Land East of Rayleigh Road, Thundersley

Air Quality Assessment

On behalf of **This Land Development Limited**

Project Ref: 332210105/300.001 | Rev: Rev.04 | Date: November 2022

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1 Introduction

1.1 Proposed Development

1.1.1 This Land Development Limited (the 'Applicant') has commissioned Stantec to undertake an air quality assessment to support an outline application for planning permission (with all matters reserved except access) for the Proposed Development at land east of Rayleigh Road, Thundersley, located adjacent to the A129 (the 'Site'). The Site is located within the administrative boundary of Castle Point Borough Council (CPBC), and 200 m to the south of the administrative boundary of Rochford District Council (RDC).

1.1.2 The description of the Proposed Development is as follows:

"The development of up to 455 new homes, a multi-use community hall, land for the provision of a healthcare facility, land for a stand-alone early years and childcare nursery, new vehicular/pedestrian access points from Stadium Way in the north and Daws Heath Road in the south, new greenways and green links, multi-functional open space, green infrastructure, surface water attenuation, landscaping and associated infrastructure. All matters reserved except access."

1.1.3 The Site was previously included in the withdrawn CPBC Local Plan (2018-2033) as allocated site HO13 and is identified as a suitable site for delivering up to 455 dwellings.

1.2 Scope of Assessment

1.2.1 This report describes existing air quality within the study area, considers the suitability of the Site for the proposed end-use and assesses the impact of the construction and operation of the Proposed Development on air quality in the study area.

1.2.2 The main air pollutants of concern during the construction period are emissions of dust and fine particulate matter (PM_{10}) associated with on-site demolition and construction activities and off-site trackout. Additionally, there is the potential for emissions of nitrogen dioxide (NO_2) and fine particulate matter (PM_{10} and $PM_{2.5}$) from construction-related vehicles.

1.2.3 The main air pollutants of concern during the operational period are NO_2, PM_{10} and $PM_{2.5}$ emissions associated with proposed and existing road traffic.

1.2.4 The Proposed Development will utilise air source heat pumps to meet its energy demand. Further assessment of emissions associated with on-site energy plant is therefore not considered to be required and has been scoped out of this assessment.

1.2.5 The assessment has been prepared taking into account the requirements of relevant local and national guidance, policy and legislation.

1.3 Consultation

1.3.1 Consultation has been carried out between Stantec and CPBC in the form of email correspondence with the Environmental Health Department in July 2021, to discuss and agree the scope and methodology of the assessment and obtain the results of the latest air quality monitoring undertaken by the Council. The following scope for the air quality assessment was agreed with the Environmental Health Officer (EHO) at CPBC:

- Defining baseline conditions within the study area, drawing upon monitoring carried out by CPBC and information within air quality Review and Assessment reports.

- Qualitative assessment of construction dust impacts, based on IAQM guidance.
- Quantitatively assessing the potential traffic impacts at human health using the ADMS Roads detailed dispersion model. The model will be verified against local monitoring data and predict NO_2 and particulates (PM_{10} and $PM_{2.5}$) concentrations for human receptors.
- Quantitatively assessing the potential traffic impacts at Thundersley Great Common Site of Special Scientific Interest (SSSI) and Garrold's Meadow SSSI using the ADMS Roads detailed dispersion model. The model will predict oxides of nitrogen (NO_x) and ammonia (NH_3).
- Consideration will be given to the cumulative impacts of other developments in the area.
- Identifying mitigation for the operational phase, if required, and appropriate construction mitigation measures based on the identified level of risk.

2 Legislation, Policy and Guidance

2.1 Air Quality Regulations

2.1.1 The Air Quality (England) Regulations 2000 (AQR) defined National Air Quality Objectives (NAQOs), a combination of concentration-based thresholds, averaging periods and compliance dates) for a limited range of pollutants. Subsequent amendments were made to the AQR in 2001 and 2002 to incorporate 'limit values' and 'target values' for a wider range of pollutants as defined in European Union (EU) Directives.

2.1.2 These amendments were consolidated by the Air Quality Standards Regulations 2010 (AQSR) (with subsequent amendments most notably in 2016 and for the devolved administrations), which transposed the EU's Directive on ambient air quality and cleaner air for Europe (2008/50/EC).

2.1.3 Following the Transition Period after the UK's departure from the EU in January 2020, the Air Quality (Amendment of Domestic Regulations) (EU Exit) Regulations 2019 (and subsequent amendments for the devolved administrations) have amended the AQ Standards Regulations 2010 to reflect the fact that the UK has left the EU. The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020 amended the $PM_{2.5}$ limit value in the AQSR to 20 $\mu g/m^3$.

2.1.4 The relevant air quality objectives (AQOs) for this assessment are shown in **Table 2-1**.

Table 2-1 Relevant AQOs / Limit Values

Pollutant	Time Period	Objectives	Source
NO_2	1-hour mean	200 $\mu g/m^3$ not to be exceeded more than 18 times a year	NAQO and AQSR limit value
	Annual mean	40 $\mu g/m^3$	NAQO and AQSR limit value
PM_{10}	24-hour mean	50 $\mu g/m^3$ not to be exceeded more than 35 times a year	NAQO and AQSR limit value
	Annual mean	40 $\mu g/m^3$	NAQO and AQSR limit value
$PM_{2.5}$	Annual mean	20 $\mu g/m^3$	AQSR limit value

2.1.5 The NAQO's for NO_2 and PM_{10} were to have been achieved by 2005 and 2004 respectively, but also continue to apply in all future years thereafter.

2.1.6 The 2019 Clean Air Strategy includes a commitment to set a "*new, ambitious, long-term target to reduce people's exposure to $PM_{2.5}$*" which the Environment Bill 2019-2021 commits the Secretary of State to setting.

National Air Pollution Plan for NO_2 in the UK

2.1.7 The national Air Quality Plan for NO_2 (DEFRA, 2018) sets out how the Government plans to deliver reductions in NO_2 throughout the UK, with a focus on reducing concentrations to below the EU Limit Values throughout the UK within the *"shortest possible time"*.

2.1.8 The plan requires all Local Authorities (LAs) in England which DEFRA identified as having exceedances of the Limit Values in their areas past 2020 to develop local plans to improve air quality and identify measures to deliver reduced emissions, with the aim of meeting the Limit Values within their area within 'the shortest time possible'. Potential measures include changing road layouts, encouraging public and private ultra-low emission vehicle (ULEV) uptake, the use of retrofitting technologies and new fuels and encouraging public transport. In cases where these measures are not sufficient to bring about the required change within 'the shortest time possible' then LAs may consider implementing access restrictions on more polluting vehicles (e.g. Clean Air Zones (CAZs)). A CAZ is defined within the plan as being "*an area where targeted action is taken to improve air quality and resources are prioritised and coordinated in a way that delivers improved health benefits and supports economic growth*" and may be charging or non-charging.

2.2 Air Quality Management

The Air Quality Strategy

2.2.1 Part IV of the Environment Act 1995 (Environment Act, 1995) required the Secretary of State to prepare and publish and 'strategy' regarding air quality.

2.2.2 The Air Quality Strategy (2007) establishes the policy framework for ambient air quality management and assessment in the UK (DEFRA, 2007). The primary objective of the Air Quality Strategy is to ensure that everyone can enjoy a level of ambient air quality which poses no significant risk to health or quality of life. The Air Quality Strategy sets out the NAQOs and Government policy on achieving these.

2.2.3 The Clean Air Strategy (2019) aims to lower national emissions of pollutants, thereby reducing background pollution and minimising human exposure to harmful concentrations of pollution. The Strategy aims to create a stronger and more coherent framework for action to tackle air pollution (DEFRA, 2019a).

Local Air Quality Management

2.2.4 Part IV of the Environment Act 1995 (Environment Act, 1995) introduced a system of Local Air Quality Management (LAQM) which requires local authorities to regularly and systematically review and assess air quality within their boundary and appraise development and transport plans against these assessments.

2.2.5 Where a AQO is unlikely to be met, the local authority must designate an Air Quality Management Area (AQMA) and draw up an Air Quality Action Plan (AQAP) setting out the measures it intends to introduce in pursuit of the AQO's within its AQMA.

2.2.6 The Local Air Quality Management Technical Guidance 2022 (LAQM.TG(22); DEFRA, 2022), issued by the Department for Environment, Food and Rural Affairs (DEFRA) for Local Authorities provides advice on where the AQOs apply. These include outdoor locations where members of the public are likely to be regularly present for the averaging period of the objective (which vary from 15 minutes to a year) as summarised in **Table 2-2**.

Table 2-2 Relevant Public Exposure

Averaging Period	AQOs should apply at:	AQOs don't apply at:
Annual mean	All locations where members of the public might be regularly exposed For example: Building façades of residential properties, schools, hospitals, care homes etc	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 residences Kerbside sites Any other location where public exposure is expected to be short term
24-hour mean and 8-hour mean	All locations where the annual mean AQO would apply, together with hotels and gardens of residences	Kerbside sites Any other location where public exposure is expected to be short term
1-hour mean	All locations where the annual mean and 24 and 8-hour mean AQOs apply as well as: Kerbside sites 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 be expected to spend one hour or longer.	Kerbside locations where the public would not be expected to have regular access
15-minute mean	All locations where members of the public might reasonably be regularly exposed for a period of 15 minutes or longer.	

2.3 Protection of Habitats

2.3.1 As well as their potential to impact on human health, some air pollutants have long been acknowledged to have effects on vegetation and freshwater systems. Whilst direct impacts of air pollutants on fauna are less common, any such effect on the health of vegetation or freshwater systems can then affect animal species that are dependent on the vegetation.

2.3.2 Biodiversity 2020 is the latest biodiversity strategy for the UK (DEFRA, 2020a) and aims to "*halt biodiversity loss, support healthy well-functioning ecosystems and establish coherent ecological networks…*". The Strategy recognises air pollution as an immediate environmental pressure on

biodiversity and planning and development as one of the sectors with the greatest potential for direct influence.

2.3.3 The Conservation of Habitats and Species Regulations 2017 (Statutory Instrument, 2017) (the 'Habitats Regulations'), transposed the Habitats Directive (European Council Directive 92/43/EEC) in England and Wales. The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (Statutory Instrument, 2019) amends the 2017 Habitats Regulations to reflect the UK's departure from the EU and came into force following the end of the Transition Period in December 2020.

2.3.4 The Habitats Regulations require the UK Government to introduce a range of measures for the protection of habitats and species. Special Areas of Conservation (SACs) are designated under these regulations, as are Special Protection Areas (SPAs). These sites form a network termed 'Natura 2000' and collectively these sites are known as European Sites, or the 'national site network'.

2.3.5 Designated Wetlands of International Importance (known as Ramsar sites) do not form part of the national site network. Many Ramsar sites overlap with SACs and SPAs and may be designated for the same or different species and habitats. All Ramsar sites remain protected in the same way as SACs and SPAs.

2.3.6 The Habitats Regulations primarily provide measures for the protection of European Sites and European Protected Species, but also require local planning authorities to encourage the management of other features that are of major importance for wild flora and fauna.

2.3.7 The Habitats Regulations require the competent authority firstly to evaluate whether a project of plan has the potential to give rise to a "*likely significant effect*" and where this is the case, an "*appropriate assessment*" is required to determine whether the development will adversely affect the integrity of the site.

2.3.8 Sites of national importance may be designated as Sites of Special Scientific Interest (SSSIs) and improved provisions for the protection and management of SSSIs (in England and Wales) were introduced by the Countryside and Rights of Way (CROW) Act 2000. If a development is "*likely to damage*" a SSSI, the CROW act requires that a relevant conservation body (i.e. Natural England) is consulted. The CROW act also provides protection to local nature conservation sites, which can be particularly important in providing 'stepping-stones' or 'buffers' to SSSIs and other sites designated under the Habitat Regulations.

Critical Levels

2.3.9 Critical levels are a quantitative estimate of exposure to one or more airborne pollutants in gaseous form, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge

2.3.10 Critical levels for NO_x for the protection of vegetation and ecosystems have been set by the UK Government within the AQSR as summarised in **Table 2-3** and are the same as the Limit Values and Natural England applies the objective to all internationally designated conservation Sites and SSSIs.

Table 2-3 Vegetation and Ecosystem Objectives

Pollutant	Time Period	Objective
Oxides of nitrogen (expressed as NO_2)	Annual mean	30 µg/m^3
	24-hour mean	75 µg/m^3
Ammonia (NH_3)	Annual mean	3 µg/m^3 (unless lichens or bryophytes are present, then 1 µg/m^3)
Sulphur dioxide (SO_2)	Annual mean and winter average	20 µg/m^3

Critical Loads

2.3.11 Critical loads for nitrogen deposition onto sensitive ecosystems have been identified by the United Nations Economic Commission for Europe (UNECE). They are defined as the amount of pollutant deposited to a given area over a year, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge.

2.3.12 In relation to combustion emissions, critical loads for eutrophication and acidification are relevant and these can occur via both wet and dry deposition; however, on a local scale only dry (direct deposition) is considered significant.

2.3.13 Empirical critical loads for eutrophication (derived from a range of experimental studies) are assigned based for different habitats, including grassland ecosystems, mire, bog and fen habitats, freshwaters, heathland ecosystems, coastal and marine habitats, and forest habitats and can be obtained from the UK Air Pollution Information System (APIS) website (APIS, 2022)

2.3.14 Critical loads for acidification have been set in the UK using an empirical approach for non-woodland habitats on a 1km grid square based upon the mineralogy and chemistry of the dominant soil series present in the grid square, and the simple mass balance (SMB) equation for both managed and unmanaged woodland habitats.

2.4 Planning Policy

National Planning Policy

2.4.1 The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how they are expected to be applied (Ministry of Housing, Communities & Local Government, 2021). The following paragraphs are considered relevant from and air quality perspective.

2.4.2 Paragraph 104 on promoting sustainable transport states:

"Transport issues should be considered from the earliest stages of plan-making and development proposals, so that: …

d) the environmental impacts of traffic and transport infrastructure can be identified, assessed and taken into account – including appropriate opportunities for avoiding and mitigating any adverse effects, and for net environmental gains; …"

2.4.3 Paragraph 105 goes on to state:

"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."

2.4.4 Paragraph 174 on conserving and enhancing the natural environment states:

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

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land stability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans, and…"

2.4.5 Paragraph 185 within ground conditions and pollution states:

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

2.4.6 Paragraph 186 states that:

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

2.4.7 Paragraph 187 states that:

"Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed".

National Planning Practice Guidance

2.4.8 Paragraph 005, Reference 32-005-20191101 (revision date 01.11.2019), of the PPG provides guidance on how considerations regarding air quality can be relevant to the development management process as follows:

"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."*

2.4.9 Paragraph 006, Reference 32-006-20191101 (revision date 01.11.2019), of the PPG identifies what specific air quality issues need to be considered in determining a planning application:

"Considerations that may be relevant to determining a planning application include whether the 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; and 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; and*
- *Have a potential adverse effect on biodiversity, especially where it would affect sites designated for their biodiversity value."*

2.4.10 Paragraph 007, Reference 32-007-20191101 (revision date 01.11.2019), of the PPG provides guidance on how detailed an assessment needs to be:

"Assessments need to be proportionate to the nature and scale of development proposed and the potential impacts (taking into account existing air quality conditions), and because of this are likely to be locationally specific".

"The following could form part of assessments:

A description of baseline conditions and any air quality concerns affecting the area, and how these could change both with and without the proposed development;

- *Sensitive habitats (including designated sites of importance for biodiversity);*
- *The assessment methods to be adopted and any requirements for the verification of modelling air quality;*
- *The basis for assessing impacts and determining the significance of an impact;*
- *Where relevant, the cumulative or in-combination effects arising from several developments;*
- *Construction phase impacts;*
- *Acceptable mitigation measures to reduce or remove adverse effects; and*
- *Measures that could deliver improved air quality even when legally binding limits for concentrations of major air pollutants are not being breached."*

2.4.11 Paragraph 008, Reference 32-008-20140306 (revision date 01.11.2019), of the PPG provides guidance on how an impact on air quality can be mitigated:

"Mitigation options will need to be locationally specific, will depend on the proposed development and need to be proportionate to the likely impact. It is important that local planning authorities work with applicants to consider appropriate mitigation so as to ensure new development is appropriate for its location and unacceptable risks are prevented. Planning conditions and obligations can be used to secure mitigation where the relevant tests are met.

Examples of mitigation include:

- *Maintaining adequate separation distances between sources of air pollution and receptors;*
- *Using green infrastructure, 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."*

Local Planning Policy

Castle Point Adopted Local Plan

2.4.12 CPBC's current Local Plan was adopted in November 1998. Until the New Local Plan is adopted, the 2007 Saved Policies from the 1998 Local Plan (CPBC, 1998) should be considered along with the NPPF. Policies related to air quality include Policy EC4 Pollution, which states:

"Development which would have a significant adverse effect on health, the natural environment, or general amenity by reason of releases of pollutants to water, land or air, or by reason of noise, dust, vibration, light or heat, will be refused".

