LAND AT DEAL GROUND AND MAY GURNEY

Environmental Statement Addendum – Chapter 11: Air Quality

Serruys Property Company Limited

Version No: Final
June 2023

CONTENTS

TABLES

11 AIR QUALITY

11.1 INTRODUCTION

This chapter of the Environmental Statement Addendum (ESA) considers the likely significant effects associated with the Proposed Development on air quality in consideration of construction and operational impacts, and is supported by Air Quality Technical Appendix 11.1.

An Environmental Statement (ES) was originally prepared in November 2010 for planning application reference 12/00875/O[1]. The original ES referred to as the "original ES" herein, included Air Quality chapter 12. In summary, all effects on air quality assessed in the original ES were found to be 'not significant'.

This ESA chapter has been prepared to address changes to the Proposed Development and account for updates to guidance, tools used in carrying out the assessment, and baseline air quality since submission of the original ES.

This chapter describes the change in scope, relevant legislation, assessment methodology and the baseline conditions relative to the original Air Quality Chapter to the ES. It then considers any potentially significant environmental affects the Proposed Development may have on the updated baseline environment; the mitigation measures required to prevent, reduce or offset any significant adverse effects; and the likely residual impacts after these measures have been employed. It also considers the suitability of the site for the proposed end-use.

11.2 METHODOLOGY

The Air Quality Chapter has been undertaken within the context of relevant planning policies, guidance documents and legislative instruments. These are summarised below.

11.2.1 Changes in Legislation, Guidance and Planning Policy

11.2.1.1 Legislation

The original ES referred to several legislative documents including the following:

- The Air Quality Standards Regulations 2010[2] - transposed from European Union (EU) Ambient Air Quality Directive (2008/50/EC)[3] and the Fourth Daughter Directive (2004/107/EC)[4];
- The Air Quality (England) Regulations 2000 and Air Quality (England) Amendment Regulations 2002;
- Environmental Protection Act 1990; and
- The Environment Act 1995 (Part IV).

[1] Proposed Redevelopment of Site to provide Mixed Residential/Commercial Development, Environmental Statement, November 2010.
[2] The Air Quality Standards Regulations (England) 2010, Statutory Instrument No 1001, The Stationary Office Limited.
[3] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.
[4] Directive 2004/107/EC of the European Parliament and of the Council of 15 December.

Of the above, and in the interim since the original ES, the AQSR 2010 were amended by the Air Quality Standards (Amendment) Regulation 2016. The amendment does not materially change the assessment methodology or conclusions of the original ES.

The air quality legislation within the original ES, therefore, remains valid. An updated review of relevant legislation to this Air Quality UES, and published in the interim since the original ES, is outlined in the following sections.

11.2.1.1.1 National Obligations

Since the original ES, the UK has withdrawn from the EU. The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020 was introduced to mirror revisions to supporting EU legislation. The fine particulate matter ($PM_{2.5}$) Limit Value is 20µg/m^3 (to be met by 2020), where previously set at 25µg/m^3.

The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023[5] introduced an annual mean concentration target of 10µg/m^3 to be met across England by 2040. Central Government (Department for the Environment Food and Rural Affairs (Defra) and Devolved Administrations) is responsible for meeting this target, however not until 2040. Local Authorities (LA) have no responsibility to achieve this target.

11.2.1.1.2 Local Obligations

As introduced in the original ES, the Air Quality Strategy (AQS) sets objectives adopted into English law via the Air Quality (England) Regulation 2000, and subsequent Air Quality (England) (Amendment) Regulations 2002, to provide the delivery framework for air quality management across England for LA and summarises the air quality standards and objectives operable within England for the protection of public health and the environment. The latest AQS for England was published in 2023[6]. The 2023 AQS does not change the overarching LA requirement / responsibility for air quality management across England.

The ambient air quality standards of relevance to human receptors in this Chapter (collectively termed Air Quality Assessment Levels (AQALs) throughout this report) are as replicated from the original ES, and presented in **Table *11-1***.

for ease of reference. The $PM_{2.5}$ AQSR AQAL has also been included for completeness, to provide an indicative assessment[7].

[5] The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023. UK Statutory Instruments 2023 No. 96.
[6] Air Quality Strategy: Framework for Local Authority Delivery, Defra. April 2023.
[7] Reference should be made to Schedule 1 of The Air Quality Standard Regulations 2010 which outlines siting of sampling point criteria, for locations where the annual mean AQAL applies.

Table 11-1 - Relevant Ambient AQALs

Pollutant	AQAL (µg/m^3)	Averaging Period
Nitrogen Dioxide (NO_2)	40	Annual Mean
	200	1-hour Mean (not to be exceeded on more than 18 occasions per annum)
Particles (as PM_{10})	40	Annual Mean
	50	24-hour mean (not to be exceeded on more than 35 occasions per annum)
Particles (as $PM_{2.5}$)	20	Annual Mean

As per the original ES, the above AQALs apply at locations where members of the public are regularly present and might reasonably be expected to be exposed to pollutant concentrations over the relevant averaging period. This is herein referred to as 'relevant exposure'. Table 11-2 provides an indication of those locations for context, not provided within the original ES.

Table 11-2 - Human Health Relevant Public Exposure

AQAL Averaging Period	AQAL Should Apply At	AQAL Should Not Apply At
Annual Mean	Building facades of residential properties, schools, hospitals etc.	Facades of offices Hotels Gardens of residences Kerbside sites
24-hour mean	As above together with hotels and gardens of residential properties	Kerbside sites where public exposure is expected to be short term
1-hour mean	As above together with kerbside sites of regular access, car parks, bus stations etc.	Kerbside sites where public would not be expected to have regular access

11.2.1.1.3 The Clean Air Strategy

The Clean Air Strategy (CAS)[8] introduced in 2019 sets out the Government's proposals aimed at delivering cleaner air in England, and indicates how devolved administrations intend to make emissions reductions. It sets out the comprehensive action that is required from across all parts of government and society to deliver clean air.

11.2.1.1.4 The 2023 Environment Improvement Plan

The 2023 Environment Improvement Plan[9] introduced in 2023 is the first revision of the UK Government's 25 Year Environment Plan (25YEP) – planned on a five-year rolling cycle. This document sets out the 5-year delivery plan to improve the natural environment. The 2023 Environment Improvement Plan builds on the 2019 Clean Air Strategy by setting environmental targets and commitments to reduce air pollution.

11.2.1.1.5 Protection of Nature Conservation Sites

The original ES did not consider the protection of nature conservation sites, as such the legislative context is summarised herein.

[8] The Clean Air Strategy, Defra. January 2019.
[9] Environmental Improvement Plan 2023, Defra. 2023.

Ecological habitats vary in terms of their sensitivity, perceived ecological value, geographic importance, and level of protection. Within the UK, there are three types of nature conservation designations: international and European designations, national designations, and local designations.

The Conservation of Habitats and Species Regulations 2010[10] (the 'Habitats Regulations'), which transpose the EU Habitats Directive[11] into legislation in the UK, introduces the precautionary principle for protected European sites, i.e. that projects can only be permitted to proceed having ascertained that there will be no adverse effect on the integrity of the designated site. It requires an assessment to determine if significant effects are likely, followed by an 'appropriate assessment' by the competent authority, if necessary.

Similarly, the Countryside and Rights of Way (CROW) Act (2000)[12] provides protection to Sites of Special Scientific Interest (SSSI) to ensure that developments are not likely to cause them damage. This act also provides a protection to local nature conservation sites too, which can be particularly important in providing 'buffers' to SSSIs and European sites.

The Environment Act 1995[13] and the Natural Environment and Rural Communities Act (NERC) 2006[14] provides and extension to the biodiversity duty set out in the Countryside and Rights of Way (CROW) Act to public bodies and statutory undertakers to ensure due regard to the conservation of biodiversity (i.e. ecological designations of local status).

Sites of ecological importance are provided environmental protection with respect to air quality, through the application of standards known as Critical Levels and Critical Loads. The level of protection afforded to an internationally designated site is significantly greater than that afforded to a local nature reserve; reflecting the relative sensitivity of the sites as well as their perceived ecological value.

11.2.1.1.6 Critical Levels

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. Critical Levels for the protection of vegetation and ecosystems apply irrespective of habitat type and are based on the concentration of the relevant pollutants in air, and are defined within the Air Quality Standards Regulations 2010, and subsequent amendments.

The Critical Level of relevance to this Chapter are specified within Table 11.3.

Table 11-3 - Critical Levels of Relevance

Pollutant	Standard (µg/m^3)	Measured As
Oxides of nitrogen (NO_x)	30	Annual Mean

11.2.1.1.7 Critical Loads

Critical Loads are a quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to

[10] UK Government, The Conservation of Habitats and Species Regulations (as amended), 2010.
[11] The Council of the European Communities, The Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora, 1992.
[12] UK Government, Countryside and Rights of Way Act 2000, 2000.
[13] UK Government, Environment Act 1995.
[14] UK Government, Natural Environment and Rural Communities Act 2006.

present knowledge. Critical Loads are set for the deposition of various substances to sensitive ecosystems. In relation to combustion emissions Critical Loads for eutrophication and acidification are relevant, which can occur via both wet and dry deposition; however, on a local scale only dry (direct deposition) is considered significant.

11.2.1.2 Guidance

The original ES referred to several guidance documents including the following:

- Department for Environment, Food and Rural Affairs (Defra): Planning Policy Guidance (PG 03);
- Defra: Planning Policy Guidance Note 13: Transport (PPG 13);
- Defra: Local Air Quality Management Technical Guidance (LAQM.TG(09)); and
- Environmental Protection UK (EPUK): Development Control: Planning for Air Quality (2010 Update).

In the interim, new guidance documents have been introduced which supersede all previous guidance. As such, this UES Chapter has been carried out in accordance with the principles contained within the updated guidance documents listed below:

- Defra: Local Air Quality Management Technical Guidance (LAQM.TG(22)) [15];
    - Defra's LAQM.TG(22) was published for use by local authorities in their LAQM review and assessment work. The document provides key guidance in aspects of air quality assessment, including screening, use of monitoring data, and use of background data that are applicable to all air quality assessments. This document provides an update to LAQM.TG(09) considered within the original ES. It is noted the overarching content of LAQM.TG(22) remains consistent with LAQM.TG(09).
- Defra: COVID-19: Supplementary Guidance. Local Air Quality Management Reporting in 2021[16];
    - Defra's supplementary guidance advises local authorities on the changes and points of references with respect to LAQM duties as a result of impacts from COVID-19 and the associated restrictions on activity.
- Environment Agency (EA): Air Quality Technical Advisory Group (AQTAG) Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air [17];
    - the purpose of this technical guidance document is to assist in carrying out a Stage 3 appropriate assessment of air quality impacts under the Habitats Regulations.
- EPUK & Institute of Air Quality Management (IAQM): Land-use planning and development control Planning for Air Quality[18];
    - EPUK and the IAQM have together published guidance to help ensure that air quality is properly accounted for in the development control process. 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. This

[15] Local Air Quality Management Technical Guidance 22, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland. August 2022.
[16] Defra and the Greater London Authority, COVID-19: Supplementary Guidance. Local Air Quality Management Reporting in 2021. April 2021.
[17] AQTAG06 – Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air. Environment Agency, March 2014 version.
[18] EPUK and IAQM, Land-Use Planning and Development Control: Planning for Air Quality, v1.2 2017.

document provides an update to the EPUK '*Development Control: Planning for Air Quality (2010 Update)*' considered within the original ES. The EPUK & IAQM guidance provides an update guidance method for determination of impacts and effects arising from road traffic emissions.

- Design Manual for Roads and Bridges (DMRB): LA 105[19];
    - The Design Manual for Roads and Bridges (DMRB) LA 105[20] states receptors, including ecological designations, within 200m of an 'affected road' source, require further assessment of potential impacts.
- IAQM: Construction and Demolition Dust Guidance[21];
    - Guidance on the assessment of dust from demolition and construction has been published by the IAQM 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 – A guide to the assessment of air quality impacts on designated nature conservation sites[22];
    - A guide to the assessment of air quality impacts on designated nature conservation sites has been published by the IAQM. This guidance is provided to assist its members in the assessment of the air quality impacts of road traffic emissions from development on designated nature conservation sites. The guidance focuses on air quality assessments in support of Habitats Regulations Assessments, but can also be applied when assessing the air quality impact on national or local designated nature conservation sites.
- Natural England: Natural England's Approach to Advising Competent Authorities on the Assessment of Road Traffic Emissions under the Habitats Regulations (NEA001)[23];
    - Natural England produced this guidance to advise competent authorities and others on the assessment of plans and projects (as required by the Habitats Regulations likely to generate road traffic emissions to air which are capable of affecting European Sites. The principles contained within can be used to assess other designations in lieu of further guidance.

11.2.1.3 Policy

11.2.1.3.1 National Policy

The original ES referenced Planning Policy Statement (PPS) 23: Planning and Pollution Control.

This has since been replaced by the National Planning Policy Framework (NPPF), which was most recently updated in 2021[24]. The NPPF sets out planning policy for England. The NPPF states that the planning system should contribute to and enhance the natural and local environment, by preventing new development from contributing to or being adversely affected by unacceptable concentrations of air

[19] AQTAG06 – Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air. Environment Agency, March 2014 version.
[20] DMRB, LA 105-Air Quality, Highways England, 2019.
[21] IAQM, Guidance on the Assessment Dust from Demolition and Construction, v1.1 2016.
[22] EPUK and IAQM, Land-Use Planning and Development Control: Planning for Air Quality, v1.2 2017.
[23] Natural England, Natural England's Approach to Advising Competent Authorities on the Assessment of Road Traffic Emissions under the Habitats Regulations (NEA001), June 2018.
[24] National Planning Policy Framework (2021). Available at: https://www.gov.uk/government/publications/national-planning-policy-framework--2.

pollution and development should, wherever possible, help to improve local environmental conditions such as air quality.

In specific relation to air quality policy, the NPPF states:

Chapter 15 - Conserving and Enhancing the Natural Environment

> *"Para 186. 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."*

The NPPF is accompanied by web based supporting Planning Practice Guidance (PPG)[25] which includes guiding principles on how planning can take account of the impacts of new development on air quality.

11.2.1.3.2 Local Policy

Norwich City Council (NCC), South Norfolk District Council (SNDC) and Broadland District Council (BDC) comprise the Greater Norwich Development Partnership, which adopted the "Joint Core Strategy (JCS)" in March 2011 (amendments adopted January 2014)[26]. The JCS sets out the overarching strategy for growth across the three districts up until 2026. However, the JCS does not contain any relevant policy specific to air quality.

In addition to the JCS, NCC and SNDC have adopted complimentary documents which compose each of the council's Local Plan. These documents refer to:

- NCC Site Allocations and Site Specific Policies[27];
- NCC Development Management Policies[28]; and
- SNDC Development Management Policies[29].

The air quality policy content of the above Local Plan documents is considered in the following subsections.

11.2.1.3.2.1 NCC Site Allocations and Site Specific Policies

> *"Policy R9: The Deal Ground – residential led mixed use development*
>
> *[…] The development must be designed to mitigate and protect against potential sources of noise and air pollution from adjoining uses, including the industrial and minerals processing uses to the west; […]"*

[25] Planning Practice Guidance Air Quality, Ministry of Housing, Communities and Local Government. November 2019.
[26] Greater Norwich Development Partnership, Joint Core Strategy for Broadland, Norwich and South Norfolk, January 2014.
[27] Norwich Local Plan, Site Allocations and Site Specific Policies, Adopted December 2014.
[28] Norwich Local Plan, Norwich Development Management Policies, Adopted December 2014.
[29] South Norfolk Local Plan, Development Management Policies Document, Adopted October 2015.

