7	10.8	43.2	0.2	Negligible
R.74	423355	420857	7.9	9.4	9.4	37.6	0.1	Negligible
R.75	423297	420813	7.9	9.4	9.4	37.5	0.1	Negligible
R.76	423267	420789	7.9	9.4	9.4	37.7	0.1	Negligible
R.77	423239	420765	7.9	9.5	9.6	38.3	0.1	Negligible
R.78	423239	420735	7.9	10.9	10.9	43.8	0.2	Negligible
R.79	423192	420686	7.9	11.7	11.7	47.0	0.3	Negligible
R.80	423177	420696	7.9	9.7	9.7	39.0	0.1	Negligible
R.81	423159	420676	7.9	9.7	9.7	38.9	0.1	Negligible

R.82	423151	420659	7.9	10.4	10.5	42.0	0.2	Negligible
R.83	422853	420434	8.3	10.9	11.0	43.9	0.2	Negligible
R.84	422634	420442	8.3	11.0	11.1	44.3	0.2	Negligible
R.85	422573	420435	8.3	11.1	11.1	44.6	0.2	Negligible
R.86	422563	420418	8.3	11.5	11.5	46.2	0.3	Negligible
R.87	422508	420403	8.3	11.2	11.2	45.0	0.2	Negligible
R.88	422459	420386	8.3	11.8	11.9	47.4	0.2	Negligible
R.89	422493	420355	8.3	9.7	9.8	39.1	0.2	Negligible
R.90	422490	420323	8.3	9.3	9.3	37.2	0.1	Negligible
R.91	422524	420298	8.3	9.4	9.4	37.7	0.1	Negligible
R.92	422524	420261	8.3	9.2	9.3	37.1	0.1	Negligible
R.93	422410	420368	8.3	11.5	11.5	46.1	0.1	Negligible
R.94	422306	420344	8.3	10.8	10.9	43.4	0.1	Negligible
R.95	422238	420317	8.3	10.3	10.3	41.2	0.1	Negligible
R.96	422244	420303	8.3	11.6	11.6	46.4	0.1	Negligible
R.97	422184	420277	8.3	11.4	11.4	45.7	0.1	Negligible

Appendix E - Modelled Results at Existing Receptors Opening Year (2030)

Table D1 Modelled NO_2 results at receptors

Receptor ID	X	Y	2019 Background NO_2	Modelled NO2 Annual Mean Concentration (2023) (ug/m^3)		Annual mean as % of Air Quality Annual Limit	Percentage change (%| when compared to AQAL	IAQM Impact Descriptor
				Future Baseline	Opening year			
R.1	422846	419831	12.3	14.2	14.21	35.5	0.0	Negligible
R.2	422946	419811	12.3	13.55	13.56	33.9	0.0	Negligible
R.3	423071	419796	11.4	13.95	13.96	34.9	0.0	Negligible
R.4	423122	419821	11.4	12.83	12.87	32.2	0.1	Negligible
R.5	423134	419784	11.4	13.89	13.91	34.8	0.0	Negligible
R.6	423258	419794	11.4	13.87	13.95	34.9	0.2	Negligible
R.7	423385	419740	11.4	13.66	13.87	34.7	0.5	Negligible
R.8	423456	419731	11.4	15.11	15.63	39.1	1.3	Negligible
R.9	423523	419697	11.4	14.64	15.56	38.9	2.3	Negligible
R.10	423543	419683	11.4	14.54	15.21	38.0	1.7	Negligible
R.11	423551	419729	11.4	15.44	20.35	50.9	12.3	**Moderate**
R.12	423550	419701	11.4	15.33	16.36	40.9	2.6	Negligible
R.13	423572	419681	11.4	15.32	15.99	40.0	1.7	Negligible
R.14	423596	419667	11.4	14.6	15.12	37.8	1.3	Negligible
R.15	423578	419645	11.4	12.31	12.61	31.5	0.7	Negligible
R.16	423634	419638	11.4	14.9	15.32	38.3	1.1	Negligible
R.17	423654	419605	11.4	13.3	13.57	33.9	0.7	Negligible
R.18	423745	419565	11.4	13.4	13.64	34.1	0.6	Negligible
R.19	423838	419542	11.4	13.71	13.97	34.9	0.6	Negligible
R.20	423924	419530	11.4	13.04	13.29	33.2	0.6	Negligible
R.21	423982	419509	11.4	13.4	13.66	34.2	0.6	Negligible
R.22	424056	419485	11.4	14.8	14.35	35.9	-1.1	Negligible
R.23	424056	419468	11.4	13.31	12.5	31.3	-2.0	Negligible
R.24	424071	419462	11.4	13.41	12.62	31.6	-2.0	Negligible
R.25	424502	419410	11.4	12.61	12.8	32.0	0.5	Negligible
R.26	424536	419398	11.4	11.8	11.92	29.8	0.3	Negligible
R.27	424540	419421	11.4	12.28	12.43	31.1	0.4	Negligible
R.28	424627	419416	11.4	11.24	11.3	28.3	0.2	Negligible
R.29	424635	419446	11.4	11.78	11.88	29.7	0.3	Negligible
R.30	424663	419452	11.4	12.08	12.2	30.5	0.3	Negligible
R.31	424772	419493	11.4	11.89	11.96	29.9	0.2	Negligible
R.32	424809	419481	11.4	11.95	12.03	30.1	0.2	Negligible
R.33	424981	419492	11.4	16.66	16.74	41.9	0.2	Negligible