Castle Point Local Plan 2018-2033 (now withdrawn)

2.4.13 CPBC submitted the Castle Point Local Plan 2018-2033 to the Secretary of State in October 2020 for examination. The plan was withdrawn by CPBC on 15 June 2022. Policies related to air quality included (CPBC, 2020a):

2.4.14 Policy NE1 Green and Blue Infrastructure and the Undeveloped Coast:

"*Development which results in the creation, restoration, enhancement, expansion and improved connections between green infrastructure features will be encouraged. The provision of green infrastructure that offers multiple benefits to the environment and local communities will be supported. Through development proposals the Council will seek to secure: […]*

c. Management of and reduction in pollution to air, water and soil through an increased provision of green infrastructure"

2.4.15 Policy NE7 Pollution Control:

"Development proposals should be designed to manage and reduce pollution through energy and water efficient design, the installation of sustainable drainage systems, and the delivery or enhancement of green and blue infrastructure;

Development proposals should be located and designed in such a manner as to not cause a significant adverse effect upon the environment, the health of new and existing residents or surrounding residential amenity by reason of pollution to land, air or water, or as a result of any form of disturbance including, but not limited to, noise, light, odour, heat, dust and vibrations;

Development proposals adjacent to, or in the vicinity of existing uses will need to demonstrate that both the ongoing use of the existing site is not compromised, and that the amenity of occupiers of the new development will be satisfactory with the ongoing normal use of the existing site, taking into account the criteria in part 2 above;

All major development proposals must be accompanied by a Construction Environment Management Plan prepared in accordance with pollution prevention guidance. These plans must specify mitigation which prevents all construction and demolition materials, entering watercourses (including when dry), and where necessary uses seasonal working to avoid any adverse effects on the integrity of Habitat sites, including those arising through disturbance; and

Where necessary, the Council will seek to manage and mitigate the effects of pollution and/or disturbance arising from development, (including during site clearance and construction) by means of appropriate planning conditions. Exceptionally, a Section 106 Agreement may be used to secure measures to control pollution and/or disturbance necessary to make the impacts of the development acceptable".

2.4.16 Policies that specifically relate to the Site include Policy HO13 Land East of Rayleigh Road, Hadleigh, which states:

"1. Land east of Rayleigh Road, as identified by the Policies Map, is allocated for residential purposes, to deliver around 455 new homes by 2033.

2. A master plan approach to this site will be taken to ensure that the development is attractively designed, contributing to environmental quality, and that infrastructure is provided to support growth in this location. The master plan must deliver the following:

- *Access arrangements for the site, which also addresses peak time congestion at nearby junctions;*
- *An urban design framework using a mix of urban design approaches built around the Arcadia approach in areas located within the Historic Natural Landscape and in the vicinity of important landscape features, and the Boulevard and Major Entry Point approaches, to create an attractive green, parkland environment, integrated into the existing landscape and topography;*
- *Respects and retains as a far as possible the hedge and tree-lined boundaries established;*
- *An approach to wildlife that results in a measurable net gain in biodiversity, including the provision of a buffer to the Little Haven Complex nature reserve.*
- *The provision of greenways through the site, linking to the existing network of green infrastructure which provide opportunity for active travel and recreation but which avoid or otherwise manage additional recreational disturbance to sensitive wildlife assets nearby;*
- *An increase in public open space provision across the site consistent with the requirement of policy HS3, delivering additional accessible natural green space and children's play equipment;*
- *Sustainable drainage measures will be implemented to ensure no increase in the risk of surface water flooding to the site or nearby properties;*
- *The provision of a multi-use community hall, and land for the provision of a healthcare facility on site;*
- *Provision of 0.13 ha of land for a stand-alone early years and childcare nursery;*
- *Main vehicular access will be taken from Stadium Way in the north and Daws Heath Road in the south; and*
- *Safeguarding of suitable access for the maintenance of foul and surface water drainage infrastructure, and any other utilities infrastructure identified on site.*

3. Detailed design proposals for the site must have regard to the Council's Residential Design Guidance.

4. Improvements to active and sustainable infrastructure, facilities and services should be secured within and as part of the development to promote modal shift and improve connectivity. This should include a public transport only route through the site, bringing all new homes on the site within 400m of public transport provision."

Rayleigh Town Centre Air Quality Action Plan

2.4.17 Rayleigh Town Centre Air Quality Action Plan (AQAP) was submitted in April 2017. It outlines the actions that RDC and Essex County Council (ECC) will pursue to improve air quality. The measures are categorised into six areas:

- monitoring: enable the revocation of Rayleigh AQMA when appropriate;
- traffic management: reduce congestion adjacent to relevant receptors;
- sustainable travel: reduce volume of vehicular traffic through Rayleigh AQMA;

- planning policy and development control: strengthen planning policies to avoid new residential development within Rayleigh AQMA, manage growth and support electric vehicle infrastructure;
- low emission vehicles: reduce emissions in Rayleigh AQMA and across the district; and
- raise awareness of the issue, increase physical activity and management of symptoms.

2.5 Assessment Guidance

2.5.1 The primary guidance documents used in undertaking this assessment are detailed in the section below.

DEFRA 'Local Air Quality Management Technical Guidance (LAQM.TG(22))'

2.5.2 DEFRA LAQM.TG (22) was published for use by local authorities in their LAQM review and assessment work (DEFRA, 2022). The document provides key guidance on aspects of air quality assessment, including screening, use of monitoring data, and use of background data that are applicable to all air quality assessments.

EPUK / IAQM 'Land-Use Planning & Development Control: Planning for Air Quality'

2.5.3 Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) have together published guidance to help ensure that air quality is properly accounted for in the development control process (EPUK / IAQM 2017). It clarifies when an air quality assessment should be undertaken, what it should contain, and how impacts should be described and assessed including guidelines for assessing the significance of impacts.

IAQM 'Guidance on the Assessment of Dust from Demolition and Construction'

2.5.4 Guidance on the assessment of dust from demolition and construction has been published by the IAQM (IAQM, 2014). The guidance provides a series of matrices to determine the risk magnitude of potential dust sources associated with construction activities in order to identify appropriate mitigation measures that are defined within further IAQM guidance.

IAQM 'Guide to the Assessment of Air Quality Impacts on Designated Nature Conservation Sites'

2.5.5 The IAQM has published guidance on the assessment of air quality impacts on designated nature conservation sites (IAQM, 2020) which adopts a similar procedure to that detailed in Natural England guidance on the assessment of road traffic emissions (Natural England, 2018) and identifies that exhaust pipe emission of ammonia (NH_3) is an additional relevant pollutant when assessing nitrogen deposition to sensitive ecological features.

3 Methodology

3.1.1 The assessment methodology detailed in the following sections has been applied to ascertain the potential impacts of emissions to air in order to identify their significance and compliance with policy and regulatory requirements (outlined in **Section 2** of this report), and whether or not additional mitigation is required.

3.1.2 This assessment first defines the 'study area' and outlines the baseline air quality (for both 'existing'[1] and relevant future years i.e. development construction, first occupation or completion) within this study area. The suitability of the Site for the proposed end-uses is then assessed followed by the impact of construction and operational activities on existing sensitive receptors located within the study area.

3.2 Baseline Air Quality

3.2.1 Any exceedances of the Limit Values along roads within the study area have been identified using the 2021 NO_2 and PM Projections Data published by DEFRA (DEFRA, 2020b). Information on baseline air quality in the study area has been obtained by collating the results of monitoring carried out by CPBC and RDC and their LAQM reports to identify potential AQMAs. Background concentrations for the study area have been defined using the national pollution maps published by DEFRA which cover the whole country on a 1x1 km grid (DEFRA, 2020c).

3.2.2 Existing critical levels and critical loads for habitats within the study area were collated from the APIS website (APIS, 2022).

3.3 Construction Dust Impacts

3.3.1 During demolition and construction, dust from on-site activities and off-site trackout by construction vehicles has the potential to impact on sensitive human receptors within the study area; the main potential impacts are loss of amenity (as a result of dust soiling) and deterioration of human health (as a result of concentrations of PM_{10}).

3.3.2 The suspension of particles in the air is dependent on surface characteristics, weather conditions and on-site activities. Impacts have the potential to occur when dust generating activities coincide with dry, windy conditions, and where sensitive receptors are located downwind of the dust source(s).

3.3.3 Separation distance is also an important factor. Large dust particles (greater than 30µm), can be potentially responsible for most dust annoyance, will largely deposit within 100 m of sources. Intermediate particles (10-30 µm) can travel 200-500 m. Consequently, significant dust annoyance is usually limited to within a few hundred metres of its source. Smaller particles (less than 10 µm), which are the predominant fraction that can be potentially responsible for human health impacts largely remain airborne. However, the impact on the short-term concentrations of PM_{10} occurs over a shorter distance due to the rapid decrease in concentrations with distance from the source due to dispersion.

3.3.4 The assessment of the risk of potential construction dust impacts has been undertaken with reference to relevant guidance (IAQM, 2014).

[1] 2019 has been used as the 'existing' year as this is the latest year for which representative local monitoring data is available. Due to COVID-19 restrictions during 2020, monitoring data from this year is not considered to be representative of typical traffic conditions.

Screening Assessment

3.3.5 The first stage of the assessment involves screening to determine if there are sensitive receptors within threshold distances of the activities associated with the construction phase of the scheme; defined as the study area. No further assessment is required if there are no receptors within the study area.

3.3.6 The IAQM guidance outlines that an assessment is only required in cases where:

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

Further Assessment

3.3.7 The risk of impacts associated with dust soiling and PM_{10} caused by the Proposed Development has been determined (following the IAQM guidance (IAQM, 2014)) based on the dust emission class (or magnitude) for each activity arising from four activities in the absence of mitigation (demolition, earthworks, construction and trackout), the sensitivity of nearby receptors and the overall sensitivity of the area. The dust emission class, receptor sensitivity and the overall sensitivity of the area are determined using the criteria outlined in **Table B-1**, **Table B-2**, **Table B-3**, **Table B-4** and **Table B-5** of **Appendix B** (based on the IAQM guidance), indicative thresholds and professional judgement. The risk of dust impacts arising is a product of the relationship between the dust emission magnitude and the area sensitivity and is based on the criteria outlined in **Table B-6** (based on the IAQM guidance). The risk of impact is then used to determine the mitigation requirements.

3.3.8 The IAQM guidance recommends that no assessment of the significance of effects is made without mitigation in place, as mitigation is assumed to be secured by planning conditions, legal requirements or required by regulations.

3.3.9 With appropriate mitigation in place, the IAQM guidance indicates that the residual effect dust emissions associated with the demolition and construction can be classified as being 'not significant'.

3.4 Demolition and Construction Road Traffic Emission Impacts

3.4.1 The potential for a significant overall effect on existing sensitive receptors within the study area as a result of emissions from demolition and construction traffic generated by the Proposed Development has been determined qualitatively, taking into consideration the screening criteria outlined in the EPUK / IAQM guidance (EPUK / IAQM, 2017) (see **Appendix C**), the anticipated routing of the generated traffic and the anticipated duration of impacts associated with the generated traffic.

3.5 Operational Road Traffic Emission Impacts

Screening Assessment

Impacts of Development-Generated Traffic on Existing Sensitive Human Receptors

3.5.1 The potential for significant impacts on existing sensitive receptors within the study area as a result of emissions from traffic generated by the Proposed Development is determined based on the screening criteria outlined in the EPUK / IAQM guidance (see **Appendix C** which includes consideration of the volume and composition of traffic generated by the Proposed Development and existing local air quality conditions (i.e. the presence of any declared AQMAs).

3.5.2 If it is not possible to screen out the potential for significant impacts, then a detailed assessment is undertaken.

Site Suitability

3.5.3 The suitability of the Site for the proposed end-uses is based upon local monitoring data, estimated background concentrations, the layout of the Proposed Development and the proximity of worst-case receptor locations within the Proposed Development to nearby sources of emissions (i.e. the local road network).

3.5.4 Where there is potential for exceedances of the AQOs, a detailed assessment of site suitability has been undertaken.

Ecological Receptors

3.5.5 In relation to ecological receptors, a detailed (quantitative) air quality assessment of impacts is required if there are sensitive habitats (within designated sites) within 200 m of a road with a 'potentially significant change'. If there are no designated sites containing sensitive habitats within 200 m of the affected road, then no further assessment is required as research shows (NE, 2018) that there is no credible risk of a significant effect beyond 200m from a road which might undermine a site's conservation objectives.

3.5.6 The potentially significant change could be associated with realignment (i.e. increased proximity to receptors), changes to speed (>10 kph) or traffic flow. The applied screening criteria for changes in road traffic flows is a change of LDV flows of more than 1,000 AADT (or HDV flows of more than 100 AADT).

3.5.7 This change in traffic flows has been shown (Natural England, 2018) to not have the potential to result in changes to annual NO_x in excess of 0.3 µg/m^3 (1% of the critical level) within a few metres of the roadside. Changes in traffic flows below the 1,000 AADT (or HDV flows of more than 100 AADT) criteria are therefore considered to not have the potential to result in significant air quality impacts in isolation.

3.5.8 To account for potential 'in-combination' effects at Habitat Regulations Sites, the threshold of 1,000 AADT has to be applied to the change in 'in-combination' traffic flows. To enable a proportionate assessment, a lower screening criteria of 50 AADT has been applied to development traffic within 10km of the Site. Joint Nature Conservation Committee (JNCC) research[2] (JNCC, 2021) indicates that such changes in traffic flows are unlikely to lead to impacts in excess of 0.5% of the annual average critical level for NO_x or critical load for N-

[2] Table 12 & 13 of the JNCC research tabulates the AADT change that could result in a 1% change of critical level or load at 1m from road edge, this exceeds 100 AADT for a majority of habitats and is based on 2019 emission factors.

deposition at 1m from road edge are therefore not considered to have the potential to result in a significant effect which might undermine a site's conservation objectives.

Detailed Assessment

Existing and Proposed Human Receptors

3.5.9 Concentrations of pollutants (NO_2, PM_{10} and $PM_{2.5}$) have been predicted for a range of worst-case locations of relevant human receptor exposure both at sensitive existing properties and within the Proposed Development itself to allow comparison with the AQOs and (for existing receptors only) determination of the significance of impacts at each receptor.

3.5.10 Emissions from road vehicles and their resultant impact at receptor locations have been predicted using the ADMS-Roads dispersion model (v5.0.0.1). The model requires the user to provide various input data, including traffic flows (in AADT format), vehicle composition (i.e. the proportion of Heavy Duty Vehicles (HDVs)), road characteristics (including road width, gradient and street canyon dimensions, where applicable), and average vehicle speed. AADT flows and the proportions of HDVs, for roads within the study area have been provided by the Project's transport consultants, Stantec. Traffic data used in this assessment are summarised in **Appendix D** and modelled roads are shown in **Figure 1**, **Appendix G**.

3.5.11 The model also requires meteorological data and has been run using 2019 meteorological data from the Southend meteorological station, which are considered suitable for this area. Appendix D provides further details on the model inputs.

3.5.12 Traffic emissions have been calculated using the Emission Factor Toolkit (EFT) v11 (DEFRA, 2021), which utilises NO_x emission factors taken from the European Environment Agency (EEA) COPERT 5.3 emission tool. The traffic data were entered into the EFT to provide emission rates for each of the road links entered into the model. Road vehicular emissions are primarily associated with the exhaust emissions but also include particles generated from abrasion (of tyres, brakes and road). The EFT allows users to calculate road vehicle pollutant emission rates for NO_x, PM_{10} and $PM_{2.5}$ (exhaust and brake, tyre and road wear) for a specified year, road type, vehicle speed and vehicle fleet composition.

3.5.13 The EFT provides pollutant emission rates for 2018 through to 2030 and takes into consideration bespoke vehicle fleet information as well as the following information available from the National Atmospheric Emissions Inventory (NAEI):

- fleet composition data for motorways, urban and rural roads in the UK (excluding London);
- fleet composition based on European emission standards from pre-Euro I to Euro6/VI (including Euro 6 subcategories);
- scaling factors reflecting improvements in the quality of fuel and some degree of retrofitting; and
- technology conversions in the national fleet.

3.5.14 As a result of this the road vehicle exhaust emissions of NO_x are projected to decrease year-on-year due to technological advances and improvements to the fleet mix i.e. penetration of Euro VI HDVs, which recent research suggests are performing well. Whilst there has been uncertainty over NO_x emissions from vehicle exhausts (particularly from Euro 5 and 6 LDVs it is important to note the EFT is not based on the Euro emission standards.

3.5.15 Generally, concentrations of air pollutants in the UK are anticipated to decrease in the coming years; as such, in most cases, the earlier the year that is assessed, the more worst-case the assessment is. The earliest year that the Proposed Development could potentially be occupied

by is 2023. Therefore, in order to take account of uncertainties relating to future year vehicle emissions and background pollutant concentrations to provide a conservative assessment, the assessment has been carried out utilising 2023 emission factors and background concentrations combined with traffic data from 2026 (which includes full development flows). This is considered a conservative assumption of emissions in the future.

Ecological Receptors

3.5.16 If a detailed assessment of impacts at ecological receptors is required, in addition to the EFT to quantify NO_x emissions; emissions of ammonia (NH_3) are calculated using the Calculator for Road Emissions of Ammonia (CREAM) tool (Air Quality Consultants, 2020c).