11.2.1.3.2.2 NCC Development Management Policies

"Policy DM2: Amenity

Existing occupiers – Development will be permitted where it would not result in an unacceptable impact on the amenity of the area or the living or working conditions or operations of neighbouring occupants. Particular regard will be given to: […]

c) the prevention of disturbance from noise, odour, vibration, air or artificial light pollution.

Future occupiers – Development will only be permitted where:

a) it provides for a high standard of amenity, satisfactory living and working conditions, adequate protection from noise and pollution and adequate levels of light and outlook for future occupiers; […]"

"Policy DM11: Environmental Hazards

[…] Air and Water Quality – In areas where an Air Quality Management Area (AQMA) has been declared (under the Environment Act, 1995), development which is likely to have an impact on air quality will be required to take particular account of the air quality action plan for that area. Where the action plan identifies poor or deteriorating air quality as an issue in localised areas within the AQMA, development will be required to incorporate measures which will mitigate against the effects of existing or potential further deterioration in local air quality through design, density, disposition of uses or travel demand management as appropriate, on a case-by-case basis."

11.2.1.3.2.3 SNDC Development Management Policies

"Policy DM3.13: Amenity, noise, and quality of life

(1) Development should ensure a reasonable standard of amenity reflecting the character of the local area. In all cases particular regard will be paid to avoiding: […]

c. Introduction of incompatible neighbouring uses in terms of noise, odour, vibration, air, dusts, insects, artificial light pollution, and other such nuisances. […]"

"Policy DM3.14: Pollution, health, and safety

a) All development should minimise and where possible reduce the adverse impact of all forms of emissions and other forms of pollution […]
b) When assessed individually or cumulatively, development proposals should ensure that there will be no unacceptable impacts on:
i. Air quality […]
c) Developments which may impact on air quality will not be permitted where they have an unacceptable impact on human health, sensitive designated species or habitats, and general amenity, unless adequate mitigation can be ensured. Development will not be granted in locations where it is likely to result in an Air Quality Management Area being designated or the worsening of air quality in an existing Air Quality Management Area. […]"

11.2.2 Scoping Opinion

Table 11.4 outlines issues relating to air quality which were included within the Scoping Opinion, and where they have been addressed within the context of this ESA Air Quality Chapter.

Table 11-4 - Summary of Consultation Relating to Air Quality

Date and Consultation Phase/Type	Consultation and Key Issues Raised	Section where Comment Addressed
Norwich City Council, Scoping Opinion, November 2022	"[…] *the Council's Environmental Quality officers have commented that the air quality environment is considered to have significantly changed due to the repercussions of the coronavirus pandemic and development which has occurred subsequent to the date of the previous application. Therefore, it is considered that the impact on air quality should be re-assessed and added to the scope of the additional environmental information. This assessment should include the impact of development of the site on the adjacent Air Quality Management Area and an assessment of air quality in particular PM2.5, in accordance with the provisions of the Environment Act 2021.*"	The ESA considers the changes in baseline environment from the original ES (see Section 11.3). The latest publicly available air quality data not impacted by the COVID-19 pandemic has been utilised as per Defra guidance. 2020 and 2021 are not considered to represent long-term trends in air quality pollutant concentrations and 2022 air quality data is not yet available. The ESA considers and provides an updated assessment of an operational phase road traffic emissions (see Section 11.4). This includes assessment of potential road traffic emission impacts at relevant receptor locations within the declared Norwich Air Quality Management Area (AQMA). The updated assessment of an operational phase road traffic emissions (see Section 11.4) includes consideration of the $PM_{2.5}$ annual mean AQAL of 20µg/m^3 as outlined in Table ***11-1***. However, it is noted that whilst the Environment Act 2021 sets national objectives for $PM_{2.5}$ compliance, this is not within the LAQM Framework as it is considered a regional pollutant, as per the Air Quality Strategy[30]. As such, assessment is not explicitly required.

[30] Defra, Policy paper, Air quality strategy: framework for local authority delivery, April 2023.

Date and Consultation Phase/Type	Consultation and Key Issues Raised	Section where Comment Addressed
		An assessment of construction dust impacts has been undertaken in accordance with IAQM guidance (see Section 11.4.1). An assessment of road traffic emissions on human and ecological receptors impacts has been undertaken (see Section 11.4.2). Traffic data generated by the site is presented within Appendix 11.1. The assessment of impacts from construction plant has been scoped out from detailed assessment as detailed in Section 11.2.5 in accordance with LAQM.TG(22).
	"The adjacent site contains Carrow Abbey Marsh County Wildlife Site (CWS), a nonstatutory designated site, with Trowse Meadows CWS adjacent to this to the south. *The habitats of the CWS are potentially vulnerable to increases in air pollution"*	An assessment of road traffic emissions on ecological receptors impacts has been undertaken (see Section 11.4.2). This includes assessment of operational phase road traffic emission contributions to the annual mean NOx Critical Level, and nutrient nitrogen and acidification Critical Loads.
South Norfolk Council, Scoping Opinion, December 2022	The Scoping Opinion received from South Norfolk District Council mirrors the response received from NCC. As such, key issues raised have been addressed above.	-
Broads Authority, Scoping Opinion, November 2022	No air quality issues raised.	-
Norwich City Council, Scoping Opinion, May 2023	No air quality issues raised.	

11.2.3 Additional Consultation

Additional consultation with the NCC and SNDC Environmental Health and Public Protection Team was undertaken to agree upon the specific detail of the Air Quality Chapter, with due consideration of the content of the Scoping Opinion as outlined within Table 11.4. The scope of works was agreed by NCC[31], advising additionally on behalf of SNDC.

[31] Email conversation with Sally Nicholson, Environmental Protection Officer, Development and City Services, Norwich City Council and SLR Consulting Ltd, 20/04/2023.

11.2.4 Assessment Methodology.

11.2.4.1 Construction Dust Assessment

The assessment of construction phase dust and particulate matter fugitive emissions has been undertaken in accordance with the IAQM *'Guidance on the Assessment of Dust from Demolition and Construction'.*

The likely impact magnitude of unmitigated dust emissions associated with demolition, earthworks, construction, and trackout is used in conjunction with the receptor sensitivity to determine the risk of impact for each activity. These sensitivities are:

- annoyance due to dust soiling;
- the risk of health effects due to an increase in exposure to PM_{10}; and
- harm to ecological receptors.

The following sensitive receptors have been considered:

- Human receptors within 350m of the Proposed Development boundary, and within 50m of routes used by construction vehicles, up to 500m from the Proposed Development; and
- Ecological receptors within 50m of the Proposed Development boundary and within 50m of routes used by construction vehicles, up to 500m from the Proposed Development.

The risk of impact is then used to determine proportionate mitigation requirements in line with the IAQM guidance, which form embedded mitigation for the Proposed Development. Through effective application of these measures residual effects are considered to be 'not significant'.

Significance is only assigned to the effect after considering the construction activity with mitigation. This is because for construction activities, the aim is to prevent significant effects on receptors through the use of effective mitigation.

The IAQM guidance therefore does not provide a framework to determine the significance of unmitigated effects, as is not considered appropriate nor relevant in this context. For these reasons, the significance of unmitigated effect of construction dust cannot be defined.

Reference should be made to the IAQM construction dust guidance for further details on the applied assessment methodology.

11.2.4.2 Road Traffic Emissions Assessment

For the assessment of operational phase road traffic emissions on ecological and human receptors, an initial screening exercise has been conducted to determine whether detailed modelling is required through definition of the affected road network. The screening criteria utilised is dependent on the application for human and ecological receptors. This is discussed further in the following sections.

Where road traffic movements cannot be screened out in accordance with the applied screening criteria, further detailed assessment has been undertaken.

11.2.4.2.1 Step 1: Numerical Screening, Human Receptors

The assessment procedure outlined within the EPUK & IAQM guidance document has been used in relation to the assessment of road traffic emissions generated by the Proposed Development human receptors. This initially comprises a screening exercise to determine whether detailed modelling is required.

Specific to locations outside of an AQMA:

- A change of Light-Duty Vehicle (LDV) flows of more than 500 Annual Average Daily Traffic (AADT); and/or
- A change of Heavy-Duty Vehicle (HDV) flows of more than 100 AADT.

Specific to locations near to or within an AQMA:

- A change of LDV flows of more than 100 AADT; and/or
- A change of HDV flows of more than 25 AADT.

If road traffic flows are found not to exceed any of the screening criteria presented, then effects are considered 'insignificant' and can be screened out of further consideration.

Where the screening criteria are exceeded (and relevant human receptors are located within 200m of the affected road network), detailed dispersion modelling has been completed following the process outlined in Section 11.2.4.2.3.

11.2.4.2.2 Step 1: Numerical Screening, Ecological Receptors

The assessment procedure outlined within the Natural England and IAQM guidance documents have been used in relation to the assessment of sensitive ecological receptors and road traffic. This comprises a staged screening procedure to determine the potential for a likely significant effect to occur, whereby potential impacts should be quantified through further detailed assessment.

The first stage is to consider whether any ecological designations with sensitive qualifying features are located within 200m of a road link that is projected to experience vehicle movements >1,000 AADT and/or >200 HDVs resulting from the Proposed Development.

For the purposes of assessing impacts, screening of development trips on European sites will be undertaken in-combination with trips associated with other projects and plans following legislation and recent case law outcomes (e.g. the Wealden Judgement). For all other designations (i.e. non-European designations), screening will be undertaken on 'project alone' trips.

If the above screening criteria are not exceeded, then impacts on ecological designations are likely to be imperceptible, whereby resultant impacts are concluded to result in 'no likely significant effect' (i.e. 'not significant').

If the screening criteria are exceeded, then detailed assessment through dispersion modelling is required to quantify the impact on Critical Levels and/or Critical Loads, following the process outlined in in Section 11.2.4.2.3.

11.2.4.2.3 Road Traffic Emissions Assessment Methodology

Where required, in order to appropriately assess road traffic impacts associated with the operation of the Proposed Development on human and ecological receptors as well as the suitability of the Site for

residential purposes, detailed dispersion modelling has been undertaken following guidance provided in LAQM.TG(22). This has utilised the Cambridge Environmental Research Consultants (CERC) ADMS-Roads v5 dispersion model.

Presently, the construction works scheduled at the Proposed Development are split in three phases (Phases 1, 2 and 3) as outlined in Table 11-5. It should be noted that the scheduling and description of construction activities occurring within these phases provided are indicative.

Table 11-5 - Summary of Construction Phasing

Phase	Description of Works	End Dates
Phase 1	May Gurney (60-80 units)	Summer 2029
Phase 2	Road and bridge infrastructure	Summer 2031
Phase 3	Deal Ground (Wensum Edge 400-450 units and Marsh Reach 160-200 units)	Summer 2038

Therefore, for the purposes of this Chapter, the following scenarios have been modelled as agreed with the Norwich City Council (NCC) Environmental Health Officer (EHO):

- 2019 Base Case (2019 BC) – Base flows for the year 2019;
- 2038 Do Minimum (2038 DM) – Without development flows for the assumed year of opening (2029), inclusive of any relevant committed development flows; and
- 2038 Do Something (2038 DS) – 2038 DM flows, plus all trips associated with the Proposed Development flows for the proposed year of opening (2038).

It is noted that mapped background concentrations and road vehicle emission factors are not forecast by Defra beyond 2030. Therefore, 2029 mapped background concentrations and 2029 road vehicle emission factors from the Emissions Factors Toolkit (EFT) have been presented and applied to the 2038 Proposed Development opening year. This assumption assumes collective trip generation associated with Phases 1-3, which is not anticipated to occur until 2038, occurs at the end of the Phase 1 completion in 2029. This approach is believed to be conservative, given the forecasted reductions in vehicle emission factors and background pollutant concentrations, generating a potential greater resultant concentration relative to what may occur in reality.

Details of model inputs are discussed exhaustively in Appendix 11.1.

With respect to human receptors, consideration has been given to the relevant AQALs. Annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ have been predicted at locations of relevant exposure at existing and proposed sensitive receptors – adjacent to the affected road network.

With respect to ecological receptors, consideration has been given to the relevant Critical Levels and Critical Loads. Road traffic emission concentrations of NOx have been predicted at ecological designations within 200m of the affected road network, with use of gridded and boundary receptors (to ensure maximum impacts are understood). Empirical methods recommended by the EAs AQTAG guidance have been used to facilitate the assessment of Critical Loads.

The assessment criteria outlined within the following sections has been used to determine the overall significance of effect, with respect to operational road traffic impacts on human and ecological receptors.

Full details of the applied assessment methodology/ inputs are provided within Appendix 11.1.

11.2.4.2.4 Road Traffic Emissions, Assessment of Effects – Human Receptors

Significance criteria as provided within EPUK & IAQM guidance has been used for the purposes of informing effects arising from road traffic emissions on human receptors where dispersion modelling has been undertaken.

Whilst describing the impact at an existing human receptor, the resultant total concentration as well as the magnitude of change in relation to respective AQALs are both considered, using the approach detailed in Table 11-6.

Table 11-6 - Operational Phase Impact Significance Matrix

Concentration with the Development / Sensitivity	**Percentage Change in Air Quality Relative to AQAL (%) / Magnitude of Impact [(A)]**			
	1 / Negligible [(A)]	**2-5 / Low**	**6-10 / Medium**	**>10 / High**
75% or less of AQAL / Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL / Low	Negligible	Slight	Moderate	Moderate
95-102% of AQAL / Medium	Slight	Moderate	Moderate	Substantial
103-109% of AQAL / High	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL / Very High	Moderate	Substantial	Substantial	Substantial

Note:
[(A)] Changes of 0%, i.e. less than 0.5%, will be described as Negligible.

Following derivation of impacts at all existing receptor locations assessed, the overall significance of the developmental 'effect' is determined based upon consideration, as necessary, of the following factors:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts;
- the worst-case assumptions adopted when undertaking the prediction of impacts; and
- the extent to which the Proposed Development has adopted best practice to eliminate and minimise emissions.

To determine the overall significance with respect to the suitability of the Site for future occupants and likely exposure to pollutant concentrations, the EPUK & IAQM guidance states:

> *"Where the air quality is such that an air quality objective at the building façade is not met, the effect on residents or occupants will be judged as significant, unless provision is made to reduce their exposure by some means."*

As such, comparison of modelled pollutant concentrations at new exposure locations on-Site has been compared with the relevant AQALs to determine site-suitability and significance.

11.2.4.2.5 Road Traffic Emissions, Assessment of Effects – Ecological Receptors

Where impacts can otherwise not be screened out, dispersion modelling has been used to quantify the impact of road traffic emissions on Critical Levels and/or Critical Loads.

Effects associated with changes can be classed as resulting in 'no likely significant effect' (i.e. 'not significant') where they are <1% of the Critical Levels and/or Critical Loads. Effects associated with contributions to the Critical Levels and/or Critical Loads of >1% are concluded within the Chapter 09 Ecology. It is noted that exceedence of this 1% threshold does not, of itself, imply damage to a habitat rather it triggers the requirement for further assessment by an ecologist to determine whether or not there is a likely significant effect on the habitat.