R.34	424627	419631	11.4	15.97	16.08	40.2	0.3	Negligible
R.35	424603	419635	11.4	13.22	13.27	33.2	0.1	Negligible
R.36	424671	419625	11.4	16.64	16.67	41.7	0.1	Negligible
R.37	424735	419585	11.4	16.36	16.39	41.0	0.1	Negligible
R.38	424850	419525	11.4	14.71	14.77	36.9	0.1	Negligible
R.39	424536	419786	11.4	16.2	16.07	40.2	-0.3	Negligible
R.40	424506	419783	11.4	14.82	14.73	36.8	-0.2	Negligible
R.41	424463	419819	11.4	14.42	14.35	35.9	-0.2	Negligible
R.42	424438	419873	11.4	16.64	16.51	41.3	-0.3	Negligible
R.43	424370	419932	11.4	17.46	17.31	43.3	-0.4	Negligible
R.44	424341	419933	11.4	15.74	15.65	39.1	-0.2	Negligible
R.45	424318	419979	11.4	17.72	17.62	44.1	-0.2	Negligible
R.46	424138	420204	14.7	16.38	16.7	41.8	0.8	Negligible
R.47	424125	420220	14.7	17.97	18.4	46.0	1.1	Negligible
R.48	424056	420332	14.7	16.99	17.02	42.6	0.1	Negligible
R.49	424024	420356	14.7	15.17	15.21	38.0	0.1	Negligible
R.50	423995	420464	14.9	15.97	16.01	40.0	0.1	Negligible
R.51	423915	420680	14.9	15.82	15.86	39.7	0.1	Negligible
R.52	424185	420498	14.7	18.83	18.64	46.6	-0.5	Negligible
R.53	424210	420585	14.7	18.62	18.43	46.1	-0.5	Negligible
R.54	424233	420630	14.7	19.59	19.35	48.4	-0.6	Negligible
R.55	424293	420715	14.7	19.15	19.19	48.0	0.1	Negligible
R.56	424341	420762	14.7	17.98	18.01	45.0	0.1	Negligible
R.57	424358	420772	14.7	18.1	18.12	45.3	0.0	Negligible
R.58	424380	420882	14.7	18.42	18.51	46.3	0.2	Negligible
R.59	424417	420976	14.7	20.85	20.98	52.5	0.3	Negligible
R.60	424460	421074	20.3	24.92	25.05	62.6	0.3	Negligible
R.61	424446	421103	20.3	22.23	22.31	55.8	0.2	Negligible
R.62	424493	421146	20.3	24.33	24.44	61.1	0.3	Negligible
R.63	424463	421150	20.3	22.07	22.14	55.4	0.2	Negligible
R.64	424490	421216	20.3	26.18	26.28	65.7	0.3	Negligible
R.65	424423	421256	20.3	12.41	12.44	31.1	0.1	Negligible
R.67	423510	420943	14.9	17.44	17.62	44.1	0.4	Negligible
R.68	423490	420928	14.9	16.84	17.01	42.5	0.4	Negligible
R.69	423454	420899	14.9	16.52	16.69	41.7	0.4	Negligible
R.70	423424	420920	14.9	11.84	11.92	29.8	0.2	Negligible
R.71	423405	420896	14.9	12.92	13.01	32.5	0.2	Negligible
R.72	423415	420871	14.9	17.77	17.95	44.9	0.4	Negligible
R.73	423377	420841	14.9	17.07	17.25	43.1	0.4	Negligible
R.74	423355	420857	14.9	13.13	13.23	33.1	0.2	Negligible
R.75	423297	420813	14.9	13.13	13.23	33.1	0.2	Negligible
R.76	423267	420789	14.9	13.43	13.54	33.9	0.3	Negligible
R.77	423239	420765	14.9	14.59	14.72	36.8	0.3	Negligible
R.78	423239	420735	14.9	20.48	20.72	51.8	0.6	Negligible

R.79	423192	420686	14.9	19.82	20.05	50.1	0.6	Negligible
R.80	423177	420696	14.9	14.24	14.36	35.9	0.3	Negligible
R.81	423159	420676	14.9	14.16	14.28	35.7	0.3	Negligible
R.82	423151	420659	14.9	16.46	16.63	41.6	0.4	Negligible
R.83	422853	420434	17.3	16.51	16.68	41.7	0.4	Negligible
R.84	422634	420442	17.3	16.85	17.02	42.6	0.4	Negligible
R.85	422573	420435	17.3	17.11	17.28	43.2	0.4	Negligible
R.86	422563	420418	17.3	18.25	18.45	46.1	0.5	Negligible
R.87	422508	420403	17.3	17.71	17.89	44.7	0.4	Negligible
R.88	422459	420386	17.3	22.75	22.91	57.3	0.4	Negligible
R.89	422493	420355	17.3	13.62	13.76	34.4	0.4	Negligible
R.90	422490	420323	17.3	11.91	12.01	30.0	0.2	Negligible
R.91	422524	420298	17.3	12.17	12.29	30.7	0.3	Negligible
R.92	422524	420261	17.3	11.68	11.79	29.5	0.3	Negligible
R.93	422410	420368	17.3	21.9	22.01	55.0	0.3	Negligible
R.94	422306	420344	17.3	16.73	16.81	42.0	0.2	Negligible
R.95	422238	420317	17.3	14.75	14.81	37.0	0.2	Negligible
R.96	422244	420303	17.3	18.4	18.48	46.2	0.2	Negligible
R.97	422184	420277	17.3	17.89	17.96	44.9	0.2	Negligible

Table D2 Modelled PM_{10} results at receptors

Receptor ID	X	Y	2019 Background PM10	Modelled PM10 Annual Mean Concentration (2023) (ug/m^3)		Annual mean as % of Air Quality Annual Limit	Percentage change (%| when compared to AQAL	IAQM Impact Descriptor
				Future Baseline	Opening Year			
R.1	422846	419831	10.9	12.8	12.8	31.9	0.0	Negligible
R.2	422946	419811	10.9	12.4	12.4	30.9	0.0	Negligible
R.3	423071	419796	11.0	13.1	13.1	32.6	0.0	Negligible
R.4	423122	419821	11.0	12.4	12.4	31.0	0.0	Negligible
R.5	423134	419784	11.0	13.0	13.0	32.5	0.0	Negligible
R.6	423258	419794	11.0	13.0	13.0	32.5	0.0	Negligible
R.7	423385	419740	11.0	12.9	12.9	32.2	0.1	Negligible
R.8	423456	419731	11.0	13.5	13.6	34.1	0.2	Negligible
R.9	423523	419697	11.0	12.9	13.1	32.7	0.6	Negligible
R.10	423543	419683	11.0	12.8	13.0	32.4	0.4	Negligible
R.11	423551	419729	11.0	13.4	13.8	34.6	1.0	Negligible
R.12	423550	419701	11.0	13.2	13.4	33.4	0.5	Negligible
R.13	423572	419681	11.0	13.1	13.3	33.2	0.4	Negligible
R.14	423596	419667	11.0	12.8	12.9	32.3	0.3	Negligible
R.15	423578	419645	11.0	11.8	11.9	29.7	0.2	Negligible
R.16	423634	419638	11.0	12.9	13.0	32.6	0.3	Negligible
R.17	423654	419605	11.0	12.2	12.3	30.8	0.2	Negligible