3.5.17 The ADMS Roads software has been used to calculate concentrations of NO_x and NH_3 at a range of transects at increasing distances from the adjacent road (at the ecological site boundary and 5 m increments for first 30 m from the road, then 10 m until 50 m from the road, then 25 m until 200 m from the road). The resultant nitrogen (and acid) deposition rates have been calculated using deposition velocities for grassland habitats of 1.5 mm/s for NO_2 and 20 mm/s for NH_3, and for taller vegetation such as trees of 3 mm/s for NO_2 and 30 mm/s for NH_3.

3.5.18 For these receptors, existing critical levels and critical loads for habitats within the study area were collated from the Air Pollution Information System website (APIS, 2022).

3.6 Assumptions and Limitations

3.6.1 There are many components that contribute to the uncertainty in predicted concentrations. The models used in this assessment are dependent upon the traffic data that have been input which will have inherent uncertainties associated with them. There is then additional uncertainty as the model is required to simplify real-world conditions into a series of algorithms.

3.6.2 There has been an acknowledged disparity between national road transport emissions projections and measured annual mean concentrations of nitrogen oxides (NO_x) and NO_2 for many years. Recent monitoring has shown that reductions in concentrations are now being measured in many parts of the country (Air Quality Consultants Ltd., 2020b), however, there is still some uncertainty regarding the rate at which emissions will reduce in the future and therefore some consideration must be given to the accuracy of any projection and to appropriately respond to this.

3.6.3 The complete development modelling has been based on 2023 emission factors and background concentrations, whilst utilising traffic flows for 2026. This is considered to provide an appropriately conservative assessment taking into account the uncertainties regarding future vehicle emission factors. The model has been verified against 2019 monitoring data.

3.6.4 Dispersion models have been widely used for air quality assessments in the UK for several years and are an accepted approach for this type of assessment. The predictions in this assessment have been made in a robust manner to minimise uncertainties where possible.

3.7 Air Quality Impacts Significance Criteria

Human Receptors

3.7.1 The relevant AQOs are set out in **Table 2-1**. The predicted pollutant concentrations in the future year (2023) at each identified sensitive receptor have been compared to the relevant AQOs and any exceedances identified.

3.7.2 Analysis of long-term monitoring data suggests that if the annual mean NO_2 concentration is less than 60 µg/m^3 then the 1-hour mean NO_2 AQO is unlikely to be exceeded where road transport is the main source of pollution. Therefore, in this assessment this concentration has

been used to screen whether the one-hour mean objective is likely to be achieved (DEFRA, 2022). Analysis of long-term monitoring data also suggests that if the annual mean PM_{10} concentration is less than 32 µg/m^3 then the 24-hour mean PM_{10} AQO is unlikely to be exceeded where road transport is the main source of pollution. Therefore, in this assessment this concentration has been used to screen whether the 24-hour mean AQO is likely to be achieved

3.7.3 There is no official guidance in the UK on how to assess the significance of the air quality impacts of existing air quality on a new development. The assessment of proposed receptors within the Site has therefore been limited to predicting pollutant concentrations at worst-case receptors within the Site and comparing these predicted concentrations to the relevant AQOs, with the overall significance being based on whether the AQOs for each pollutant are exceeded or not.

3.7.4 There is no official guidance in the UK on how to assess the significance of the air quality impacts of a new development on existing receptors. The approach developed by EPUK and the IAQM (EPUK / IAQM, 2017), which considers the change in air quality as a result of a Proposed Development on existing receptors in combination with baseline concentrations at the receptors, has therefore been used. The guidance sets out three stages: determining the magnitude of change at each receptor, describing the impact, and assessing the overall significance. Impact magnitude relates to the change in pollutant concentration; the impact description relates this change to the air quality objective and is shown in **Table 3-1**.

Table 3-1 Impact Significance Criteria

Long term average Concentration at receptor in assessment year	**% Changes in Concentration with development in relation to AQO**			
	1*	**2-5**	**6-10**	**>10**
> 110 % [a]	Moderate	Substantial	Substantial	Substantial
>102% - ≤110% [b]	Moderate	Moderate	Substantial	Substantial
>95% - ≤102% [c]	Slight	Moderate	Moderate	Substantial
>75% - ≤95% [d]	Negligible	Slight	Moderate	Moderate
≤75% [e]	Negligible	Negligible	Slight	Moderate

Where concentrations increase the impact is described as adverse, and where it decreases as beneficial.
% change rounded to nearest whole number. Where the % change is 0 (i.e. Less than 0.5%) the impact will be Negligible.
[a] NO_2 or PM_{10}: > 44 µg/m^3 annual mean; $PM_{2.5}$ >27.5 µg/m^3 annual mean; PM_{10} >35.2 µg/m^3 annual mean (days).
[b] NO_2 or PM_{10}: > 40.8 – ≤ 44 µg/m^3 annual mean; $PM_{2.5}$ > 20.4 – ≤22 µg/m^3 annual mean; PM_{10} >32.64 – ≤35.2 µg/m^3 annual mean (days).
[c] NO_2 or PM_{10}: > 38 – ≤40.8 µg/m^3 annual mean; $PM_{2.5}$ >19 – ≤20.4µg/m^3 of annual mean; PM_{10} >30.4 – ≤32.64 µg/m^3 annual mean (days).
[d] NO_2 or PM_{10}: >30 - ≤38 µg/m^3 annual mean; $PM_{2.5}$ >15 - ≤19 µg/m^3 annual mean; or <24 - ≤ 30.4 µg/m^3 annual mean (days).
[e] NO_2 or PM_{10}: ≤30 µg/m^3 annual mean; $PM_{2.5}$ ≤15 µg/m^3 annual mean; PM_{10} ≤24 µg/m^3 annual mean (days).

3.7.5 The guidance states that the overall assessment of significance should be based on professional judgement, taking into account factors including:

- the number of properties affected by ‘slight’, ‘moderate’ or ‘substantial’ adverse air quality impacts and a judgement on the overall balance;
- the magnitude of the changes and the descriptions of the impacts at the receptors;
- whether or not an exceedance of an AQO is predicted to arise in the operational study area (where there are significant changes in traffic) where none existed before or an exceedance area is substantially increased;

- the uncertainty, comprising the extent to which worst-case assumptions have been made; and
- the extent to which an AQO is exceeded.

3.7.6 Therefore, where impacts at an individual receptor are classified as 'negligible' or 'slight', effects would typically be considered 'not significant'. However, where 'moderate' or 'substantial' adverse impacts are identified at individual receptors, the overall effect needs to be considered in the round taking into account the changes at all of the modelled receptor locations, with a judgement made as to whether the overall air quality effect of the development is 'significant' or not.

Ecological Receptors

3.7.7 In terms of the impact of road traffic emissions on ecological receptors, an impact of less than 1% of the critical level or load is accepted to be a pragmatic threshold for determining no likely significant effects (Natural England, 2018). It should be noted that an impact of more than 1% is not, per se, an indication that a significant effect exists, only the possibility of one which would trigger the need for further, more detailed assessment of the ecological sensitivity and value of the habitat.

3.7.8 Where the predicted impact exceeds 1%, consideration needs to be given to the overall critical level or load. Where the critical level or load is exceeded, input is required from the Project's Ecologist to ascertain the potential significant of the impact and resultant effects.

4 Baseline Environment

4.1 Site Context

4.1.1 The Site is located on the land east of Rayleigh Road, Thundersley. To the north is Rayleigh Road Park and to the east Little Haven Nature Reserve and a hospice. The Site is approximately 28ha in area. It is bounded to the south by Daws Heath Road and to the west by Rayleigh Road. The area surrounding the Site is predominately residential.

4.2 Study Area

4.2.1 The study area adopted for this assessment is as follows:

- for the construction dust risk assessment, the study area (based on IAQM, 2014 guidance) is defined as compromising the area up to 350 m from the site boundary and 50 m from the route used by construction vehicles (up to 500 m from the site entrances);
- for the operational phase road traffic emissions assessment, the study area (based on EPUK / IAQM, 2017 guidance) includes the Site, all roads (and adjacent properties) within 250 m of the site boundary and any other roads (and adjacent properties) predicted to exceed the screening criteria outlined in **Appendix C** and;
- for the operational phase ecological assessment, the study area includes the following ecological sites as agreed with the EHO at CPBC and the Project Ecologist:
    - Thundersley Great Common Site of Special Scientific Interest (SSSI), located approximately 160 m to the west of the Site;
    - Garrold's Meadow SSSI, located approximately 1.5 km to the east of the Site; and

4.3 Sensitive Receptor Locations

4.3.1 Relevant sensitive human receptor locations are places where members of the public might be expected to be regularly present over the averaging period of the AQOs. The NO_2, PM_{10} and $PM_{2.5}$ annual mean AQO sensitive locations include existing residences, education facilities and the existing hospice, as well as the proposed residences and childcare nursery.

4.3.2 The 1-hour mean NO_2 AQO sensitive locations will include the existing and proposed residences, the existing hospice, the existing and proposed education facilities and the outdoor play area. When identifying these receptors, particular attention has been paid to assessing impacts close to junctions, traffic lights and roundabouts where traffic may become congested, where there is a combined effect of several road links and routes along which substantial volumes of traffic generated by the Proposed Development will travel.

4.3.3 Based on these criteria, twenty-four existing residential properties and one school within the study area, as well as five proposed residential properties within the Proposed Development itself have been identified as worst-case receptors for the assessment. The locations of these receptors have been chosen to represent locations where impacts from road traffic generated by the Proposed Development are likely to be the greatest i.e. as a result of development traffic at junctions. These locations are described in **Appendix D** and shown in **Figure 2**, **Appendix G**

4.3.4 Concentrations have also been predicted at four CPBC diffusion tube monitoring sites located at Hart Road, Daws Heath and Rayleigh Road in order to verify the modelled results. **Appendix D** provides further details on the verification method.

4.3.5 There are a number of statutory designated ecological sites in the area that are within 200 m of roads along which development-related traffic exceeds the screening criteria in **Paragraphs 3.5.5. – 3.5.8.** These include Thundersley Great Common SSSI, located 160 m to the east of the Site, and Garrold's Meadow SSSI, located 1.5 km to the east of the Site. All remaining statutory designated ecological sites in the area which are within 200 m of an affected road (i.e. Benfleet and Southend Marshes SPA, Foulness Mid-Essex Coast Phase 5 SPA and Essex Estuaries SAC) have been screened out from further assessment on the basis that development-related traffic is not expected to exceed the screening criteria in **Paragraphs 3.5.5. – 3.5.8**.

4.3.6 The lowest critical loads for the most sensitive habitat present within 200 m of the road at modelled ecological receptor locations (shown in **Figure 3**, **Appendix G**) are presented in **Table 4-1**. Data have been obtained from the APIS website (APIS, 2022).

Table 4-1 Deposition and Site Relevant Critical Loads

Receptor	Description	Applied Habitat	Critical Load	
			Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (CLmaxN - keqN/ha/yr)
ECO1	Thundersley Great Common SSSI	Acid Grassland	8	1.1
ECO2	Thundersley Great Common SSSI	Acid Grassland	8	1.1
ECO3	Garrold's Meadow SSSI	Neutral Grassland	20	1.1

4.4 Ambient Air Quality

EU Limit Values

4.4.1 The study area does not contain any predicted or measured exceedances of the Limit Values either in the current year (2019) or in the future year (2023). The study area is not within a zone where DEFRA have reported an exceedance of the Limit Values either in the 'existing' baseline year (2019) or in future years.

LAQM

4.4.2 CPBC and RDC have investigated air quality as part of their responsibilities under the LAQM regime. The closest AQMA to the Site is Rayleigh AQMA, declared by RDC and located approximately 240 m to the north of the Site. CPBC has not declared and AQMAs.

Local Monitoring Data

NO_2

4.4.3 CPBC carries out monitoring at one automatic monitoring station (HAD1) at Hadleigh's Fire Station, however this monitoring station is not located within the study area. The Council also deploys NO_2 diffusion tubes at 32 sites, including eight locations within the study area.

4.4.4 RDC does not undertake automatic continuous monitoring, however it undertakes diffusion tube monitoring at ten sites, mostly within the Rayleigh AQMA.

4.4.5 2015-2020 monitoring results for the most representative and closest monitoring locations to the Site are provided in **Table 4-2** and their locations are shown in **Figure 4**, **Appendix G**. Whilst monitoring results for 2020 have been included in **Table 4-2** where available, it should be noted that due to the COVID-19 pandemic and lockdown restrictions in place, measured

concentrations in 2020 are not considered to be representative of normal conditions and are lower than previous years.

Table 4-2 Measured Annual Mean NO_2 Concentrations 2015 – 2020

Site ID	Site Type	Within AQMA	Annual Mean (µg/m^3)					
			2015	2016	2017	2018	2019	2020
CPBC								
CP18*	Roadside	No	31.2	34.3	33.7	31.1	28.0	19.1
CP19*	Urban Background	No	-	24.8	24.6	21.6	25.1	21.4
CP20*	Roadside	No	16.7	20.6	21.9	18.0	18.9	13.6
CP27*	Urban	No	-	27.8	26.8	23.8	25.3	21.5
CP28	Urban Background	No	-	28.4	27.6	25.7	25.5	18.4
CP29[a]	Kerbside	No	30.7	32.8	31.2	30.3	30.2	-
CP30	Roadside	No	31.0	30.7	31.3	29.8	27.9	22.4
CP31	Urban Background	No	20.2	22.0	22.5	21.0	20.9	16.0
RDC								
HOG	Suburban	No	-	-	17.7	16.4	16.8	-
HRD	Roadside	Yes	-	-	28.6	28.9	28.0	-
AQO		**40**						

2015 – 2019 bias adjusted and annualised (where appropriate) data taken from the CPBC and RDC Air Quality Annual Status Reports (ASRs) for 2019 (CPBC, 202b and RBC, 2020).
2020 bias adjusted and annualised (where appropriate) data have been obtained from the CPBC ASR for 2020 (CPBC, 2021).
[a] Low data capture in 2019 and therefore has not been used for model verification.
* Used for model verification.

4.4.6 Measured concentrations at the closest monitoring locations to the Site, (CP20 and CP27), have been well below the annual mean AQO in all recent years. Measured concentrations at remaining monitoring locations have also been well below the annual mean objective, even location HRD, located within the AQMA. Furthermore, measured concentrations are below 60 µg/m^3, indicating that it is unlikely that any exceedances of the 1-hour mean objective have occurred. The trend of results across monitored sites indicate that air quality is improving which is in accordance with national trends (Air Quality Consultants, 2020b).

PM_{10} and $PM_{2.5}$

4.4.7 Neither CPBC nor RDC have undertaken any PM_{10} or $PM_{2.5}$ monitoring within the study area.

4.5 Predicted Background Concentrations

4.5.1 Estimated background concentrations for the Site, modelled receptor locations and monitoring sites used for model verification have been obtained from the latest 2018-based national maps provided by DEFRA (DEFRA, 2020c) and are shown in **Table 4-3**.

4.5.2 The background concentrations are all well below the relevant AQOs both in the 'existing' and future years.

Table 4-3 Estimated Annual Mean Background Concentrations

Year	Location (x_y)	Annual Mean (µg/m^3)		
		NO_2	PM_{10}	$PM_{2.5}$
2019	579_188[a]	15.4	15.1	10.3
	579_189[b]	17.4	15.6	10.6
	580_188[c]	15.1	14.8	10.0
	580_189[d]	20.3	16.4	10.9
2023	579_188[a]	14.9	14.8	10.1
	579_189[b]	16.8	15.4	10.3
	580_188[c]	14.6	14.5	9.8
	580_189[d]	19.5	16.1	10.6
AQO		**40**	**40**	**20**

a) Existing receptors, E04, E12, E15, E22 – E25 and monitoring locations CP18 and CP19.
b) Monitoring location CP27.
c) Proposed receptor locations N1, N2 and N5, monitoring location CP20 and existing receptor locations E05 – E11, E13, E14, E20 and E21.
d) Existing receptor locations E01, E02, E03, E16 – E19, and proposed receptor locations N3 and N4.
Note: Projections in the 2018 reference year background maps and associated tools are based on assumptions which were current before the Covid-19 outbreak in the UK. In consequence these tools do not reflect short- or longer-term impacts on emissions in 2020 and beyond resulting from behavioural change during the national or local lockdowns.

4.6 Baseline Deposition – Ecological Receptors

4.6.1 The three-year average (2017-2019) nitrogen and acid deposition rates for each of the ecological receptors with habitats that are sensitive to either nitrogen or acid deposition are presented in **Table 4-4**. Data have been obtained from the APIS website (APIS, 2022).

Table 4-4 Baseline Deposition Rates

Habitat	Total Nitrogen Deposition (kgN/ha/yr)	Acid Deposition	
		Nitrogen (keqN/ha/yr)	Sulphur (keqS/ha/yr)
ECO1 Thundersley Great Common SSSI (A127 Southend Arterial Road transect)			
Acid Grassland	15	1.1	0.1
ECO_2 Thundersley Great Common SSSI (A129 Rayleigh Road transect)			
Acid Grassland	15	1.1	0.1
ECO_3 Garrold's Meadow SSSI			
Neutral Grassland	15.3	1.1	0.1

4.7 Predicted Baseline Concentrations

Human Receptors

4.7.1 The ADMS-Roads model has been used to predict baseline NO_2, PM_{10} and $PM_{2.5}$ concentrations at each of the existing receptor locations identified in **Figure 2**, **Appendix G**. The results for the baseline scenarios are presented in **Table 4-5**.

