Appendix 7.12

BIODIVERSITY AIR QUALITY MODELLING ASSESSMENT

Air Quality
CONSULTANTS

Biodiversity Air Quality Modelling Assessment: Hillingdon Water Sports Facility and Activity Centre (HWSFAC), Broadwater Lake

September 2023

Experts in air quality
management & assessment

Document Control

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Contents

Tables

Figures

1 Introduction

1.1 This report presents the potential changes to air quality at designated nature conservation sites associated with the construction and operation of the proposed recreational development at Hillingdon Water Sports Facility and Activity Centre (HWSFAC), Broadwater Lake, Moorhall Road, Harefield, Uxbridge UB9 6PE (hereafter referred to as the 'Site'). The proposed development is described as (hereafter referred to as the 'Development'):

"*Redevelopment of the site to create the Hillingdon Watersports Facility and Activity Centre including demolition of existing Broadwater Lake Sailing Club (BSC) clubhouse at the north of the lake and erection of a building to be occupied by HOAC and BSC including changing facilities, meeting rooms, storage, Workshop and seasonal worker accommodation (sui generis), activity shelters; installation of pontoons and concrete slipways; boat shed; equipment storage huts (north of lake and at entrance); boat parking and racking areas; camping area; outdoor activity areas; ecological enhancement throughout the site; new pedestrian routes through the peninsula; landscaping including new woodland, dense vegetation screens and boundary treatment; new access and access road; localised dredging and land reclamation; relocation of existing sailing area and creation of floating and fixed islands within the lake; coach drop off and turning area; vehicle parking; cycle parking; and associated works.*"

1.2 This report accompanies AQC report ref no. J20/13430A/10 (AQC, 2023) which describes the air quality effects on public health and those during the construction phase. It sets out the predicted air quality concentrations and deposition fluxes at nearby designated sites to allow the project ecologist (Greengage) to assess the potential for significant effects.

1.3 The Development will lead to changes in traffic flows on roads which pass within 200 m of designated nature conservation sites (the Mid Colne Valley Site of Special Scientific Interest (SSSI) and Harefield Pit SSSI; see Figure 1). Road traffic can emit nitrogen oxides (NOx) and ammonia, and some sensitive vegetation may be affected by elevated concentrations of these pollutants. Furthermore, the deposition of both NOx and ammonia can alter the nutrient and acidity balance of some ecosystems, causing changes to their composition and health. This assessment has quantified the changes to NOx and ammonia concentrations that would be caused by the Development, as well as the changes to nitrogen and acid deposition fluxes.

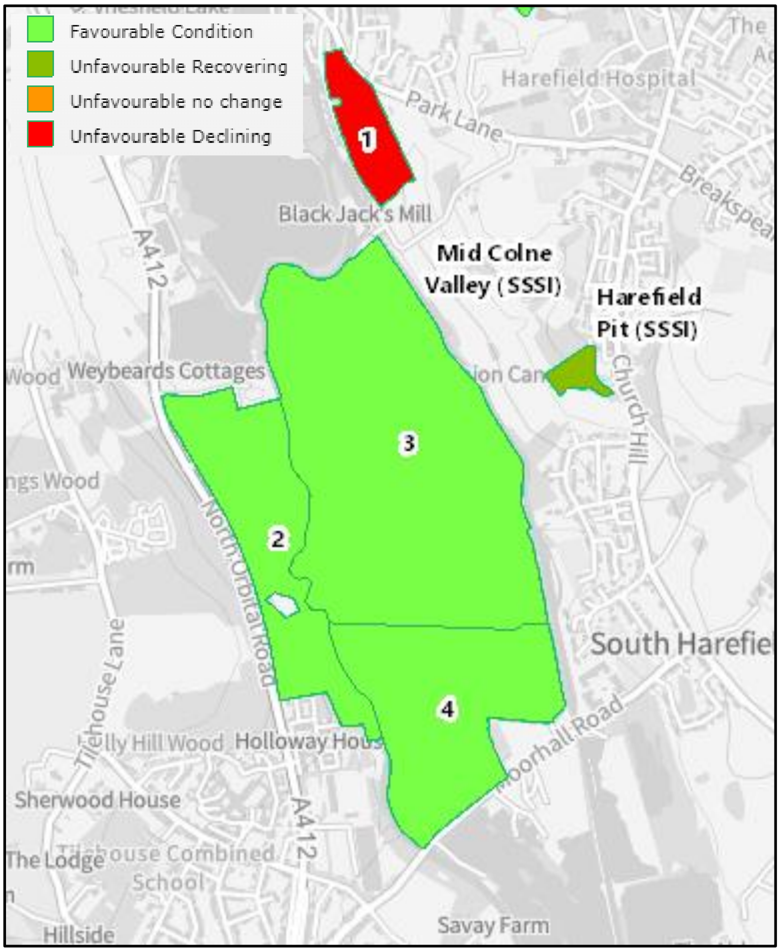

Figure 1: Designated Nature Conservation Sites near to the Proposed Development

Source: Defra MAGIC Map, 2023, online. Available: https://magic.defra.gov.uk/magicmap.aspx

1.4 In this report, the term 'impact' refers to a change to concentrations or deposition fluxes, while the term 'effect' refers to the consequence of that change. Because this is a screening report, the approach has been to consider changes to air quality and deposition in the context of *potential* effects on ecosystem health. This has relied on published and commonly accepted screening criteria which make worst-case assumptions regarding the sensitivity of any given habitat to air pollution effects. This assessment does not extend to defining the specific sensitivity of the habitats in practice and is thus worst-case.

1.5 This report describes existing local air quality conditions (base year 2019; 2020 and 2021 were not used due to the impacts of the Covid-19 pandemic, discussed further in Paragraphs 5.25 and 5.26), and the predicted air quality in the future assuming that the Development does, or does not proceed. The assessment of traffic-related impacts focuses on 2024, which is both the peak construction year and the anticipated year of partial opening.

1.6 This report has been prepared taking into account all relevant local and national guidance and regulations, and follows a methodology set out by the London Borough of Hillingdon (LBH). The professional experience of the consultants involved in the assessment is summarised in Appendix A1.

2 Policy Context

2.1 Protection of nature conservation sites is provided by an array of different local, national, and international policies. This effectively provides different levels of protection to different types of sites, as outlined below.

Sites of National and Local Importance

2.2 Sites of national importance are designated as SSSIs. Originally notified under the National Parks and Access to the Countryside Act (1949), SSSIs have been re-notified under the Wildlife and Countryside Act (1981). Improved provisions for the protection and management of SSSIs (in England and Wales) were introduced by the Countryside and Rights of Way Act (2000) (the "CROW" act). If a development is "*likely to damage*" a SSSI, the CROW act requires that a relevant conservation body (in this case Natural England (NE)) is consulted.

2.3 The CROW act also provides protection to local nature conservation sites, which can be particularly important in providing 'stepping stones' or 'buffers' to SSSIs and European sites. A broad range of site designations are included under the umbrella term of 'sites of local importance'. They are largely non-statutory designations, with sites identified by the local authority, the Wildlife Trusts, or other local groups. An ancient woodland inventory is provided by NE to identify the locations of the main historic woodlands. It is important to note, however, that local site designations, including ancient woodlands, are frequently updated and that there is no single published database which includes all sites. It is thus necessary to apply professional judgement in determining the key locations where a proposed project might have air quality effects, noting that sites which are both highly sensitive and highly valuable would be expected to be designated as being of national or international importance.

2.4 The CROW act is less prescriptive than the Habitats Regulations in terms of assessment approach. In particular, the requirement to ensure the absence of Likely Significant Effect ('LSE') in combination with other plans and projects is specific to the Regulations (and thus to European sites). This does not, however, mean that other plans and projects may be ignored with respect to impacts on nationally- and locally- designated sites. Planning policy (see the next section) defines the main assessment requirements with respect to the impacts of new developments on sites of national and local importance.

Planning Policy

National Policies

2.5 The National Planning Policy Framework (NPPF) (2021) sets out planning policy for England. It states that the purpose of the planning system is to contribute to the achievement of sustainable development, and that the planning system has three overarching objectives, one of which (Paragraph 8c) is an environmental objective:

"to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy".

2.6 With respect to protecting biodiversity, the NPPF places a heavy reliance on the designation status of sites (for example if they are designated as a SSSI), explaining that planning policies and decisions should contribute to and enhance the natural environment by:

"protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan)" (Paragraph 174).

Furthermore, *"Plans should: distinguish between the hierarchy of international, national and locally designated sites"* (Paragraph 175).

2.7 The NPPF provides specific guidance on determining planning applications with respect to protecting habitats and biodiversity, explaining that local planning authorities should apply the following principles:

a) *"if significant harm to biodiversity resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused;*

b) *development on land within or outside a Site of Special Scientific Interest, and which is likely to have an adverse effect on it (either individually or in combination with other developments), should not normally be permitted. The only exception is where the benefits of the development in the location proposed clearly outweigh both its likely impact on the features of the site that make it of special scientific interest, and any broader impacts on the national network of Sites of Special Scientific Interest;*

c) *development resulting in the loss or deterioration of irreplaceable habitats (such as ancient woodland and ancient or veteran trees) should be refused, unless there are wholly exceptional reasons and a suitable compensation strategy exists; and*

d) *development whose primary objective is to conserve or enhance biodiversity should be supported; while opportunities to improve biodiversity in and around developments should be integrated as part of their design, especially where this can secure measurable net gains for biodiversity or enhance public access to nature where this is appropriate"* (Paragraph 180).

2.8 In Paragraph 181, the NPPF explains that European sites, candidate or proposed European 2000 sites, and sites required as compensatory measures for effects on designated sites should be afforded the same planning protection as those with a statutory UK designation.

2.9 The NPPF is supported by Planning Practice Guidance (PPG) (Ministry of Housing, Communities & Local Government, 2019), which includes guiding principles on how planning can take account of the impacts of new development on air quality. Within the section on air quality, the PPG states that:

"Air quality considerations may … be relevant to obligations and policies relating to the conservation of nationally and internationally important habitats and species".

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

…whether the proposed development could significantly change air quality during the construction and operational phases (and the consequences of this for public health and biodiversity)".

2.10 The PPG sets out the information that may be required in an air quality assessment, making clear that:

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

Local Policies

2.11 The Local Plan Part 1: Strategic Policies (London Borough of Hillingdon, 2012) was adopted by LBH in November 2012, and includes one Strategic Objective (SO) and one policy directly related to biodiversity conservation. The relevant SO includes SO8: "*Protect and enhance biodiversity to support the necessary changes to adapt to climate change. Where possible, encourage the development of wildlife corridors*".

2.12 Policy EM7, 'Biodiversity and Geological Conservation', states that:

"The Council will review all the Borough grade Sites of Importance for Nature Conservation (SINCs). Deletions, amendments and new designations will be made where appropriate within the Hillingdon Local Plan: Part 2 – Site Specific Allocations Local Development Document. These designations will be based on previous recommendations made in discussions with the Greater London Authority.