R.18	423745	419565	11.0	12.3	12.3	30.9	0.2	Negligible
R.19	423838	419542	11.0	12.5	12.6	31.5	0.2	Negligible
R.20	423924	419530	11.0	12.5	12.6	31.5	0.3	Negligible
R.21	423982	419509	11.0	12.7	12.8	32.1	0.3	Negligible
R.22	424056	419485	10.9	13.0	12.8	32.0	-0.5	Negligible
R.23	424056	419468	10.9	12.3	11.9	29.9	-0.9	Negligible
R.24	424071	419462	10.9	12.3	12.0	30.0	-0.9	Negligible
R.25	424502	419410	10.9	12.2	12.3	30.8	0.2	Negligible
R.26	424536	419398	10.9	11.7	11.8	29.4	0.1	Negligible
R.27	424540	419421	10.9	12.0	12.1	30.2	0.2	Negligible
R.28	424627	419416	10.9	11.4	11.4	28.6	0.1	Negligible
R.29	424635	419446	10.9	11.7	11.8	29.5	0.1	Negligible
R.30	424663	419452	10.9	11.9	12.0	30.0	0.2	Negligible
R.31	424772	419493	10.9	11.8	11.8	29.6	0.1	Negligible
R.32	424809	419481	10.9	11.8	11.9	29.7	0.1	Negligible
R.33	424981	419492	10.9	14.7	14.7	36.7	0.1	Negligible
R.34	424627	419631	10.9	14.2	14.2	35.5	0.1	Negligible
R.35	424603	419635	10.9	12.6	12.6	31.5	0.0	Negligible
R.36	424671	419625	10.9	14.7	14.7	36.7	0.0	Negligible
R.37	424735	419585	10.9	14.5	14.5	36.3	0.0	Negligible
R.38	424850	419525	10.9	13.5	13.5	33.8	0.1	Negligible
R.39	424536	419786	10.9	14.4	14.3	35.7	-0.3	Negligible
R.40	424506	419783	10.9	13.5	13.5	33.7	-0.2	Negligible
R.41	424463	419819	10.9	13.3	13.2	33.1	-0.2	Negligible
R.42	424438	419873	10.9	14.7	14.6	36.4	-0.3	Negligible
R.43	424370	419932	10.9	15.0	14.9	37.3	-0.3	Negligible
R.44	424341	419933	10.9	13.8	13.8	34.4	-0.2	Negligible
R.45	424318	419979	10.9	15.0	14.9	37.2	-0.2	Negligible
R.46	424138	420204	11.4	13.1	13.3	33.2	0.4	Negligible
R.47	424125	420220	11.4	13.8	14.0	35.0	0.5	Negligible
R.48	424056	420332	11.4	13.6	13.6	34.1	0.0	Negligible
R.49	424024	420356	11.4	12.6	12.6	31.4	0.0	Negligible
R.50	423995	420464	12.0	13.6	13.6	34.0	0.0	Negligible
R.51	423915	420680	12.0	13.5	13.5	33.8	0.0	Negligible
R.52	424185	420498	11.4	14.9	14.7	36.9	-0.3	Negligible
R.53	424210	420585	11.4	14.7	14.6	36.5	-0.3	Negligible
R.54	424233	420630	11.4	15.4	15.2	38.0	-0.4	Negligible
R.55	424293	420715	11.4	15.1	15.1	37.7	0.0	Negligible
R.56	424341	420762	11.4	14.3	14.3	35.8	0.0	Negligible
R.57	424358	420772	11.4	14.3	14.3	35.9	0.0	Negligible
R.58	424380	420882	11.4	14.6	14.6	36.6	0.1	Negligible
R.59	424417	420976	11.4	15.1	15.1	37.8	0.1	Negligible
R.60	424460	421074	12.3	16.5	16.6	41.5	0.2	Negligible
R.61	424446	421103	12.3	14.8	14.8	37.0	0.1	Negligible