Table 4-5 Predicted Baseline Concentrations of NO_2, PM_{10} and $PM_{2.5}$ in 2019 and 2023

Receptor	Annual Mean (µg/m³)					
	NO_2		PM_{10}		$PM_{2.5}$	
	2019	2023	2019	2023	2019	2023
E01	28.1	25.0	18.1	17.8	11.8	11.6
E02	37.1	31.3	19.8	19.5	12.8	12.5
E03	31.9	27.7	18.4	18.1	12.0	11.8
E04	30.5	25.6	17.5	17.2	11.8	11.5
E05	23.6	20.5	16.2	15.9	10.9	10.6
E06	26.2	22.4	16.7	16.4	11.2	10.9
E07	23.3	20.4	16.2	15.9	10.9	10.6
E08	21.6	19.2	15.9	15.6	10.7	10.5
E09	22.1	19.5	16.0	15.7	10.8	10.5
E10	16.8	15.8	15.1	14.8	10.2	10.0
E11	19.7	17.8	15.6	15.3	10.5	10.3
E12	26.7	22.8	16.9	16.5	11.4	11.1
E13	26.3	22.5	16.5	16.2	11.1	10.8
E14	23.3	20.4	16.1	15.8	10.8	10.5
E15	23.1	20.3	16.3	16.0	11.0	10.8
E16	28.6	25.3	18.2	17.9	11.9	11.6
E17	32.8	28.3	18.9	18.5	12.3	12.0
E18	**41.0**	34.1	20.2	19.8	13.1	12.7
E19	31.0	27.0	18.4	18.1	12.0	11.7
E20	20.6	18.4	15.7	15.4	10.6	10.4
E21	19.6	17.7	15.6	15.3	10.5	10.3
E22	35.8	29.4	18.9	18.6	12.6	12.2
E23	29.5	24.9	17.6	17.2	11.8	11.5
E24	24.4	21.2	16.5	16.2	11.2	10.9
E25	29.2	24.6	17.6	17.2	11.8	11.5
AQO	**40**		**40**		**20**	

Exceedances of the AQOs are highlighted in bold.

4.7.2 The annual mean NO_2 AQO is predicted to be exceeded at receptor location E18 in 2019. E18 is located within the RDC Rayleigh AQMA. The are no predicted exceedances of the annual mean NO_2 AQO at any of the modelled receptor locations in 2023. There are also no exceedances of the annual mean PM_{10} and $PM_{2.5}$ AQOs at any of the modelled receptors in either 2019 or 2023.

4.7.3 Furthermore, NO_2 concentrations are predicted to be lower than 60 µg/m³ in 2019 and 2023, indicating that exceedances of the 1-hour mean AQO are unlikely, and predicted concentrations of PM_{10} are lower than 32 µg/m³ during 2019 and 2023, indicating that exceedances of the 24-hour mean AQO are unlikely.

4.7.4 As shown in **Table 4-5**, concentrations are predicted to decline in the future. This predicted reduction in vehicle emissions in the future is associated with expected technological advances and improvements in the vehicle fleet mix.

Ecological Receptors

4.7.5 Predicted concentrations and deposition rates for the baseline scenarios are presented in **Appendix F**.

4.7.6 There are predicted exceedances of the 24-hour mean NO_x critical level in 2019 only within Garrold's Meadow SSSI. There are exceedances of the annual mean NO_x critical level in 2019 within Thundersley Great Common SSSI and predicted exceedances of the annual mean NH_3 critical level in Thundersley Great Common SSSI in 2019 and 2023.

4.7.7 The critical loads for nitrogen and acid deposition are predicted to be exceeded in the Thurdersley Great Common SSSI in 2019 and 2023. There are no predicted exceedances of the critical loads for nitrogen or acid deposition in Garrold's Meadow SSSI in either 2019 or 2023.

5 Predicted Impacts

5.1 Construction Dust Impacts

Screening Assessment

5.1.1 There are a number of existing sensitive human receptors (including residential properties, a school and places of work) located within 350 m of the Site boundary and within 50 m of the routes that will be used by demolition and construction vehicles. As such, further assessment of the risk of dust soiling and PM_{10} emissions is required.

5.1.2 There are no ecological receptors within 50 m of the site boundary or within 50 m of a route to be used by construction vehicles on the public highway.

Further Assessment

Dust Emission Magnitude

5.1.3 The dust emissions magnitude of demolition, earthworks and construction activities and as a result of trackout have been determined based the criteria shown in **Table B-1**, **Appendix B**

5.1.4 Proposed demolition activities comprise the demolition of existing single-storey storage sheds and stables, with a building volume of less than 20,000 m^3. Based on this, the dust emission magnitude of demolition activities is judged to be ‘small’.

5.1.5 Proposed earthworks activities will primarily involve excavating material, haulage, tipping and stockpiling and landscaping. The Site is greater than 100,000 m^2 in area and soil type at the Site varies between sandy loam to clayey loam with an arenaceous to argillic grain size (British Geological Survey, 2021). The soil type at the Site is therefore considered to be potentially dusty Based on this, the dust emission magnitude of earthworks activities is judged to be ‘large’.

5.1.6 Construction activities comprise the construction of a mixture of two-storey and three-storey building, with an estimated total building volume of greater than 100,000 m^3. Based on this, the dust emission magnitude of construction activities is judged to be ‘large’.

5.1.7 The number of HDVs that will exit the Site on a daily basis is unknown, however, given the large size of the Site there is potential for the outward HDV movements to exceed 50 per day during certain phases of the construction period. In addition, the length of unpaved haul roads is likely to be greater than 100 m. Based on this, the dust emission magnitude of trackout is judged to be ‘large’.

Area Sensitivity

5.1.8 The area sensitivity to dust soiling and human health impacts has been determined based on the criteria shown in **Table B-3**, **Table B-4**, **Table B-5**, **Appendix B** .

5.1.9 Residential properties and schools are classed as being 'high sensitivity' receptors to dust soiling, based on the IAQM guidance (IAQM, 2014) (see **Table B-3**, **Appendix B**). There are more than 10 residential properties located within 20 m of the Site boundary; as such, the sensitivity of the area surrounding the Site to dust soiling is judged to be ‘high’.

5.1.10 The IAQM guidance states that trackout may occur for distance of up to 500 m from large sites. As the demolition and construction traffic routing is currently unknown, the worst-case assumption has been made that all main roads may potentially be used by HDVs leaving the Site entrance(s). There are more than 10 residential properties located within 20 m of roads

extending up to 500 m of the Site; as such, the sensitivity to dust soiling of the area surrounding roads along which material may be tracked is judged to be 'high'.

5.1.11 The IAQM also defines residential properties and schools as being 'high sensitivity' receptors to human health impacts (see **Table B-4**, **Appendix B**). Background concentrations of PM_{10} concentrations for the Site are presented in **Table 4-4** (16.4 µg/m^3 in 2019). Based on the predicted background PM_{10} concentrations and the number of sensitive receptors within 20 m of the site boundary and roads along which material may be, the sensitivity to human health impacts of the areas surrounding the Site and the area surrounding roads along which material may be tracked are judged to be 'low'.

Risk of Impacts

5.1.12 The risk of construction dust impacts, without mitigation, have been defined based on the criteria shown in **Table B-6**, **Appendix B** and are presented in **Table 5-1**.

Table 5-1 Risk of Construction Dust Impacts without Mitigation

Potential Impact	Risk			
	Demolition	**Earthworks**	**Construction**	**Trackout**
Dust Soiling	Medium Risk	High Risk	High Risk	High Risk
Human Health	Negligible Risk	Low Risk	Low Risk	Low Risk

5.2 Demolition and Construction Road Traffic Emission Impacts

Screening Assessment

5.2.1 At present, detailed information regarding the construction methodology for the development, specific activities and traffic movements is not available. However, a Construction Environmental Management Plan (CEMP) will outline measures to control and minimise the risk of adverse effects from construction activities. The CEMP will be submitted to CPBC for their approval. The CEMP will consider Heavy Goods Vehicles (HGV) and other construction traffic movements, including details of routing and times of day of movements. HGV access will be prevented or minimised, where possible, on traffic sensitive roads, residential streets, congested roads or unsuitable junctions.

5.2.2 Vehicle movements associated with access, demolition and construction will vary through the construction programme, with short periods of peak HGV movements associated with demolition and the delivery of materials during the construction phase. However, when the HGV movements are averaged over a full year period (Annual Average Daily Traffic - AADT), these will be significantly lower than peak movements. Together with the implementation of the CEMP, the construction vehicle movements, impacts on human health receptors in the area are considered to be temporary and not significant. Moreover, vehicle movements associated with construction are typically significantly lower than the number of vehicle movements associated with operation of the development, which have been taken into account in this assessment.

5.3 Site Suitability

Screening Assessment

5.3.1 The Site is located adjacent to the A129 Rayleigh Road which carries a large volume of traffic; therefore, a more detailed assessment of site suitability has been undertaken.

Detailed Assessment

5.3.2 Predicted concentrations at modelled receptor locations are presented in **Table 5-2**. Details of the proposed receptors are provided in **Appendix D** and their locations are shown in **Figure 2**, **Appendix G**.

Table 5-2 Predicted Concentrations within the Site

Receptor	Annual Mean (µg/m³)		
	NO_2	PM_{10}	$PM_{2.5}$
N1	17.2	15.1	10.2
N2	18.4	15.5	10.4
N3	26.1	17.8	11.6
N4	21.6	16.7	10.9
N5	18.5	15.5	10.4
AQO	**40**	**40**	**20**

5.3.3 Predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ are well below the relevant AQOs all worst-case receptors, therefore, air quality within the Proposed Development, without mitigation, will be acceptable.

5.4 Operational Road Traffic Impacts at Human Receptors

Screening Assessment

5.4.1 The Proposed Development will generate additional traffic during the operational phase, which will result in an increase of over 100 AADT along roads located within an AQMA, and 500 AADT on roads outside of an AQMA, thus exceeding the EPUK / IAQM screening criteria (see **Appendix C**). As such, it is not possible to screen out the potential for significant impacts from operational traffic generated by the Proposed Development on existing sensitive properties and, therefore a detailed assessment has been undertaken.

Detailed Assessment

5.4.2 Predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ at existing receptors, both without and with the Proposed Development in place, are presented in **Table 5-3**, **Table 5-4** and **Table 5-5**. The 'without development' scenario predicted concentrations include background concentrations and emissions from existing traffic, and the 'with development' scenario predicted concentrations include background concentrations, and emissions from existing traffic and traffic generated by the Proposed Development.

Table 5-3 Predicted Concentrations of NO_2 (µg/m³), % Change and Impact at each Receptor

Receptor	2023 Without Development	2023 With Development	Change (as % of AQO)	Impact Descriptor
E01	25.0	25.0	0%	Negligible
E02	31.3	31.5	1%	Negligible
E03	27.7	28.0	1%	Negligible
E04	25.6	26.2	2%	Negligible
E05	20.5	21.0	1%	Negligible
E06	22.4	23.1	2%	Negligible

Receptor	2023 Without Development	2023 With Development	Change (as % of AQO)	Impact Descriptor
E07	20.4	20.9	1%	Negligible
E08	19.2	19.6	1%	Negligible
E09	19.5	20.0	1%	Negligible
E10	15.8	15.9	0%	Negligible
E11	17.8	18.1	1%	Negligible
E12	22.8	23.2	1%	Negligible
E13	22.5	22.9	1%	Negligible
E14	20.4	20.7	1%	Negligible
E15	20.3	20.5	1%	Negligible
E16	25.3	25.4	0%	Negligible
E17	28.3	28.4	0%	Negligible
E18	34.1	34.3	0%	Negligible
E19	27.0	27.1	0%	Negligible
E20	18.4	18.8	1%	Negligible
E21	17.7	18.1	1%	Negligible
E22	29.4	29.9	1%	Negligible
E23	24.9	25.2	1%	Negligible
E24	21.2	21.5	1%	Negligible
E25	24.6	25.0	1%	Negligible
AQO	**40**		-	

Table 5-4 Predicted Concentrations of PM_{10} (µg/m³), % Change and Impact at each Receptor

Receptor	2023 Without Development	2023 With Development	Change (as % of AQO)	Impact Descriptor
E01	17.8	17.8	0%	Negligible
E02	19.5	19.5	0%	Negligible
E03	18.1	18.2	0%	Negligible
E04	17.2	17.3	0%	Negligible
E05	15.9	16.0	0%	Negligible
E06	16.4	16.6	0%	Negligible
E07	15.9	16.1	0%	Negligible
E08	15.6	15.8	0%	Negligible
E09	15.7	15.9	0%	Negligible
E10	14.8	14.8	0%	Negligible
E11	15.3	15.4	0%	Negligible
E12	16.5	16.6	0%	Negligible
E13	16.2	16.3	0%	Negligible
E14	15.8	15.8	0%	Negligible
E15	16.0	16.0	0%	Negligible
E16	17.9	17.9	0%	Negligible
E17	18.5	18.6	0%	Negligible
E18	19.8	19.9	0%	Negligible
E19	18.1	18.1	0%	Negligible
E20	15.4	15.5	0%	Negligible
E21	15.3	15.4	0%	Negligible
E22	18.6	18.7	0%	Negligible
E23	17.2	17.3	0%	Negligible

Receptor	2023 Without Development	2023 With Development	Change (as % of AQO)	Impact Descriptor
E24	16.2	16.3	0%	Negligible
E25	17.2	17.3	0%	Negligible
AQO	**40**		-	

Table 5-5 Predicted Concentrations of $PM_{2.5}$ (µg/m³), % Change and Impact at each Receptor

Receptor	2023 Without Development	2023 With Development	Change (as % of AQO)	Impact Descriptor
E01	11.6	11.6	0%	Negligible
E02	12.5	12.6	0%	Negligible
E03	11.8	11.8	0%	Negligible
E04	11.5	11.6	0%	Negligible
E05	10.6	10.7	0%	Negligible
E06	10.9	11.0	1%	Negligible
E07	10.6	10.7	0%	Negligible
E08	10.5	10.5	0%	Negligible
E09	10.5	10.6	0%	Negligible
E10	10.0	10.0	0%	Negligible
E11	10.3	10.3	0%	Negligible
E12	11.1	11.2	0%	Negligible
E13	10.8	10.9	0%	Negligible
E14	10.5	10.6	0%	Negligible
E15	10.8	10.8	0%	Negligible
E16	11.6	11.6	0%	Negligible
E17	12.0	12.0	0%	Negligible
E18	12.7	12.8	0%	Negligible
E19	11.7	11.8	0%	Negligible
E20	10.4	10.4	0%	Negligible
E21	10.3	10.3	0%	Negligible
E22	12.2	12.3	0%	Negligible
E23	11.5	11.6	0%	Negligible
E24	10.9	10.9	0%	Negligible
E25	11.5	11.5	0%	Negligible
AQO	**20**		-	

5.4.3 The predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations in 2023, both without and with the Proposed Development in place, are below the relevant AQOs at all existing receptors. Furthermore, predicted annual mean NO_2 concentrations are below 60µg/m³ at all receptors, indicating that exceedances of the 1-hour mean NO_2 AQO are not likely, and the predicted annual mean PM_{10} concentrations are below 32 µg/m³ at all receptors, indicating that exceedances of the 24-hour mean PM_{10} AQO are not likely.

5.4.4 The changes in annual mean NO_2 concentrations (when rounded to the nearest whole number) are 2% at two receptors and 0-1% at the remaining receptors. Using the criteria set out in **Table 3-**1, these impacts are described as being 'negligible' at all modelled receptor locations.

5.4.5 The changes in annual mean PM_{10} and $PM_{2.5}$ concentrations (when rounded to the nearest whole number) are 0-1% at all receptors. Using the criteria set out in **Table 3-1**, the PM_{10} and $PM_{2.5}$ impacts are described as being 'negligible' at all modelled receptor locations.

5.5 Operational Road Traffic Impacts at Ecological

5.5.1 Full results for the ecological assessment are provided in **Appendix F** and modelled receptor locations are shown in **Figure 3**, **Appendix G**.

Thundersley Great Common SSSI

5.5.2 There are no predicted exceedances of the annual mean and 24-hour NO_x critical levels within the Thundersley Great Common SSSI, without or with the Proposed Development in place in 2023. However, there are exceedances of the annual mean NH_3 critical level and acid and nitrogen deposition critical loads at all receptor location locations within the SSSI without or with the Proposed Development in place in 2023, due to high background levels.

5.5.3 The changes in NO_x and NH_3 concentrations and nitrogen and acid deposition do not exceed 1% of the critical level / load (or 10% of the critical level for 24-hour NO_x concentrations) within the Thundersley Great Common SSSI. Therefore, the scheme contributions to NO_x and NH_3 concentrations, and nitrogen and acid deposition within the SSSI are considered to be insignificant.

Garrold's Meadow SSSI

5.5.4 There are no predicted exceedances of the annual mean NO_x and NH_3, and 24-hour NO_x critical levels, or nitrogen deposition critical load, within Garrold's Meadow SSSI, without or with the Proposed Development in place in 2023. However, there are exceedances of the acid deposition critical load at all receptor location locations within the SSSI without or with the proposed Development in place in 2023, due to high background levels.