11.2.5 Effects Not Requiring Further Assessment

In line with the Scoping Opinion and based on the receiving environment, expected parameters of the Proposed Development and expected scale of impact/potential for a pathway for effect on the environment, the following described impacts have been scoped out of the assessment:

- transboundary impacts – on the basis that impacts will be localised NCC and SNDC administrative areas and not experienced across international boundaries; and
- LAQM.TG(22) guidance states that with the application of suitable control measures and site management, exhaust emissions from on-site Non-Road Mobile Machinery (NRMM) are "*unlikely to make a significant impact on local air quality. In the vast majority of cases they will not need to be quantitatively assessed*". As such, suitable control measures are provided in Section 11.5.1.1.2 and no further assessment is considered to be required.

11.3 Changes In Baseline Conditions

11.3.1 ES Baseline

11.3.1.1 Receptors

The original ES did not present specific discrete receptors for consideration with the scope of the Chapter, with the exception of a number of residential properties on Whitlingham Lane, which are considered qualitatively as part of the construction phase assessment. These receptors are still considered relevant in context of the construction phase and their respective sensitivities to construction dust are not expected to have altered. They have therefore been considered within the updated construction phase assessment as part of this Air Quality Chapter to the ESA.

The original ES did not consider ecological receptors.

11.3.1.2 Baseline Air Quality

The original ES Chapter identified four AQMAs within Norwich, however, none of the considered AQMAs were within the locale of the Site.

The original ES and review of baseline air quality was informed by 4 No. air quality monitors:

- 256 King Street;
- Lakenfields;
- Reads Flour Mill; and

- Upper King Street.

The above monitoring locations recorded a range of concentrations in 2009 with a measured exceedence of the NO_2 annual mean AQAL at 256 King Street in 2009. No PM_{10} or $PM_{2.5}$ monitoring was considered. Given the age of the monitoring datasets presented within the original ES and relevance to current baseline air quality, they are not reproduced herein.

11.3.2 ES Future Baseline

Annual mean NO_2 concentrations considered within the original ES baseline evaluation were sourced from air quality monitoring, primarily completed by NCC. No trends were assumed regarding future-year roadside concentrations based on previous years monitoring as only 2009 annual mean concentrations were presented.

In consideration of estimated background concentrations, NETCEN estimates were presented for 2010 and 2015. The 2015 concentrations highlighted how background concentrations were expected to decrease in the future. The 2015 estimated annual mean background concentrations (11.5µg/m^3 for NO_2 and 15.8µg/m^3 for PM_{10}) were well below the respective annual mean AQAL.

Future receptors were not considered within the original ES.

11.3.3 Current Baseline

11.3.3.1 Local Authority Review and Assessment

NCC, SNDC and BDC, in fulfilment of statutory requirements, have conducted ongoing exercises to review and assess air quality within their area of administration. The latest publicly available Local Air Quality Management (LAQM) report for NCC, SNDC and BDC (not impacted by the COVID-19 pandemic) at the time of writing are their 2020 Annual Status Reports (ASRs)[32,33]. The monitoring data published in both documents has therefore been considered.

As referenced in Section 11.3.1.2, in 2012 NCC declared a single central AQMA (the 'Central Norwich AQMA') for exceedences of the annual mean NO_2 AQAL. This central AQMA consolidates the revoked four smaller AQMAs (St Augustines, Grapes Hill, Castle, and Riverside AQMA) and is located approximately 450m west of the Application Site. At the closest point, the Central Norwich AQMA is located approximately 500m to the west of the Site, as illustrated in Figure 11.1-5 in Appendix 11.1

11.3.3.2 Automatic Air Quality Monitoring

The closest automatic monitor to the Site is the Norwich Lakenfields AURN urban background site (titled 'CM2' within the ASR), located approximately 820m south-west of the Site. The monitor is part of the UK Automatic Urban Rural Network (AURN) - a countrywide network of air quality monitoring stations operated on behalf of Defra.

Automatic monitoring is also undertaken within NCC at 'CM1', a roadside monitor located approximately 1.4km north-west from the Application Site at a kerbside location within Norwich city centre. Due to the difference in surroundings / classification between the Site and the CM1 automatic monitor location,

[32] Norwich City Council, 2020 Air Quality ASR, November 2020.
[33] Broadland and South Norfolk District Councils, 2020 Air Quality ASR, June 2020.

similar pollutant concentrations are not anticipated and therefore data from the monitor has not been considered further within this Chapter.

SNDC did not undertake any automatic monitoring over the considered 2015 – 2019 period.

The details and results of the automatic monitoring location of relevance to the Site as presented within the NCC 2020 ASR are presented within Table 11-7 to

Table ***11-12***. All data has therefore been ratified by NCC.

Table 11-7 - Automatic Monitoring Details

Monitoring Location	Site Classification	NGR (m)		Within AQMA?	Pollutants Measured	Inlet Height (m)
		X	Y			
AURN Norwich Lakenfields (CM2)	Urban Background	623637	306940	No	NO_2, NO_x, PM_{10}, $PM_{2.5}$, O_3	2.5

Table 11-8 - Automatic Monitoring: Annual Mean NO_2 Results

Monitoring Location	2019 Data Capture (%)	NO_2 Annual Mean Concentration (µg/m³)				
		2015	2016	2017	2018	2019
AURN Norwich Lakenfields (CM2)	99	12	14.2	13	12	13

Table 11-9 - Automatic Monitoring: Number of NO_2 Hourly Mean Exceedences

Monitoring Location	2019 Data Capture (%)	NO_2 1-Hour Means >200µg/m³ (A)				
		2015	2016	2017	2018	2019
AURN Norwich Lakenfields (CM2)	99	0 (55)	0	0	0	0
(A) If the period of valid data is less than 85%, the 99.8th percentile of 1-hour means is provided in brackets.						

Table 11-10 - Automatic Monitoring: Annual Mean PM_{10} Results

Monitoring Location	2019 Data Capture (%)	PM_{10} Annual Mean Concentration (µg/m³)				
		2015	2016	2017	2018	2019
AURN Norwich Lakenfields (CM2)	90	15	16	16	16	14

Table 11-11 - Automatic Monitoring: Number of PM_{10} Daily Mean Exceedences

Monitoring Location	2019 Data Capture (%)	PM_{10} 24-Hour Means >50µg/m³ (A)				
		2015	2016	2017	2018	2019
AURN Norwich Lakenfields (CM2)	90	5	1 (27)	5	1	4
(A) If the period of valid data is less than 85%, the 90.4th percentile of 24-hour means is provided in brackets.						

Table 11-12 - Automatic Monitoring: Annual Mean $PM_{2.5}$ Results

Monitoring Location	2019 Data Capture (%)	$PM_{2.5}$ Annual Mean Concentration (µg/m³)				
		2015	2016	2017	2018	2019
AURN Norwich Lakenfields (CM2)	97	12	11	12	10	10

Annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations recorded at the closest and most relevant automatic monitoring location relative to the Site (Norwich Lakenfields AURN) are well below the respective AQALs for the period assessed: no exceedences of any considered AQAL were monitored over the considered 2015 – 2019 period.

11.3.3.3 Passive Diffusion Tube Monitoring

Passive diffusion tube monitoring is currently undertaken by NCC, SNDC and BDC at numerous locations throughout the Councils' administrative areas as part of their commitment to LAQM.

The details and results of the monitoring locations of relevance to the Site (i.e. within 1.2km of the Site) are presented in Table 11-13. Annual mean NO_2 concentrations recorded at all closest and most relevant monitoring locations are below the AQAL for the period assessed. There are no SNDC diffusion tube monitoring locations of relevance in the Site locale.

Table 11-13 - Passive Diffusion Tube Monitoring Results

Local Authority	Monitoring Location	Site Classification	NGR (m)		2019 Data Capture (%)	Annual Mean NO_2 Concentration (µg/m³)				
			X	Y		2015	2016	2017	2018	2019
NCC	DT4	Urban Background	623681	307016	100	11.8	12.9	13.9	11.8	12
	DT22	Roadside	623901	307710	100	21.6	23.3	25.3	31.1	29.4
	DT21	Roadside	623880	307659	100	34.3	32.9	32.5	29.1	30.9
	DT1	Roadside	623863	307679	100	36.2	37.7	36.3	33.3	34.2
	DT32	Kerbside	623399	307664	100	-	-	-	27.2	27.1
	DT31	Kerbside	623380	307700	100	-	-	-	37.2	38.6
BDC	BN10	Roadside	625264	308411	100	20.6	20	19.8	18.7	21.4

11.3.3.4 Defra Mapped Background Concentrations

Background pollutant concentration data on a 1km x 1km spatial resolution is provided by Defra through the UK Air Information Resource (AIR) website and is routinely used to support LAQM and Air Quality Assessments. It is noted this data source of mapped background concentrations is an update to the NETCEN data source considered within the original ES.

Annual mean background concentrations of NO_2, NO_x, PM_{10} and $PM_{2.5}$ have been obtained from the Defra published background maps (2018 base year), based on the 1km grid square containing the Application Site and the human road traffic emission receptors. The Defra mapped background concentrations for the

base year (2019), and the earliest anticipated predicted Proposed Development opening year (2029) are presented in Table 11-14.

Table 11-14 - Defra Mapped Background Pollutant Concentrations

Grid Square (X, Y) (m)	Year	Annual Mean NO_2 Concentration (µg/m^3)			
		NO_x	NO_2	PM_{10}	$PM_{2.5}$
624500, 306500	2019	19.6	14.4	16.6	10.1
	2029	13.3	10.1	15.4	9.2
624500, 307500	2019	23.3	16.6	15.2	9.9
	2029	17.6	12.9	14.0	8.9
623500, 307500	2019	21.1	15.3	15.5	10.3
	2029	15.2	11.4	14.2	9.3
623500, 306500	2019	17.5	13.0	15.0	9.8
	2029	12.4	9.4	13.7	8.8

11.3.4 Changes in Baseline

In the interim in the original ES, all four AQMAs referenced within the original ES were revoked in 2016. A new AQMA covering an area around the centre of Norwich (the 'Central Norwich AQMA') was declared in 2012 due to exceedences of the annual mean NO_2 AQAL. At the closest point, the Central Norwich AQMA is located approximately 500m to the west of the Site, as illustrated in Figure 11.1-5 in Appendix 11.1.

In the interim period between the original ES, there is potential for new sensitive human receptor locations to have been introduced into the study area by new developments. Further, given the change in assessment methodology accounting for updated guidance, new sensitive human receptor locations of relevant exposure require consideration. All four AQMAs considered in the original ES were revoked in 2016. A new AQMA covering an area around the centre of Norwich (the 'Central Norwich AQMA') was declared in 2012 due to exceedences of the annual mean NO_2 AQAL.

The ESA study area has been refined in line with the criteria for each updated assessment, described in Section 11.2.4. Where sensitive human and ecological receptors are located within the affected areas and are therefore considered relevant to the assessment, these have been specifically discussed for each of the impact assessments (Section 11.4). It is noted that ecological receptors were not considered or assessed against within the original ES and therefore represent new receptors. It is also noted dispersion modelling of road traffic emissions was not undertaken within the original ES and therefore all human receptors represent newly considered receptors within the context of this Air Quality Chapter to the UES. This includes consideration of receptors within the Central Norwich AQMA .

Given the changes in monitored concentrations and background estimates summarised in Section 11.3.4, and continued prediction for long-term reduction in air pollutant concentrations, it may be reasonable to expect the ESA future baseline will exhibit an improved outlook in terms of air quality.

Since the original ES, concentrations of NO_2 monitored at 256 King Street have decreased (this correlated to 2019 monitoring location DT1, facilitating comparison). The annual mean NO_2 concentration at this

location has reduced from 44.2µg/m^3 in 2009 to 34.2µg/m^3 in 2019. None of the monitors considered exceed the annual mean NO_2 AQAL in the updated period assessed (2015 – 2019). This improvement is consistent with current prediction and trends for pollutant concentrations across the UK.

Background concentration predictions within the original ES were provided from NETCEN estimations and illustrated how background concentrations are expected to decrease. Within this Air Quality Chapter of the ESA, 2019 background concentrations are sourced by Defra projections baselined in 2018. Whilst current estimates of background concentrations are greater than in the original ES, they are still well below the respective AQALs and also predict improvement in future background concentrations. The change in estimations is likely due updates in how the backgrounds are calculated.

11.4 Assessment of Effects

11.4.1 Construction Phase Effects

Where figures relating to area of the site, volume of the site, approximate number of construction vehicles or distances to receptors are given, these relate to thresholds as defined in the IAQM guidance to guide the assessor to define the dust emissions magnitude and sensitivity of the area.

For the purpose of this construction dust assessment, it is assumed that phasing activities will be concurrent as worst-case assessment. As such, all phases are considered in one assessment as illustrated in

Table *11-15* below. However, when considering the sensitivity of the surrounding area, it has been assumed that phases 1 will have been constructed and populated as worst-case assessment. It is noted that, due to the distance between those areas comprising Phase 2 and Phase 3 works, consideration of these phases would not increase the overall sensitivity to construction phase dust impacts.

11.4.1.1 Screening Assessment

As shown in in Figure 11.1-6 in Appendix 11.1, there are 'human receptors' within 350m of the Application Site and within 50m of the site access roads (assessed up to 500m from the site entrances). Additionally, there are 'ecological receptors' within 50m of the site boundary and within 50m of the site access roads (assessed up to 500m from the site entrances). Therefore, an assessment of construction dust on human and ecological receptors is required.

11.4.1.2 Potential Dust Emission Magnitude

A summary of the dust emission magnitude for each phase is presented within

Table *11-15*.

Table 11-15 - Construction Dust Assessment

Activity		Dust Emission Magnitude
Demolition	The site currently comprises two buildings previously used as offices which are to be demolished. Total building volume to be demolished is <10,000m^3 with a mix of potentially dusty construction materials (i.e. brick) and less dusty construction materials (i.e. metal sheeting). The Site is currently partially comprised of a levelled concrete surface which will have to be broken up/demolished to facilitate earthworks. Demolition activities are <10m above ground level.	Medium
Earthworks	Site earthworks are required over an area of >10,000m^2. The site comprises areas with a levelled surface, corresponding to Phases 1 and 3. As such, earthworks in those areas are expected to be minimal. Due to the size of the site, >10-heavy earth moving vehicles may be required on site.	Large
Construction	The total building volume associated with the proposed development is predicted to be greater than 100,000m^3. Construction materials have potential for dust generation. Concrete batching is considered unlikely given the availability of ready-mix concrete off-site. Piling considered unlikely to be required given the residential nature of the development site. However, should piling be proposed the overall dust emission magnitude would not increase above 'large'.	Large
Trackout (A)	Construction vehicles will access the Site via two entrances off Bracondale/The Street. Given the scale and nature of works required, there are anticipated to be >50 HDV outward movements in a maximum worst-case day. Unpaved road lengths have the potential to exceed 100m in length.	Large
Note: (A) Trackout is defined as any dust emissions which are transported from the site to the surrounding area/local road network via construction vehicles travelling to and from the site.		

11.4.1.3 Sensitivity of the Area

11.4.1.3.1 Dust Soiling Impacts

There are <10 residential (highly sensitive) receptors within 20m of the Site and 10-100 residential (highly sensitive) receptors within 50m of the Site (including consideration of receptors introduced following completion of Phase 1).

There are also 10-100 residential (highly sensitive) receptors located less than 20m from the access routes within 500m of the Site entrance (including consideration of receptors introduced following completion of Phase 1 and assuming that vehicles travel west along Bracondale when leaving the Site) – commensurate of a large site.

The sensitivity of the area with respect to dust soiling effects on people and property in relation to demolition, earthworks and construction is therefore considered to be 'medium', and 'high' in relation to trackout.