R.62	424493	421146	12.3	16.1	16.1	40.3	0.2	Negligible
R.63	424463	421150	12.3	14.6	14.6	36.6	0.1	Negligible
R.64	424490	421216	12.3	16.1	16.1	40.3	0.1	Negligible
R.65	424423	421256	8.3	10.1	10.2	25.4	0.0	Negligible
R.67	423510	420943	7.9	13.1	13.2	33.0	0.3	Negligible
R.68	423490	420928	7.9	12.9	13.0	32.4	0.3	Negligible
R.69	423454	420899	7.9	12.7	12.8	32.0	0.2	Negligible
R.70	423424	420920	7.9	9.8	9.8	24.6	0.1	Negligible
R.71	423405	420896	7.9	10.5	10.5	26.3	0.1	Negligible
R.72	423415	420871	7.9	13.5	13.6	34.1	0.3	Negligible
R.73	423377	420841	7.9	13.1	13.2	32.9	0.3	Negligible
R.74	423355	420857	7.9	10.6	10.6	26.6	0.1	Negligible
R.75	423297	420813	7.9	10.5	10.6	26.5	0.1	Negligible
R.76	423267	420789	7.9	10.6	10.7	26.7	0.1	Negligible
R.77	423239	420765	7.9	10.9	10.9	27.3	0.2	Negligible
R.78	423239	420735	7.9	13.2	13.4	33.4	0.3	Negligible
R.79	423192	420686	7.9	14.8	14.9	37.2	0.4	Negligible
R.80	423177	420696	7.9	11.2	11.2	28.1	0.2	Negligible
R.81	423159	420676	7.9	11.1	11.2	28.0	0.2	Negligible
R.82	423151	420659	7.9	12.5	12.6	31.6	0.2	Negligible
R.83	422853	420434	8.3	13.1	13.2	32.9	0.2	Negligible
R.84	422634	420442	8.3	13.3	13.4	33.4	0.3	Negligible
R.85	422573	420435	8.3	13.4	13.5	33.7	0.3	Negligible
R.86	422563	420418	8.3	14.1	14.2	35.6	0.3	Negligible
R.87	422508	420403	8.3	13.6	13.7	34.2	0.3	Negligible
R.88	422459	420386	8.3	14.6	14.7	36.8	0.2	Negligible
R.89	422493	420355	8.3	10.9	11.0	27.4	0.2	Negligible
R.90	422490	420323	8.3	10.1	10.1	25.3	0.1	Negligible
R.91	422524	420298	8.3	10.3	10.3	25.9	0.2	Negligible
R.92	422524	420261	8.3	10.0	10.1	25.2	0.1	Negligible
R.93	422410	420368	8.3	14.1	14.1	35.3	0.1	Negligible
R.94	422306	420344	8.3	12.9	13.0	32.4	0.1	Negligible
R.95	422238	420317	8.3	11.9	12.0	29.9	0.1	Negligible
R.96	422244	420303	8.3	14.3	14.3	35.8	0.1	Negligible
R.97	422184	420277	8.3	14.0	14.0	35.0	0.1	Negligible

Table D3 Modelled $PM_{2.5}$ results at receptors

Receptor ID	X	Y	2019 Background PM2.5	Modelled PM10 Annual Mean Concentration (2023) (ug/m^3)		Annual mean as % of Air Quality Annual Limit	Percentage change (%| when compared to AQAL	IAQM Impact Descriptor
				Future Baseline	Opening year			
R.1	422846	419831	7.1	8.1	8.1	32.3	0.0	Negligible
R.2	422946	419811	7.1	7.9	7.9	31.4	0.0	Negligible
R.3	423071	419796	7.3	8.5	8.5	33.9	0.0	Negligible
R.4	423122	419821	7.3	8.1	8.1	32.5	0.0	Negligible
R.5	423134	419784	7.3	8.5	8.5	33.9	0.0	Negligible
R.6	423258	419794	7.3	8.5	8.5	33.8	0.0	Negligible
R.7	423385	419740	7.3	8.4	8.4	33.6	0.0	Negligible
R.8	423456	419731	7.3	8.8	8.8	35.2	0.2	Negligible
R.9	423523	419697	7.3	8.4	8.5	34.1	0.5	Negligible
R.10	423543	419683	7.3	8.4	8.4	33.8	0.4	Negligible
R.11	423551	419729	7.3	8.7	8.9	35.8	0.9	Negligible
R.12	423550	419701	7.3	8.6	8.7	34.7	0.5	Negligible
R.13	423572	419681	7.3	8.5	8.6	34.5	0.4	Negligible
R.14	423596	419667	7.3	8.4	8.4	33.7	0.3	Negligible
R.15	423578	419645	7.3	7.8	7.8	31.4	0.1	Negligible
R.16	423634	419638	7.3	8.4	8.5	34.0	0.3	Negligible
R.17	423654	419605	7.3	8.0	8.1	32.3	0.2	Negligible
R.18	423745	419565	7.3	8.1	8.1	32.4	0.2	Negligible
R.19	423838	419542	7.3	8.2	8.2	32.9	0.2	Negligible
R.20	423924	419530	7.3	8.2	8.2	32.9	0.3	Negligible
R.21	423982	419509	7.3	8.3	8.4	33.5	0.3	Negligible
R.22	424056	419485	7.4	8.6	8.4	33.8	-0.4	Negligible
R.23	424056	419468	7.4	8.2	8.0	31.9	-0.8	Negligible
R.24	424071	419462	7.4	8.2	8.0	32.0	-0.8	Negligible
R.25	424502	419410	7.4	8.1	8.2	32.7	0.2	Negligible
R.26	424536	419398	7.4	7.9	7.9	31.5	0.1	Negligible
R.27	424540	419421	7.4	8.0	8.1	32.2	0.2	Negligible
R.28	424627	419416	7.4	7.7	7.7	30.8	0.1	Negligible
R.29	424635	419446	7.4	7.9	7.9	31.6	0.1	Negligible
R.30	424663	419452	7.4	8.0	8.0	32.0	0.1	Negligible
R.31	424772	419493	7.4	7.9	7.9	31.7	0.1	Negligible
R.32	424809	419481	7.4	7.9	7.9	31.8	0.1	Negligible
R.33	424981	419492	7.4	9.5	9.5	38.0	0.1	Negligible
R.34	424627	419631	7.4	9.2	9.2	36.9	0.1	Negligible
R.35	424603	419635	7.4	8.3	8.3	33.3	0.0	Negligible
R.36	424671	419625	7.4	9.5	9.5	37.9	0.0	Negligible
R.37	424735	419585	7.4	9.4	9.4	37.6	0.0	Negligible
R.38	424850	419525	7.4	8.8	8.8	35.4	0.1	Negligible