5.5.5 The changes in NO_x and NH_3 concentrations and nitrogen and acid deposition do not exceed 1% of the critical level / load (or 10% of the critical level for 24-hour NO_x concentrations) within Garrold's Meadow SSSI. Therefore, the scheme contributions to NO_x and NH_3 concentrations, and nitrogen and acid deposition within the SSSI are considered to be insignificant.

5.6 Impact Significance

5.6.1 The IAQM guidance recommends that no judgement of the significance of effects of construction dust without mitigation is made, as mitigation is assumed to be secured by planning conditions, legal requirements or required by regulations (IAQM, 2014). Following the implementation of appropriate mitigation measures (as described in **Section 6.1**) the residual effects will be 'not significant'.

5.6.2 Overall, taking into account the conservative nature of the assessment, and the criteria set out in **Section 3.7**, the operational air quality effects of the Proposed Development are considered to be 'not significant' on the basis that:

- Road traffic emissions associated with the Proposed Development will not cause any exceedances of the AQOs.
- Impacts as a result of road traffic emissions associated with the operation of the Proposed Development will be 'negligible' at all receptors.
- Predicted concentrations of pollutants (NO_2, PM_{10} and $PM_{2.5}$) at worst-case sensitive locations within the Proposed Development will be well below the relevant AQOs and, therefore, new residents / users of the development will experience acceptable air quality.

5.6.3 In relation to road traffic impacts on ecological sites, the scheme contribution to NO_x and NH_3, and acid and nitrogen deposition within Thundersley Great Common SSSI and Garrold's Meadow SSSI are less than 1% of the critical level / load (or 10% for 24-hour NO_x). Therefore,

the scheme contributions to NO_x and NH_3 concentrations, and nitrogen and acid deposition within the SSSIs are considered to be insignificant.

6 Mitigation

6.1 Construction

6.1.1 The following standard mitigation measures from the IAQM guidance (IAQM, 2014) are recommended, taking into account the outcomes of the construction dust risk assessment (presented in **Table 5-1**).

Communication

- Develop and implement a stakeholder communications plan.
- Display the name and contact details of persons accountable on the site boundary.
- Display the head or regional office information on the site boundary.

Management

- Develop and implement a dust management plan.
- Record all dust and air quality complaints, identify causes and take measures to reduce emissions.
- Record exceptional incidents and action taken to resolve the situation.
- Carry out regular site inspections to monitor compliance with the dust management plan and record results.
- Increase site inspection frequency during prolonged dry or windy conditions and when activities with high dust potential are being undertaken.
- Agree dust monitoring locations with the local authority and instigate monitoring three months in advance of works commencing in the area.
- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as possible.
- Erect solid screens or barriers around dusty activities or the site boundary at least as high as any stockpile on site.
- Fully enclose Site or specific operations where there is a high potential for dust production and the Site is active for an extensive period.
- Avoid site run off of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove potentially dusty materials from the Site as soon as possible.
- Cover, seed or fence stockpiles to prevent wind whipping.
- Ensure all vehicles switch off engines when stationary.
- Avoid the use of diesel or petrol powered generators where possible.

- Produce a Construction Logistics Plan to manage the delivery of goods and materials.
- Only use cutting, grinding and sawing equipment with dust suppression equipment.
- Ensure an adequate supply of water on-site for dust suppressant.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use water sprays on such equipment where appropriate.
- Ensure equipment is readily available on-site to clean up spillages of dry materials.
- No on-site bonfires and burning of waste materials on-site.

Demolition

- Incorporate 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 water suppression is used during demolition operation.
- Avoid explosive blasting, using appropriate manual and mechanical alternatives.
- Bag and remove any biological debris or damp down such material before demolition.

Earthworks

- Re-vegetate earthworks and exposed areas /soil stockpiles to stabilise surfaces as soon as practicable.
- Only remove the cover in small areas during work and not all at once.

Construction

- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless required for a particular process.
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored silos with suitable emissions control systems.

Trackout

- Use water assisted dust sweepers on the site access and local roads.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving the Site are covered to prevent escape of materials.
- Record inspection of on-site haul routes and any subsequent action, repairing as soon as reasonably practicable.
- Install hard surfaced haul routes which are regularly damped down.
- Install a wheel wash with a hard-surfaced road to the site exit where site layout permits.

- The site access gate to be located at least 10m from receptors where possible.

6.2 Operation

6.2.1 The impacts of road traffic generated by the Proposed Development on air quality have been judged to be 'not significant' and the Site is considered to be suitable for the proposed end-uses without the need for further mitigation. However, a Residential Travel Plan has been developed which is likely to further reduce vehicles trips (and therefore pollutants emissions) associated with the Proposed Development. The Travel Plan includes the following measures to encourage active and sustainable travel by future users of the Site:

- Distribution of a Residential Travel Information Pack to each household upon first occupation.
- The proposed site accesses onto Stadium Way and Daws Heath Road have been designed with 3.5m wide shared footway/ cycleway, 2m wide footway and informal pedestrian crossings to existing pedestrian infrastructure.
- Internally, the Site will encourage pedestrians and cyclists by providing direct, well-lit, and open routes, with clear signage and links to the wider network.
- Cycle parking spaces will be provided onsite.
- Electric vehicle charging points will be provided at a level to meet required standards.

7 Summary and Conclusions

7.1.1 The air quality impacts associated with the Proposed Development at land east of Rayleigh Road, Hadleigh located within the administrative boundary of CPDC have been assessed.

7.1.2 CPBC and RDC have investigated air quality as part of their responsibilities under the LAQM regime. The closest AQMA to the Site is Rayleigh AQMA, declared by RDC and located approximately 240 m to the north of the Site. CPBC has not declared any AQMAs.

7.1.3 The construction works have the potential to create dust. During construction it is recommended that in accordance with the IAQM guidance a package of mitigation measures is put in place to minimise the risk of elevated PM_{10} concentrations and dust nuisance in the surrounding area. With mitigation in place the construction impacts are judged as not significant.

7.1.4 Concentrations of NO_2, PM_{10} and $PM_{2.5}$ have been predicted for a number of worst-case locations representing existing properties adjacent to the road network, as well as future receptor locations within the Site. Predicted concentrations are below the relevant AQOs at all of the existing and proposed receptor locations with the Proposed Development in place. The operational effects of the Proposed Development on human receptor locations are judged to be 'not significant'.

7.1.5 The increases in NO_x and NH_3 concentrations, and acid and nitrogen deposition, on ecological receptors are considered to be insignificant within Thundersley Great Common and Garrold's Meadow SSSIs.

7.1.6 Mitigation measures to reduce the impacts of the development on air quality concentrations are not considered to be required, however additional transport related mitigation measures will be employed through a Travel Plan to reduce emissions from the Development.

7.1.7 The Proposed Development is therefore considered to be in accordance with the requirements of the NPPF, and relevant local and national planning policy and guidance regarding air quality.

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Appendix A Glossary

Abbreviations	Meaning
AADT	Annual Average Daily Traffic
APIS	Air Pollution Information System
AQAP	Air Quality Action Plan
AQFA	Air Quality Focus Areas
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
CAZ	Clean Air Zone
CEMP	Construction Environmental Management Plan
CPBC	Castle Point Borough Council
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
Diffusion Tube	A passive sampler used for collecting NO_2 in the air
EA	Environment Agency
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
HDV	Heavy Duty Vehicle; a vehicle with a gross vehicle weight greater than 3.5 tonnes. Includes Heavy Goods Vehicles and buses
HE	Highways England
IAQM	Institute of Air Quality Management
LA	Local Authority
LAQM	Local Air Quality Management
NAEI	National Atmospheric Emission Inventory
NAQO	National Air Quality Objective as set out in the Air Quality Strategy and the Air Quality Regulations
NO_2	Nitrogen Dioxide

NO_x	Oxides of nitrogen generally considered to be nitric oxide and NO_2. Its main source is from combustion of fossil fuels, including petrol and diesel used in road vehicles
NPPF	National Planning Policy Framework
$PM_{10}/PM_{2.5}$	Small airborne particles less than 10/2.5 µm in diameter
PPG	Planning Practice Guidance
RDC	Rochford District Council
Receptor	A location where the effects of pollution may occur
SPG	Supplementary Planning Guidance
UNECE	United Nations Economic Commission for Europe
ULEZ	Ultra-Low Emission Zone
WHO	World Health Organisation

Appendix B IAQM Dust Guidance (2014) Approach

Table B-1 Dust Emission Magnitude Classification

Activity	Dust Emission Magnitude		
	Large	**Medium**	**Small**
Demolition	Total building volume of >50,000 m^3, potentially dusty construction material, on-site crushing and screening, demolition activities >20 m above ground	Total building volume of 20,000 – 50,000 m^3, potentially dusty construction material, demolition activities 10 – 20 m above ground level	Total building volume of <20,000 m^3, construction material with low potential for dust release, demolition activities <10 m above ground, demolition during wetter months
Earthworks	Total site area of >10,000 m^2, potentially dusty soil type, >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes	Total site area of 2,500 - 10,000 m^2, moderately dusty soil type, 5 - 10 heavy earth moving vehicles active at any one time, formation of bunds 4 - 8 m in height, total material moved 20,000 - 100,000 tonnes	Total site area of <2,500 m^2, soil type with large grain size, <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	Total building volume >100,000 m^2, on-site concrete batching, sandblasting	Total building volume 25,000 - 100,000 m^2, potentially dusty construction material, on-site concrete batching	Total building volume <25,000 m^2, construction material with low potential for dust release
Trackout	>50 HDV outwards movements in any one day, potentially dusty surface material, unpaved road length >100 m	10 - 50 HDV outwards movements in any one day, moderately dusty surface material, unpaved road length 50 - 100 m	<10 HDV outwards movements in any one day, surface material with low potential for dust release, unpaved road length <50 m

Table B-2 Receptor Sensitivity

Receptor Sensitivity	Impact		
	High	**Medium**	**Low**
High	An area where: Users can reasonably expect enjoyment of a high level of amenity; The appearance, aesthetics of value of their property would be diminished by soiling; The people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Examples include dwellings, museums and other culturally important collections, medium and long-term 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 objective, a relevant location would be one where individuals may be exposed for eight hours or more per day. 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 Locations where there is a community of particularly dust sensitive species such as vascular species included in the Red Data List for Great Britain. Indicative examples include a SAC designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.
Medium	An area where: Users would expect to enjoy of a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; The appearance, aesthetics of value of their property could be diminished by soiling; 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. Examples include parks and places of work.	Locations where 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 objective, a relevant location would be one where individuals may be exposed for eight hours or more per day. Examples include office and shop workers, but will generally not include workers occupationally exposed to for 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 example is a SSSI with dust sensitive features.

Low	An area where: The enjoyment of amenity would not reasonably be expected; Property would not reasonably be expected to be diminished I appearance, aesthetics or value by soiling; 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. Examples include playing fields, farmland (unless commercially sensitive horticultural), footpaths, short-term car parks and roads.	Locations where human exposure is transient. Examples include 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 LNR with dust sensitive features.

Table B-3 Sensitivity of an Area to Dust Soiling Effects

Receptor Sensitivity	**Number of Receptors**	**Distance from 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 B-4 Sensitivity of an 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
		10 – 100	High	High	Medium	Low	Low
		1 - 10	High	Medium	Low	Low	Low
	28 - 32 µg/m^3	>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	>100	High	Medium	Low	Low	Low
		10 – 100	High	Medium	Low	Low	Low
		1 - 10	Medium	Low	Low	Low	Low

	<24 µg/m^3	>100	Medium	Low	Low	Low	Low
		10 – 100	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
Medium	>32 µg/m^3	>10	High	Medium	Low	Low	Low
		1 - 10	Medium	Low	Low	Low	Low
	28 - 32 µg/m^3	>10	Medium	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
	24 - 28 µg/m^3	>10	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
	<24 µg/m^3	>10	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
Low	-	≥1	Low	Low	Low	Low	Low

Table B-5 Sensitivity of an Area to Ecological Impacts

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

Table B-6 Risk of Dust Impacts Calculation Matrix

Sensitivity of Area		**Dust Emission Magnitude**		
		Large	**Medium**	**Small**
Demolition	High	High Risk	Medium Risk	Medium Risk
	Medium	High Risk	Medium Risk	Low Risk
	Low	Medium Risk	Low Risk	Negligible Risk
Earthworks	High	High Risk	Medium Risk	Low Risk
	Medium	Medium Risk	Medium Risk	Low Risk
	Low	Low Risk	Low Risk	Negligible Risk
Construction	High	High Risk	Medium Risk	Low Risk
	Medium	Medium Risk	Medium Risk	Low Risk
	Low	Low Risk	Low Risk	Negligible Risk
Trackout	High	High Risk	Medium Risk	Low Risk
	Medium	Medium Risk	Low Risk	Negligible Risk
	Low	Low Risk	Low Risk	Negligible Risk

Appendix C EPUK IAQM Guidance (2017) Screening Criteria

The Development Will:	Indicative Criteria to Proceed to an Air Quality Assessment
Cause a significant change in LDV traffic flows on local roads with relevant receptors.	A change of LDV flow of: >100 AADT within or adjacent to an AQMA; and >500 AADT elsewhere.
Cause a significant change in HDV flows on local roads with relevant receptors.	A change of HDV flow of: >25 AADT within or adjacent to an AQMA; and >100 AADT elsewhere.
Realign roads i.e. changing the proximity of receptors to traffic lanes.	Where the change is 5 m or more and the road is within an AQMA.
Introduce a new junction or remove an existing junction near to relevant receptors.	Applies to junctions that cause traffic to significantly change vehicle acceleration / deceleration, e.g. traffic lights, or roundabouts.
Introduce or change a bus station.	A change of bus flows of: >25 AADT within or adjacent to an AQMA; and >100 AADT elsewhere.
Have an underground car park with extraction system.	The ventilation extract for the car park will be located within 20 m of a relevant receptor; and The car park will have >100 movements per day (total in and out).

The screening criteria presented is amended from Table 6.2 of the EPUK / IAQM guidance (EPUK / IAQM, 2017). Only the screening criteria relevant to changes in transport (including both traffic and the transport network) are outlined.

Appendix D Model Inputs and Results Processing

D.1 Summary of Model Inputs

Meteorological Data	2019 hourly data from Southend meteorological station has been used in the model. The wind rose is shown in **Appendix D.5**.
ADMS	Version 5.0.1.3
Time Varying Emission Factors	Based on Department for Transport statistics. Table TRA0307. Motor vehicle traffic distribution by time of day and day of the week on all roads, Great Britain: 2019
Latitude	51.6°
Surface Roughness	A value of 0.5 for 'parkland and open suburbia' was used to represent the modelled area and the meteorological station site.
Minimum Monin-Obukhov length	A value of 30 for 'cities and large towns' was used to represent the modelled area and the meteorological station site.
Emission Factor Toolkit (EFT)	V11 (DEFRA, 2021)
NO_x to NO_2 Conversion	NO_x to NO_2 calculator version 8.1, August 2020 (DEFRA, 2020d)
Background Maps	2018 reference year background maps (DEFRA, 2020b)

D.2 Human Receptor Locations

Receptor	Location	X	Y	Height (m)
Existing Receptors				
E01	10, Brook Road	580409.4	189700.2	1.5
E02	Weir House, Arterial Road	580119	189645.1	1.5
E03	529, Rayleigh Road	580049.7	189444.9	1.5
E04	2, Daws Heath Road	579976.4	188813.2	1.5
E05	5, Daws Heath Road	580011.5	188841.1	1.5
E06	27, Daws Heath Road	580041.7	188828.9	1.5
E07	45, Daws Heath Road	580145.8	188819.1	1.5
E08	80, Daws Heath Road	580269.5	188788.7	1.5
E09	87, Daws Heath Road	580314.6	188815.2	1.5
E10	The Enchanted Wood Pre-school	580334.5	188731.5	1.5
E11	112, Daws Heath Road	580398.9	188799.6	1.5
E12	6, Heathfield	579996.6	188755.7	1.5
E13	21, Tollgate	580014.4	188710.6	1.5
E14	302, Rayleigh Road	580045.4	188645.9	1.5

Receptor	Location	X	Y	Height (m)
E15	333, Rayleigh Road	579958.5	188758.2	1.5
E16	25, Weir Farm Road	580054.7	189749.8	1.5
E17	114, High Road	580136.3	189735.6	1.5
E18	The Chestnuts, High Road	580216.4	189737.7	1.5
E19	1, Kingsley Crescent	580104.6	189610	1.5
E20	54, Daws Heath Road	580152.4	188792.3	1.5
E21	156, Daws Heath Road	580631.7	188827.2	1.5
E22	384, Rayleigh Road	579914.9	188934.8	1.5
E23	378, Rayleigh Road	579934.3	188886.9	1.5
E24	361, Rayleigh Road	579934	188818.2	4.5
E25	377, Rayleigh Road	579903.4	188896.9	1.5
Proposed Receptors				
N1	Proposed Development Southwest	580149.4	188851.4	1.5
N2	Proposed Development East of Southern Site Access	580642.2	188860.4	1.5
N3	Proposed Development Northwest	580032	189301.2	1.5
N4	Proposed Development Northern Site Access	580266.8	189280.9	1.5
N5	Proposed Development West of Southern Site Access	580603.6	188857.5	1.5