11.4.1.3.2 Human Health Impacts

The maximum 2019 mapped background PM_{10} concentration (2018 reference year) for the $1km^2$ grid squares centred on the Site is estimated to be $16.6\mu g/m^3$ (i.e. falls into the $<24\mu g/m^3$ class).

Given the above information regarding the number of residential receptors within 20m and 50m of the Site boundary and within 20m of the identified trackout routes, the sensitivity of the area with respect to human health impacts in relation to demolition, earthworks, construction and trackout is therefore considered to be 'low'.

11.4.1.3.3 Ecological Impacts

Two local ecological designations are present within 20m of the Site boundary:

- Whitlingham Local Nature Reserve (LNR); and
- Carrow Abbey Marsh and Trowse Meadows (CAM & TM) County Wildlife Site (CWS).

Both receptors have been assumed to contain dust sensitive features to facilitate a conservative assessment and are therefore considered to be 'low' sensitivity receptors in accordance with the stated IAQM guidance (i.e. in reflection of their 'local' designation status). The sensitivity of the area with respect to ecological impacts in relation to demolition, earthworks, construction and trackout is therefore considered to be 'low'.

11.4.1.3.4 Summary

A summary of the sensitivity of the surrounding area is detailed in Table 11-16, whilst the spatial density of nearby receptors discussed is provided in Figure 11.1-6 in Appendix 11.1.

Table 11-16 - Sensitivity of the Area to Construction Dust Impacts

Potential Impact	Demolition	Earthworks	Construction	Trackout
Dust Soiling Impacts	Medium	Medium	Medium	High
Human Health Impacts	Low	Low	Low	Low
Ecological Impacts	Low	Low	Low	Low

11.4.1.4 Risk of Impact (Unmitigated)

The outcome of the assessment of the potential 'magnitude of dust emissions', and the 'sensitivity of the area' are combined in the table below to determine the risk of impact which is used to inform the selection of appropriate mitigation.

Table 11-17 - Risk of Construction Phase Dust Impacts: Requirements for Site Specific Mitigation

Potential Impact	Demolition	Earthworks	Construction	Trackout
Dust Soiling Impacts	Medium Risk	Medium Risk	Medium Risk	Large Risk
Human Health Impacts	Low Risk	Low Risk	Low Risk	Low Risk
Ecological Impacts	Low Risk	Low Risk	Low Risk	Low Risk

Following the construction dust assessment, the Site is found to be at worst 'Large Risk' in relation to dust soiling effects on people and property, and 'Low Risk' in relation to human health impacts and ecological impacts. However, potential dust effects during the construction phase are considered to be temporary in nature and may only arise at particular times (i.e. certain activities and/or meteorological conditions).

Nonetheless, commensurate with the above designation of dust risk, mitigation measures, as identified by IAQM guidance are required to ensure that any potential impacts arising from the construction phase of the Proposed Development are reduced and, where possible, completely removed.

In accordance with IAQM guidance, providing effective mitigation measures are implemented, as detailed in Table 11-25, it is considered that the overall effect at all receptors will be 'not significant'. These are considered within the Residual Effects section later in this chapter.

11.4.2 Additional Operational Phase Effects

11.4.2.1 Human Receptors

Consistent with the assessment criteria outlined in Section 11.2.4.2.1, road traffic flows generated by the Proposed Development on the local road network have been compared against the EPUK & IAQM prescribed screening thresholds.

The extent of the road links where road traffic movements cannot be screened out, i.e. the 'affected road network' is presented within Appendix 11.1. Dispersion modelling has therefore been undertaken for these links. The spatial extent of the modelled domain (modelled road links and human receptors considered) is illustrated in Figure 11-5 of Appendix 11.1.

11.4.2.1.1 NO_2 Modelling Results

Table 11-18 presents the annual mean NO_2 concentrations predicted at all assessed receptor locations of relevant exposure for the 2019 BC, 2038 DM and 2038 DS scenarios.

Table 11-18 - Predicted Annual Mean NO_2 Concentrations – 2038 Development Opening Year

Receptor	Predicted Annual Mean NO_2 Concentration ($\mu g/m^3$)			% Change of AQAL	% of 2038 DS Relative to AQAL	EPUK & IAQM Impact Descriptor
	2019 BC	2038 DM (A)	2038 DS (A)			
Existing Receptors						
R1	18.8	11.8	12.4	1.4	31.0	Negligible
R2	16.5	10.9	11.1	0.3	27.8	Negligible
R3	30.4	18.5	18.8	0.5	47.0	Negligible
R4	30.1	17.6	17.8	0.5	44.5	Negligible
R5	27.7	16.8	17.0	0.4	42.5	Negligible
R6	32.4	19.0	19.2	0.4	48.0	Negligible
R7	25.6	15.9	16.0	0.3	40.0	Negligible
R8	27.5	16.7	16.8	0.3	42.0	Negligible
R9	23.6	14.7	14.7	0.2	36.8	Negligible
R10	36.1	19.9	20.1	0.5	50.3	Negligible

Receptor	Predicted Annual Mean NO_2 Concentration ($\mu g/m^3$)			% Change of AQAL	% of 2038 DS Relative to AQAL	EPUK & IAQM Impact Descriptor
	2019 BC	2038 DM (A)	2038 DS (A)			
R11	25.7	15.3	15.4	0.2	38.5	Negligible
R12	17.3	11.2	11.2	0.1	28.0	Negligible
R13	18.0	11.5	11.5	0.1	28.8	Negligible
R14	24.2	14.2	14.3	0.2	35.8	Negligible
R15	24.9	14.5	14.6	0.2	36.5	Negligible
New Receptors (B)						
NR1	-	-	12.1	-	30.3	-
NR2	-	-	11.4	-	28.5	-
NR3	-	-	11.4	-	28.5	-
NR4	-	-	11.5	-	28.8	-
NR5	-	-	11.5	-	28.8	-
NR6	-	-	14.2	-	35.5	-

Notes:
(A) Scenario modelled with 2029 emission factors and 2029 mapped background pollutant concentrations.
(B) Exposure at new receptors (future occupants) only applies in the 2038 DS scenario i.e. with development consent.

As shown in Table 11-18, there are no predicted exceedences of the annual mean NO_2 AQAL in either the 'do-minimum' or 'do-something' scenarios in the 2038 completed development scenario year (2029 precautionary inputs applied).

The predicted percentage change of annual mean NO_2 concentrations ranges from between 1% of the AQAL (i.e. a 'low' magnitude of impact) to <0.5% of the AQAL (i.e. a 'negligible' magnitude of impact). Concentrations with the Proposed Development in the 'do-something' scenario are predicted to be <75% of the AQAL at all receptors (i.e. all receptors are of 'very low' sensitivity). An unmitigated 'negligible' impact is therefore predicted at all receptor locations in accordance with the assessment methodology.

The maximum predicted annual mean NO_2 concentration (2038 DS) at all receptors newly introduced by the Proposed Development was at Receptor NR6, located to the centre of the Site, north of the river Yare, with a predicted concentration of 14.2$\mu g/m^3$; this represents 35.5% of the AQAL (i.e. 'well-below').

The empirical relationship given in LAQM.TG(22) states that exceedences of the 1-hour mean NO_2 AQAL are unlikely to occur where annual mean concentrations are <60$\mu g/m^3$. Annual mean NO_2 concentrations predicted at all receptor locations are well below this limit. Therefore, it is unlikely that an exceedence of the 1 hour mean AQAL will occur as a result of absolute and incremental concentrations associated with the Proposed Development.

11.4.2.1.2 PM_{10} Modelling Results

Table 11-19 presents the annual mean PM_{10} concentrations predicted at all assessed receptor locations of relevant exposure for the 2019 BC, 2038 DM and 2038 DS scenarios.

Table 11-19 - Predicted Annual Mean PM_{10} Concentrations – 2038 Development Opening Year

Receptor	Predicted Annual Mean PM_{10} Concentration ($\mu g/m^3$)			% Change of AQAL	% of 2038 DS Relative to AQAL	EPUK & IAQM Impact Descriptor
	2019 BC	2038 DM (A)	2038 DS (A)			
Existing Receptors						
R1	17.5	16.4	16.7	0.7	41.8	Negligible
R2	17.0	15.9	15.9	0.2	39.8	Negligible
R3	18.0	17.2	17.3	0.3	43.3	Negligible
R4	18.3	17.4	17.5	0.3	43.8	Negligible
R5	18.0	17.0	17.1	0.2	42.8	Negligible
R6	19.0	18.1	18.2	0.3	45.5	Negligible
R7	17.5	16.5	16.5	0.1	41.3	Negligible
R8	17.9	16.9	17.0	0.2	42.5	Negligible
R9	17.1	16.0	16.0	0.1	40.0	Negligible
R10	19.8	19.1	19.2	0.3	48.0	Negligible
R11	17.5	16.5	16.6	<0.1	41.5	Negligible
R12	15.8	14.7	14.8	<0.1	37.0	Negligible
R13	16.0	14.9	14.9	<0.1	37.3	Negligible
R14	18.8	17.8	17.9	0.1	44.8	Negligible
R15	18.9	18.0	18.0	0.1	45.0	Negligible
New Receptors (B)						
NR1	-	-	16.5	-	41.3	-
NR2	-	-	16.1	-	40.3	-
NR3	-	-	16.1	-	40.3	-
NR4	-	-	16.2	-	40.5	-
NR5	-	-	16.1	-	40.3	-
NR6	-	-	14.6	-	36.5	-

Notes:

(A) Scenario modelled with 2029 emission factors and 2029 mapped background pollutant concentrations.

(B) Exposure at new receptors (future occupants) only applies in the 2038 DS scenario i.e. with development consent.

As shown in Table 11-19, there are no predicted exceedences of the annual mean PM_{10} AQAL in either the 'do-minimum' or 'do-something' scenarios in the 2038 completed development scenario year (2029 precautionary inputs applied).

The predicted percentage change of annual mean PM_{10} concentrations ranges from between 1% of the AQAL (i.e. a 'negligible' magnitude of impact) to <0.5% of the AQAL (i.e. a 'negligible' magnitude of impact). Concentrations with the Proposed Development in the 'do-something' scenario are predicted to be <75% of the AQAL at all receptors (i.e. all receptors are of 'very low' sensitivity). An unmitigated 'negligible' impact is therefore predicted at all receptor locations in accordance with the assessment methodology.

The maximum predicted annual mean PM_{10} concentration (2038 DS) at all receptors newly introduced by the Proposed Development was at Receptor NR1. Receptor NR1 is located to the south of the Site, adjacent to the Site access road approximately 25m from Bracondale, with a predicted concentration of 16.5µg/m^3; this represents 41.3% of the AQAL (i.e. 'well-below').

Based upon the maximum predicted annual mean PM_{10} concentration of 19.8µg/m^3 (predicted at Receptor R10 – 2038 DS), this equates to less than 3 days where 24-hour mean PM_{10} concentrations are predicted to be greater than 50µg/m^3. This is well below the 35 permitted exceedences, and therefore the number of maximum exceedences is in compliance with the 24-hour mean AQAL.

11.4.2.1.3 $PM_{2.5}$ Modelling Results

Table 11-20 presents the annual mean $PM_{2.5}$ concentrations predicted at all assessed receptor locations of relevant exposure for the 2019 BC, 2038 DM and 2038 DS scenarios.

Table 11-20 - Predicted Annual Mean $PM_{2.5}$ Concentrations – 2038 Development Opening Year

Receptor	Predicted Annual Mean $PM_{2.5}$ Concentration ($\mu g/m^3$)			% Change of AQAL	% of 2038 DS Relative to AQAL	EPUK & IAQM Impact Descriptor
	2019 BC	2038 DM (A)	2038 DS (A)			
Existing Receptors						
R1	10.6	9.7	9.9	0.8	49.5	Negligible
R2	10.4	9.4	9.5	0.2	47.5	Negligible
R3	11.5	10.6	10.7	0.3	53.5	Negligible
R4	11.9	11.0	11.1	0.3	55.5	Negligible
R5	11.7	10.8	10.9	0.2	54.5	Negligible
R6	12.3	11.5	11.5	0.3	57.5	Negligible
R7	11.4	10.5	10.6	0.2	53.0	Negligible
R8	11.7	10.8	10.8	0.2	54.0	Negligible
R9	11.2	10.3	10.3	0.1	51.5	Negligible
R10	12.8	12.0	12.1	0.3	60.5	Negligible
R11	11.5	10.6	10.6	0.1	53.0	Negligible
R12	10.3	9.4	9.4	<0.1	47.0	Negligible
R13	10.4	9.5	9.5	<0.1	47.5	Negligible
R14	11.4	10.5	10.5	0.1	52.5	Negligible
R15	11.5	10.6	10.6	0.1	53.0	Negligible
New Receptors (B)						
NR1	-	-	9.8	-	49.0	-
NR2	-	-	9.6	-	48.0	-
NR3	-	-	9.6	-	48.0	-
NR4	-	-	9.6	-	48.0	-
NR5	-	-	9.6	-	48.0	-
NR6	-	-	9.3	-	46.5	-

Notes:
(A) Scenario modelled with 2029 emission factors and 2029 mapped background pollutant concentrations.
(B) Exposure at new receptors (future occupants) only applies in the 2038 DS scenario i.e. with development consent.

As shown in Table 11-20, there are no predicted exceedences of the annual mean $PM_{2.5}$ AQAL in either the 'do-minimum' or 'do-something' scenarios in the 2038 completed development scenario year (2029 precautionary inputs applied).

The predicted percentage change of annual mean $PM_{2.5}$ concentrations ranges from between 1% of the AQAL (i.e. a 'negligible' magnitude of impact) to <0.5% of the AQAL (i.e. a 'negligible' magnitude of impact). Concentrations with the Proposed Development in the 'do-something' scenario are predicted to be <75% of the AQAL at all receptors (i.e. all receptors are of 'very low' sensitivity). An unmitigated 'negligible' impact is therefore predicted at all receptor locations in accordance with the assessment methodology.

The maximum predicted annual mean $PM_{2.5}$ concentration (2038 DS) at all receptors newly introduced by the Proposed Development was at Receptors NR1 with a predicted concentration of 9.8µg/m^3; this represents 49.0% of the AQAL (i.e. 'well-below').

11.4.2.2 Significance of Air Quality Impacts, Human Receptors

In relation to the Proposed Development, the unmitigated impact significance associated with operational phase development trips and impacts at human receptors has been predicted in accordance with the stated assessment methodology. The following factors have been taken into account in assessing significance of effects:

- existing receptors:
  - there are no predicted exceedences of the annual mean NO_2, PM_{10} and $PM_{2.5}$ AQALs as a result of the Proposed Development in the 2038 completed development scenario year;
  - a negligible impact on annual mean NO_2 and PM_{10} concentrations has been predicted at all considered receptor locations in the 2038 completed development scenario year;
  - there is considered to be no risk of exceedence of the 1-hour mean NO_2 AQA in the 2038 completed development scenario year, based upon the absolute predicted annual mean NO_2 concentrations and the marginal change in annual mean NO_2 concentrations; and
  - exceedences of the 24-hour mean PM_{10} AQAL are considered unlikely in the 2038 completed development scenario year, based upon the absolute predicted annual mean PM_{10} concentrations and the marginal change in annual mean PM_{10} concentrations.
- proposed receptors:
  - there are no predicted exceedences of the annual mean NO_2, PM_{10} and $PM_{2.5}$ AQALs at proposed receptor locations of relevant exposure in the 2038 completed development scenario year;
  - there is considered to be no risk of exceedence of the 1-hour mean NO_2 AQAL in the 2038 completed development scenario year, based upon the absolute predicted annual mean NO_2 concentrations and the marginal change in annual mean NO_2 concentrations; and
  - exceedences of the 24-hour mean PM_{10} AQAL are considered unlikely in the 2038 completed development scenario year, based upon the absolute predicted annual mean PM_{10} concentrations and the marginal change in annual mean PM_{10} concentrations.
- modelling assumptions:
  - all modelled concentrations have been verified against NCC monitoring data; and
  - a precautionary approach has been applied to the 2038 completed development scenario year through the use of 2029 mapped background concentration and emission factors.