R.39	424536	419786	7.4	9.3	9.3	37.0	-0.2	Negligible
R.40	424506	419783	7.4	8.9	8.8	35.3	-0.2	Negligible
R.41	424463	419819	7.4	8.7	8.7	34.8	-0.1	Negligible
R.42	424438	419873	7.4	9.5	9.4	37.7	-0.2	Negligible
R.43	424370	419932	7.4	9.7	9.6	38.4	-0.2	Negligible
R.44	424341	419933	7.4	9.0	9.0	35.9	-0.2	Negligible
R.45	424318	419979	7.4	9.6	9.6	38.4	-0.2	Negligible
R.46	424138	420204	7.6	8.5	8.6	34.5	0.3	Negligible
R.47	424125	420220	7.6	8.9	9.0	36.0	0.4	Negligible
R.48	424056	420332	7.6	8.8	8.8	35.2	0.0	Negligible
R.49	424024	420356	7.6	8.2	8.2	32.8	0.0	Negligible
R.50	423995	420464	7.9	8.8	8.8	35.2	0.0	Negligible
R.51	423915	420680	7.9	8.7	8.7	35.0	0.0	Negligible
R.52	424185	420498	7.6	9.5	9.4	37.6	-0.3	Negligible
R.53	424210	420585	7.6	9.4	9.3	37.3	-0.3	Negligible
R.54	424233	420630	7.6	9.7	9.7	38.6	-0.4	Negligible
R.55	424293	420715	7.6	9.6	9.6	38.4	0.0	Negligible
R.56	424341	420762	7.6	9.2	9.2	36.7	0.0	Negligible
R.57	424358	420772	7.6	9.2	9.2	36.7	0.0	Negligible
R.58	424380	420882	7.6	9.3	9.4	37.4	0.1	Negligible
R.59	424417	420976	7.6	9.6	9.6	38.5	0.1	Negligible
R.60	424460	421074	8.3	10.6	10.6	42.5	0.2	Negligible
R.61	424446	421103	8.3	9.6	9.7	38.6	0.1	Negligible
R.62	424493	421146	8.3	10.3	10.4	41.5	0.1	Negligible
R.63	424463	421150	8.3	9.5	9.6	38.2	0.1	Negligible
R.64	424490	421216	8.3	10.4	10.4	41.6	0.1	Negligible
R.65	424423	421256	8.3	9.3	9.3	37.3	0.0	Negligible
R.67	423510	420943	7.9	10.8	10.8	43.3	0.2	Negligible
R.68	423490	420928	7.9	10.6	10.7	42.7	0.2	Negligible
R.69	423454	420899	7.9	10.5	10.6	42.4	0.2	Negligible
R.70	423424	420920	7.9	8.9	9.0	35.9	0.1	Negligible
R.71	423405	420896	7.9	9.3	9.3	37.3	0.1	Negligible
R.72	423415	420871	7.9	11.0	11.1	44.2	0.3	Negligible
R.73	423377	420841	7.9	10.7	10.8	43.2	0.2	Negligible
R.74	423355	420857	7.9	9.4	9.4	37.6	0.1	Negligible
R.75	423297	420813	7.9	9.4	9.4	37.5	0.1	Negligible
R.76	423267	420789	7.9	9.4	9.4	37.7	0.1	Negligible
R.77	423239	420765	7.9	9.5	9.6	38.3	0.1	Negligible
R.78	423239	420735	7.9	10.9	10.9	43.8	0.2	Negligible
R.79	423192	420686	7.9	11.7	11.7	47.0	0.3	Negligible
R.80	423177	420696	7.9	9.7	9.7	39.0	0.1	Negligible
R.81	423159	420676	7.9	9.7	9.7	38.9	0.1	Negligible
R.82	423151	420659	7.9	10.4	10.5	42.0	0.2	Negligible
R.83	422853	420434	8.3	10.9	11.0	43.9	0.2	Negligible

R.84	422634	420442	8.3	11.0	11.1	44.3	0.2	Negligible
R.85	422573	420435	8.3	11.1	11.1	44.6	0.2	Negligible
R.86	422563	420418	8.3	11.5	11.5	46.2	0.3	Negligible
R.87	422508	420403	8.3	11.2	11.2	45.0	0.2	Negligible
R.88	422459	420386	8.3	11.8	11.9	47.4	0.2	Negligible
R.89	422493	420355	8.3	9.7	9.8	39.1	0.2	Negligible
R.90	422490	420323	8.3	9.3	9.3	37.2	0.1	Negligible
R.91	422524	420298	8.3	9.4	9.4	37.7	0.1	Negligible
R.92	422524	420261	8.3	9.2	9.3	37.1	0.1	Negligible
R.93	422410	420368	8.3	11.5	11.5	46.1	0.1	Negligible
R.94	422306	420344	8.3	10.8	10.9	43.4	0.1	Negligible
R.95	422238	420317	8.3	10.3	10.3	41.2	0.1	Negligible
R.96	422244	420303	8.3	11.6	11.6	46.4	0.1	Negligible
R.97	422184	420277	8.3	11.4	11.4	45.7	0.1	Negligible

Appendix F - Modelled Results at Existing Receptors (2030) Sensitivity Test, Manually Assigned Traffic Flow