D.3 Ecological Receptor Locations

Receptor	Location	X	Y	Height (m)
ECO1_000m	Thundersley Great Common SSSI – northern transect	579849.8	189569.9	0
ECO1_005m		579849.4	189564.9	0
ECO1_010m		579849	189559.9	0
ECO1_015m		579848.6	189555	0
ECO1_020m		579848.1	189550	0
ECO1_030m		579847.3	189540	0
ECO1_040m		579846.4	189530.1	0
ECO1_050m		579845.5	189520.1	0
ECO1_075m		579843.4	189495.2	0
ECO1_100m		579841.2	189470.3	0
ECO1_125m		579839	189445.4	0
ECO2_000m	Thundersley Great Common SSSI – eastern transect	579878.4	189435.1	0
ECO2_005m		579873.4	189435.1	0
ECO2_010m		579868.4	189435.2	0
ECO2_015m		579863.4	189435.3	0
ECO2_020m		579858.4	189435.4	0
ECO2_030m		579848.4	189435.6	0
ECO2_040m		579838.4	189435.8	0
ECO2_050m		579828.4	189436	0
ECO2_075m		579803.4	189436.5	0
ECO2_100m		579778.4	189436.9	0
ECO2_125m		579753.4	189437.4	0
ECO2_150m		579728.4	189437.9	0
ECO2_175m		579703.4	189438.3	0
ECO2_200m		579678.4	189438.8	0
ECO3_000m	Garrold's Meadow SSSI	582363.5	188986.6	0
ECO3_005m		582362.4	188981.7	0

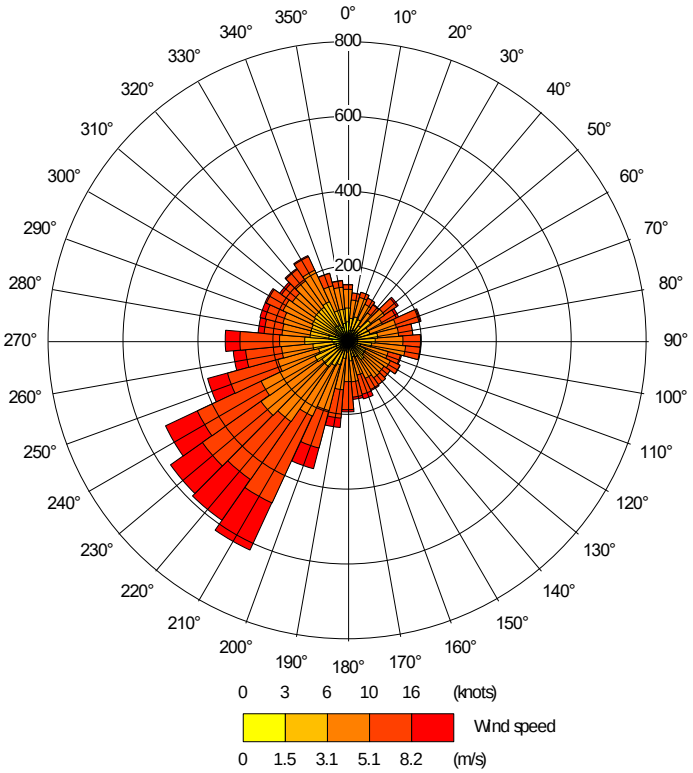
Receptor	Location	X	Y	Height (m)
ECO3_010m		582361.3	188976.9	0
ECO3_015m		582360.1	188972	0
ECO3_020m		582359	188967.1	0
ECO3_030m		582356.8	188957.4	0
ECO3_040m		582354.5	188947.6	0
ECO3_050m		582352.3	188937.9	0
ECO3_075m		582346.7	188913.5	0
ECO3_100m		582341.1	188889.2	0
ECO3_125m		582335.4	188864.8	0
ECO3_150m		582329.8	188840.4	0
ECO3_175m		582324.2	188816.1	0
ECO3_200m		582318.6	188791.7	0

D.4 Traffic Data

Link No. and Location	2019 Baseline		2026 Without Development		2026 With Development	
	AADT	%HDV	AADT	%HDV	AADT	%HDV
1 - A127/A129 Roundabout (North)	24893	2.00%	25815	2.0%	25892	2.0%
2 - A127/A129 Roundabout (East)	64845	4.00%	67596	4.0%	68110	4.0%
3 - A127/A129 Roundabout (South)	31075	2.00%	32226	2.0%	33453	1.9%
4 - A127/A129 Roundabout (West)	74378	4.00%	77534	4.0%	78341	4.0%
5 - Stadium Way	8016	4.50%	8313	4.5%	9454	4.0%
6 - Rayleigh Road (South of Stadium Way)	27905	2.00%	28939	2.0%	30027	1.9%
7 - Daws Heath Road (East of double mini roundabouts)	10846	1.50%	11247	1.5%	12584	1.3%
8 - Rayleigh Road (South of Hart Road)	16076	1.50%	16672	1.5%	17606	1.4%
9 - Daws Heath Road (East of Access)	10846	1.50%	11247	1.5%	11527	1.5%
10- Harts Road	11211	1.00%	11626	1.0%	11761	1.0%
11- A127 eastbound off-slip	12087	2.00%	12535	2.0%	12938	1.9%

12 - A127 eastbound on-slip	7720	2.00%	8005	2.0%	8227	1.9%
13- A127 westbound off-slip	9257	2.00%	9601	2.0%	9920	1.9%
14- A127 westbound on-slip	11684	2.00%	12116	2.0%	12520	1.9%
15- Arterial Road	283	0.00%	288	0.0%	288	0.0%
16-Roundabout AB	24446	2.00%	25352	2.0%	26099	1.9%
17-Roundabout BC	24294	2.00%	25194	2.0%	25790	2.0%
18 Roundabout CD	23056	2.00%	23910	2.0%	24466	2.0%
19 Roundabout DA	24837	2.00%	25757	2.0%	26498	1.9%
22 AccessS	0	0.00%	0	0.0%	1337	0.0%
23 AccessN	0	0.00%	0	0.0%	1337	0.0%

D.5 Windrose



2019 Windrose for Southend Meteorological Station

Appendix E Model Verification

NO_2

Most NO_2 is produced in the atmosphere by the reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emission of nitrogen oxides (NO_x = NO + NO_2). The model has been run to predict the 2019 annual mean road-NO_x contribution at four monitoring locations (identified in **Table 4-1).** Concentrations have been modelled at a height of 3 m for CP18 and CP21, 2 m for CP19 and 2.5 m for CP27.

A primary adjustment factor of **2.86** has been determined as the slope of the best fit line between the modelled road NO_x contribution and the 'measured' road-NO_x (which is calculated from the measured and background NO_2 concentrations within DEFRA's NO_x from NO_2 calculator (DEFRA, 2019e)), forced through zero (**Figure E-1**). This factor has then been applied to the raw modelled road-NO_x concentration to provide adjusted modelled road-NO_x concentrations.

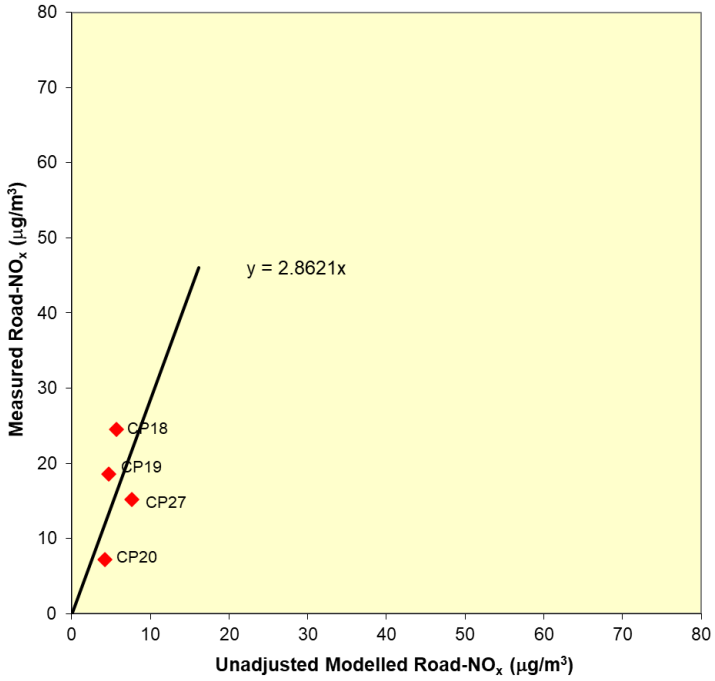


Figure E-1 Measured and Unadjusted Road-NO_x Comparison

The total NO_2 concentrations have then been determined by combining the adjusted modelled road-NO_x concentrations with the background NO_2 concentration within DEFRA's NO_x from NO_2 calculator (DEFRA, 2019e). A secondary adjustment factor of **1.0** has then been calculated as the slope of the best fit line applied to the adjusted data and forced through zero (**Figure E-2**).

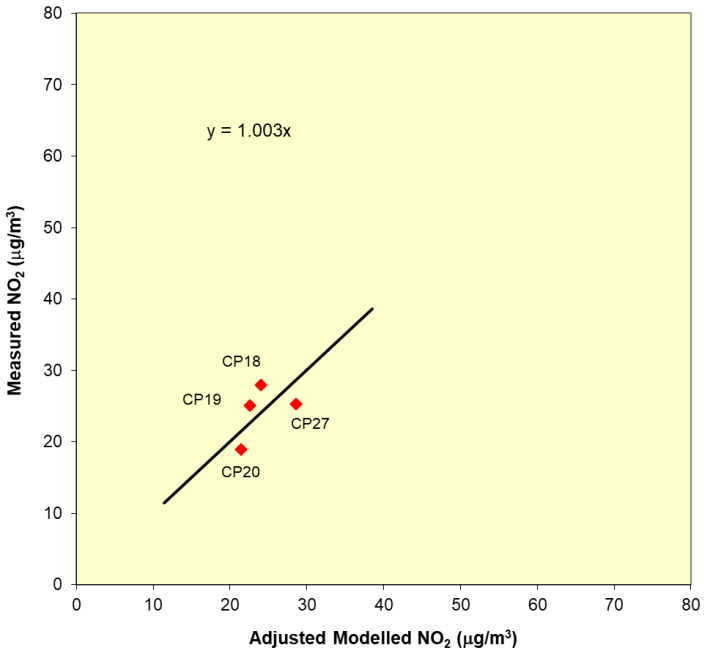


Figure E-2 Measured and Primary Adjusted Modelled NO_2 Comparison

Figure E-3 compares final adjusted modelled total NO_2 at each of the monitoring sites, to measured total NO_x and shows the 1:1 relationship, as well as ±10% and ±25% of the 1:1 line.

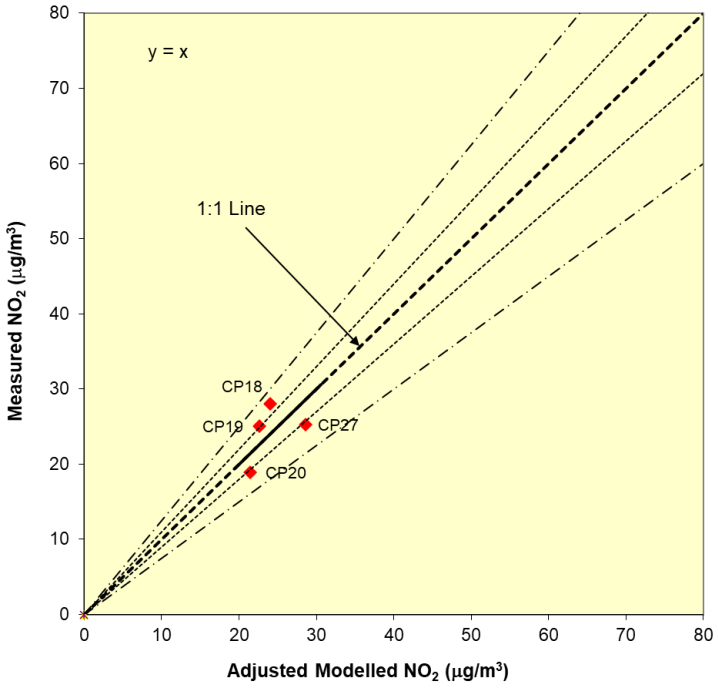


Figure E-3 Measured and Final Adjusted Modelled NO_2 Comparison

The calculated adjustment factors imply that overall, the model has under-predicted the road-NO_x contribution. This is a common experience with this and most other models. The calculated Root Mean

Square Error (RMSE) for this verification (3.1 µg/m^3) lies within the range considered to be good by DEFRA (DEFRA, 2022) (0 – 4 µg/m^3).

PM_{10} and $PM_{2.5}$

There is no monitoring of PM_{10} or $PM_{2.5}$ concentrations undertaken in close proximity to the Site. Therefore, the adjustment factor calculated of NO_2 has been applied to the modelled road-PM_{10} and road-$PM_{2.5}$ concentrations.

Appendix F Ecological Receptor Results

Table F-1 Predicted Annual Mean NO_x Concentrations at Ecological Receptor Locations

Receptor	Designated Site	Critical Level	Background (µg/m³)		Road Contribution (µg/m³)					Total Concentration (µg/m³)		
			Base Year	Future Year	Base Year	Future Year - DM	Future year - DS	Absolute Change	Change as % of Critical Level	Base Year	Future Year - DM	Future year DS
ECO1_000m	Thundersley Great Common SSSI	30	24.5	23.4	5.6	3.9	3.9	0.1	0.3%	**30.1**	27.3	27.4
ECO1_005m	Thundersley Great Common SSSI	30	24.5	23.4	5.5	3.7	3.8	0.1	0.3%	30.0	27.2	27.3
ECO1_010m	Thundersley Great Common SSSI	30	24.5	23.4	5.3	3.6	3.7	0.1	0.3%	29.8	27.1	27.2
ECO1_015m	Thundersley Great Common SSSI	30	24.5	23.4	5.2	3.5	3.6	0.1	0.3%	29.7	27.0	27.1
ECO1_020m	Thundersley Great Common SSSI	30	24.5	23.4	5.1	3.5	3.5	0.1	0.2%	29.5	26.9	27.0
ECO1_030m	Thundersley Great Common SSSI	30	24.5	23.4	4.8	3.3	3.4	0.1	0.2%	29.3	26.7	26.8
ECO1_040m	Thundersley Great Common SSSI	30	24.5	23.4	4.6	3.2	3.2	0.1	0.2%	29.1	26.6	26.7
ECO1_050m	Thundersley Great Common SSSI	30	24.5	23.4	4.4	3.0	3.1	0.1	0.2%	28.9	26.5	26.5
ECO1_075m	Thundersley Great Common SSSI	30	24.5	23.4	4.1	2.8	2.9	0.1	0.2%	28.5	26.2	26.3
ECO1_100m	Thundersley Great Common SSSI	30	24.5	23.4	3.8	2.6	2.7	0.1	0.2%	28.3	26.0	26.1
ECO1_125m	Thundersley Great Common SSSI	30	24.5	23.4	3.6	2.4	2.5	0.1	0.2%	28.1	25.9	26.0
ECO2_000m	Thundersley Great Common SSSI	30	24.5	23.4	4.0	2.8	2.8	0.1	0.3%	28.5	26.2	26.3
ECO2_005m	Thundersley Great Common SSSI	30	24.5	23.4	3.9	2.7	2.8	0.1	0.3%	28.4	26.1	26.2
ECO2_010m	Thundersley Great Common SSSI	30	24.5	23.4	3.9	2.7	2.7	0.1	0.3%	28.4	26.1	26.2
ECO2_015m	Thundersley Great Common SSSI	30	24.5	23.4	3.8	2.6	2.7	0.1	0.3%	28.3	26.0	26.1
ECO2_020m	Thundersley Great Common SSSI	30	24.5	23.4	3.7	2.6	2.6	0.1	0.3%	28.2	26.0	26.1
ECO2_030m	Thundersley Great Common SSSI	30	24.5	23.4	3.6	2.5	2.6	0.1	0.2%	28.1	25.9	26.0
ECO2_040m	Thundersley Great Common SSSI	30	24.5	23.4	3.5	2.4	2.5	0.1	0.2%	28.0	25.8	25.9
ECO2_050m	Thundersley Great Common SSSI	30	24.5	23.4	3.4	2.3	2.4	0.1	0.2%	27.9	25.8	25.8
ECO2_075m	Thundersley Great Common SSSI	30	24.5	23.4	3.2	2.2	2.2	0.1	0.2%	27.6	25.6	25.7
ECO2_100m	Thundersley Great Common SSSI	30	24.5	23.4	2.9	2.0	2.1	0.1	0.2%	27.4	25.5	25.5
ECO2_125m	Thundersley Great Common SSSI	30	24.5	23.4	2.8	1.9	1.9	0.1	0.2%	27.2	25.3	25.4
ECO2_150m	Thundersley Great Common SSSI	30	24.5	23.4	2.6	1.8	1.8	0.0	0.2%	27.1	25.2	25.3