Therefore, on the basis of the above, the overall effect on air quality as a result of the additional construction and operational phase proposed development trips is considered to be 'not significant'.

11.4.2.3 Ecological Receptors

11.4.2.3.1 Step 1, Ecological Assessment Screening

Table 11-21 details the extent of ecological designations located within 200m of a road link expected to witness a development vehicular flow. Where the traffic flow is above the IAQM screening thresholds (outlined in Section 11.2.4.2.2), this is marked in bold.

Table 11-21 - Ecological designations within 200m of an affected link

ID	Site	Designation	Project Alone		In Combination	
			Total AADT	HDV %	Total AADT	HDV %
ER1	CAM & TM	CWS	**2,499** (A)	0.0	-	-
ER2	Whitlingham (Object A)	LNR	**2,537**	0.0	-	-
ER3	Whitlingham (Object B)	LNR	38	0.0	-	-
ER4	Whitlingham (Object C)	LNR	<1,000 (B)	0.0	-	-

Notes:

(A) No dilution of traffic accounting for phase 1 has been calculated to facilitate a conservative assessment.

(B) Given the location to the north-eastern extent of the Proposed Development, site access route trips will have diluted below 1,000AADT within 200m of this receptor.

Two local designations, the CAM & TM CWS and the Whitlingham LNR (Object A, B and C) (receptors ER1 -ER4) are found within 200m of the road links expected to witness development generated traffic flows as illustrated in Figure11.1-7 in Appendix 11.1. ER1 and ER2 are above the 'project alone' IAQM prescribed screening criteria (i.e. >1,000 AADT) on road links within 200m of the receptor.

Consistent with the staged screening procedure, further assessment with the use of dispersion modelling to quantify the effect on Critical Loads / Critical Levels has therefore been undertaken for receptors ER1 and ER2. The spatial extent of the modelled domain is illustrated in illustrated in Figure 11-5 of Appendix 11.1.

No further assessment is necessary at receptors ER3 and ER4.

11.4.2.3.2 Step 2, Detailed Ecological Assessment

Results presented herein relate to the maximum modelled impact of each individual ecological designation requiring detailed assessment (i.e. where impacts cannot be screened out), and as such, represents a conservative assessment.

11.4.2.3.2.1 Annual Mean NOx Critical Level

Table 11-22 presents the maximum modelled 2038 operational phase road traffic emission contribution impact to the annual mean NOx Critical Level (30µg/m^3) at all considered ecological receptor locations requiring further screening of potential impacts.

Table 11-22 - Maximum Predicted Annual Mean NOx Impacts – 2038

ID	Designation	Maximum Modelled NO_X Annual Mean Concentration			
		Change (Project Alone)		Total (2038 DS)	
		µg/m^3	% of Critical Level	µg/m^3 (A)	% of Critical Level
ER1	CWS	1.4	4.6	19.9	66.4
ER2	LNR	0.2	0.8	18.7	62.2

Note: 2029 Defra background applied

As presented in Table 11-22, operational phase project alone road traffic emission contributions are <1% of the annual mean NOx Critical Level at habitats within ER2 Whitlingham LNR.

Furthermore, as presented in Table 11-22 operational phase project alone road traffic emission contributions are >1% of the annual mean NOx Critical Level at habitats within ER1 CAM & TM CWS. Reference should be made to Figure 11.1-7 within Appendix 11.1 for an illustration of the extent of the CAM & TM CWS where road traffic emission contributions are above >1% of the NOx Critical Level. However, it is noted that with the applied background, there are no exceedences of the annual mean NOx Critical Level predicted at any location within the CAM & TM CWS . Reference should be made to Chapter 09 Ecology for the overall determination of the significance of effect arising from operational phase road traffic emission contributions to the annual mean NOx Critical Level at habitats within the CAM & TM CWS.

11.4.2.3.2.2 Nutrient Nitrogen Critical Load

Table 11-23 presents the maximum modelled 2038 operational phase road traffic emission contribution impact to the nutrient nitrogen Critical Load at all considered ecological receptor locations requiring further screening of potential impacts.

Table 11-23 - Maximum Predicted Nutrient Nitrogen Impacts – 2038

ID	Designation	Applied Critical Load (Kg N/ha/yr)	Maximum Modelled Contribution			
			Project Alone		2038 DS	
			Kg N/ha/yr	% of Min Critical Load	Kg N/ha/yr	% of Min Critical Load
ER1	CWS	15	0.1	0.7	-	-
ER2	LNR	20	<0.1	0.1	-	-

As presented in Table 11-23, operational phase project alone road traffic emission contributions are <1% of the nutrient nitrogen Critical Load at habitats within ER1 CAM & TM CWS and ER2 Whitlingham LNR.

11.4.2.3.2.3 Acid Critical Load

Table 11-24 presents the maximum modelled 2038 operational phase road traffic emission contribution impact to the acidification Critical Load at all considered ecological receptor locations requiring further screening of potential impacts.

Table 11-24 - Maximum Predicted Acidification Impacts – 2038

ID	Designation	MaxN Critical Load (keq/ha/yr)	Maximum Modelled Contribution	
			Project Alone	
			keq/ha/yr	% of MaxN Critical Load
ER1	CWS	Not Sensitive	-	-
ER2	LNR	4.856	<0.1	<0.1

As presented in Table 11-24, operational phase project alone road traffic emission contributions are <1% of the acid Critical Load at habitats within ER2 Whitlingham LNR. It is restated that habitats within ER1 CAM &TM CWS are not sensitive to acidification and, therefore, no assessment is completed.

11.4.2.4 Significance of Air Quality Impacts, Ecological Receptors

In relation to the Proposed Development, the unmitigated impact significance associated with operational phase development trips and impacts at ecological receptors has been predicted in accordance with the stated assessment methodology. The significance of effect is as follows:

- Operational phase project alone development trips are below the 'stage 1' screening criterion (i.e. <1,000AADT) on links within 200m of ER3 and ER4. Therefore, road traffic emission contributions are concluded to result in 'no likely significant effect' (i.e. not significant) without further required assessment;
- Operational phase project alone development trips are above the 'stage 1' screening criterion (i.e. >1,000AADT) on links within 200m of ER1 and ER2. Further detailed assessment of road traffic emission impacts has concluded:
    - At ER1: Operational phase project alone road traffic emission contributions are >1% of the annual mean NOx Critical Level. Reference should be made to Chapter 9 Ecology for the overall determination of the significance of effect arising from operational phase road traffic emission contributions to the annual mean NOx CLe at habitats within the CAM & TM CWS;
    - At ER2: Operational phase project alone road traffic emission contributions are <1% of the annual mean NOx Critical Level. Therefore, road traffic emission contributions will result in 'no likely significant effect' (i.e. not significant) on the annual mean NOx Critical Level;
    - At ER1 and ER2: Operational phase project alone road traffic emission contributions are <1% of the applied nutrient nitrogen Critical Loads. Therefore, road traffic emission contributions will result in 'no likely significant effect' (i.e. not significant) on the nutrient nitrogen Critical Load; and
    - At ER2: Operational phase project alone road traffic emission contributions are <1% of the applied acid Critical Load. Therefore, road traffic emission contributions will result in 'no likely significant effect' (i.e. not significant) on the acid Critical Load.

11.4.3 Additional Cumulative Effects

11.4.3.1 Construction Phase

Cumulative dust effects arising from construction activities could be experienced where construction activities from more than one scheme overlaps at an affected receptor, dependent on the impact (e.g. dust soiling, human health and ecological). However, all schemes which are considered to pose a risk of cumulative effects will have had to undertake a construction dust assessment separately relating to their own site activities and associated risks, with the recommendation of best practice mitigation to remedy residual effects 'not significant'. These measures would be integrated into a Construction Environmental Management Plan (CEMP) or similar, to be adhered to during construction, as part of their own environmental responsibilities and commitment.

In accordance with IAQM guidance, following the implementation of the recommended mitigation, effects will be 'not significant'. As such, it is not anticipated that there would be significant cumulative effects associated with construction phase dust emissions.

11.4.3.2 Operational Phase

In consideration of the likely changes in road traffic flows that may occur on the local highway network as a result of the proposed development, consideration has been given to the potential maximum traffic flows that could occur in the future assessment year (i.e. 2038) should the Proposed Development become fully operational.

The traffic flows used for the assessment includes vehicle movements associated with wider background growth as applied through location specific TEMPro growth factors. As such, the dispersion modelling results are inherently cumulative in nature. The cumulative operational effect of the Proposed Development is therefore considered to be 'not significant'.

11.5 Requirement for Additional Mitigation

11.5.1 Alternate or Additional Mitigation

11.5.1.1 Construction Phase

11.5.1.1.1 Dust Control Measures

An assessment of the significance of impacts associated with construction phase dust has been undertaken in accordance with the IAQM methodology. A summary of the risk category associated with each identified source of construction phase dust is presented within Table 11-25, for the purposes of identifying mitigation requirements.

The risk of dust soiling effects is assessed as 'Medium' from demolition, earthworks and construction activities but 'High' from trackout activities. The risk of human health effects and ecological impacts from PM_{10} is assessed as low from demolition, earthworks, construction and trackout activities.

In order to control potential impacts, the mitigation measures presented within Table 11-25 are proposed for the scheme. These mitigation measures should be secured by planning condition.

Table 11-25 - Construction Dust Mitigation Measures

Site Application	Mitigation Measures
Highly Recommended	
Communications	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
	Display the head or regional office contact information.
	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site.
Construction	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
Demolition	Ensure effective water suppression is used during demolition operations. Handheld sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.

Site Application	Mitigation Measures
	Avoid explosive blasting, using appropriate manual or mechanical alternatives.
	Bag and remove any biological debris or damp down such material before demolition.
Monitoring	Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary, with cleaning to be provided if necessary.
	Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.
	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
	Agree dust deposition, dust flux, or real-time PM_{10} continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.
Operating Vehicle / Machinery and Sustainable Travel	Ensure all vehicles switch off engines when stationary - no idling vehicles.
	Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable.
	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.
	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).
Operations	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
	Use enclosed chutes and conveyors and covered skips.
	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
	Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
Preparing and Maintaining the Site	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.
	Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.

Site Application	Mitigation Measures
	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
	Avoid site runoff of water or mud.
	Keep site fencing, barriers and scaffolding clean using wet methods.
	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.
	Cover, seed or fence stockpiles to prevent wind whipping.
	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
	Make the complaints log available to the local authority when asked.
Site Management	Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the logbook.
	Hold regular liaison meetings with other high risk construction sites within 500m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport deliveries which might be using the same strategic road network routes.
	Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
	Avoid dry sweeping of large areas.
	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
	Record all inspections of haul routes and any subsequent action in a site logbook.
	Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
	Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
Trackout	Access gates to be located at least 10m from receptors where possible.
Waste Management	Avoid bonfires and burning of waste materials.
Desirable	
	Avoid scabbling (roughening of concrete surfaces) if possible.
Construction	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.

Site Application	Mitigation Measures
	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.
Demolition	Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).
Earthworks	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
	Use Hessian, mulches or tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable
	Only remove the cover in small areas during work and not all at once.

Potential dust effects during the construction phase considered to be temporary in nature. The impacts are determined to be temporary as they will only potentially occur throughout the construction phase and short-term because these will only arise at particular times when certain activities and meteorological conditions for creating the level of magnitude predicted combine.

However, the application of the above dust control and mitigation measures, it is considered that impacts at all receptors will be 'not significant' in accordance with the IAQM guidance.

11.5.1.1.2 NRMM Emissions

The following controls outlined within LAQM.TG(22) and IAQM guidance should apply to NRMM:

- ensure all NRMM complies with the appropriate EU Directive Staged Emission Standard;
- where feasible, ensure further abatement plant is installed on NRMM equipment, e.g. Diesel Particulate Filters (DPFs);
- ensure all vehicles switch off their engines when stationary – no idling vehicles;
- avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where possible; and
- impose and signpost a maximum-speed-limit of 15mph on surfaced and 10mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided).

Successful implementation of the above mitigation measures, which should be secured by planning condition, would ensure that emissions from the construction phase and NRMM used during construction are 'not significant'.

11.5.1.2 Operational Phase

11.5.1.2.1 Human Receptors

In accordance with EPUK & IAQM guidance, the overall effect of the development on NO_2, PM_{10} and $PM_{2.5}$ concentrations at all assessed receptor locations are considered to be 'not significant', despite the overly worst-case assessment approach i.e. use of 2029 mapped background concentration and emission factors. This approach is believed to be conservative, given the forecasted reductions in vehicle emission factors and background pollutant concentrations, generating a potential greater resultant concentration relative to what may occur.

In addition, predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ within the Site at new receptor locations are considered to be 'well below' both the long and short term AQALs. Effects associated with likely exposure of future occupants are therefore considered to be 'not significant', despite the overly worst-case assessment approach discussed.

As such, long-term scheme-specific mitigation measures in relation to operational effects arising from road traffic emissions are therefore not considered to be necessary.

11.5.1.2.2 Ecological Receptors

The assessment of road traffic emissions on ecological receptors concluded that resultant effects on Whitlingham LNR are considered 'not significant'. The resultant effects on the CAM & TM CWS require specialist conclusion from the project ecologist, please refer to ESA Chapter 09 – Ecology for conclusion of the significant effect of the receptor.

As not significant effects are identified within this ESA long-term scheme-specific mitigation measures in relation to operational effects arising from road traffic emissions are therefore not considered to be necessary.

11.6 Residual Effects

11.6.1 Construction Phase

On the basis that the mitigation measures outlined in Table 11-25 are implemented, the residual effects from all construction phase activities are predicted to be 'not significant'.

11.6.2 Operational Phase

Unmitigated effects on human receptors associated with road traffic emissions are considered 'not significant' and therefore residual effects are also 'not significant'. However, with the implementation of additional mitigation (as recommended), air quality effects are likely to be reduced further.

The effects on ecological receptors associated with the road traffic emissions assessment were referred to the Ecologist (see Chapter 09) for an assessment of their significance.

11.7 Other Environmental Issues

This section seeks to detail any considerations and environmental effects that have been identified with regard to the range of topics which have been introduced into the EIA requirements through the EIA Regulations 2017. Where there are no such considerations or environmental effects relevant to air quality, this is also specified for clarity.

11.7.1 Other Environmental Issues of Relevance

11.7.1.1 Infrastructure

No issue in respect of infrastructure is considered relevant to this chapter.

11.7.1.2 Waste

No issue in respect of waste is considered relevant to this chapter.

11.7.1.3 Population and Human Health

This Chapter has described and assessed issues relevant to population and human health by assessing the likely air quality impacts associated with the proposed development. As such, this ES chapter has inherently considered this other environmental issue.

11.7.1.4 Climate and Change

No issue in respect of climate and carbon is considered relevant to this chapter.

11.7.1.5 Risk of Major Accidents and/or Disasters

No issue in respect of climate and carbon is considered relevant to this chapter.