Table D1 Modelled NO_2 results at receptors

Receptor ID	X	Y	2019 Background NO2	Modelled NO2 Annual Mean Concentration (2023) (ug/m^3)		Annual mean as % of Air Quality Annual Limit	Percentage change (%) when compared to AQAL	IAQM Impact Descriptor
				Future Baseline	Peak Construction			
R.7	423385.31	419740.31	11.4	13.7	13.9	34.7	0.5	Negligible
R.8	423455.91	419731.41	11.4	15.1	15.6	39.1	1.3	Negligible
R.9	423522.69	419696.81	11.4	14.6	15.6	38.9	2.3	Negligible
R.10	423542.81	419682.69	11.4	14.5	15.2	38.0	1.7	Negligible
R.11	423551.31	419729.19	11.4	15.4	20.4	50.9	12.3	**Moderate**
R.12	423549.81	419701	11.4	15.3	16.4	40.9	2.6	Negligible
R.13	423572.19	419680.69	11.4	15.3	16.0	40.0	1.7	Negligible
R.14	423595.81	419666.81	11.4	14.6	15.1	37.8	1.3	Negligible
R.15	423578	419645.19	11.4	12.3	12.6	31.5	0.7	Negligible
R.16	423634.19	419637.91	11.4	14.9	15.3	38.3	1.1	Negligible
R.17	423654.31	419604.59	11.4	13.3	13.6	33.9	0.7	Negligible
R.18	423745.31	419565	11.4	13.4	13.6	34.1	0.6	Negligible
R.19	423837.81	419542.19	11.4	13.7	14.0	34.9	0.6	Negligible
R.20	423923.91	419530.41	11.4	13.0	13.3	33.2	0.6	Negligible
R.21	423981.59	419509.09	11.4	13.4	13.7	34.2	0.6	Negligible
R.25	424502.19	419410	11.4	12.6	12.8	32.0	0.5	Negligible
R.26	424536.19	419398	11.4	11.8	11.9	29.8	0.3	Negligible
R.27	424540.41	419421.31	11.4	12.3	12.4	31.1	0.4	Negligible
R.29	424634.59	419446.09	11.4	11.8	11.9	29.7	0.3	Negligible
R.30	424663.31	419451.59	11.4	12.1	12.2	30.5	0.3	Negligible
R.34	424626.81	419631	11.4	16.0	16.1	40.2	0.3	Negligible
R.46	424138.31	420204.09	14.7	16.4	16.7	41.8	0.8	Negligible
R.47	424125.41	420219.81	14.7	18.0	18.4	46.0	1.1	Negligible
R.58	424379.5	420881.69	14.7	18.4	18.5	46.3	0.2	Negligible
R.59	424417.31	420975.81	14.7	20.9	21.0	52.5	0.3	Negligible

R.60	424459.5	421073.69	20.3	24.9	25.1	62.6	0.3	Negligible
R.62	424492.59	421146.09	20.3	24.3	24.4	61.1	0.3	Negligible
R.64	424489.91	421215.59	20.3	26.2	26.3	65.7	0.3	Negligible
R.67	423509.5	420942.81	20.3	17.4	17.6	44.1	0.4	Negligible
R.68	423490.09	420927.59	20.3	16.8	17.0	42.5	0.4	Negligible
R.69	423453.59	420898.69	20.3	16.5	16.7	41.7	0.4	Negligible
R.71	423405.19	420896	20.3	12.9	13.0	32.5	0.2	Negligible
R.72	423415.09	420871.19	20.3	17.8	18.0	44.9	0.4	Negligible
R.73	423377	420841.19	20.3	17.1	17.3	43.1	0.4	Negligible
R.74	423355.09	420856.69	20.3	13.1	13.2	33.1	0.2	Negligible
R.75	423296.69	420812.59	20.3	13.1	13.2	33.1	0.2	Negligible
R.76	423266.91	420788.91	15.6	13.4	13.5	33.9	0.3	Negligible
R.77	423239.19	420764.91	15.4	14.6	14.7	36.8	0.3	Negligible
R.78	423238.91	420734.5	14.9	20.5	20.7	51.8	0.6	Negligible
R.79	423192.09	420686.09	14.9	19.8	20.1	50.1	0.6	Negligible
R.80	423176.91	420696.19	14.9	14.2	14.4	35.9	0.3	Negligible
R.81	423159.19	420676.09	14.9	14.2	14.3	35.7	0.3	Negligible
R.82	423151	420658.81	14.9	16.5	16.6	41.6	0.4	Negligible
R.83	422852.81	420434	14.9	16.5	16.7	41.7	0.4	Negligible
R.84	422633.91	420441.5	14.9	16.9	17.0	42.6	0.4	Negligible
R.85	422573.41	420434.81	14.9	17.1	17.3	43.2	0.4	Negligible
R.86	422562.69	420417.81	14.9	18.3	18.5	46.1	0.5	Negligible
R.87	422507.69	420402.59	14.9	17.7	17.9	44.7	0.4	Negligible
R.88	422459.31	420386.31	14.9	22.8	22.9	57.3	0.4	Negligible
R.89	422492.81	420355.41	14.9	13.6	13.8	34.4	0.4	Negligible
R.90	422489.81	420323.09	14.9	11.9	12.0	30.0	0.2	Negligible
R.91	422523.81	420298.31	14.9	12.2	12.3	30.7	0.3	Negligible
R.92	422524.41	420261	14.9	11.7	11.8	29.5	0.3	Negligible
R.93	422409.5	420367.91	14.9	21.9	22.0	55.0	0.3	Negligible
R.96	422244.19	420303.31	17.3	18.4	18.5	46.2	0.2	Negligible

Table D2 Modelled NO_2 results with improved background concentrations at receptors

Receptor ID	X	Y	2030 Background NO_2	Modelled NO_2 Annual Mean Concentration (2023) (ug/m^3)		Annual mean as % of Air Quality Annual Limit	Percentage change (%| when compared to AQAL	IAQM Impact Descriptor
				Future Baseline	Opening Year			
R.11	423551.31	419729.19	11.1	18.53	20.1	50	4	Negligible