Hillingdon's biodiversity and geological conservation will be preserved and enhanced with particular attention given to:

1. *The conservation and enhancement of the natural state of:*
    - *Harefield Gravel Pits*
    - *Colne Valley Regional Park*
    - *Fray's Farm Meadows*
    - *Harefield Pit*

2. *The protection and enhancement of all Sites of Importance for Nature Conservation. Sites with Metropolitan and Borough Grade 1 importance will be protected from any adverse impacts and loss. Borough Grade 2 and Sites of Local Importance will be protected from loss with harmful impacts mitigated through appropriate compensation.*

3. *The protection and enhancement of populations of protected species as well as priority species and habitats identified within the UK, London and the Hillingdon Biodiversity Action Plans.*

4. *Appropriate contributions from developers to help enhance Sites of Importance for Nature Conservation in close proximity to development and to deliver/assist in the delivery of actions within the Biodiversity Action Plan.*

5. *The provision of biodiversity improvements from all development, where feasible.*

6. *The provision of green roofs and living walls which contribute to biodiversity and help tackle climate change.*

7. *The use of sustainable drainage systems that promote ecological connectivity and natural habitats."*

2.13 LBH adopted the Local Plan Part 2: Development Management Policies (London Borough of Hillingdon, 2020) in January 2020, which delivers the detail of the strategic policies set out in the Local Plan Part 1: Strategic Policies. Together the documents form a comprehensive development strategy for the Borough up to 2026. The Local Plan Part 2 includes two policies that relate to biodiversity and are relevant to the Development.

2.14 Policy DMEI 7 'Biodiversity Protection and Enhancement' states that *"…B) If development is proposed on or near to a site considered to have features of ecological or geological value, applicants must submit appropriate surveys and assessments to demonstrate that the proposed development will not have unacceptable effects. The development must provide a positive contribution to the protection and enhancement of the site or feature of ecological value"*.

2.15 Policy DMCI 3 'Public Open Space Provision' states that *"…B) Development proposals within the immediate vicinity of public open space must not impact negatively on the amenity, ecological value and functionality of the space. All impacts must be mitigated through the design of the scheme"*.

3 Critical Levels and Critical Loads

3.1 EU Directive 2008/50/EC (The European Parliament and the Council of the European Union, 2008) sets a limit value for annual mean concentrations of nitrogen oxides and for annual and winter mean concentrations of sulphur dioxide. The same values have been set as domestic objectives within the Air Quality (England) Regulations (2000) and the Air Quality (England) (Amendment) Regulations (2002). The limit values and objectives only apply a) more than 20 km from an agglomeration (about 250,000 people), and b) more than 5 km from Part A industrial sources, motorways and built-up areas of more than 5,000 people.

3.2 Critical levels (CLes) and critical loads (CLos) are the ambient concentrations and deposition fluxes below which significant harmful effects to sensitive ecosystems are unlikely to occur. Some of the CLes are set at the same concentrations as the objectives but do not have the same spatial constraints on where they apply. Exceedances of the CLes and CLos are considered in the context of preventing harm to sites which are protected under the various designation frameworks outlined in Section 2. The CLes relevant to this assessment are set out in Table 1. The CLos are specific to different habitat types, and those which are most relevant to this assessment are provided in Table 2.

Table 1: Vegetation and Ecosystem CLes [a]

Pollutant	Time Period	CLe
Nitrogen Oxides (expressed as NO_2)	Annual Mean [a,b]	30 µg/m^3
	24-Hour Mean [a,c]	75 (200[d]) µg/m^3
Ammonia	Annual Mean	3 (1[e]) µg/m^3

a The CLes are defined by the World Health Organisation (WHO, 2000).

b Away from major sources (see Paragraph 3.1), this CLe is set as an objective (Defra, 2007) and a limit value (The European Parliament and the Council of the European Union, 2008).

c This CLe is not an objective and thus does not have the same legal standing.

d The CLe is 75 µg/m^3 but Natural England and IAQM both recommend that a value of 200 µg/m^3 is usually more appropriate for current UK conditions. The current assessment considers values of both 75 µg/m^3 and 200 µg/m^3.

e The more stringent CLe of 1 µg/m^3 only applies where lichens or bryophytes are present or form a key part of the ecosystem integrity.

Table 2: Vegetation and Ecosystem CLos

Habitat Type (and EUNIS code) [a]	Nutrient Nitrogen (kgN/ha/yr) [b]	Acid Deposition 'N_{max}' (keq/ha/yr) [c]
Bromus Erectus Lowland Calcareous Grassland (R1A)	10	4.856
Mixed Woodland [d]	10	4.856 [e]

a The European Nature Information System (European Environment Agency, 2021).

[b] CLos for nutrient nitrogen taken from (APIS, 2013).

[c] CLos for acid deposition have been taken from (APIS, 2023). N_{max} is the value above which additional nitrogen deposition will lead to an exceedance.

[d] The Mid Colne Valley SSSI is not designated for woodland habitat, and as such there is no specific CLo available on APIS for the woodland present on the site. A worst-case CLo of 10 kgN/ha/yr has therefore been used as to represent the woodland habitats on the site.

[e] As point [d] above. The acid deposition CLo for Lowland Calcareous Grassland has been used for woodland in this assessment.

4 Relevant Guidance

4.1 Different organisations have issued assessment guidance and screening criteria for different types of emissions sources and different site designations. This has resulted in different levels of protection being provided with respect to effects of the same pollutants on the same sites. There is no single official guidance document which fully covers the impacts assessed in this report and so it is helpful to consider the protection provided with respect to different development types.

Environment Agency

4.2 The Environment Agency has published criteria which allow impacts from developments requiring environmental permits to be rapidly screened out as insignificant (Environment Agency, 2021a; 2021b). These are applied to the impacts from developments in isolation (i.e., not in combination with other plans or projects). Exceeding these criteria does not mean that there is an LSE, it simply means that further consideration is required of the potential changes to air quality or deposition. No further assessment is required if the changes caused by the proposed development (termed the Process Contributions 'PC' by the Environment Agency) are all less than the relevant criteria in Table 3.

Table 3: Environment Agency Screening Criteria (% of CLe or CLo)

Site Type	Averaging Period [a]	Impacts of Ammonia Emissions from Intensive Pig and Poultry Farms	Impacts from Other Emissions
Nature 2000 Sites	LT	4% to 20% [b]	1%
	ST	- [c]	10%
SSSIs	LT	20% to 50% [b]	1%
	ST	- [c]	10%
NNRs, LNRs, LWS, and AW	LT or ST	100%	100%

[a] LT = Long Term (annual mean or 1-week mean), ST = Short-term (15-minute, 1-hour and 24-hour).

[b] The upper thresholds apply in where there are no other intensive farms which might affect the same receptors. Internally, the Environment Agency has begun requiring detailed modelling wherever the PC exceeds 4% of a CLe or CLo and the 20% criterion is not supported but is still recommended in the Environment Agency's published guidance.

[c] There is no short-term CLes for ammonia and no short-term CLos.

4.3 The Environment Agency (2021a) also notes that there is no need for further consideration of changes to concentrations or deposition fluxes if:

- the annual mean concentration or flux is less than 70% of the CLe or CLo; and
- the short-term Process Contribution is less than 20% of the short-term CLe minus twice the long-term background concentration.

4.4 These criteria have been widely applied to the results from detailed dispersion modelling but are principally intended by the Environment Agency to guide a decision as to whether detailed modelling is required, with changes below the criteria not requiring such modelling.

National Highways

4.5 National Highways (then Highways England) issued guidance on the assessment of air quality impacts caused by Highways England road schemes as part of its Design Manual for Roads and Bridges (DMRB). The current version of this guidance is LA 105 (Highways England, 2019). This states that the air quality impacts of each individual project should be scoped out from any further assessment where the changes caused by the project in isolation (i.e., not in combination with other plans or projects) do not meet any of the following criteria within 200 m of a designated site:

- annual average daily traffic (AADT) >=1,000; or
- heavy duty vehicle (HDV) AADT >=200; or
- a change in speed band; or
- a change in carriageway alignment by >=5m.

4.6 As with the Environment Agency criteria, National Highways uses these values to define when a more detailed consideration of air quality impacts is required and not to define an LSE.

4.7 Where detailed air quality modelling has been carried out, guidance from National Highways is that there will be no significant effect wherever:

- the total nitrogen deposition is less than the relevant CLo; OR
- the change to nitrogen deposition caused by the proposed development (alone) is <1% of the CLo.

4.8 Changes with respect to a CLe are also considered to be not significant where one of the above criteria is met.

4.9 Where the potential for an LSE cannot be discounted using the above criteria, National Highways refers to Table 21 of Natural England Report 210 (Caporn et al., 2016), which is reproduced in Appendix A4 of this current report. This table estimates the increase to nitrogen deposition which would reduce species richness by one species. National Highways states that the effects will be not significant (i.e., no LSE) if the increases to nitrogen deposition caused by the project alone (i.e., not in combination with other projects or plans) are smaller than those in Appendix A4. This approach is described here in order to add context to the more robust approach which has been followed in the current assessment.

Natural England

4.10 Natural England's guidance on advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations (Natural England, 2018) recommends the use of the DMRB criteria (see Paragraph 4.5) for changes to traffic caused by all types of plans or projects, and not just for highways schemes. In the same way, irrespective of their original derivation, Natural England (2018) adopts the 1% change criterion from the Environment Agency (Table 3) as a basis for screening out the need for more detailed assessment. It explains:

"the AADT thresholds and 1% of critical load/level are considered by Natural England's air quality specialists … to be suitably precautionary, as any emissions below this level are … considered to be imperceptible". It goes on: *"There can therefore be a high degree of confidence in* [the use of these criteria] *to screen for risks of an effect".*

4.11 Natural England (2018) further explains that the AADT criteria have "*been adopted here to simply help trigger when to look further where traffic projection data is the sole means of assessment –* [triggering the criteria] *does not immediately mean there will be an effect*".

4.12 A key difference between how these criteria are applied by Natural England (2018) when compared with both National Highways and the Environment Agency is that Natural England suggests that they should be applied first to the change caused by each individual project and then to the changes caused by relevant plans and projects in combination with one another.

4.13 Natural England provides guidance on which plans and projects should be considered within an in-combination assessment for European sites. It explains that this "*is restricted to plans and projects which are 'live' at the same time as the assessment being undertaken. These can potentially include:*

- *The incomplete or non-implemented parts of plans or projects that have already commenced;*
- *Plans or projects given consent or given effect but not yet started;*
- *Plans or projects currently subject to an application for consent or proposed to be given effect;*
- *Projects that are the subject of an outstanding appeal;*
- *Ongoing plans or projects that are the subject of regular review and renewal;*
- *Any draft plans being prepared by any public body;*
- *Any proposed plans or projects that are reasonably foreseeable and/or published for consultation prior to application."*

4.14 Natural England also explains that an exhaustive search for live plans or projects which could potentially fall within the scope of an 'in-combination' assessment is not necessary:

"it is Natural England's view that staff in a competent authority can apply their professional judgment when considering this. It might be that a pragmatic approach to identifying the most pertinent ones may be required from the competent authority. It might be reasonable to initially limit a search to those plans and projects which are of most direct relevance to the subject plan or project under HRA (i.e. the likelihood of that plan or project's effects impacting upon the same site in-combination with the proposed plan or project). This may be those which are simply the closest to the site or within a certain distance from it, or the most influential in nature."