11.7.2 Summary

With the exception of population and human health, which is considered inherently within the content of the Chapter, no additional environment issues have been identified of relevance to this chapter.

With regards to the IEA regulations 2017, in terms of air quality there are not considered to be any likely significant effects with regards to Other Environmental Issues.

11.8 Summary of Effects

Assuming the implementation of relevant mitigation measures, the overall effect of the development in terms of existing sensitive receptors surrounding the Proposed Development is predicted to be 'not significant'.

11.9 Conclusions

The air quality chapter of the original ES included qualitative air quality assessments to assess the construction and operational phases of the proposed residential-led mixed-use development on land at May Gurney and Deal Ground, Norwich.

This chapter of the ESA has considered the predicted effects of the original ES, and the current and future baseline, in the context of the material amendments and updates to guidance.

A qualitative assessment of the potential dust impacts during the construction of the development has been undertaken. Through good practice and implementation of appropriate mitigation measures, it is expected that the release of dust would be effectively controlled and mitigated, with resulting impacts considered to be 'not significant'. All dust impacts are considered to be temporary and short-term in nature.

Emissions from plant / NRMM on-site is predicted to result in a 'not significant' impact on air quality.

Additional development trips arising during the operational phase of the scheme are predicted to result in a negligible impact on annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations at all human receptor locations. There are no predicted exceedences of the annual mean NO_2, PM_{10} and $PM_{2.5}$ AQALs at proposed receptor locations of relevant exposure introduced by the Proposed Development. There is no predicted risk of exceedence of the 1-hour mean NO_2 or 24-hour mean PM_{10} AQALs at existing or proposed receptors as a result of the Proposed Development. As such, the overall effect is considered to be 'not significant'.

Additional development trips and associated road traffic emission contributions arising during the operational phase of the scheme are predicted to result in 'no likely significant effect' (i.e. not significant) on the nutrient nitrogen and acid Critical Loads at all considered ecological designations, and 'no likely significant effect' (i.e. not significant) on the annual mean NOx Critical Level at ecological receptors ER – E4. However, additional development trips and associated road traffic emission contributions arising during the operational phase of the scheme are predicted to result in impacts of >1% of the annual mean NOx Critical Level at ecological receptor ER1. The significance of effect on this receptor will be determined within Chapter 09 – Ecology of this ESA.

Environmental Statement Addendum – Chapter 11: Air Quality
Appendix 11.1

11 AIR QUALITY TECHNICAL APPENDIX – CONTENTS

TABLES

FIGURES

Road Traffic Dispersion Modelling Methodology

In order to appropriately assess road traffic emission impacts associated with the operational phase of the Proposed Development, including an assessment of the suitability of the Site for residential purposes, detailed dispersion modelling has been undertaken following guidance provided in the Department for Environment, Food and Rural Affairs (Defra)'s Local Air Quality Management Technical Guidance (LAQM.TG(22))[1]. This has utilised the Cambridge Environmental Research Consultants (CERC) ADMS-Roads v5 dispersion model, focussing on concentrations of oxides of nitrogen (NO_X), nitrogen dioxide (NO_2) and particulate matter (as PM_{10} and $PM_{2.5}$).

Presently, the construction works scheduled at the Proposed Development are split in three phases (Phases 1, 2 and 3) as outlined in Table 11.1-1. It should be noted that the scheduling and description of construction activities occurring within these phases provided are indicative.

Table 11.1-1 - Summary of Construction Phasing

Phase	Description of Works	End Dates
Phase 1	May Gurney (60-80 units)	Summer 2029
Phase 2	Road and bridge infrastructure	Summer 2031
Phase 3	Deal Ground (Wensum Edge 400-450 units and Marsh Reach 160-200 units)	Summer 2038

Therefore, for the purposes of this Chapter, the following scenarios have been modelled as agreed with the Norwich City Council (NCC) Environmental Health Officer (EHO[2]):

- 2019 Base Case (2019 BC) – Base flows for the year 2019;
- 2038 Do Minimum (2038 DM) – Without development flows for the assumed full year of opening (2038), inclusive of any relevant committed development flows; and
- 2038 Do Something (2038 DS) – 2038 DM flows, plus all trips associated with the Proposed Development for the proposed full year of opening (2038).

It is noted that mapped background concentrations and road vehicle emission factors are not forecast by Defra beyond 2030. Therefore, 2029 mapped background concentrations and 2029 road vehicle emission factors from the Emissions Factors Toolkit (EFT) have been presented and applied to the 2038 Proposed Development opening year. This assumption assumes collective trip generation associated with Phases 1-3, which is not anticipated to occur until 2038, occurs at the end of the Phase 1 completion in 2029.This approach is believed to be conservative, given the forecasted reductions in vehicle emission factors and background pollutant concentrations, generating a potential greater resultant concentration relative to what may occur in reality.

Furthermore, this facilitates a conservative assessment of the Site suitability for new residents as part of Phase 1 as it assumes that the maximum number of operational vehicle trips generated by the Proposed

[1] Local Air Quality Management Technical Guidance 22, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland. August 2022.

[2] Email conversation with Sally Nicholson, Environmental Protection Officer, Development and City Services, Norwich City Council and SLR Consulting Ltd, 20/04/2023.

Development as a whole (including Phases 2 and 3) will occur upon completion of the first phase (which is theoretically not possible) and therefore brings forward the date of likely exposure for new residents.

Traffic Inputs

Traffic data was provided by Odyssey – the appointed transport consultant. Traffic data inputs used in support of the operational phase assessment has been informed by analysis undertaken and presented within Chapter 10: Transport.

To inform the scope of Air Quality Chapter 11 to the ESA, updated location specific traffic surveys were completed by Odyssey to provide a 2023 baseline traffic dataset in the vicinity of the Site. 2023 traffic counts were adjusted to a 2019 baseline / verification year and 2038 completed development opening year by Odyssey. The location specific 2023 traffic counts were supplemented by 2019 traffic data obtained from the DfT traffic count website[3], a LAQM.TG(22) recommended source of traffic data. 2019 baseline DfT were adjusted to a 2038 completed development opening year using growth factors provided by Odyssey.

Traffic speeds were modelled at the relevant speed limit for each road as outlined in Table 11.1-2. However, where appropriate, the speeds have been reduced to simulate queues at junctions, traffic lights and other locations where queues or slower traffic are known to be an issue, in accordance with LAQM.TG(22). Traffic speeds have been assumed to be consistent across all the modelled scenarios.

The latest Emissions Factors Toolkit (EFT) (version 11.0) developed by Defra[4] has been used to determine vehicle emission factors for input into the ADMS-Roads dispersion model.

To initially inform the spatial extent of the model, changes in traffic volumes on the local road network were compared to screening thresholds provided within Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) guidance[5]:

- 500 Light Duty Vehicles (LDV) and/or 100 Heavy Duty Vehicles (HDV) as 24-hour Annual Average Daily Traffic (AADT) at locations away from an AQMA; and
- 100 LDV and/or 100 HDV as 24-hour AADT at locations within or adjacent to an Air Quality Management Area (AQMA).

Where relevant, neighbouring links within 200m[6] of considered receptor locations were also included within the dispersion model to facilitate a robust assessment, rather than rely on their individual contributions being represented within the appropriate background datasets.

Additional traffic flows from nearby consented developments have been included within the traffic data used within the dispersion modelling scenarios, through the use of standard location specific TEMPro growth factors. Reference should be made to Chapter 10 Transport for further details. As such, the

[3] Department for Transport, Road Traffic Statistics website. https://roadtraffic.dft.gov.uk/.

[4] Defra, EFT v11.0 (2021). https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html.

[5] EPUK and IAQM, Land-Use Planning and Development Control: Planning for Air Quality, v1.2 2017.

[6] The Design Manual for Roads and Bridges (DMRB) LA 105 guidance (DMRB, LA 105-Air Quality, Highways England, 2019) states receptors, including ecological designations, within 200m of an 'affected road' source, require further assessment of potential impacts.

cumulative effects of nearby consented schemes has been taken into consideration during this assessment in terms of operational phase road traffic emissions.

Details of the traffic flows used in this assessment are provided in Table 11.1-2, whilst the modelled roads in relation to the Site are presented in Figure 11.1-5.

Table 11.1-2 - Traffic Data Used Within the Assessment

Link ID	Link	2019 BC		2038 DM		2038 DS		Speed (kph) [(A)]
		AADT	% HDV	AADT	% HDV	AADT	% HDV	
L0	Site Access	0	0.0	0	0.0	2,499	0.0	48
L1	Bracondale	3,652	10.7	4,404	10.7	6,865	6.9	64/48
L2	Martineau Lane	25,221	7.9	30,414	7.9	31,645	7.6	64
L3	A147 (east)	23,648	6.8	28,518	6.8	29,749	6.5	64/48
L4	A147 (to Ber Street)	13,086	7.9	15,780	7.9	16,248	7.7	48
L5	A147 North (to King Street)	21,438	5.7	25,853	5.7	26,616	5.6	48
L6	A147 North (to Koblenz Avenue)	20,517	6.3	24,742	6.3	25,505	6.1	48
L7	A147 (to Hall Road)	13,086	7.9	15,780	7.9	16,248	7.7	48
L8	A147 (to Brazen Gate)	18,184	11.4	21,928	11.4	22,396	11.2	48
L9	A146	35,994	4.0	43,406	3.7	44,307	3.7	64/80
L9E	A146 Eastbound	18,443	3.0	22,241	3.1	22,676	3.0	64/80
L9W	A146 Westbound	18,775	3.0	22,641	3.1	23,107	3.1	64/80
L10	The Street	3,652	10.7	4,404	10.7	4,442	10.6	32/48
L11	Barrett Road	15,311	2.9	18,464	2.9	18,794	2.9	48/64

Note:
A) Speeds based upon National Speed Limits. Traffic speeds have been adjusted to take into account queues and congestion in accordance with LAQM.TG(22).

Meteorological Data

To calculate pollutant concentrations at identified sensitive receptor locations the dispersion model uses sequential hourly meteorological data, including wind direction, wind speed, temperature, cloud cover and stability, which exert significant influence over atmospheric dispersion.

The dispersion modelling has been undertaken using 2019 data from the Norwich Airport meteorological station, located approximately 6.5km to the north of the Site – the closest representative meteorological station relative to the Site.

LAQM.TG(22) recommends that meteorological data should have a percentage of usable hours greater than 85%. 2019 meteorological data from Norwich Airport meteorological station includes 8,760 lines of usable hourly data for the year, i.e. 100% usable data. This is therefore suitable for the dispersion modelling exercise.

A surface roughness value of 0.5m was used to represent the dispersion site (parkland and open suburbia). Whereas a surface roughness value of 0.3m was used to represent the meteorological station (agricultural areas max).

A wind rose is presented in Figure 11.1-1

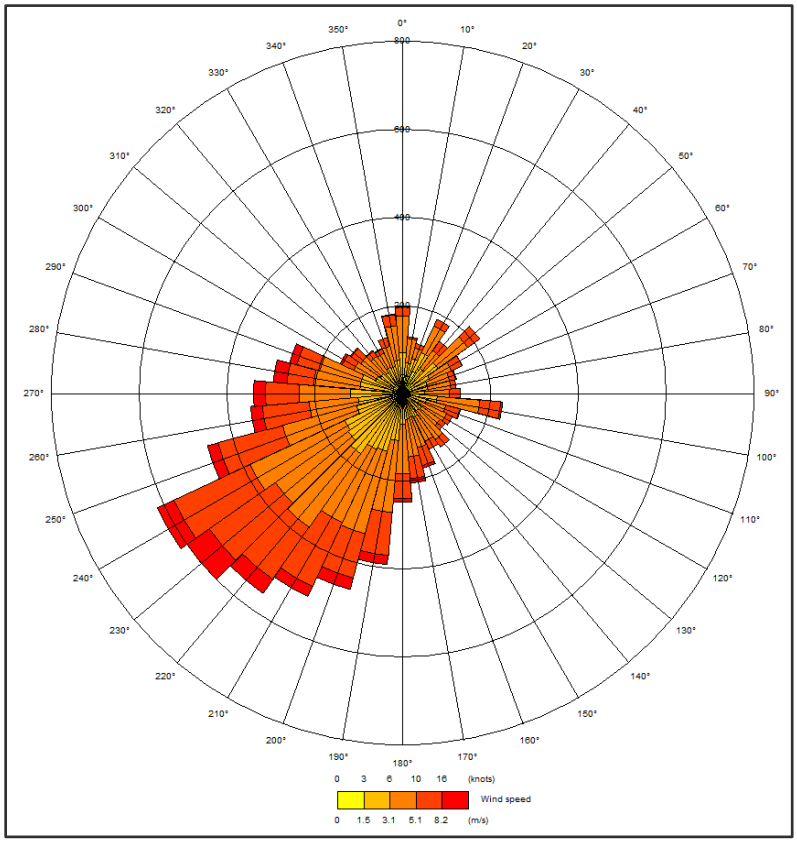

Figure 11.1-1 - Wind Rose for Norwich Airport Meteorological Station (2019)

Sensitive Receptors

Human Receptors

Human receptors considered in the assessment of emissions from road traffic are shown Table 11.1-3, whilst their locations are illustrated in Figure 11.1-5.

Receptors R1 – R15 are representative of worst-case exposure locations at existing receptors within the development locale, relative to the affected road network discussed.

New receptors introduced as a result of the Proposed Development, NR1 – NR6, are selected as the locations of worst-case exposure on the Site relative to the surrounding modelled road network.

All receptors were considered in relation to exposure at breathing height relative to the adjacent modelled road, at ground level, i.e. 0m, 1.5m or 2.5m height. Receptor locations represent relevant exposure – in accordance with LAQM.TG(22) presented in Table 11-2 of the ESA.

Table 11.1-3 - Receptor Locations Considered

Receptor	X (m)	Y (m)	Height (m)	Short-Term Only
Existing Receptors				
R1	624415	306984	1.5	N
R2	624357	306955	0	N
R3	624092	307279	1.5	N
R4	623997	307339	1.5	N
R5	623957	307566	1.5	N
R6	623957	307604	1.5	N
R7	623863	307674	1.5	N
R8	623884	307723	2.5	N
R9	623566	307665	1.5	N
R10	623521	307688	1.5	N
R11	623253	307797	1.5	N
R12	623934	306766	1.5	N
R13	623921	306732	1.5	N
R14	624468	306420	0	N
R15	624674	306381	0	N
New Receptors				
NR1	624521	306951	1.5	N
NR2	624499	306968	1.5	N
NR3	624547	306960	1.5	N
NR4	624539	306984	1.5	N
NR5	624554	306980	1.5	N
NR6	624549	307175	1.5	N

Ecological Receptors

Table 11.1-4 details the ecological designations (with sensitive qualifying features) located within 200m of road links projected to experience developmental-generated vehicle movements requiring detailed assessment. These comprise one Local Nature Reserve (LNR) and one County Wildlife Site (CWS).

Their locations are Figure 11.1-5.

Table 11.1-4 - Sensitive Ecological Designations Considered Within the Modelling Assessment

ID	Name	Designation
ER1	Carrow Abbey Marsh and Trowse Meadows (CAM & TM)	CWS
ER2	Whitlingham	LNR

All receptors have assumed a height of 0m and are represented in the model using gridded and polygon boundary receptors (within 200m of the affected road) to identify the maximum modelled impact.

Details of baseline conditions for the above designations are provided in the 'Ecological Baseline Conditions' section below.