Table D3 Modelled PM_{10} results at receptors

Receptor ID	X	Y	2019 Background PM10	Modelled PM10 Annual Mean Concentration (2023) (ug/m^3)		Annual mean as % of Air Quality Annual Limit	Percentage change (%| when compared to AQAL	IAQM Impact Descriptor
				Future Baseline	Peak Construction			
R.7	423385.31	419740.31	11.0	12.9	12.9	32.2	0.1	Negligible
R.8	423455.91	419731.41	11.0	13.5	13.6	34.1	0.2	Negligible
R.9	423522.69	419696.81	11.0	12.9	13.1	32.7	0.6	Negligible
R.10	423542.81	419682.69	11.0	12.8	13.0	32.4	0.4	Negligible
R.11	423551.31	419729.19	11.0	13.4	13.8	34.6	1.0	Negligible
R.12	423549.81	419701	11.0	13.2	13.4	33.4	0.5	Negligible
R.13	423572.19	419680.69	11.0	13.1	13.3	33.2	0.4	Negligible
R.14	423595.81	419666.81	11.0	12.8	12.9	32.3	0.3	Negligible
R.15	423578	419645.19	11.0	11.8	11.9	29.7	0.2	Negligible
R.16	423634.19	419637.91	11.0	12.9	13.0	32.6	0.3	Negligible
R.17	423654.31	419604.59	11.0	12.2	12.3	30.8	0.2	Negligible
R.18	423745.31	419565	11.0	12.3	12.3	30.9	0.2	Negligible
R.19	423837.81	419542.19	11.0	12.5	12.6	31.5	0.2	Negligible
R.20	423923.91	419530.41	11.0	12.5	12.6	31.5	0.3	Negligible
R.21	423981.59	419509.09	11.0	12.7	12.8	32.1	0.3	Negligible
R.25	424502.19	419410	10.9	12.2	12.3	30.8	0.2	Negligible
R.26	424536.19	419398	10.9	11.7	11.8	29.4	0.1	Negligible
R.27	424540.41	419421.31	10.9	12.0	12.1	30.2	0.2	Negligible
R.29	424634.59	419446.09	10.9	11.7	11.8	29.5	0.1	Negligible
R.30	424663.31	419451.59	10.9	11.9	12.0	30.0	0.2	Negligible
R.34	424626.81	419631	10.9	14.2	14.2	35.5	0.1	Negligible
R.46	424138.31	420204.09	11.4	13.1	13.3	33.2	0.4	Negligible
R.47	424125.41	420219.81	11.4	13.8	14.0	35.0	0.5	Negligible
R.58	424379.5	420881.69	11.4	14.6	14.6	36.6	0.1	Negligible
R.59	424417.31	420975.81	11.4	15.1	15.1	37.8	0.1	Negligible
R.60	424459.5	421073.69	12.3	16.5	16.6	41.5	0.2	Negligible
R.62	424492.59	421146.09	12.3	16.1	16.1	40.3	0.2	Negligible
R.64	424489.91	421215.59	12.3	16.1	16.1	40.3	0.1	Negligible
R.67	423509.5	420942.81	8.3	13.1	13.2	33.0	0.3	Negligible
R.68	423490.09	420927.59	8.3	12.9	13.0	32.4	0.3	Negligible
R.69	423453.59	420898.69	8.3	12.7	12.8	32.0	0.2	Negligible
R.71	423405.19	420896	8.3	10.5	10.5	26.3	0.1	Negligible
R.72	423415.09	420871.19	8.3	13.5	13.6	34.1	0.3	Negligible
R.73	423377	420841.19	8.3	13.1	13.2	32.9	0.3	Negligible
R.74	423355.09	420856.69	8.3	10.6	10.6	26.6	0.1	Negligible
R.75	423296.69	420812.59	8.3	10.5	10.6	26.5	0.1	Negligible
R.76	423266.91	420788.91	8.2	10.6	10.7	26.7	0.1	Negligible
R.77	423239.19	420764.91	8.5	10.9	10.9	27.3	0.2	Negligible
R.78	423238.91	420734.5	7.9	13.2	13.4	33.4	0.3	Negligible

R.79	423192.09	420686.09	7.9	14.8	14.9	37.2	0.4	Negligible
R.80	423176.91	420696.19	7.9	11.2	11.2	28.1	0.2	Negligible
R.81	423159.19	420676.09	7.9	11.1	11.2	28.0	0.2	Negligible
R.82	423151	420658.81	7.9	12.5	12.6	31.6	0.2	Negligible
R.83	422852.81	420434	7.9	13.1	13.2	32.9	0.2	Negligible
R.84	422633.91	420441.5	7.9	13.3	13.4	33.4	0.3	Negligible
R.85	422573.41	420434.81	7.9	13.4	13.5	33.7	0.3	Negligible
R.86	422562.69	420417.81	7.9	14.1	14.2	35.6	0.3	Negligible
R.87	422507.69	420402.59	7.9	13.6	13.7	34.2	0.3	Negligible
R.88	422459.31	420386.31	7.9	14.6	14.7	36.8	0.2	Negligible
R.89	422492.81	420355.41	7.9	10.9	11.0	27.4	0.2	Negligible
R.90	422489.81	420323.09	7.9	10.1	10.1	25.3	0.1	Negligible
R.91	422523.81	420298.31	7.9	10.3	10.3	25.9	0.2	Negligible
R.92	422524.41	420261	7.9	10.0	10.1	25.2	0.1	Negligible
R.93	422409.5	420367.91	7.9	14.1	14.1	35.3	0.1	Negligible
R.96	422244.19	420303.31	8.3	14.3	14.3	35.8	0.1	Negligible

Table D4 Modelled $PM_{2.5}$ results at receptors

Receptor ID	X	Y	2019 Background PM2.5	Modelled PM2.5 Annual Mean Concentration (2023) (ug/m^3)		Annual mean as % of Air Quality Annual Limit	Percentage change (%| when compared to AQAL	IAQM Impact Descriptor
				Future Baseline	Peak Construction			
R.7	423385.31	419740.31	7.3	8.4	8.4	33.6	0.0	Negligible
R.8	423455.91	419731.41	7.3	8.8	8.8	35.2	0.2	Negligible
R.9	423522.69	419696.81	7.3	8.4	8.5	34.1	0.5	Negligible
R.10	423542.81	419682.69	7.3	8.4	8.4	33.8	0.4	Negligible
R.11	423551.31	419729.19	7.3	8.7	8.9	35.8	0.9	Negligible
R.12	423549.81	419701	7.3	8.6	8.7	34.7	0.5	Negligible
R.13	423572.19	419680.69	7.3	8.5	8.6	34.5	0.4	Negligible
R.14	423595.81	419666.81	7.3	8.4	8.4	33.7	0.3	Negligible
R.15	423578	419645.19	7.3	7.8	7.8	31.4	0.1	Negligible
R.16	423634.19	419637.91	7.3	8.4	8.5	34.0	0.3	Negligible
R.17	423654.31	419604.59	7.3	8.0	8.1	32.3	0.2	Negligible
R.18	423745.31	419565	7.3	8.1	8.1	32.4	0.2	Negligible
R.19	423837.81	419542.19	7.3	8.2	8.2	32.9	0.2	Negligible
R.20	423923.91	419530.41	7.3	8.2	8.2	32.9	0.3	Negligible
R.21	423981.59	419509.09	7.3	8.3	8.4	33.5	0.3	Negligible
R.25	424502.19	419410	7.4	8.1	8.2	32.7	0.2	Negligible
R.26	424536.19	419398	7.4	7.9	7.9	31.5	0.1	Negligible
R.27	424540.41	419421.31	7.4	8.0	8.1	32.2	0.2	Negligible
R.29	424634.59	419446.09	7.4	7.9	7.9	31.6	0.1	Negligible
R.30	424663.31	419451.59	7.4	8.0	8.0	32.0	0.1	Negligible