4.15 Natural England also stresses that, at the screening stage, the competent authority must "*remember that the subject plan or project remains the focus of any in-combination assessment. Therefore, it is Natural England's view that care should be taken to avoid unnecessarily combining the insignificant effects of the subject plan or project with the effects of other plans or projects which can be considered significant in their own right… it is only the appreciable effects of those other plans and projects that are not themselves significant alone which are added into an in-combination assessment with the subject proposal.*"

IAQM

4.16 IAQM issued a guide to the assessment of air quality impacts on designated nature conservation sites in 2019, which was then amended in 2020 (Holman et al, 2020). This summarises the other guidance referred to above, but does not definitively recommend any one complete assessment approach. The limited areas where the IAQM guidance adds to, or unambiguously supports, that contained within other guidance documents are:

- on traffic screening criteria:
    - if the DMRB criteria (Paragraph 4.5) are used, they should be applied to changes in traffic caused by the development alone as well as in combination with other projects and plans;
- on the Environment Agency screening criteria:
    - the Environment Agency criteria (Paragraph 4.2) are suitable for screening the need for further assessment from all types of emissions sources where detailed air quality modelling has been carried out and not just those requiring environmental permits. The criteria should, though, "*be used in the context of an in-combination assessment*". The guidance also hints that the 100% criterion used by the Environment Agency for local site designations should not be used and that the 1% criterion should be used instead. The 100% criterion is not used in this assessment.
    - the 1% criterion should not be used rigidly, or with more precision than the modelling can justify (for example emphasising the difference between 0.9% and 1.1%);

  - that exceeding the 1% criterion is simply an indication that further investigation is needed and does not necessarily indicate an LSE;
- on defining in-combination projects:
  - projects and plans to be considered include those that may have been approved but are, as yet, incomplete, the subject of an outstanding appeal, or ongoing review;
- on receptor siting:
  - it is recommended that the predictions are not made closer than 2 m from the edge of the road; and
- on designation types:
  - the IAQM document covers all site designation types and thus suggests that the same overall assessment method should be applied regardless of the designation.

CIEEM

4.17 The Chartered Institute of Ecology and Environmental Management (CIEEM) has published advice on the Ecological Assessment of Air Quality Impacts (CIEEM, 2021), which is intended for use by both ecologists and air quality specialists. This provides six steps to exploring potential effects:

1) identifying the baseline ecological features and air quality;

2) assessing confounding factors, background pollution trends, the relative importance of each sector, and the sensitivity of the receptor;

3) determining if the CLes or CLos are exceeded;

4) applying the CLes and CLos with expert judgement;

5) considering the project duration and seasonal effects; and

6) considering the relative importance of ambient concentrations versus deposition fluxes.

JNCC

4.18 The Joint Nature Conservation Committee (JNCC) has published Decision-Making Thresholds (DMTs) and Site-Relevant Thresholds (SRTs) for air pollution (Chapman and Kite, 2021), which were developed for JNCC by AQC (AQC, 2021). The thresholds define changes caused by individual projects (i.e. not in combination with other projects and plans) which can be discounted as not significant without additional work. Where the appropriate thresholds are exceeded, then further assessment will be needed. The SRTs are for emissions from industry and agriculture and take account of the overall development pressure in an area. The DMT for road traffic takes account of the scale of each development within the context of overall traffic growth but is ultimately expressed as a proportion of the baseline traffic flow. The thresholds are set out in Table 4, with additional guidance on defining development density given in Table 5.

4.19 The JNCC guidance makes clear that an air quality assessment is only necessary if the effects of a project have not already been assessed. This is particularly relevant with respect to development sites which are allocated in strategic development plans which have themselves been considered through an HRA. For example, there is no need to consider impacts on a European site from a development site which is allocated within a Local Plan if those impacts have already been considered when developing that Plan. The guidance also makes clear that the study area for the assessment of impacts from road traffic should not extend more than 10 km from a plan boundary, and that impacts alongside the Strategic Road Network[1] only require consideration for road infrastructure schemes.

4.20 Where the DMT for road traffic in Table 4 is exceeded, a "road-relevant" approach may be taken based on the distance between the affected road and the nearest boundary of a designated site. The JNCC guidance recommends that professional judgement is used, taking account of the predicted reduction with distance away from the road, and a view as to whether other plans and projects are likely to cause a combined exceedance of the 1% criterion described in Paragraph 4.10 (Chapman and Kite, 2021).

4.21 There are specific exceptions where the JNCC criteria should not be used. These are summarised as:

- 'clean' or 'pristine' sites (i.e. those with very low existing levels of air pollution) where there is reason to doubt the improving background trend;
- sites with sensitive epiphytic or epilithic components that are, or form an important part of, a qualifying feature of the site and which are at or just below their CLo or CLe;
- sites with sensitive epiphytic or epilithic components that are, or form an important part of, a qualifying feature of the site and which are at or just below their CLo or CLe;
- sites with a highly localised and sensitive qualifying feature(s) that may coincide spatially with maxima of nitrogen deposition / ammonia concentrations from clusters of emission sources; and
- situations where it may be inappropriate to rely on DMTs because the assumptions which underpin them do not reflect the particular circumstances which apply (Chapman and Kite, 2021).

1 Our roads - Highways England, Official list of trunk roads (transport.gov.scot), Welsh Government strategic road network map | Traffic Wales, Link Corridors and Trunk Roads brochure | Department for Infrastructure (infrastructure-ni.gov.uk).

4.22 The development of these criteria included widespread consultation with ecology specialists and UK nature conservation agencies, as well as extensive legal review. The criteria are thus considered appropriate for use in this assessment.

Table 4: Site-Relevant and Decision-Making Thresholds for Application to Individual Plans and Projects (AQC, 2021)

Development Density	Very Low	Low	Medium	High
Site-Relevant Thresholds for On-site Emissions				
Annual Mean NH_3 (lichens/bryophytes) ($\mu g/m^3$)	0.0075	0.0034	0.0020	0.00079
Annual Mean NH_3 (higher plants) ($\mu g/m^3$)	0.022	0.010	0.0060	0.0024
Annual Mean NOx ($\mu g/m^3$)	0.087	0.046	0.030	0.014
Annual Mean N dep (woodland (kg-N/ha/yr)	0.13	0.057	0.034	0.013
Annual Mean N dep (grassland) (kg-N/ha/yr)	0.088	0.040	0.024	0.0093
Decision-Making Threshold for Road Traffic				
Increase in Traffic Flow	0.15% of AADT in the year that the assessment is carried out			

Table 5: Guidance on Defining Development Density for On-site Emissions (AQC, 2021)

Development Density	Very Low	Low	Medium	High
Description [a]	Remote area which sees very little development	Area which sees small amounts of development	Typical agriculture / industrial area	Area experiencing intensive growth (e.g. Powys or Immingham docks)
Example Number of additional new projects below the thresholds within 5 km of proposed development over 13 yrs [a]	1	5	10	30

[a] These might be either industrial or agricultural projects, or both.

5 Assessment Approach

Consultation

5.1 An Environmental Impact Assessment (EIA) Scoping Report was prepared and submitted to the LBH by Quod in February 2023, requesting a formal Scoping Opinion. A Scoping Opinion was subsequently received on 22 March 2023, in which LBH stated that the "*Effect of development on NOx concentrations and N critical loads due to emissions from traffic associated with the Proposed Development once operational*" should be scoped into the EIA, with the following reasoning:

"This aspect is scoped-in due to the need to ascertain the effect of NOx concentrations on sensitive species within the SSSI as well N deposition (wet and dry) on the critical loads for sensitive species within the study area. SSSI is listed as containing nitrogen- and acid-sensitive species. The operation phase development traffic may have the potential to cause an increase in ambient nitrogen oxides (NOx) levels, and dry (nitrogen) deposition rates and wet (acid) deposition rates, and thus impact upon the sensitive features of the designated site."

5.2 The response also detailed the methodology to be used in the modelling of the ecological impacts from the Development-generated traffic, both during the construction and operation of the Development. Specifically, it states:

"5 Methodology

a) Identification of affected roads;

b) Identification of designated sites sensitive to NOx concentrations and N-deposition within the study area;

c) Calculation of predicted concentrations of NOx concentrations and N-deposition in the baseline, and the anticipated opening year; and

d) Evaluation of the results of the modelling exercise against the criteria level / criteria loads for the two pollutants.

Identification of Designated Sites sensitive to NOx Concentrations and N-deposition

For the assessment of the likely impact of changes in air quality as a result of the Proposed Development on Mid-Colne Valley Site of Special Scientific Interest sensitive habitats, reference will be made to the Critical Levels of NOx and Critical Loads of Nitrogen Deposition for the relevant habitat types given on the Air Pollution Information System (APIS) website and in the Environment Agency's and Defra's website.

<u>Calculations of Predicted Concentrations of NOx Concentrations at Designated Sites</u>

An air pollution advanced dispersion modelling system is required to predict the baseline and future impacts of NOx emissions arising from road traffic onto the designated sites.

<u>Calculation of Nitrogen Deposition Impacts on Designated Sites</u>

The assessment is to be undertaken in accordance with current guidance which is summarized below:

a) Identification of habitats sensitive to nitrogen deposition

b) Calculating the Nitrogen Deposition Rate - The total average nitrogen deposition rate for the 5 x 5 km grid square containing the Mid-Colne Valley Site of Special Scientific Interest obtained from the APIS website. Mid-Colne Valley Site of Special Scientific Interest SSSI is covered by several 5 x 5 km grid squares and, therefore, the higher of the average nitrogen deposition rates is to be used in order to provide a worst-case assessment.

c) Background NOx and NO_2 Concentrations - Background concentrations of NOx and NO_2 obtained either from DEFRA's website or by using available monitored data (whichever is the highest value) for the baseline year. The baseline background concentrations are to be applied to all future assessment scenarios to provide a worst-case approach to the prediction of total NOx and NO_2 concentrations at the Mid-Colne Valley transects.

d) Calculating NO_2 road contribution concentrations along a Transect - The air quality dispersion model used to predict road contribution concentrations at the transect points selected representing worst case locations across the Mid-Colne Valley.

e) Calculating the Nitrogen Deposition Rate - The rate of nitrogen deposition due to dry deposition of NO_2 calculated along the selected transects using the factor of 1μg/m^3 of NO_2 = 0.1kg N ha-1 yr-1 as provided in the DMRB guidance.

f) Calculating the change in Nitrogen Deposition – The road contributions is then added to the APIS average nitrogen deposition rate to give the total deposition rate at each receptor."