Background Concentrations

Ambient Concentrations

Annual mean background concentrations used for the purposes of the assessment have been obtained from the Defra supplied background maps (2018 reference year)[7], based on the 1km grid squares which cover the modelled area and considered human receptors. Applied background concentrations are presented within Table 11-14 of the main body of the Air Quality Chapter to the ESA.

It is acknowledged there is a local background monitoring site - AURN Norwich Lakenfields (CM2) located approximately 800m south-west of the Site, however preference was to utilise the Defra supplied background maps given its inclusion of background contributions from the minor roads near receptor locations and air quality monitoring locations applied within the verification assessment.

As the relationship between NO_2 and NO_X is not linear, the NO_2 Adjustment for NO_X Sector Removal Tool[8] has been used – in accordance with LAQM.TG(22). No adjustment for background concentration variability with height has been made.

Deposition Fluxes

Habitat specific background deposition rates have been obtained from the Air Pollution Information System (APIS) website, based on the 1km grid squares which cover the modelled area. Further detail on these datasets can be found in the 'Ecological Baseline Conditions' section below.

Ecological Baseline Conditions

Critical Loads, Critical Levels and background conditions vary at each ecological designation (based upon geography, sensitivity and interest features). APIS has been used to provide details of baseline conditions at the assessed ecological designations requiring detailed assessment. APIS is a support tool for the assessment of potential effects of air pollutants on habitats and species, developed in partnership by the UK conservation agencies and regulatory agencies and the Centre for Ecology and Hydrology.

APIS provides a 3-year background dataset (based upon an average of 2018/2019/2020, as a 2019 annual mean concentration) with no forecast reductions allowing for future year projection. However, preference was to utilise the Defra supplied background concentration estimates for the purposes of the ecological road traffic modelling assessment to maintain consistency with the verification procedure and incorporate the future projection of concentration estimates given that the completed development opening year, and maximum potential road traffic emission contribution impact at ecological designations, will not occur until 2038 as indicated by the phasing plan.

For the assessment of locally important designations, Critical Loads / deposition rates were obtained via the 'search by location' function via APIS – requiring the location (NGR coordinate) and primary habitat type to be defined. Details of the applied assessed primary habitat type present at each designation were

[7] Defra Background Maps (2018-Reference) http://uk-air.defra.gov.uk/data/laqm-background-home.

[8] Defra NO_2 Adjustment for NO_x Sector Removal Tool (v8.0).

based upon information provided in the draft East Norwich Masterplan and South Yare Wildlife Group, State of the Natural Environment Report and confirmed by the project ecologist.

Where variables spatially vary (i.e. reported as 1km grid squares), worst case values reported across the whole assessed designation have been used (i.e. min Critical Loads / max background values). This approach assumes that the location of maximum impact coincides at the location of greatest sensitivity to facilitate a conservative assessment. Further detail is provided below.

Critical Levels

Table 11.1-5 details the applied baseline annual mean NO_X Critical Level conditions at each assessed ecological designation. The maximum background concentration for covering each designation has been reported.

As discussed, preference was to utilise the Defra supplied 1km background concentration estimates for the purposes of the ecological road traffic modelling assessment.

Table 11.1-5 - Baseline Annual Mean NOx Critical Level Conditions at Ecological Receptors

	NOx Annual Mean Concentration (µg/m^3)	
Site	**Critical Level**	**2029 Defra (2018-Reference) Max Background [(A)]**
ER1	30	12.92 [(A)]
ER2	30	12.92 [(A)]
Notes: (A) Grid Square (X, Y) (m): 624500, 307500.		

Critical Loads

Nutrient Nitrogen

Table 11.1-6 details the applied baseline nutrient nitrogen Critical Load conditions at each assessed ecological designation. The maximum background dataset for each designation has been reported.

Nutrient nitrogen critical loads are habitat / species specific (derived from a range of experimental studies) available via APIS. '*Indicative values within nutrient nitrogen critical load ranges for use in air pollution impact assessments*' presented on APIS[9] has been reviewed to source a corresponding nutrient nitrogen Critical Loads by habitat type for the corresponding ecological receptors. The project ecologist confirmed which habitat to apply. The current loads have been calculated based upon the location of maximum road traffic emission contribution / impact from the Site to facilitate a worst-case assessment.

Table 11.1-6 - Baseline Nutrient Nitrogen Critical Load Conditions at Ecological Receptors

		Critical Load Range (Min – Max)	**Critical Load Applied in Assessment**	**Current Load**
Site	**Nitrogen Class/Habitat**	**(kgN/ha/yr)**		
ER1	Rich Fens	15 - 30	15	22.1
ER2	Neutral Grassland	20 - 30	30	22.1

[9] APIS, https://www.apis.ac.uk/indicative-critical-load-values [accessed May 2023].

Acidification

Table 11.1-7 details the applied baseline acidification Critical Load conditions at each assessed ecological designation. The maximum background dataset for each designation has been reported.

Acidification Critical Load are dependent on soil chemistry, as well as habitat type. In the UK, empirical Critical Load have been assigned at a 1km grid square resolution based upon the mineralogy and chemistry of the dominant soil series present in the grid square, as provided on APIS. Where there is spatial variation in these Critical Loads across an ecological designation, the minimum values have been reported.

The project ecologist confirmed which habitat to apply. It is noted APIS states that 'Rich Fens' habitats are not sensitive to acidification and, therefore, no Critical Load is stated and no assessment is provided.

Table 11.1-7 - Baseline Acidification Critical Load Conditions at Ecological Receptors

		Critical Load (Min)			Max Background	
		$CL_{max}S$	$CL_{min}N$	$CL_{max}N$	N	S
Site	Acidity Class/Habitat	(keq/ha/yr)				
ER1	Rich Fens	Not Sensitive				
ER2	Neutral Grassland	4	0.856	4.856	1.58	0.13

Model Outputs

Human Receptors

The background pollutant values have been used in conjunction with the concentrations predicted by the ADMS-Roads model to calculate predicted total annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ for each respective scenario.

For the prediction of annual mean NO_2 concentrations for all modelled scenarios at receptor locations, the road NO_X contributions have been converted to total NO_2 following the methodology in LAQM.TG(22) using the latest version of Defra's NOx to NO_2 conversion tool (v8.1)[10]. The modelled NO_2 road contribution was then added to the appropriate NO_2 background concentration value to obtain an overall total annual mean NO_2 concentration.

For the prediction of short-term NO_2 impacts, LAQM.TG(22) advises that it is valid to assume that exceedences of the 1-hour mean AQAL for NO_2 are unlikely to occur where the annual mean NO_2 concentration is <60µg/m^3. This approach has thus been adopted for the purposes of this assessment, at relevant receptor locations with an applicable exposure period.

For the prediction of short-term PM_{10}, LAQM.TG(22) provides an empirical relationship between the annual mean and the number of exceedences of the 24-hour mean AQAL for PM_{10} that can be calculated as follows:

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

This relationship has thus been adopted to determine whether exceedences of the short-term PM_{10} AQAL are likely in this assessment.

[10] Defra NO_x to NO_2 Calculator v8.1 (2020), available at https://laqm.defra.gov.uk/air-quality/air-quality-assessment/no2-adjustment-for-nox-sector-removal-tool/.

Verification of the ADMS-Roads assessment has been undertaken as the 'Model Verification' section below. All results presented in the assessment are those calculated following the process of model verification, using an adjustment factor of 2.576 for NO_2, PM_{10} and $PM_{2.5}$.

Ecological Receptors

Deposition Rates

Road dry deposition fluxes were calculated from the adjusted road-NO_2 using empirical methods provided within the Environment Agency's (EA) Air Quality Technical Advisory Group's (AQTAG) guidance[11], which are subsequently recommended within the IAQM's ecological guidance[12].

In recognition of the NO_X to NO_2 non-linear relationship (facilitated by the NO_X to NO_2 conversion tool), the above adjusted road NO_2 contribution used for screening nutrient nitrogen and acidity was derived through subtraction of modelled NO_2 concentrations from the scenarios discussed above (2038DM and 2038DS).

Road dry deposition fluxes were calculated using the following equation:

Dry deposition flux ($\mu g/m^2/s$) = ground level concentration ($\mu g/m^3$) x deposition velocity (m/s)

The applied deposition velocities for the relevant chemical species are provided in Table 11.1-8. These velocities vary, dependant on land use.

Table 11.1-8 - Applied Deposition Velocities

Chemical Species	Recommended Deposition Velocity (m/s)	
NO_2	Grassland	0.0015
	Woodland	0.0030

Critical Loads – Nutrient Nitrogen

For the assessment of nutrient nitrogen, the predicted road deposition rates were converted from $\mu g/m^2/s$ to units of kgN/ha/year using a standard conversion factor of 95.9.

Critical Loads – Acidification

For the assessment of acidification, the predicted road deposition rates were converted to units of equivalents (keq/ha/year), which is a measure of how acidifying the chemical species can be, by multiplying the dry deposition flux ($\mu g/m^2/s$) by the standard conversion factor of 6.84.

The calculation of the process contribution of nitrogen to the Critical Load function has been carried out according to the guidance on APIS[13], to determine which compound is the primary contributor to acidity in the local setting, as evidenced in Figure 11.1-2, where:

[11] AQTAG06 – Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air. Environment Agency, March 2014 version.

[12] Institute of Air Quality Management, A Guide to the Assessment of Air Quality Impacts on Designated Nature Conservation Sites. 2020.

[13] http://www.apis.ac.uk/clf-guidance [accessed May 2023].

- $CL_{max}S$ — the maximum critical load of sulphur, above which the deposition of sulphur alone would be considered to lead to an exceedance;
- $CL_{min}N$ — a measure of the ability of a system to "consume" deposited nitrogen (e.g. via immobilisation and uptake of the deposited nitrogen); and
- $CL_{max}N$ — the maximum critical load of acidifying nitrogen, above which the deposition of nitrogen alone would be considered to lead to an exceedence.

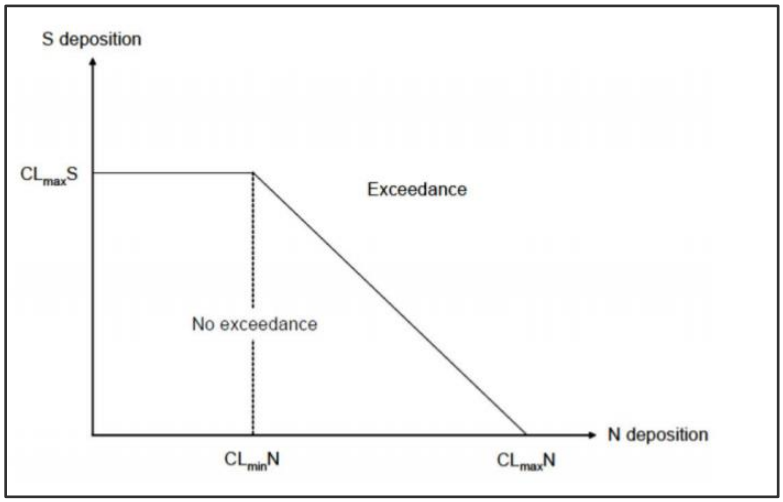

Figure 11.1-2 - Acidification Critical Load Function

As presented in Table 11.1-7, the total current N load is greater than the $CL_{min}N$ at all considered ecological receptors. Therefore, the assessment of additional NO_2 contributions to acid deposition has been undertaken against the $CL_{max}N$ Critical Load. Furthermore, given that sulphur vehicular emissions have not been calculated within this assessment (as standard practice for UK assessments – given the use of low sulphur fuels), the above acid critical load function has only considered inputs of nitrogen solely relative to '$CL_{max}N$'.

Uncertainty

Dispersion modelling is inherently uncertain and is principally reliant on the accuracy and representativity of its inputs. In acknowledgement of this, the ADMS-Roads dispersion model has been verified with the latest representative publicly available local monitoring data, as collected by NCC.

In addition, there is a widely acknowledged disparity between emission factors and ambient monitoring data[14]. To help minimise any associated uncertainty when forming conclusions from the results, this assessment has utilised the latest EFT (version 11.0) utilising COPERT 5.3 emission factors, and associated tools/datasets published by Defra.

Furthermore, the dispersion modelling assessment has utilised 2029 as the full development opening year, however in reality only the first phase is expected to be complete at this stage: 2038 is the completed development opening year. As such, use of 2029 as the completed development opening year introduces an element of conservatism into the assessment, bringing forward the date of completion. This is likely to exaggerate resultant absolute concentrations and impacts (concentration change), given the forecasted

[14] Carslaw, et al. (2011). Trends in NO_x and NO_2 emissions and ambient measurements in the UK.

reductions in vehicle emission factors and background pollutant concentrations. Use of further sensitivity modelling is not considered relevant or appropriate (i.e. too pessimistic).

MODEL VERIFICATION

The ADMS-Roads dispersion model has been widely validated for this type of assessment and is specifically listed in the Defra's LAQM.TG(22) guidance as an accepted dispersion model.

Model validation undertaken by the software developer (CERC) will not have included validation in the vicinity of the Site. It is therefore necessary to perform a comparison of modelled results with local monitoring data at relevant locations. This process of verification attempts to minimise modelling uncertainty and systematic error by correcting modelled results by an adjustment factor to gain greater confidence in the final results.

Prior to undertaking model verification, model setup parameters and input data were reviewed to maximise the performance of the dispersion model in relation to the real-world conditions.

Consistent with advice provided by Defra to local authorities across England, 2019 has been used for the purposes of model verification as relates to the most recent year of monitoring data available which hasn't been impacted by the COVID-19 pandemic. Use of monitoring data recorded in 2020 for the purposes of model verification introduces an element of uncertainty into the final adjusted modelled predictions, as monitoring conditions experienced for the majority of 2020 / 2021 are not deemed to be representative of long-term baseline conditions and could lead to a systematic underprediction at modelled receptor locations. This approach has been agreed with the EHO at NCC.**NOx / NO_2 Verification**

NOx / NO_2 verification relates to the comparison and adjustment of modelled road-NOx (as output from the ADMS-Roads dispersion model), relative to monitored road-NOx.

For NOx / NO_2 model verification, 2019 LAQM NCC monitoring data has been used for those roadside locations situated adjacent to a modelled link i.e. where traffic data exists (Table 11.1-9).

Table 11.1-9 - Local Monitoring Data Used for Model Verification

Site ID	X (m)	Y (m)	2019 Monitored NO_2 Concentration (µg/m^3)	2019 Data Capture (%)
DT1	623863	307679	34.2	100
DT21	623880	307659	29.4	100
DT22	623880	307659	30.9	100
DT31	623380	307700	38.6	100

As NO_2 concentrations are solely reported using diffusion tubes, NOx was back calculated using the latest version of Defra's NOx to NO_2 Calculator (v8.1). The NOx to NO_2 Calculator was also used to facilitate the conversion of modelled road-NOx (as output from the ADMS-Roads dispersion model) into road-NO_2.

Verification was completed using the 2019 Defra background mapped concentrations (2018 base year) for the relevant 1km x 1km grid squares (i.e. those within which the model verification locations are located), with those already modelled sources removed, to avoid duplication. This was limited to removal of 'Primary A Road in' for the verification assessment.

Initial comparison of the unadjusted modelled vs. monitored road NOx at all relevant verification locations outlined in Table 11.1-9 is provided in Table 11.1-11. An initial adjustment factor of 2.789 has been derived, based on a linear regression forced through zero, as shown in Figure 11.1-3.