R.34	424626.81	419631	7.4	9.2	9.2	36.9	0.1	Negligible
R.46	424138.31	420204.09	7.6	8.5	8.6	34.5	0.3	Negligible
R.47	424125.41	420219.81	7.6	8.9	9.0	36.0	0.4	Negligible
R.58	424379.5	420881.69	7.6	9.3	9.4	37.4	0.1	Negligible
R.59	424417.31	420975.81	7.6	9.6	9.6	38.5	0.1	Negligible
R.60	424459.5	421073.69	8.3	10.6	10.6	42.5	0.2	Negligible
R.62	424492.59	421146.09	8.3	10.3	10.4	41.5	0.1	Negligible
R.64	424489.91	421215.59	8.3	10.4	10.4	41.6	0.1	Negligible
R.67	423509.5	420942.81	8.3	10.8	10.8	43.3	0.2	Negligible
R.68	423490.09	420927.59	8.3	10.6	10.7	42.7	0.2	Negligible
R.69	423453.59	420898.69	8.3	10.5	10.6	42.4	0.2	Negligible
R.71	423405.19	420896	8.3	9.3	9.3	37.3	0.1	Negligible
R.72	423415.09	420871.19	8.3	11.0	11.1	44.2	0.3	Negligible
R.73	423377	420841.19	8.3	10.7	10.8	43.2	0.2	Negligible
R.74	423355.09	420856.69	8.3	9.4	9.4	37.6	0.1	Negligible
R.75	423296.69	420812.59	8.3	9.4	9.4	37.5	0.1	Negligible
R.76	423266.91	420788.91	8.2	9.4	9.4	37.7	0.1	Negligible
R.77	423239.19	420764.91	8.5	9.5	9.6	38.3	0.1	Negligible
R.78	423238.91	420734.5	7.9	10.9	10.9	43.8	0.2	Negligible
R.79	423192.09	420686.09	7.9	11.7	11.7	47.0	0.3	Negligible
R.80	423176.91	420696.19	7.9	9.7	9.7	39.0	0.1	Negligible
R.81	423159.19	420676.09	7.9	9.7	9.7	38.9	0.1	Negligible
R.82	423151	420658.81	7.9	10.4	10.5	42.0	0.2	Negligible
R.83	422852.81	420434	7.9	10.9	11.0	43.9	0.2	Negligible
R.84	422633.91	420441.5	7.9	11.0	11.1	44.3	0.2	Negligible
R.85	422573.41	420434.81	7.9	11.1	11.1	44.6	0.2	Negligible
R.86	422562.69	420417.81	7.9	11.5	11.5	46.2	0.3	Negligible
R.87	422507.69	420402.59	7.9	11.2	11.2	45.0	0.2	Negligible
R.88	422459.31	420386.31	7.9	11.8	11.9	47.4	0.2	Negligible
R.89	422492.81	420355.41	7.9	9.7	9.8	39.1	0.2	Negligible
R.90	422489.81	420323.09	7.9	9.3	9.3	37.2	0.1	Negligible
R.91	422523.81	420298.31	7.9	9.4	9.4	37.7	0.1	Negligible
R.92	422524.41	420261	7.9	9.2	9.3	37.1	0.1	Negligible
R.93	422409.5	420367.91	7.9	11.5	11.5	46.1	0.1	Negligible
R.96	422244.19	420303.31	8.3	11.6	11.6	46.4	0.1	Negligible

Appendix G – Emissions Mitigation Assessment - Damage Cost Calculations

Damage costs are a set of impact values defined per tonne of emission. These values estimate the external costs associated with a marginal change in pollutant emissions. They can be combined with forecasts of emission changes to provide an approximate valuation of the aggregate external impacts of a project.

Damage costs have been calculated using Defra's damage cost appraisal toolkit[14], which has involved the following steps:

- Quantify, in tonnes per annum, the pollutant emissions (NOx and $PM_{2.5}$) associated with the proposed development (i.e. emissions from both the operational traffic generated, and from the proposed gas boiler);
- Convert damage cost values to relevant base year prices for the first year of development operation (2030);
- Uplift damage costs by 2% year-on-year, to reflect the assumption that willingness to pay for health outcomes will rise in line with real per capita GDP growth for first 5 years of development operation;

Apply damage cost factors to calculate the annual damage costs associated with the first 5 years of development operation

Vehicle trip rates have been provided by the project transport consultant, Emissions (tonnes per year) of NOx and PM2.5 have been calculated using the Defra Emission Factor Toolkit (EFT) version 10.1. The following assumptions have been made in the EFT:

- Average speed of 50kph has been assumed; and
- An average distance travelled of 12.7km has been assumed, based on the average distance travelled to work in Kirklees according to 2011 census data[15].

The total present values for damage costs for the first five years of development operation are presented in Table F.1. The total central value is £126,753.

Pollutant	**Central damage costs present value (£) 2030-2034**
NOx road transport	£49,956
$PM_{2.5}$ road transport	£76,797
Total	**£126,753**

[14] Defra (2020) Air quality appraisal: damage costs toolkit available at: Assess the impact of air quality - GOV.UK (www.gov.uk)
[15] https://www.nomisweb.co.uk/census/2011/WD702EW/view/1946157272?cols=measures

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