Study Area

5.3 Consideration has been given to potential effects on the Mid Colney Valley SSSI and Harefield Pit SSSI within 200 m of roads on which traffic flows have been predicted by Robert West (the appointed transport consultants for the scheme) to increase as a result of the scheme. This is the distance used in guidance from National Highways (Highways England, 2019) and Natural England (2018).

5.4 Relevant habitat features within the designated sites, and where relevant their potential geographic extent, have been identified with reference to:

- APIS;
- Natural England;
- MAGIC maps[2]; and
- Aerial imagery.

5.5 The traffic data show that the construction and operational traffic generated by the Development will exceed the DMT of 0.15% of the existing AADT flow on the A412, Moorfield Road, Moorhall Road and Church Hill. The Harefield Pit SSSI (close to Church Hill) is designated for 'earth heritage', and as such is not considered a relevant receptor for this assessment as there are no features identified as being sensitive to air pollution. Unit 1 of the Mid Colne Valley SSSI (see Figure 1) is located adjacent to Park Lane, along which the Development is not expected to generate any traffic, and will thus not be considered further.

5.6 Development-generated traffic flows exceed the DMT within 200 m of Units 2 and 4 of the Mid Colne Valley SSSI (on the A412, Moorfield Road and Moorhall Road). The Natural England website (Natural England, 2023) shows that those units do not include the Lowland Calcareous Grassland habitat for which the SSSI is designated; the habitat is listed as 'standing open water and canals'. The Air Pollution Information System website (APIS, 2023) lists the Lowland Calcareous Grassland within the SSSI for its habitat interest, and the variety of breeding bird species and 'Mixed lowland damp grassland, scrub and woodland' for breeding interest.

5.7 The project ecologist (Greengage) has advised that Unit 2 includes grassland adjacent to the River Colne, however field surveys have shown that there is no grassland adjacent to Broadwater Lake. Further south than the field survey location there are several areas being used as High Speed Two (HS2) compounds adjacent to the A412. There is a large HS2 compound adjacent to Moorhall Road (within Unit 4 of the SSSI). There is grassland adjacent to Moorhall Road, and HS2 will be required to restore the land once construction is completed (2027 at the earliest).

5.8 While the SSSI Units adjacent to affected roads are not designated for sensitive habitats, they have nonetheless been assessed for the existing woodland, and potential grassland species (i.e., the areas that are currently used for HS2 and may be restored to grassland in the future). The impacts at open water areas have not been included within this assessment.

Receptors

5.9 Impacts have been predicted at transects of receptors running perpendicular to each affected road. These transects have the roadside receptors identified in Table 6 as their origin and extend 200 m from each road. The transects are shown in Figure 2 and Figure 3. All receptors and transects have

2 Defra MAGIC Map, 2023, online. Available: https://magic.defra.gov.uk/magicmap.aspx

been modelled at a height of 1.5 m to ensure consistency with the national background deposition modelling carried out on behalf of Defra and used within this assessment.

Table 6: Description of Transect Origin Locations for Mid Colne Valley SSSI

Transect	X coordinate	Y coordinate
Moorhall_1	504519.7	188349.7
Moorhall_2	504640.5	188447.6
Moorhall_3	504705.2	188637.6
Moorhall_4	504891.1	188716.4
A412_1	503638.8	189705.7
A412_2	503781.8	189464.7
A412_3	503910.1	189186.6
A412_4	503999.1	188801.7

[a] Only the location of the receptor at the start of each transect is given. Each transect extends 200 m from the affected road. The transects of receptors are described in Appendix A1.

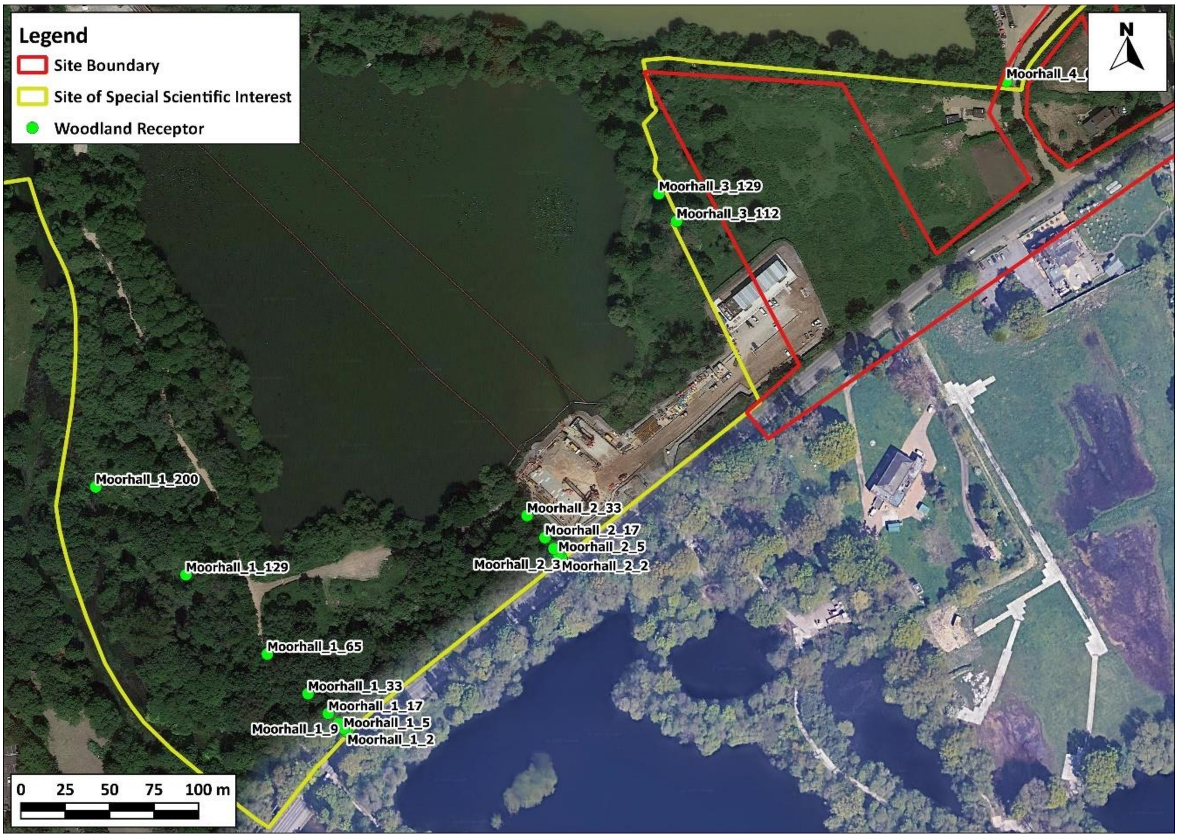

Figure 2: Transect Locations for Designated Conservation Sites – Moorhall Road

Imagery ©2023 Google, Imagery © 2023 Bluesky, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2023

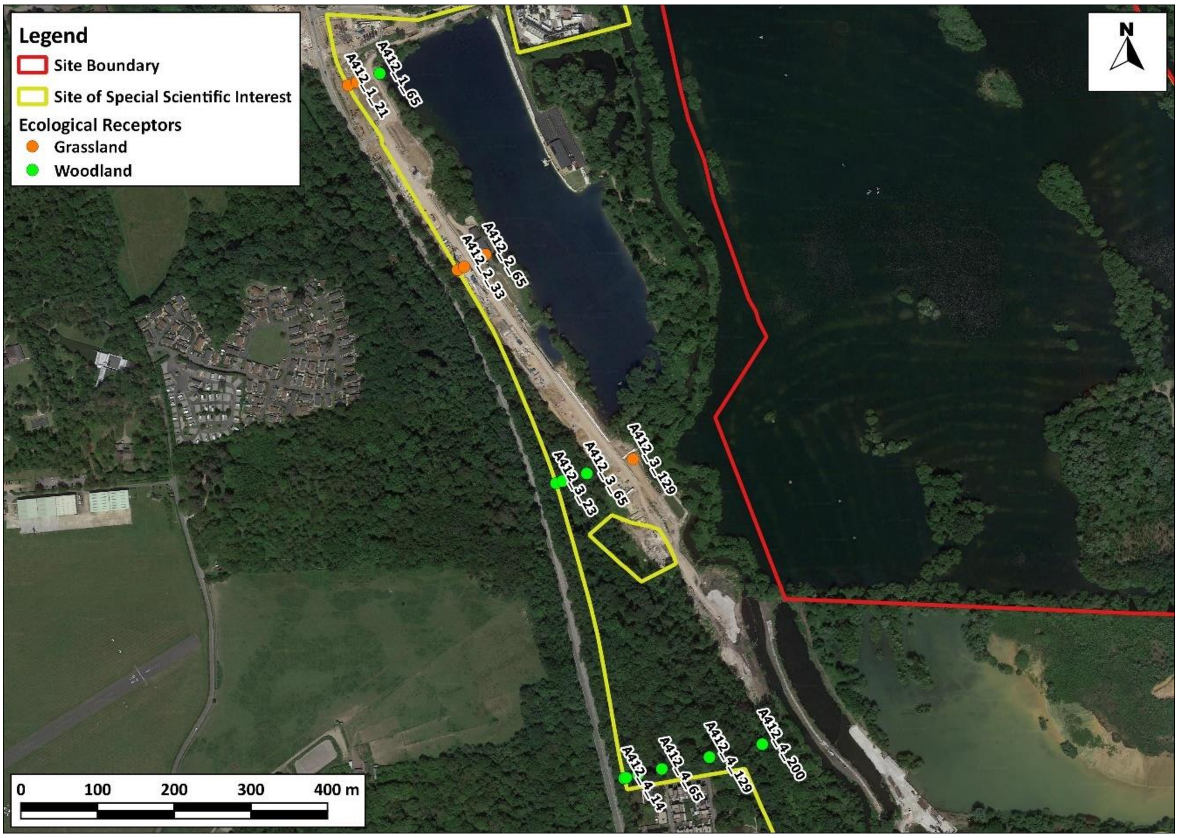

Figure 3: Transect Locations for Designated Conservation Sites – North Orbital Road (A412)

Imagery ©2023 Google, Imagery © 2023 Bluesky, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2023

Modelling Methodology

5.10 Concentrations have been predicted using the ADMS-Roads dispersion model, with emissions of NOx derived using Defra's Emission Factor Toolkit (EFT) (v11.0) (Defra, 2023), and emissions of ammonia derived using AQC's Calculator for Road Emissions of Ammonia (CREAM) (v1A) model (AQC, 2020a). Traffic flows have been derived from data provided by the transport consultant (Robert West). The model results for NOx have been adjusted using a verification factor calculated using national measurements (see Appendix A5 for verification methodology), while those for ammonia were verified using the same dispersion model during development of the CREAM emissions model. Details of the model inputs and the model verification are provided in Appendix A5. Nitrogen and Acid deposition fluxes have been calculated from the predicted concentrations of nitrogen dioxide and ammonia.