Receptor	Designated Site	Critical Level	Background (µg/m³)		Road Contribution (µg/m³)					Total Concentration (µg/m³)		
			Base Year	Future Year	Base Year	Future Year - DM	Future year - DS	Absolute Change	Change as % of Critical Level	Base Year	Future Year - DM	Future year DS
ECO2_175m	Thundersley Great Common SSSI	30	24.5	23.4	2.4	1.7	1.7	0.0	0.1%	26.9	25.1	25.1
ECO2_200m	Thundersley Great Common SSSI	30	24.5	23.4	2.3	1.6	1.6	0.0	0.1%	26.8	25.0	25.0
ECO3_000m	Garrold's Meadow SSSI	30	20.5	19.6	6.5	4.5	4.5	0.0	0.1%	27.0	24.1	24.1
ECO3_005m	Garrold's Meadow SSSI	30	20.5	19.6	6.2	4.2	4.3	0.0	0.1%	26.7	23.9	23.9
ECO3_010m	Garrold's Meadow SSSI	30	20.5	19.6	5.9	4.0	4.1	0.0	0.1%	26.4	23.7	23.7
ECO3_015m	Garrold's Meadow SSSI	30	20.5	19.6	5.6	3.8	3.9	0.0	0.1%	26.1	23.5	23.5
ECO3_020m	Garrold's Meadow SSSI	30	20.5	19.6	5.4	3.7	3.7	0.0	0.1%	25.8	23.3	23.3
ECO3_030m	Garrold's Meadow SSSI	30	20.5	19.6	4.9	3.4	3.4	0.0	0.1%	25.4	23.0	23.0
ECO3_040m	Garrold's Meadow SSSI	30	20.5	19.6	4.5	3.1	3.1	0.0	0.1%	25.0	22.7	22.8
ECO3_050m	Garrold's Meadow SSSI	30	20.5	19.6	4.2	2.9	2.9	0.0	0.1%	24.7	22.5	22.5
ECO3_075m	Garrold's Meadow SSSI	30	20.5	19.6	3.5	2.4	2.4	0.0	0.1%	24.0	22.0	22.1
ECO3_100m	Garrold's Meadow SSSI	30	20.5	19.6	3.0	2.1	2.1	0.0	0.1%	23.5	21.7	21.7
ECO3_125m	Garrold's Meadow SSSI	30	20.5	19.6	2.7	1.8	1.8	0.0	0.1%	23.1	21.4	21.5
ECO3_150m	Garrold's Meadow SSSI	30	20.5	19.6	2.3	1.6	1.6	0.0	0.1%	22.8	21.2	21.2
ECO3_175m	Garrold's Meadow SSSI	30	20.5	19.6	2.1	1.4	1.4	0.0	0.1%	22.6	21.1	21.1
ECO3_200m	Garrold's Meadow SSSI	30	20.5	19.6	1.9	1.3	1.3	0.0	0.0%	22.4	20.9	20.9

Exceedances of the critical level are highlighted in bold.

Table F-2 Predicted 24-hour Mean NO_x Concentrations at Ecological Receptor Locations

Receptor	Designated Site	Critical Level	Background (µg/m³)		Road Contribution (µg/m³)					Total Concentration (µg/m³)		
			Base Year	Future Year	Base Year	Future Year - DM	Future year - DS	Absolute Change	Change as % of Critical Level	Base Year	Future Year - DM	Future year DS
ECO1_000m	Thundersley Great Common SSSI	75	49.0	46.9	25.8	17.6	18.0	0.3	0.4%	74.8	64.5	64.8
ECO1_005m	Thundersley Great Common SSSI	75	49.0	46.9	25.3	17.3	17.6	0.3	0.4%	74.3	64.2	64.5
ECO1_010m	Thundersley Great Common SSSI	75	49.0	46.9	24.8	17.0	17.3	0.3	0.4%	73.8	63.9	64.2
ECO1_015m	Thundersley Great Common SSSI	75	49.0	46.9	24.4	16.7	17.0	0.3	0.4%	73.4	63.6	63.9
ECO1_020m	Thundersley Great Common SSSI	75	49.0	46.9	24.0	16.4	16.7	0.3	0.4%	73.0	63.3	63.6
ECO1_030m	Thundersley Great Common SSSI	75	49.0	46.9	23.3	15.9	16.2	0.3	0.4%	72.2	62.8	63.1
ECO1_040m	Thundersley Great Common SSSI	75	49.0	46.9	22.6	15.5	15.8	0.3	0.4%	71.6	62.4	62.7
ECO1_050m	Thundersley Great Common SSSI	75	49.0	46.9	22.1	15.1	15.4	0.3	0.4%	71.1	62.0	62.3
ECO1_075m	Thundersley Great Common SSSI	75	49.0	46.9	21.0	14.4	14.7	0.3	0.4%	70.0	61.3	61.6
ECO1_100m	Thundersley Great Common SSSI	75	49.0	46.9	20.3	13.9	14.2	0.3	0.5%	69.2	60.8	61.1
ECO1_125m	Thundersley Great Common SSSI	75	49.0	46.9	19.7	13.5	13.9	0.4	0.5%	68.7	60.4	60.7
ECO2_000m	Thundersley Great Common SSSI	75	49.0	46.9	22.1	15.1	15.6	0.4	0.6%	71.0	62.0	62.5
ECO2_005m	Thundersley Great Common SSSI	75	49.0	46.9	21.7	14.9	15.3	0.4	0.6%	70.7	61.8	62.2
ECO2_010m	Thundersley Great Common SSSI	75	49.0	46.9	21.4	14.6	15.1	0.4	0.6%	70.3	61.5	61.9
ECO2_015m	Thundersley Great Common SSSI	75	49.0	46.9	21.0	14.4	14.8	0.4	0.5%	70.0	61.3	61.7
ECO2_020m	Thundersley Great Common SSSI	75	49.0	46.9	20.7	14.2	14.6	0.4	0.5%	69.7	61.1	61.5
ECO2_030m	Thundersley Great Common SSSI	75	49.0	46.9	20.1	13.8	14.2	0.4	0.5%	69.1	60.7	61.0
ECO2_040m	Thundersley Great Common SSSI	75	49.0	46.9	19.5	13.4	13.8	0.4	0.5%	68.5	60.3	60.6
ECO2_050m	Thundersley Great Common SSSI	75	49.0	46.9	19.0	13.0	13.4	0.4	0.5%	68.0	59.9	60.3
ECO2_075m	Thundersley Great Common SSSI	75	49.0	46.9	17.9	12.3	12.6	0.3	0.4%	66.9	59.2	59.5
ECO2_100m	Thundersley Great Common SSSI	75	49.0	46.9	17.0	11.6	11.9	0.3	0.4%	66.0	58.5	58.8
ECO2_125m	Thundersley Great Common SSSI	75	49.0	46.9	16.3	11.1	11.4	0.3	0.4%	65.2	58.0	58.3
ECO2_150m	Thundersley Great Common SSSI	75	49.0	46.9	15.7	10.7	10.9	0.3	0.3%	64.6	57.6	57.8
ECO2_175m	Thundersley Great Common SSSI	75	49.0	46.9	15.1	10.3	10.6	0.2	0.3%	64.1	57.2	57.4
ECO2_200m	Thundersley Great Common SSSI	75	49.0	46.9	14.7	10.0	10.2	0.2	0.3%	63.7	56.9	57.1
ECO3_000m	Garrold's Meadow SSSI	75	40.9	39.3	35.0	24.1	24.3	0.2	0.2%	**76.0**	63.4	63.6

Receptor	Designated Site	Critical Level	Background (µg/m³)		Road Contribution (µg/m³)					Total Concentration (µg/m³)		
			Base Year	Future Year	Base Year	Future Year - DM	Future year - DS	Absolute Change	Change as % of Critical Level	Base Year	Future Year - DM	Future year DS
ECO3_005m	Garrold's Meadow SSSI	75	40.9	39.3	33.4	23.0	23.2	0.2	0.2%	74.4	62.3	62.4
ECO3_010m	Garrold's Meadow SSSI	75	40.9	39.3	32.0	22.0	22.2	0.2	0.2%	72.9	61.3	61.4
ECO3_015m	Garrold's Meadow SSSI	75	40.9	39.3	30.6	21.1	21.2	0.2	0.2%	71.5	60.3	60.5
ECO3_020m	Garrold's Meadow SSSI	75	40.9	39.3	29.3	20.2	20.3	0.2	0.2%	70.3	59.4	59.6
ECO3_030m	Garrold's Meadow SSSI	75	40.9	39.3	27.1	18.6	18.8	0.1	0.2%	68.0	57.9	58.0
ECO3_040m	Garrold's Meadow SSSI	75	40.9	39.3	25.1	17.3	17.4	0.1	0.2%	66.0	56.5	56.7
ECO3_050m	Garrold's Meadow SSSI	75	40.9	39.3	23.4	16.1	16.2	0.1	0.2%	64.3	55.3	55.5
ECO3_075m	Garrold's Meadow SSSI	75	40.9	39.3	19.8	13.6	13.7	0.1	0.1%	60.8	52.9	53.0
ECO3_100m	Garrold's Meadow SSSI	75	40.9	39.3	17.1	11.7	11.8	0.1	0.1%	58.0	51.0	51.1
ECO3_125m	Garrold's Meadow SSSI	75	40.9	39.3	15.2	10.4	10.5	0.1	0.1%	56.1	49.7	49.8
ECO3_150m	Garrold's Meadow SSSI	75	40.9	39.3	13.7	9.4	9.5	0.1	0.1%	54.6	48.6	48.7
ECO3_175m	Garrold's Meadow SSSI	75	40.9	39.3	12.4	8.5	8.6	0.1	0.1%	53.4	47.8	47.9
ECO3_200m	Garrold's Meadow SSSI	75	40.9	39.3	11.4	7.8	7.9	0.1	0.1%	52.3	47.1	47.1

Exceedances of the critical level are highlighted in bold.

Table F-3 Predicted Annual Mean NH_3 Concentrations at Ecological Receptor Locations

Receptor	Designated Site	Critical Level	Background (µg/m³)		Road Contribution (µg/m³)					Total Concentration (µg/m³)		
			Base Year	Future Year	Base Year	Future Year - DM	Future year - DS	Absolute Change	Change as % of Critical Level	Base Year	Future Year - DM	Future year DS
ECO1_000m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.2	0.2	0.2	0.0	0.3%	**1.8**	**1.6**	**1.6**
ECO1_005m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.2	0.2	0.0	0.3%	**1.8**	**1.6**	**1.6**
ECO1_010m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.2	0.2	0.0	0.3%	**1.8**	**1.6**	**1.6**
ECO1_015m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.2	0.2	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO1_020m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.2	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO1_030m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO1_040m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO1_050m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO1_075m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO1_100m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO1_125m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO2_000m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO2_005m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO2_010m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO2_015m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO2_020m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO2_030m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO2_040m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.3%	**1.7**	**1.6**	**1.6**
ECO2_050m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.2%	**1.7**	**1.6**	**1.6**
ECO2_075m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.2%	**1.7**	**1.6**	**1.6**
ECO2_100m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.2%	**1.7**	**1.6**	**1.6**
ECO2_125m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.2%	**1.7**	**1.6**	**1.6**
ECO2_150m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.2%	**1.7**	**1.6**	**1.6**
ECO2_175m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.2%	**1.7**	**1.5**	**1.5**
ECO2_200m	Thundersley Great Common SSSI	1	**1.6**	**1.5**	0.1	0.1	0.1	0.0	0.2%	**1.7**	**1.5**	**1.5**
ECO3_000m	Garrold's Meadow SSSI	3	1.6	1.5	0.2	0.2	0.2	0.0	0.1%	1.8	1.7	1.7

Receptor	Designated Site	Critical Level	Background (µg/m³)		Road Contribution (µg/m³)					Total Concentration (µg/m³)		
			Base Year	Future Year	Base Year	Future Year - DM	Future year - DS	Absolute Change	Change as % of Critical Level	Base Year	Future Year - DM	Future year DS
ECO3_005m	Garrold's Meadow SSSI	3	1.6	1.5	0.2	0.2	0.2	0.0	0.1%	1.8	1.7	1.7
ECO3_010m	Garrold's Meadow SSSI	3	1.6	1.5	0.2	0.2	0.2	0.0	0.1%	1.8	1.6	1.6
ECO3_015m	Garrold's Meadow SSSI	3	1.6	1.5	0.2	0.2	0.2	0.0	0.1%	1.7	1.6	1.6
ECO3_020m	Garrold's Meadow SSSI	3	1.6	1.5	0.2	0.2	0.2	0.0	0.0%	1.7	1.6	1.6
ECO3_030m	Garrold's Meadow SSSI	3	1.6	1.5	0.1	0.2	0.2	0.0	0.0%	1.7	1.6	1.6
ECO3_040m	Garrold's Meadow SSSI	3	1.6	1.5	0.1	0.1	0.1	0.0	0.0%	1.7	1.6	1.6
ECO3_050m	Garrold's Meadow SSSI	3	1.6	1.5	0.1	0.1	0.1	0.0	0.0%	1.7	1.6	1.6
ECO3_075m	Garrold's Meadow SSSI	3	1.6	1.5	0.1	0.1	0.1	0.0	0.0%	1.7	1.6	1.6
ECO3_100m	Garrold's Meadow SSSI	3	1.6	1.5	0.1	0.1	0.1	0.0	0.0%	1.7	1.5	1.6
ECO3_125m	Garrold's Meadow SSSI	3	1.6	1.5	0.1	0.1	0.1	0.0	0.0%	1.7	1.5	1.5
ECO3_150m	Garrold's Meadow SSSI	3	1.6	1.5	0.1	0.1	0.1	0.0	0.0%	1.6	1.5	1.5
ECO3_175m	Garrold's Meadow SSSI	3	1.6	1.5	0.1	0.1	0.1	0.0	0.0%	1.6	1.5	1.5
ECO3_200m	Garrold's Meadow SSSI	3	1.6	1.5	0.1	0.1	0.1	0.0	0.0%	1.6	1.5	1.5

Exceedances of the critical level are highlighted in bold.

Table F-4 Predicted Annual Nitrogen Deposition at Ecological Receptor Locations

Receptor	Designated Site	Critical Load	Background (kgN/ha/yr)		Road Contribution (kgN/ha/yr)					Total Deposition (kgN/ha/yr)		
			Base Year	Future Year	Base Year	Future Year - DM	Future year - DS	Absolute Change	Change as % of Critical Load	Base Year	Future Year - DM	Future year DS
ECO1_000m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	1.2	1.2	1.2	0.0	0.3%	**16.2**	**15.0**	**15.0**
ECO1_005m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	1.2	1.1	1.2	0.0	0.3%	**16.2**	**14.9**	**14.9**
ECO1_010m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	1.2	1.1	1.1	0.0	0.3%	**16.2**	**14.9**	**14.9**
ECO1_015m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	1.1	1.1	1.1	0.0	0.3%	**16.1**	**14.9**	**14.9**
ECO1_020m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	1.1	1.0	1.1	0.0	0.3%	**16.1**	**14.8**	**14.8**
ECO1_030m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	1.0	1.0	1.0	0.0	0.3%	**16.0**	**14.8**	**14.8**
ECO1_040m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	1.0	0.9	1.0	0.0	0.2%	**16.0**	**14.7**	**14.7**
ECO1_050m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.9	0.9	0.9	0.0	0.2%	**15.9**	**14.7**	**14.7**
ECO1_075m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.9	0.8	0.8	0.0	0.2%	**15.9**	**14.6**	**14.6**
ECO1_100m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.8	0.8	0.8	0.0	0.2%	**15.8**	**14.5**	**14.6**
ECO1_125m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.7	0.7	0.7	0.0	0.2%	**15.7**	**14.5**	**14.5**
ECO2_000m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.8	0.8	0.8	0.0	0.3%	**15.8**	**14.6**	**14.6**
ECO2_005m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.8	0.8	0.8	0.0	0.3%	**15.8**	**14.6**	**14.6**
ECO2_010m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.8	0.8	0.8	0.0	0.3%	**15.8**	**14.5**	**14.6**
ECO2_015m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.8	0.7	0.8	0.0	0.3%	**15.8**	**14.5**	**14.6**
ECO2_020m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.8	0.7	0.8	0.0	0.3%	**15.8**	**14.5**	**14.5**
ECO2_030m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.8	0.7	0.7	0.0	0.2%	**15.8**	**14.5**	**14.5**
ECO2_040m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.7	0.7	0.7	0.0	0.2%	**15.7**	**14.5**	**14.5**
ECO2_050m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.7	0.7	0.7	0.0	0.2%	**15.7**	**14.5**	**14.5**
ECO2_075m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.7	0.6	0.6	0.0	0.2%	**15.7**	**14.4**	**14.4**
ECO2_100m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.6	0.6	0.6	0.0	0.2%	**15.6**	**14.4**	**14.4**
ECO2_125m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.6	0.6	0.6	0.0	0.2%	**15.6**	**14.3**	**14.4**
ECO2_150m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.5	0.5	0.5	0.0	0.2%	**15.5**	**14.3**	**14.3**
ECO2_175m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.5	0.5	0.5	0.0	0.1%	**15.5**	**14.3**	**14.3**
ECO2_200m	Thundersley Great Common SSSI	8	**15.0**	**13.8**	0.5	0.5	0.5	0.0	0.1%	**15.5**	**14.2**	**14.3**
ECO3_000m	Garrold's Meadow SSSI	20	15.3	14.1	1.5	1.4	1.5	0.0	0.1%	16.8	15.5	15.5