Table 11.1-10 – NO_x / NO_2 Model Verification – Initial (2.789)

Site ID	Monitored Road NOx (µg/m³)	Modelled Road NOx (µg/m³)	Ratio (Monitored vs. Modelled Road NOx)	Adjustment Factor	Adjusted Modelled Total NO_2 (µg/m³)	Monitored Total NO_2 (µg/m³)	% Difference (Adjusted Modelled NO_2 vs Monitored NO_2)
DT1	40.1	8.1	5.0		25.8	34.2	-24.4
DT21	33.0	10.4	3.2		29.0	30.9	-6.1
DT22	29.9	11.4	2.6		30.3	29.4	+3.1
DT31	49.9	20.7	2.4	2.789	42.0	38.6	+8.7

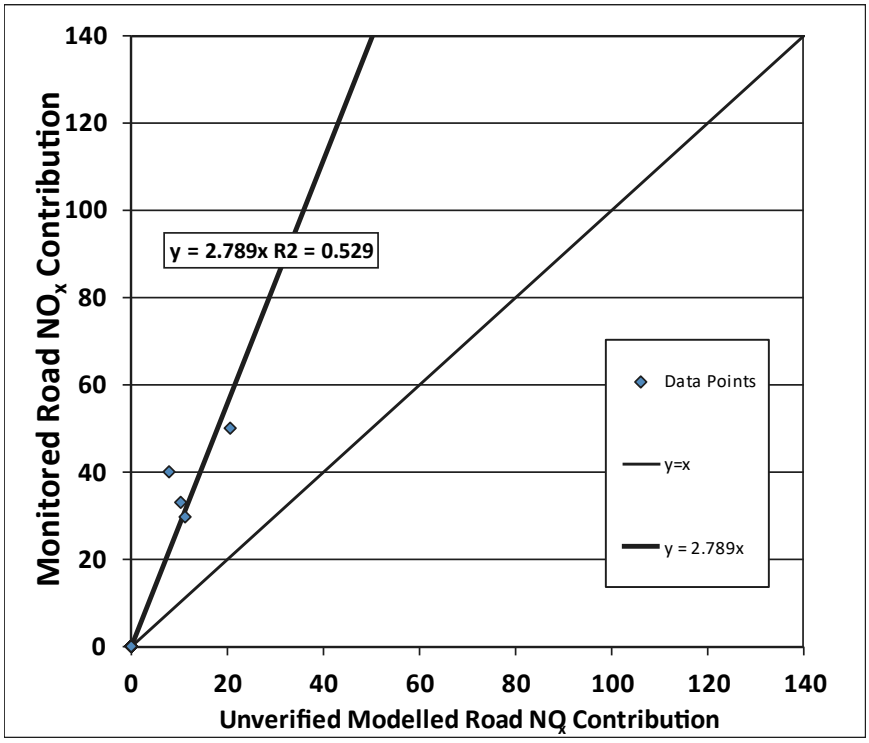

Figure 11.1-3 - Comparison of Modelled vs. Monitored Road NO_x Contribution - Initial (2.789)

LAQM.TG(22) states that:

> *"In order to provide more confidence in the model predictions and the decisions based on these, the majority of results should be within 25% of the monitored concentrations as a minimum, preferably within 10%".*

The difference between modelled vs. monitored NO_2 concentrations was inside the 25% recommended tolerance at all locations, however within the 10% ideal tolerance at three locations. At DT1 there was a large underprediction in modelled NO_2 concentrations following adjustment with the initial factor (2.789). A review of the DT1 monitoring location (and surrounding modelled environments) was undertaken to understand the reason for modelled versus monitored concentrations. DT1 is located near King Street for which no traffic data was available and as such, road traffic emissions from King Street had not been captured in the model exercise.

The verification exercise was therefore repeated, however, omitting DT1.

Comparison of the unadjusted modelled vs. monitored road NOx at the three remaining verification locations is provided in Table 11.1-11. An adjustment factor of 2.576 has been derived, based on a linear regression forced through zero, as shown in Figure 11.1-4.

Table 11.1-11 - NO_x / NO_2 Model Verification - Final (2.576)

Site ID	Monitored Road NOx (µg/m³)	Modelled Road NOx (µg/m³)	Ratio (Monitored vs. Modelled Road NOx)	Adjustment Factor	Adjusted Modelled Total NO_2 (µg/m³)	Monitored Total NO_2 (µg/m³)	% Difference (Adjusted Modelled NO_2 vs Monitored NO_2)
DT21	33.0	10.4	3.2		28.0	30.9	-9.5
DT22	29.9	11.4	2.6		29.2	29.4	-0.8
DT31	49.9	20.7	2.4	2.576	40.1	38.6	+3.8

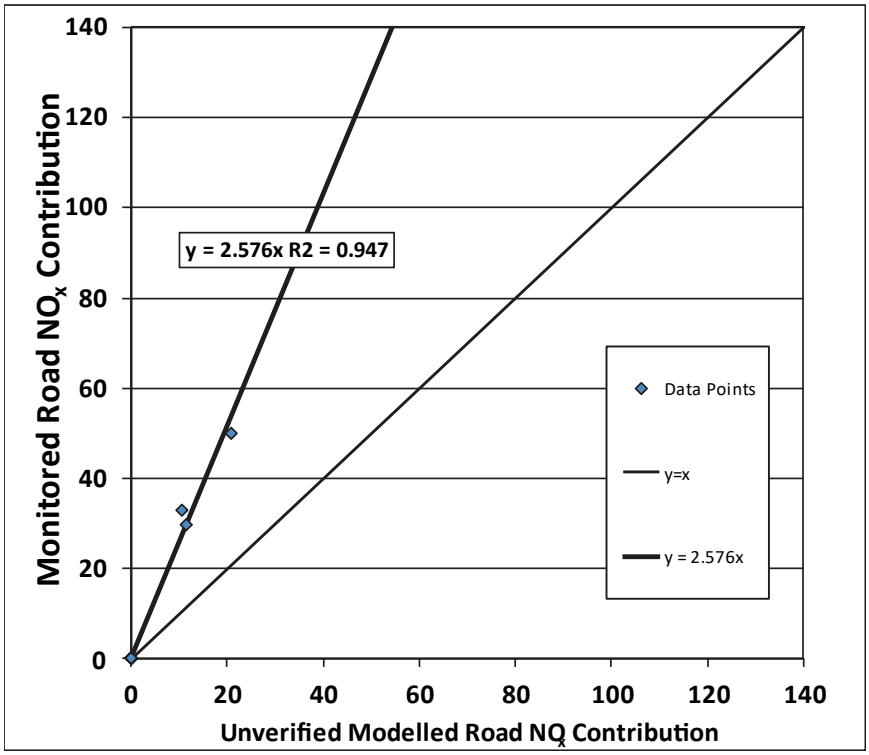

Figure 11.1-4 - Comparison of Modelled vs. Monitored Road NO_x Contribution - Final (2.576)

As noted in Table 11.1-11, the difference between the adjusted modelled NO_2 and monitored NO_2 is within ±10% at all verification locations and therefore within the ideal LAQM.TG(22) prescribed limit. In addition, a verification factor of 2.576 reduces the Root Mean Square Error (RMSE) from a value of 11.5µg/m³ to 1.9µg/m³ – within the ideal LAQM.TG(22) prescribed limit (10% of the annual mean AQAL). On this basis, the derived verification factor (2.576) was considered acceptable and was subsequently applied to all road-NOx concentrations predicted (as output of the ADMS Roads dispersion model).

No further improvement to the ADMS-Roads dispersion model could be achieved.

PM_{10} / $PM_{2.5}$ Verification

The adjustment factor of 2.576 was also applied to road-PM_{10} and $PM_{2.5}$ concentrations (as output of the ADMS Roads dispersion model), following the recommendations of LAQM.TG(22), in lieu of any roadside specific PM_{10} / $PM_{2.5}$ monitoring locations which could be applied to model verification.

FIGURES

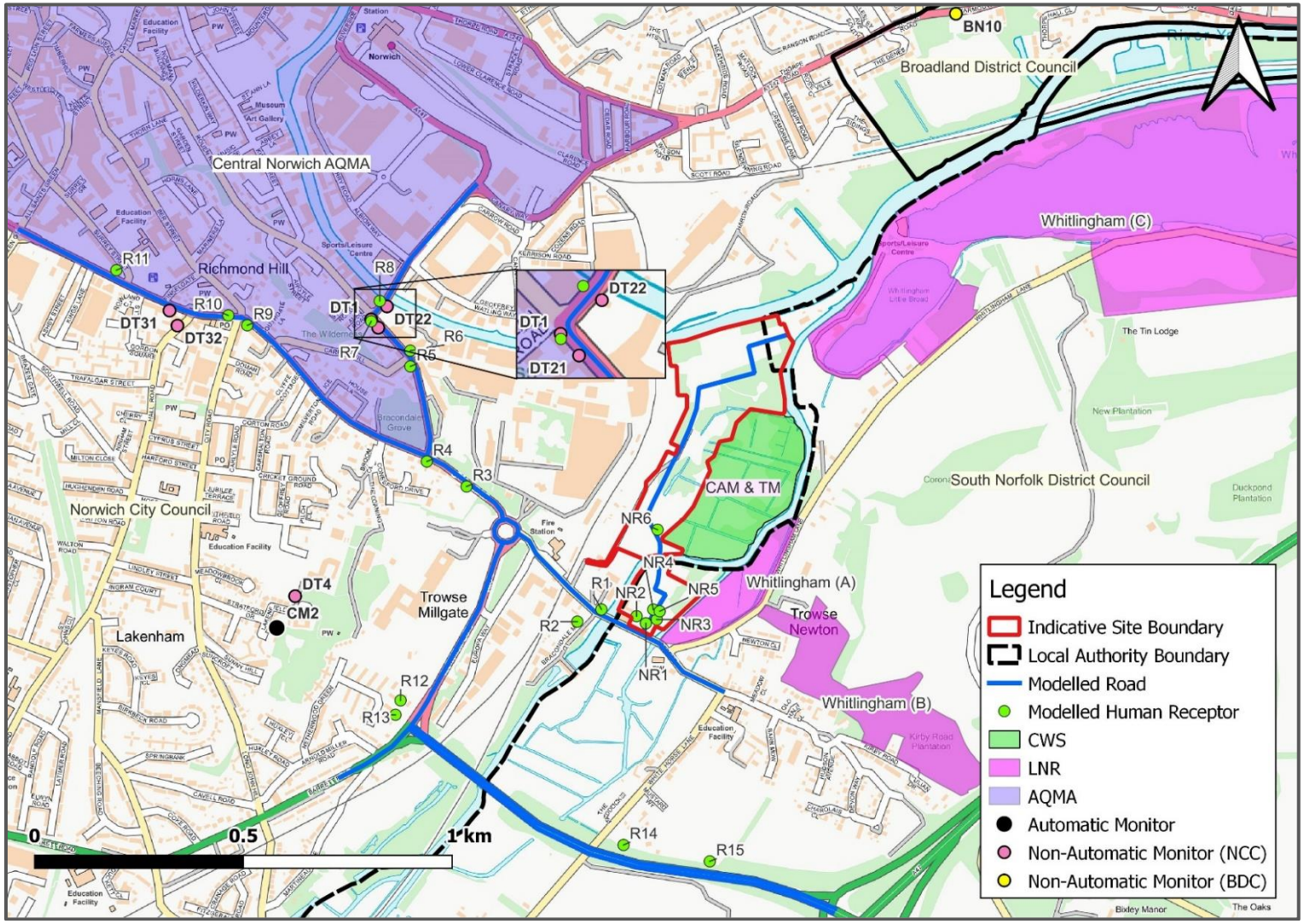

Figure 11.1-5 - Modelled Road Links, Receptors and Monitoring Locations

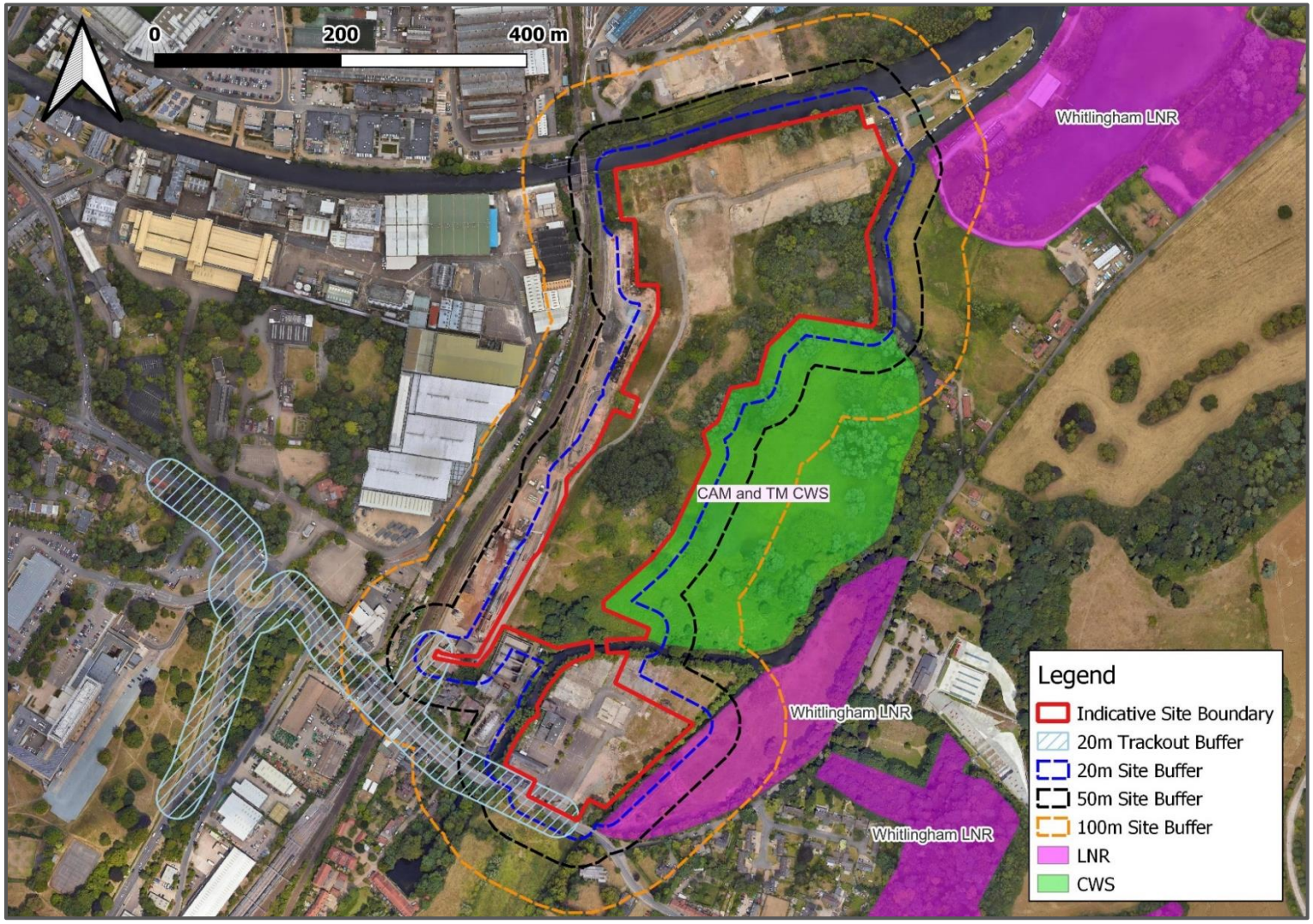

Figure 11.1-6 - Construction Dust Assessment Buffer

Figure 11.1-7 - Modelled NO_X Annual Mean Road Traffic Emission Contribution > 1% of Critical Level