5.11 Deposition has been calculated from the predicted ambient concentrations using the forest and grassland deposition velocities set out in Table A5.3 in Appendix A5. Both grassland and forest deposition velocities have been assessed because the habitats within this assessment may include both short and tall vegetation types.

Assessment Scenarios

5.12 NOx and ammonia concentrations, and nitrogen and acid deposition fluxes, have been predicted for the peak construction year and for the first year of operation. The peak construction year is anticipated in 2024. The anticipated first year of full operation is 2025, with the potential for a partial opening in 2024. Thus, the full operational traffic, and associated baseline flows for 2025 have been used for the assessment of impacts in 2024, to ensure a worst-case assessment. Predictions have been made for the following scenarios:

A) base year 2019;

B) **construction/operation** – 2024 without any increase in traffic from 2019 (including future-year emission factors, base-year background concentrations and fluxes and base-year traffic within the dispersion model);

C) **construction** - 2024 without the construction traffic associated with the Development but with the forecast background increase in traffic from 2019 (including future-year emissions factors and base-year background concentrations and fluxes);

operation - 2024 (utilising 2025 traffic flows), without the traffic associated with the operation of the Development but with the forecast background increase in traffic from 2019 (including future-year emissions factors and base-year background concentrations and fluxes);

D) **construction** - 2024 with both the construction of the Development and background traffic growth (including future-year emissions factors and base-year background concentrations and fluxes); and

operation – 2024 (utilising 2025 traffic flows), with both the fully operational Development and background traffic growth (including future-year emissions factors and base-year background concentrations and fluxes).

5.13 Predictions for 2024 are based on a return to ‘typical’ activity levels and assume no impact as a result of the Covid-19 pandemic in this year, to ensure a worst-case assessment (as the influence of the pandemic has generally been to reduce concentrations of the pollutants considered in this assessment); see Paragraphs 5.25 and 5.26.

5.14 The six 2024 scenarios have been compared to derive the impacts of the Development alone and in-combination with other projects and plans:

- the difference between scenarios C and D (for both construction and operation) represents the change caused by the Development which, for consistency with other regimes, is termed the Process Contribution (‘PC’);

- the difference between scenarios B and D (for both construction and operation) represents the In-Combination Change ('ICC').

5.15 Traffic data for the future year scenarios have been factored by the transport consultant to account for growth in flows due to in-combination projects. In addition, traffic flows associated with the construction of HS2 have been included in all seven scenarios, to ensure that the impacts of emissions from HS2 construction vehicles are considered. Further details are provided in Appendix A5.

Background Concentrations and Fluxes

5.16 Background concentrations of ammonia, and nitrogen and acid nitrogen deposition fluxes, have been taken from the APIS website (APIS, 2023). The ammonia concentrations and nitrogen deposition fluxes represent 1 km x 1 km averages, with the acid deposition fluxes representing 5 km x 5 km averages. APIS presents 3-year mean values, and the values centred on the calendar year of 2019 have been used in this assessment, to align with the baseline traffic data used. These have been adjusted to represent 3-year averages centred on 2024 using the rate of change, at each individual receptor, predicted using the 1 km x 1 km averages provided by JNCC, which were developed as part of the Business-as-Usual forecast in JNCC's Nitrogen Futures project[3].

5.17 Background concentrations of NOx and nitrogen dioxide have been defined using Defra's 2018-based background maps (Defra, 2023). These cover the whole of the UK on a 1 km x 1 km grid. The background annual mean nitrogen oxides and nitrogen dioxide maps for 2019 have been calibrated against concurrent measurements from national monitoring sites (AQC, 2020b). The calibration factor calculated has also been applied to future year backgrounds (see Paragraph A5.6).

5.18 The Mid Colne Valley SSSI covers more than one 5 km x 5 km area, as identified in the Scoping Response (Paragraph 5.2), however all of the modelled transects are located within a single 5 km x 5 km grid cell, and the acid deposition flux value for that grid cell has been used in this assessment. The modelled transects cover three 1 km x 1 km grid cells, and the maximum NOx, nitrogen dioxide and ammonia concentrations and nitrogen deposition fluxes from those three cells have been used in this assessment. As set out in Paragraph 5.2, no change between the baseline year and future year background concentrations or fluxes has been assumed.

5.19 Estimated background concentrations of NOx and ammonia are set out in Table 7. Background NOx concentrations are below the CLe. Background ammonia concentrations exceed the lower CLe.

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3 https://jncc.gov.uk/our-work/nitrogen-futures/. A linear rate of change has been assumed between 2017 and the 2030 Business as Usual scenario, with the APIS 2018 data scaled based on the location-specific predicted changes. Acid nitrogen deposition has been scaled proportionally to nutrient nitrogen.

Table 7: Estimated Annual Mean Background Pollutant Concentrations in 2019 (μg/m³)

Year	NOx	NO_2	NH_3
2019	24.6	16.8	1.4
CLe	**30**	**-**	**1 [a]**

[a] The more stringent CLe of 1 μg/m³ only applies where lichens or bryophytes are present or form a key part of the ecosystem integrity. While the APIS website states that they do not form a key part of the ecosystem integrity, they may be present at the site, thus the more stringent Cle has been used in this assessment.

5.20 Background nitrogen and acid nitrogen deposition fluxes for both forest and grassland habitat types are presented in Table 8. Predicted background nitrogen deposition rates exceeded the relevant CLo, whereas predicted background acid deposition rates do not exceed the relevant CLo.

Table 8: Estimated Annual Mean Background Deposition Fluxes in 2019 at the Mid Colne Valley SSSI (μg/m³)

Habitat Type	Nutrient Nitrogen Deposition (kgN/ha/yr)	Acid Nitrogen Deposition (keq/ha/yr)	Nutrient Nitrogen CLo (kgN/ha/yr)	Acid Nitrogen CLo (keq/ha/yr)
Forest	28.2	2.34	10	4.856
Grassland	15.9	1.35	10	4.856

Uncertainty

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

5.22 An important stage in the process of modelling road traffic emissions of is model verification, which involves comparing the model output with measured concentrations (see Appendix A5). There are no suitable roadside NOx or nitrogen dioxide monitoring sites to adjust the model against local measurements, and as such an average verification factor, based on a number of air quality impact assessments, has been used (see Paragraph A5.6). Similarly, there are no suitable roadside ammonia monitoring sites in the area which can be used to verify the modelled ammonia concentrations. Development of the CREAM model, which has been used in this assessment, included verifying the emissions model, combined with the ADMS-Roads dispersion model, against measurements from the most dense roadside ammonia monitoring network in Europe. The modelling has thus been verified as far as is possible.

5.23 Predicting pollutant concentrations in a future year will always be subject to greater uncertainty. For obvious reasons, the model cannot be verified in the future, and it is necessary to rely on a series of projections provided by DfT and Defra as to what will happen to traffic volumes, background pollutant concentrations and vehicle emissions. Historic versions of Defra's EFT tended to over-state emissions reductions into the future. However, analyses of the most recent versions of Defra's EFT carried out by AQC (2020c; 2020d) suggest that, on balance, these versions are unlikely to over-state the rate at which NOx emissions decline in the future at an 'average' site in the UK. In practice, the balance of evidence suggests that NOx concentrations are most likely to decline more quickly in the future, on average, than predicted by the current EFT, especially against a base year of 2016 or later. Using EFT v11.0 for future-year forecasts in this report thus provides a robust assessment, given that the model has been verified using an average factor taken from several studies, calculated against measurements made in 2019[4].

5.24 Historically, less attention has been given to calculating emissions of ammonia from road traffic than to calculating emissions of NOx. Future forecasts of traffic-related ammonia are thus quite uncertain. However, the CREAM model takes a deliberately conservative approach regarding these future uncertainties and can thus be considered robust.

5.25 Forecasts of future-year concentrations are usually based on measurements made during a recent year. They then take account of projected changes over time to factors such as the composition of the vehicle fleet and the uptake of other new technologies, as well as population increases etc. In early 2020, activity in the UK was disrupted by the Covid-19 pandemic. As a result, concentrations of traffic-related air pollutants fell appreciably (Defra Air Quality Expert Group, 2020). While the pandemic may cause long-lasting changes to travel activity patterns, it is reasonable to expect a return to more typical activity levels in the future. 2020 is thus likely to present as an atypically low pollution year for roadside pollutant concentrations, although recent analysis of 2021 data indicates that concentrations in that year were less affected (AQC, 2022).

5.26 It is not currently possible to make robust predictions of the rate at which travel activity patterns will return to historically-normal levels; or the extent of any long-lasting changes to travel behaviour. The most robust approach to making future-year projections is thus to base these on measurements made during 2019, and to use activity forecasts made before the impact of the pandemic was understood, which is the approach that has been taken in this assessment.

Assumptions

5.27 It is necessary to make a number of assumptions when carrying out an air quality assessment; in order to account for some of the uncertainty in the approach, as described above, assumptions made have generally sought to reflect a realistic worst-case scenario. Key assumptions made in carrying out this assessment include:

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4 EFT v11.0 includes emission factors for more future years than EFT v10.0, however the factors for the years assessed are identical in both versions.

- the assumption that the Development is complete and fully operational in 2024. This will have overestimated the traffic emissions and hence the 2024 "With Scheme" concentrations. In reality the Development is unlikely to be fully operational before 2025, thus it will not be generating its full traffic volumes until this year;
- the assumption that HS2 construction traffic will be using the affected road network in the baseline and future assessment years;
- the assumption that there will be no change in the background concentrations between the baseline year (2019) and assessment year (2024), as well as using the maximum background concentrations, will both provide a worst-case assessment; and
- that the Iver Water Works meteorological monitoring station appropriately represents conditions in the study area (this is discussed further in Appendix A5).

6 Impact Assessment

Changes to Traffic Flows

6.1 There are no roads within the study area on which the Development is predicted to increase traffic flows by more than the criteria defined by National Highways (Paragraph 4.5). There are, however, some roads on which the increase in traffic caused by the proposed development exceeds the DMT for road traffic defined by JNCC (Table 4) and these pass within 200 m of the Mid Colne Valley SSSI (Units 2 and 4). It has thus been necessary to consider the air quality impacts of the Development on these Units.

Air Quality Conditions at Worst-case Locations

6.2 Air quality conditions at the worst-case locations within the Mid Colne Valley SSSI, for the operational and construction traffic impacts are set out in Table 9 and Table 10, respectively. Predictions are presented for three separate locations:

- the receptor with highest predicted concentrations and fluxes;
- the receptor with the maximum PC; and
- the receptor with the maximum ICC.