Receptor	Designated Site	Critical Load	Background (kgN/ha/yr)		Road Contribution (kgN/ha/yr)					Total Deposition (kgN/ha/yr)		
			Base Year	Future Year	Base Year	Future Year - DM	Future year - DS	Absolute Change	Change as % of Critical Load	Base Year	Future Year - DM	Future year DS
ECO3_005m	Garrold's Meadow SSSI	20	15.3	14.1	1.4	1.4	1.4	0.0	0.1%	16.7	15.4	15.4
ECO3_010m	Garrold's Meadow SSSI	20	15.3	14.1	1.4	1.3	1.3	0.0	0.1%	16.7	15.4	15.4
ECO3_015m	Garrold's Meadow SSSI	20	15.3	14.1	1.3	1.2	1.3	0.0	0.1%	16.6	15.3	15.3
ECO3_020m	Garrold's Meadow SSSI	20	15.3	14.1	1.2	1.2	1.2	0.0	0.0%	16.5	15.2	15.3
ECO3_030m	Garrold's Meadow SSSI	20	15.3	14.1	1.1	1.1	1.1	0.0	0.0%	16.4	15.1	15.2
ECO3_040m	Garrold's Meadow SSSI	20	15.3	14.1	1.0	1.0	1.0	0.0	0.0%	16.3	15.1	15.1
ECO3_050m	Garrold's Meadow SSSI	20	15.3	14.1	1.0	0.9	0.9	0.0	0.0%	16.3	15.0	15.0
ECO3_075m	Garrold's Meadow SSSI	20	15.3	14.1	0.8	0.8	0.8	0.0	0.0%	16.1	14.8	14.8
ECO3_100m	Garrold's Meadow SSSI	20	15.3	14.1	0.7	0.7	0.7	0.0	0.0%	16.0	14.7	14.7
ECO3_125m	Garrold's Meadow SSSI	20	15.3	14.1	0.6	0.6	0.6	0.0	0.0%	15.9	14.6	14.7
ECO3_150m	Garrold's Meadow SSSI	20	15.3	14.1	0.5	0.5	0.5	0.0	0.0%	15.8	14.6	14.6
ECO3_175m	Garrold's Meadow SSSI	20	15.3	14.1	0.5	0.5	0.5	0.0	0.0%	15.8	14.5	14.5
ECO3_200m	Garrold's Meadow SSSI	20	15.3	14.1	0.4	0.4	0.4	0.0	0.0%	15.7	14.5	14.5

Exceedances of the critical load are highlighted in bold.

Table F-5 Predicted Annual Acid Deposition at Ecological Receptor Locations

Receptor	Designated Site	Critical Load (Min CLMaxN)	Background (keq/ha/yr)		Road Contribution (keq/ha/yr)					Total Deposition (keq/ha/yr)		
			Base Year	Future Year	Base Year	Future Year - DM	Future year - DS	Absolute Change	Change as % of Critical Load	Base Year	Future Year - DM	Future year DS
ECO1_000m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.09	0.08	0.08	0.00	0.1%	**1.29**	**1.19**	**1.20**
ECO1_005m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.08	0.08	0.08	0.00	0.1%	**1.28**	**1.19**	**1.19**
ECO1_010m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.08	0.08	0.08	0.00	0.1%	**1.28**	**1.19**	**1.19**
ECO1_015m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.08	0.08	0.08	0.00	0.1%	**1.28**	**1.19**	**1.19**
ECO1_020m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.08	0.07	0.08	0.00	0.1%	**1.28**	**1.19**	**1.19**
ECO1_030m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.07	0.07	0.07	0.00	0.1%	**1.27**	**1.18**	**1.18**
ECO1_040m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.07	0.07	0.07	0.00	0.1%	**1.27**	**1.18**	**1.18**
ECO1_050m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.07	0.06	0.07	0.00	0.1%	**1.27**	**1.18**	**1.18**
ECO1_075m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.06	0.06	0.06	0.00	0.1%	**1.26**	**1.17**	**1.17**
ECO1_100m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.06	0.05	0.06	0.00	0.1%	**1.26**	**1.16**	**1.17**
ECO1_125m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.05	0.05	0.05	0.00	0.1%	**1.25**	**1.16**	**1.16**
ECO2_000m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.06	0.06	0.06	0.00	0.1%	**1.26**	**1.17**	**1.17**
ECO2_005m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.06	0.05	0.06	0.00	0.1%	**1.26**	**1.17**	**1.17**
ECO2_010m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.06	0.05	0.06	0.00	0.1%	**1.26**	**1.17**	**1.17**
ECO2_015m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.06	0.05	0.05	0.00	0.1%	**1.26**	**1.16**	**1.17**
ECO2_020m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.06	0.05	0.05	0.00	0.1%	**1.26**	**1.16**	**1.16**
ECO2_030m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.05	0.05	0.05	0.00	0.1%	**1.25**	**1.16**	**1.16**
ECO2_040m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.05	0.05	0.05	0.00	0.1%	**1.25**	**1.16**	**1.16**
ECO2_050m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.05	0.05	0.05	0.00	0.1%	**1.25**	**1.16**	**1.16**
ECO2_075m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.05	0.04	0.05	0.00	0.1%	**1.25**	**1.16**	**1.16**
ECO2_100m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.04	0.04	0.04	0.00	0.1%	**1.24**	**1.15**	**1.15**
ECO2_125m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.04	0.04	0.04	0.00	0.1%	**1.24**	**1.15**	**1.15**
ECO2_150m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.04	0.04	0.04	0.00	0.1%	**1.24**	**1.15**	**1.15**
ECO2_175m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.04	0.03	0.04	0.00	0.1%	**1.24**	**1.15**	**1.15**
ECO2_200m	Thundersley Great Common SSSI	1.1	**1.20**	**1.11**	0.03	0.03	0.03	0.00	0.1%	**1.23**	**1.14**	**1.14**
ECO3_000m	Garrold's Meadow SSSI	1.1	**1.20**	**1.11**	0.11	0.10	0.10	0.00	0.1%	**1.31**	**1.21**	**1.21**

Receptor	Designated Site	Critical Load (Min CLMaxN)	Background (keq/ha/yr)		Road Contribution (keq/ha/yr)					Total Deposition (keq/ha/yr)		
			Base Year	Future Year	Base Year	Future Year - DM	Future year - DS	Absolute Change	Change as % of Critical Load	Base Year	Future Year - DM	Future year DS
ECO3_005m	Garrold's Meadow SSSI	1.1	**1.20**	**1.11**	0.10	0.10	0.10	0.00	0.1%	**1.30**	**1.21**	**1.21**
ECO3_010m	Garrold's Meadow SSSI	1.1	**1.20**	**1.11**	0.10	0.09	0.09	0.00	0.1%	**1.30**	**1.20**	**1.20**
ECO3_015m	Garrold's Meadow SSSI	1.1	**1.20**	**1.11**	0.09	0.09	0.09	0.00	0.1%	**1.29**	**1.20**	**1.20**
ECO3_020m	Garrold's Meadow SSSI	1.1	**1.20**	**1.11**	0.09	0.08	0.09	0.00	0.1%	**1.29**	**1.20**	**1.20**
ECO3_030m	Garrold's Meadow SSSI	1.1	**1.20**	**1.11**	0.08	0.08	0.08	0.00	0.1%	**1.28**	**1.19**	**1.19**
ECO3_040m	Garrold's Meadow SSSI	1.1	**1.20**	**1.11**	0.07	0.07	0.07	0.00	0.1%	**1.27**	**1.18**	**1.18**
ECO3_050m	Garrold's Meadow SSSI	1.1	**1.20**	**1.11**	0.07	0.07	0.07	0.00	0.1%	**1.27**	**1.18**	**1.18**
ECO3_075m	Garrold's Meadow SSSI	1.1	**1.20**	**1.11**	0.06	0.06	0.06	0.00	0.0%	**1.26**	**1.17**	**1.17**
ECO3_100m	Garrold's Meadow SSSI	1.1	**1.20**	**1.11**	0.05	0.05	0.05	0.00	0.0%	**1.25**	**1.16**	**1.16**
ECO3_125m	Garrold's Meadow SSSI	1.1	**1.20**	**1.11**	0.04	0.04	0.04	0.00	0.0%	**1.24**	**1.15**	**1.15**
ECO3_150m	Garrold's Meadow SSSI	1.1	**1.20**	**1.11**	0.04	0.04	0.04	0.00	0.0%	**1.24**	**1.15**	**1.15**
ECO3_175m	Garrold's Meadow SSSI	1.1	**1.20**	**1.11**	0.03	0.03	0.03	0.00	0.0%	**1.23**	**1.14**	**1.14**
ECO3_200m	Garrold's Meadow SSSI	1.1	**1.20**	**1.11**	0.03	0.03	0.03	0.00	0.0%	**1.23**	**1.14**	**1.14**

Exceedances of the critical load are highlighted in bold.

Appendix G Figures

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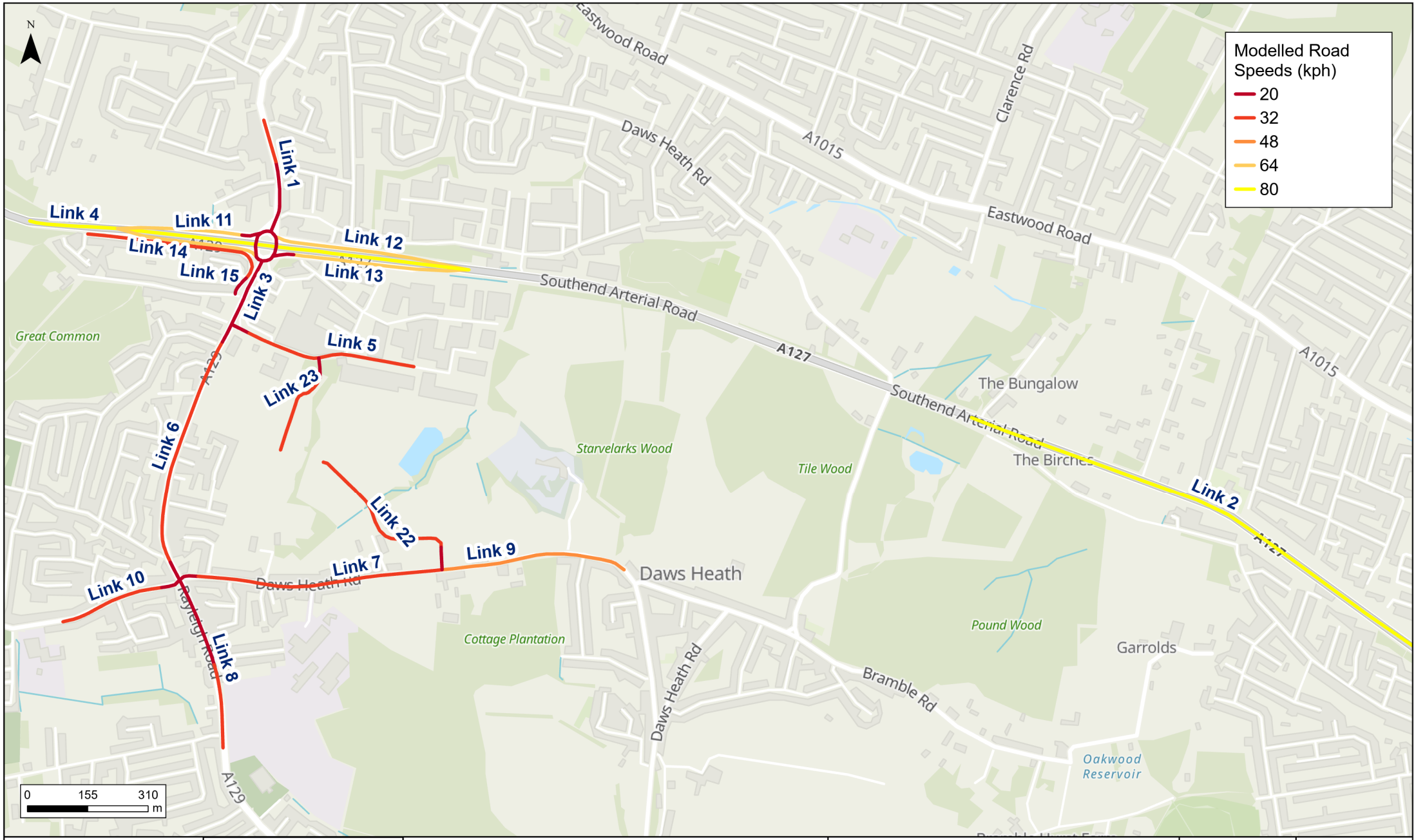

Stantec	**This Land Development Limited**	**Land East of Rayleigh Road** Modelled Roads	GB Topographic: Contains OS data © Crown Copyright and database right 2022 Contains data from OS Zoomstack	1:12,500 @ A4	Date: 10/11/2022
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				Figure 1	Rev A

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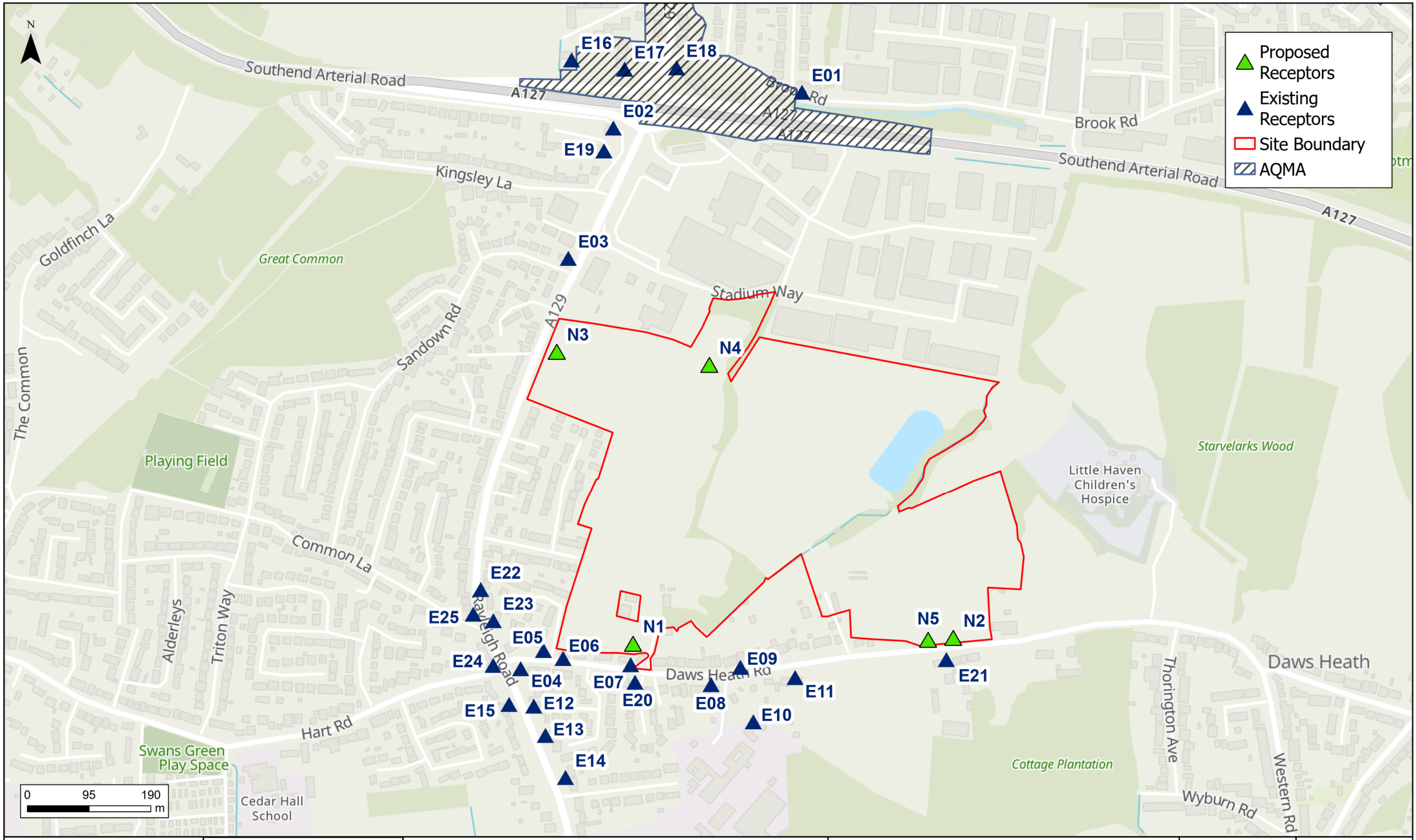

Stantec	This Land Development Limited	**Land East of Rayleigh Road** Modelled Existing and Proposed Human Receptor Locations	GB Topographic: Contains OS data © Crown Copyright and database right 2022 Contains data from OS Zoomstack	1:7,500 @ A4	Date: 10/11/2022
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				Figure 2	Rev B

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				Figure 3	Rev B

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Land East of Rayleigh Road

Air Quality Monitoring Locations

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Figure 4	Rev A