6.3 Results are provided for all four assessment scenarios described in Paragraph 5.12.

Table 9: Air Quality Conditions at Worst-case Locations at Mid Colne Valley SSSI During Peak Construction

Year	2019	2024			CLe / CLo
Pollutant/Averaging Period	Existing Baseline	No Growth [a]	Without Development [b]	With Development [c]	
At Location with Maximum Concentration or Flux [d] and Maximum ICC					
Annual Mean NH_3 (µg/m^3)	2.25	2.31	2.35	2.35	**1**
Annual Mean NOx (µg/m^3)	58.36	42.91	43.57	43.60	**30**
24-Hr Mean NOx (µg/m^3)	92.77	74.08	74.90	74.94	**75/200**
Nitrogen Deposition (kg-N/ha/yr)	36.11	36.05	36.34	36.35	**10**
Acid Deposition (keq/ha/yr)	2.91	2.90	2.92	2.92	**4.856**
At Location with Maximum PC					
Annual Mean NH_3 (µg/m^3)	1.99	2.03	2.05	2.06	**1**
Annual Mean NOx (µg/m^3)	44.02	36.19	36.60	36.69	**30**
24-Hr Mean NOx (µg/m^3)	78.33	67.61	68.20	68.32	**75/200**
Nitrogen Deposition (kg-N/ha/yr)	33.71	33.67	33.87	33.91	**10**
Acid Deposition (keq/ha/yr)	2.73	2.73	2.74	2.75	**4.856**

[a] Assuming future-year emissions factors and base-year background concentrations/fluxes, but excluding any increase in traffic on local roads between 2019 and 2024.

[b] Assuming future-year emissions factors and base-year background concentrations/fluxes and forecast increase to traffic on local roads (excluding the Development) between 2019 and 2024.

[c] Assuming future-year emissions factors and base-year background concentrations/fluxes, forecast increases to traffic and the Development.

[d] These maxima might relate to different locations in different scenarios.

Table 10: Air Quality Conditions at Worst-case Locations at Mid Colne Valley SSSI During Full Operation

Year	2019	2024			CLe / CLo
Pollutant/Averaging Period	Existing Baseline	No Growth [a]	Without Development [b]	With Development [c]	
At Location with Maximum Concentration or Flux [d] and Maximum ICC					
Annual Mean NH_3 (µg/m^3)	2.25	2.31	2.36	2.36	**1**
Annual Mean NOx (µg/m^3)	58.36	42.91	43.73	43.76	**30**
24-Hr Mean NOx (µg/m^3)	92.77	74.08	75.10	75.13	**75/200**
Nitrogen Deposition (kg-N/ha/yr)	36.11	36.05	36.41	36.42	**10**
Acid Deposition (keq/ha/yr)	2.91	2.90	2.93	2.93	**4.856**
At Location with Maximum PC					
Annual Mean NH_3 (µg/m^3)	1.99	2.03	2.06	2.06	**1**
Annual Mean NOx (µg/m^3)	44.02	36.19	36.71	36.78	**30**
24-Hr Mean NOx (µg/m^3)	78.33	67.61	68.34	68.46	**75/200**
Nitrogen Deposition (kg-N/ha/yr)	33.71	33.67	33.92	33.96	**10**
Acid Deposition (keq/ha/yr)	2.73	2.73	2.75	2.75	**4.856**

[a] Assuming future-year emissions factors and base-year background concentrations/fluxes, but excluding any increase in traffic on local roads between 2019 and 2024.

[b] Assuming future-year emissions factors and base-year background concentrations/fluxes and forecast increase to traffic on local roads (excluding the Development) between 2019 and 2024.

[c] Assuming future-year emissions factors and base-year background concentrations/fluxes, forecast increases to traffic and the Development.

[d] These maxima might relate to different locations in different scenarios.

6.4 The annual mean CLe for NOx, during both the construction and operation of the Development, will be exceeded in 2024. In 2024, the maximum 24-hour mean NOx concentrations are not predicted to exceed either the CLe set by WHO or the value commonly recommended by Natural England, for either the operational or construction traffic impacts. Ammonia concentrations will exceed the worst-case CLe of 1 µg/m^3 in 2024 (the background concentrations are higher than the CLe; see Table 7).

6.5 The nitrogen deposition fluxes are predicted to exceed the CLo in 2024, due to the background concentrations being higher than the relevant standards (see Table 8). In contrast, the acid deposition fluxes are predicted to be below the CLo in 2024 and as such no exceedances are expected.

Changes to Air Quality at Worst-case Locations

6.6 Table 11 summarises the changes to concentrations and deposition fluxes at the worst-case identified locations during the construction of the Development. Table 12 expresses these changes in relation to the CLes (Table 1) and CLos (Table 2). The same, respective, information is shown in Table 13 and Table 14 for the operation of the Development.

Table 11: Summary of Worst-case Changes to Air Quality Conditions at Mid Colne Valley SSSI During Construction

Year	Change from Existing Baseline			ICC	PC
Pollutant/Averaging Period	Without IC[a]	With IC[a] Without Development	With IC[a] and With Development		
At Location with Maximum Concentration or Flux With IC + Development and Maximum ICC					
Annual Mean NH_3 (µg/m^3)	0.06	0.10	0.10	0.04	<0.01
Annual Mean NOx (µg/m^3)	-15.45	-14.79	-14.76	0.69	0.03
24-Hr Mean NOx (µg/m^3)	-18.69	-17.88	-17.83	0.86	0.04
Nitrogen Deposition (kg-N/ha/yr)	-0.06	0.22	0.24	0.30	0.01
Acid Deposition (keq/ha/yr)	<0.01	0.02	0.02	0.02	<0.01
At Location with Maximum PC					
Annual Mean NH_3 (µg/m^3)	0.04	0.07	0.07	0.03	<0.01
Annual Mean NOx (µg/m^3)	-7.83	-7.42	-7.34	0.50	0.08
24-Hr Mean NOx (µg/m^3)	-10.73	-10.14	-10.02	0.71	0.12
Nitrogen Deposition (kg-N/ha/yr)	-0.04	0.16	0.20	0.24	0.04
Acid Deposition (keq/ha/yr)	<0.01	0.01	0.01	0.02	<0.01

[a] i.e., with and without forecast increases to traffic which are unrelated to the Development.

Table 12: Summary of Worst-case Changes to Air Quality Conditions in the Mid Colne Valley SSSI as Percentage of Relevant Criteria [a] During Construction

Year	As % of CLe/CLo	
Pollutant/Averaging Period	**PC**	**ICC**
At Location with Maximum Concentration or Flux With IC + Development and Maximum ICC		
Annual Mean NH_3	0%	4%
Annual Mean NOx	0%	2%
24-Hr Mean NOx [b]	0%	1%
Nitrogen Deposition	0%	3%
Acid Deposition	0%	0%
At Location with Maximum PC		
Annual Mean NH_3	0%	3%
Annual Mean NOx	0%	2%
24-Hr Mean NOx [b]	0%	1%
Nitrogen Deposition	0%	2%
Acid Deposition	0%	0%

[a] Following guidance from the IAQM (Paragraph 4.16) percentage values have been rounded to the nearest whole number.

[b] Values are as a percentage of the lower Cle of 75 $\mu g/m^3$.

6.7 None of the predicted operational PCs are greater than 1% of the CLos/CLes. Thus, according to the guidance summarised in Section 4, the effects of the Development, when viewed in isolation, will be not significant and will not give rise to an LSE. The ICCs for annual mean NOx, annual mean ammonia and nitrogen deposition are greater than 1% of the CLos/CLes. Guidance from Natural England and IAQM (see Section 4) does not, therefore, allow the effects in-combination with other relevant projects to be immediately discounted due to operational impacts on concentrations of annual mean NOx and ammonia and nitrogen deposition fluxes.

Table 13: Summary of Worst-case Changes to Air Quality Conditions at Mid Colne Valley SSSI During Full Operation

Year	Change from Existing (2019) Baseline			ICC	PC
Pollutant/Averaging Period	Without IC[a]	With IC[a] Without Development	With IC[a] and With Development		
At Location with Maximum Concentration or Flux With IC + Development and of Maximum ICC					
Annual Mean NH_3 (µg/m^3)	0.06	0.11	0.11	0.04	<0.01
Annual Mean NOx (µg/m^3)	-15.45	-14.62	-14.60	0.85	0.02
24-Hr Mean NOx (µg/m^3)	-18.69	-17.67	-17.64	1.05	0.03
Nitrogen Deposition (kg-N/ha/yr)	-0.06	0.29	0.30	0.37	0.01
Acid Deposition (keq/ha/yr)	<0.01	0.02	0.02	0.03	<0.01
At Location with Maximum PC					
Annual Mean NH_3 (µg/m^3)	0.04	0.07	0.08	0.03	<0.01
Annual Mean NOx (µg/m^3)	-7.83	-7.32	-7.24	0.59	0.08
24-Hr Mean NOx (µg/m^3)	-10.73	-9.99	-9.88	0.85	0.11
Nitrogen Deposition (kg-N/ha/yr)	-0.04	0.20	0.24	0.28	0.04
Acid Deposition (keq/ha/yr)	<0.01	0.01	0.02	0.02	<0.01

[a] i.e., with and without forecast increases to traffic which are unrelated to the Development.

Table 14: Summary of Worst-case Changes to Air Quality Conditions in the Mid Colne Valley SSSI as Percentage of Relevant Criteria [a] During Full Operation

Year	As % of CLe/CLo	
Pollutant/Averaging Period	PC	ICC
At Location with Maximum Concentration or Flux With IC + Development and Maximum ICC		
Annual Mean NH_3	0%	4%
Annual Mean NOx	0%	3%
24-Hr Mean NOx [b]	0%	1%
Nitrogen Deposition	0%	4%
Acid Deposition	0%	1%
At Location with Maximum PC		
Annual Mean NH_3	0%	3%
Annual Mean NOx	0%	2%
24-Hr Mean NOx [b]	0%	1%
Nitrogen Deposition	0%	3%
Acid Deposition	0%	0%

[a] Following guidance from the IAQM (Paragraph 4.16) percentage values have been rounded to the nearest whole number.

[b] Values are as a percentage of the lower CLe of 75 µg/m^3.

6.8 None of the predicted construction PCs are greater than 1% of the CLos/CLes. Thus, according to the guidance summarised in Section 4, the effects of the construction of the Development, when viewed in isolation, will be not significant and will not give rise to an LSE. The ICCs for annual mean NOx, annual mean ammonia and nitrogen deposition are greater than 1% of the CLos/CLes. Guidance from Natural England and IAQM (see Section 4) does not, therefore, allow the effects in-combination with other relevant projects to be immediately discounted due to construction impacts on concentrations of annual mean NOx and ammonia and nitrogen deposition fluxes.

Spatial Distribution of Air Quality Impacts

6.9 Figure 4 and Figure 5 show the approximate spatial distribution of where the annual mean ICC NOx and ammonia changes are predicted to exceed 1% of the CLes across the Mid Colne Valley SSSI, during construction and operation, respectively.

6.10 For NOx, the area over which the ICC exceeds 1% of the CLe (when rounded) covers approximately 9,400 m^2 for the construction impacts and approximately 17,900 m^2 for the operational impacts (0.7% and 1.3% of the total SSSI area, respectively). Aerial imagery suggests that the area where the ICC exceeds 1% of the CLe is partially covered by existing woodland and the HS2 compounds.

6.11 For ammonia, the area over which the ICC exceeds 1% of the Cle (when rounded) covers approximately 36,000 m^2 for the construction impacts and approximately 90,000 m^2 for the operational impacts (2.5% and 6.4% of the total SSSI area, respectively). Aerial imagery suggests that the area where the ICC exceeds 1% of the CLe is partially covered by existing woodland and the HS2 compounds.

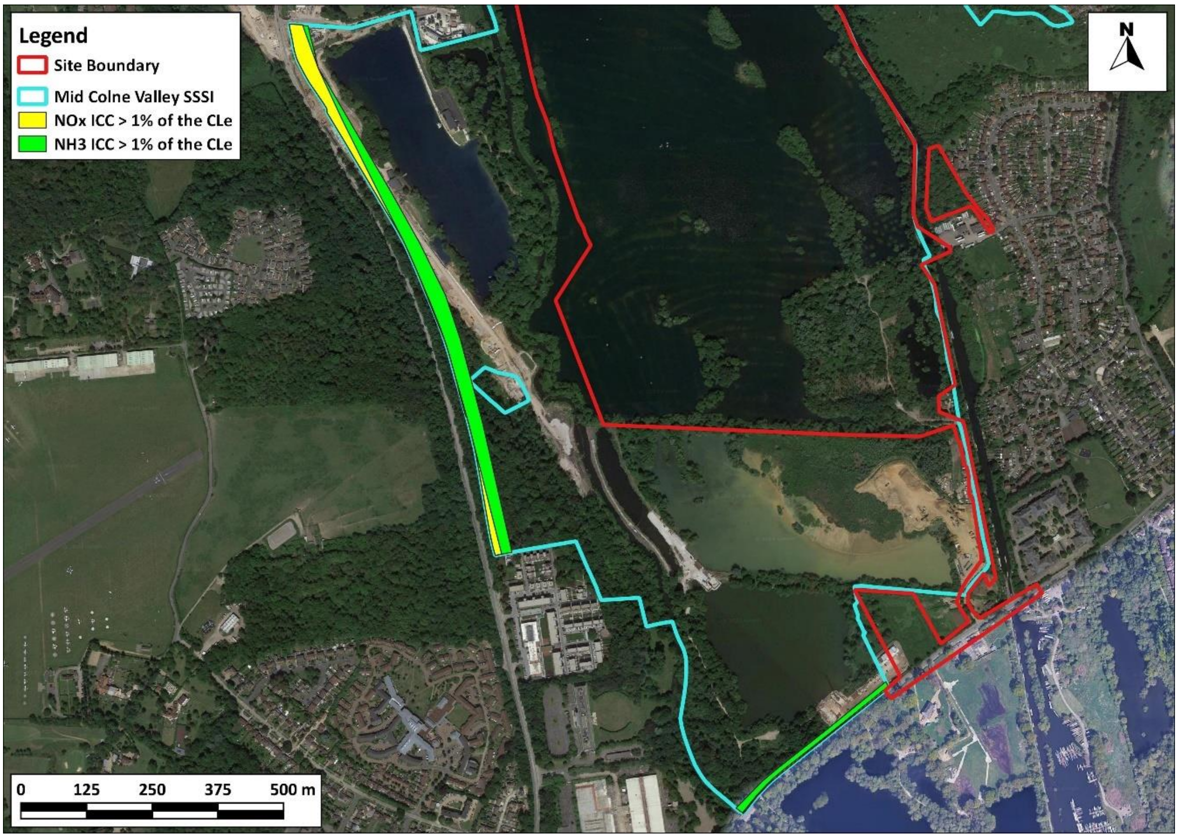

Figure 4: Area over which the Predicted ICC for Annual Mean NOx and NH_3 Exceed 1% of the CLes in the Mid Colne Valley SSSI During Construction

Imagery ©2023 Google, Imagery © 2023 Bluesky, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2023

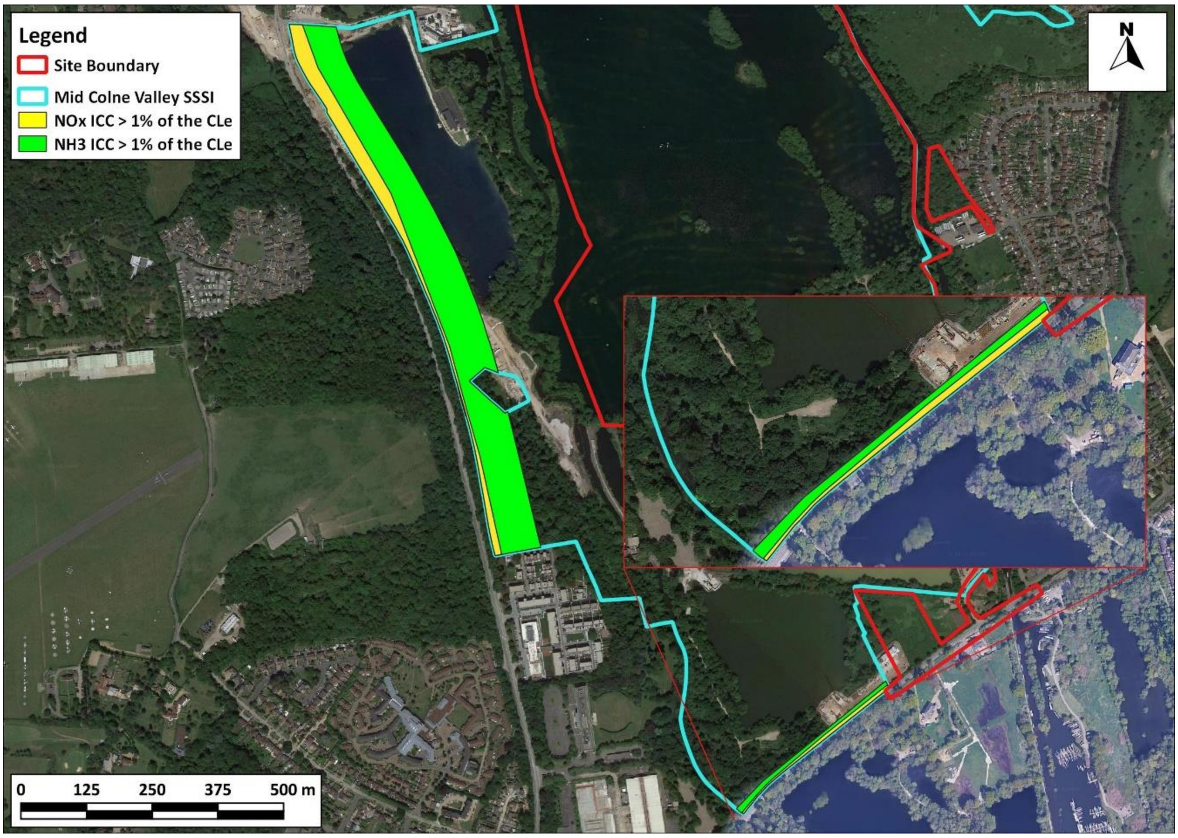

Figure 5: Area over which the Predicted ICC for Annual Mean NOx and NH_3 Exceed 1% of the CLes in the Mid Colne Valley SSSI During Operation

Imagery ©2023 Google, Imagery © 2023 Bluesky, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2023

6.12 Figure 6 and Figure 7 show the spatial distribution of the predicted nitrogen deposition changes across the Mid Colne Valley SSSI, during construction and operation respectively. The area over which the ICC exceeds 1% of the CLo (when rounded) covers approximately 20,000 m^2 for the construction impacts and approximately 44,000 m^2 for the operational impacts (1.4% and 3.1% of the total SSSI area, respectively). Aerial imagery suggests that the area where the ICC exceeds 1% of the CLo is partially covered by existing woodland and the HS2 compounds.

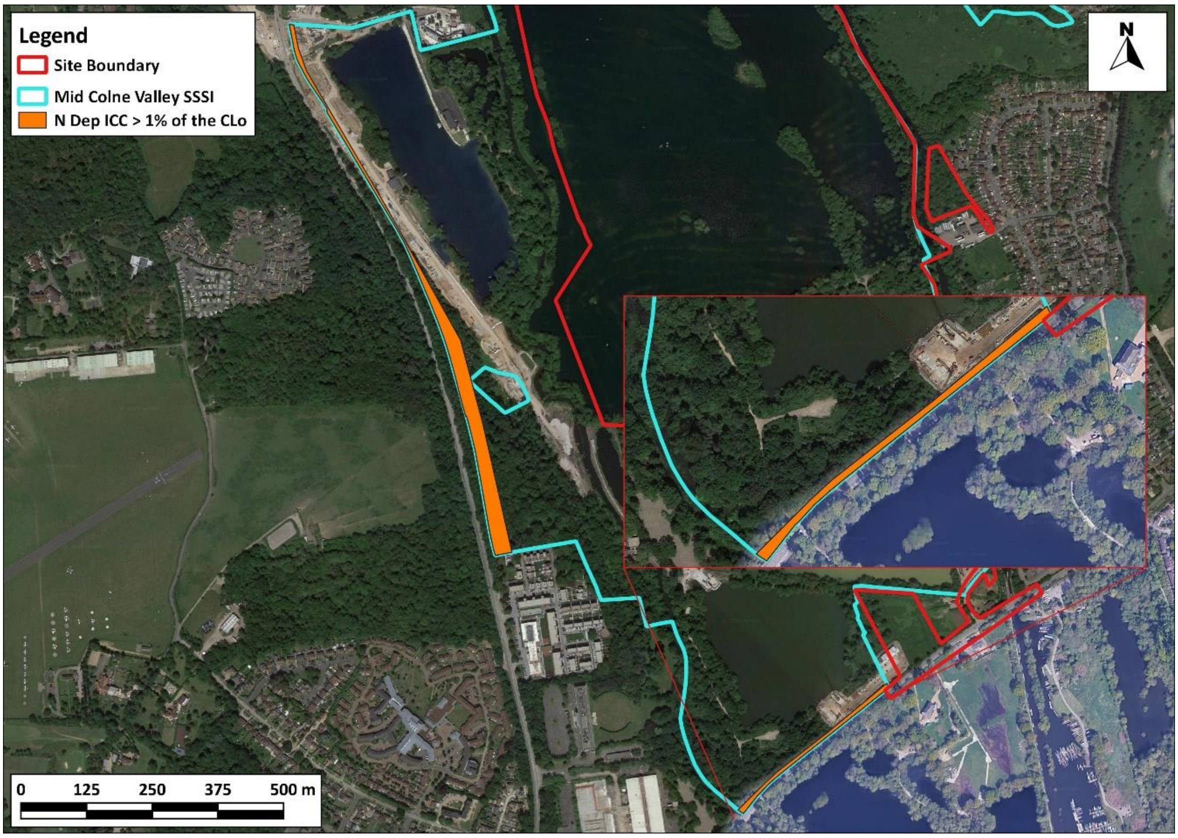

Figure 6: Area over which the Predicted ICC for Nitrogen Deposition Exceeds 1% of the CLo in the Mid Colne Valley SSSI During Construction

Imagery ©2023 Google, Imagery © 2023 Bluesky, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2023

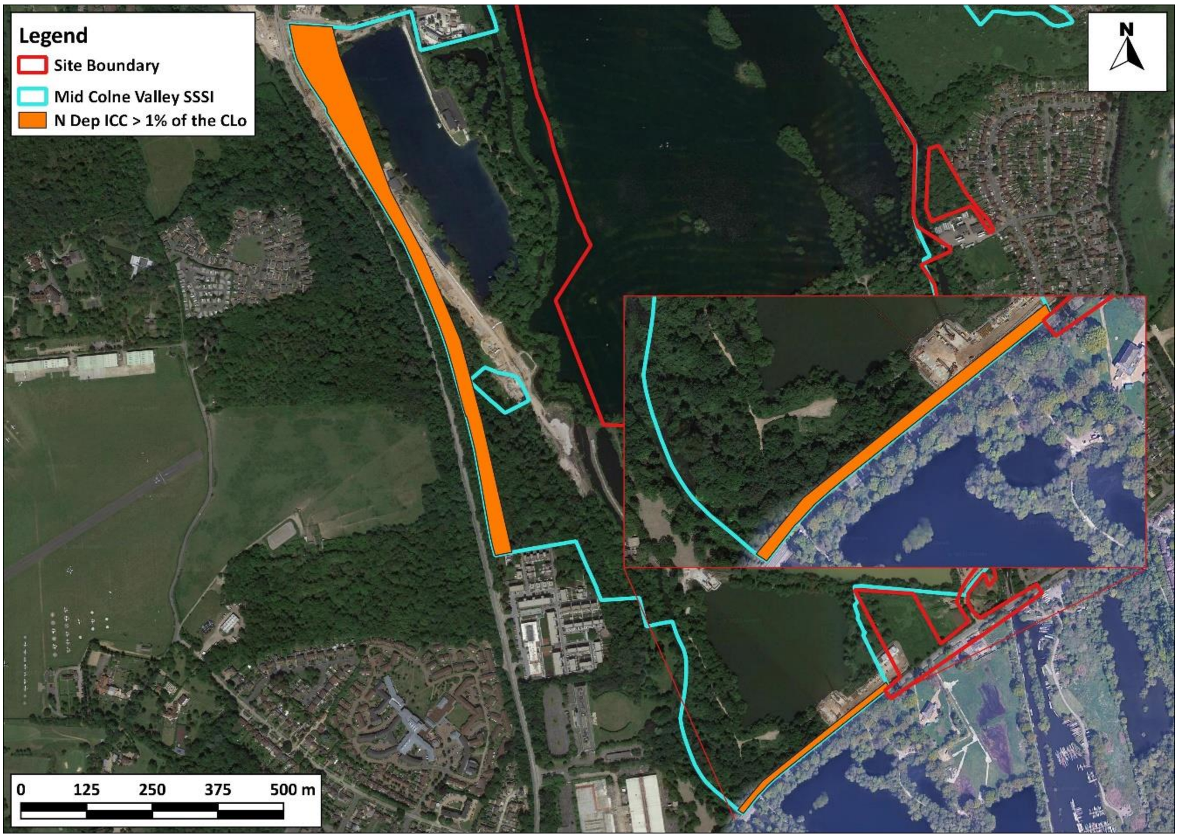

Figure 7: Area over which the Predicted ICC for Nitrogen Deposition Exceeds 1% of the CLo in the Mid Colne Valley SSSI During Operation

Imagery ©2023 Google, Imagery © 2023 Bluesky, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2023

6.13 Figure 4 to Figure 7 show that the areas where the ICC are predicted to exceed 1% of the CLe or CLo are small compared to the total area of the SSSI, and cover areas that are currently occupied by HS2 compounds. Over the remainder of the site, impacts will be smaller.

Assessment

6.14 It should be noted that the maximum background concentrations and fluxes across the study area have been used to provide a worst-case assessment, and it has been assumed that there will be no change between the baseline year (2019) and the assessment year (2024). It is, therefore, not appropriate to present the PCs and ICCs as a percentage of the autonomous changes that would be expected during that time.

6.15 It should also be recognised that the deposition velocities which have been used for ammonia may be particularly conservative. There is strong evidence that where ammonia concentrations are high, the deposition of ammonia can be significantly inhibited (Cape et al, 2008). The deposition velocities for ammonia used in this assessment were developed by the AQTAG to be precautionary in most settings. Thus, close to emissions sources it is likely to have caused the deposition of ammonia to have been over-predicted.

7 Conclusions

7.1 This report has set out the changes to air quality at relevant designated nature conservation sites associated with the Development. The emissions which have been considered are emissions from road traffic generated during the construction of the Development and by the completed and occupied Development. The increase to traffic associated with the Development will be greater than the Decision-Making Threshold defined by JNCC, meaning that a quantitative assessment is required. The assessment has been based on pre-pandemic activity and emissions forecasts, to ensure a worst-case assessment that does not take into account temporary reductions in pollutant concentrations as a result of reduced activity levels during the Covid-19 pandemic.

7.2 The Development will increase concentrations of NOx and ammonia, and nitrogen and acid deposition fluxes within the Mid Colne Valley SSSI. These increases, when considering the changes brought about by the Development in-isolation, can be discounted as insignificant through the application of commonly accepted screening criteria. However, there is a small area of the site where these increases, in-combination with other projects and plans, cannot readily be discounted as insignificant through application of the same criteria. Information available from Natural England and APIS does not identify these areas as containing the features for which the SSSI has been designated. Examination of aerial photographs suggests that these areas, over which significant in-combination effects cannot immediately be discounted, are mainly woodland areas and construction compounds.

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9 Glossary

AA	Appropriate Assessment
AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
APIS	Air Pollution Information System
AQAL	Air Quality Assessment Level
AQC	Air Quality Consultants
AQMA	Air Quality Management Area
Autonomous Measures	Measures which are unrelated to a plan or project which is being determined
Autonomous Reductions	Forecast improvements resulting from autonomous measures.
CLe	Critical Level - **"***concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge*" **(APIS, 2023)**
CLo	Critical Load – "*a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge*" **(APIS, 2023)**
CROW	Countryside and Rights of Way Act
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
EU	European Union
EUNIS	European Nature Information System
Exceedance	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HMSO	Her Majesty's Stationery Office
IAQM	Institute of Air Quality Management
JAQU	Joint Air Quality Unit

kph	Kilometres Per hour
LAEI	London Atmospheric Emissions Inventory
LAQM	Local Air Quality Management
LBH	London Borough of Hillingdon
LDV	Light Duty Vehicles (<3.5 tonnes)
LEZ	Low Emission Zone
LNR	Local Nature Reserve
LSE	Likely Significant Effect. An effect is 'likely' if it cannot be excluded on the basis of objective information. An effect is 'significant' if it undermines the conservation objectives.
µg/m³	Microgrammes per cubic metre
NE	Natural England
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)
NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
OLEV	Office for Low Emission Vehicles
PC	Process Contribution
PPG	Planning Practice Guidance
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
TEMPro	Trip End Model Presentation Program

10 Appendices

A1 Transect Locations

A1.1 Table A1.1 presents each receptor at selected transect locations, along with the distance from the nearest road.

Table A1.1: Transect Receptor Locations and Distances from the Nearest Road

Receptor	X coordinate	Y coordinate	Distance from road (m)
Moorhall_1_2	504519.7	188349.7	2
Moorhall_1_3	504519.0	188350.4	3
Moorhall_1_5	504517.5	188351.8	5
Moorhall_1_9	504514.7	188354.6	9
Moorhall_1_17	504508.9	188360.2	17
Moorhall_1_33	504497.5	188371.4	33
Moorhall_1_65	504474.6	188393.7	65
Moorhall_1_129	504428.7	188438.3	129
Moorhall_1_200	504377.9	188487.9	200
Moorhall_2_2	504640.5	188447.6	2
Moorhall_2_3	504639.9	188448.4	3
Moorhall_2_5	504638.6	188450.0	5
Moorhall_2_9	504636.1	188453.1	9
Moorhall_2_17	504631.0	188459.3	17
Moorhall_2_33	504621.0	188471.7	33
Moorhall_2_65	504600.8	188496.6	65
Moorhall_2_129	504560.6	188546.3	129
Moorhall_2_200	504515.9	188601.5	200
Moorhall_4_65	504891.1	188716.4	65
Moorhall_4_129	504862.5	188773.7	129
Moorhall_4_200	504830.8	188837.2	200
Moorhall_3_112	504705.2	188637.6	112
Moorhall_3_129	504695.2	188653.0	129
Moorhall_3_200	504650.9	188708.5	200
A412_4_14	503999.1	188801.7	14
A412_4_17	504001.6	188802.5	17
A412_4_33	504017.2	188806.3	33
A412_4_65	504048.2	188813.9	65
A412_4_129	504110.4	188829.2	129
A412_4_200	504179.3	188846.2	200
A412_3_23	503910.1	189186.6	23
A412_3_33	503918.6	189189.4	33
A412_3_65	503950.4	189199.3	65

Receptor	X coordinate	Y coordinate	Distance from road (m)
A412_3_129	504010.7	189218.1	129
A412_3_200	504079.4	189239.4	200
A412_2_24	503781.8	189464.7	24
A412_2_33	503790.3	189468.9	33
A412_2_65	503818.1	189484.8	45
A412_2_129	503873.6	189516.6	129
A412_2_200	503935.3	189551.8	200
A412_1_21	503638.8	189705.7	21
A412_1_33	503650.2	189709.7	33
A412_1_65	503680.1	189721.2	45
A412_1_129	503739.8	189744.2	129
A412_1_200	503806.0	189769.7	200

A2 Professional Experience

Dr Denise Evans, BSc (Hons) PhD MIEnvSc MIAQM

Dr Evans is an Associate Director with AQC, with more than 23 years' relevant experience. She has prepared air quality review and assessment reports for local authorities and has appraised local authority air quality assessments on behalf of the UK governments and provided support to the Review and Assessment helpdesk. She has extensive modelling experience, completing air quality and odour assessments to support applications for a variety of development sectors including residential, mixed use, urban regeneration, energy, commercial, industrial, and road schemes, assessing the effects of a range of pollutants against relevant standards for human and ecological receptors. Denise has acted as an Expert Witness and is a Member of the Institute of Air Quality Management.

Dr Kate Wilkins, BSc (Hons) MSc PhD MIEnvSc MIAQM

Dr Wilkins is a Senior Consultant with AQC with over five years' experience in the field of air quality. Since joining AQC in January 2018, she has undertaken numerous air quality impact assessments for road traffic, combustion plant and construction dust throughout the UK for both standalone assessments and for EIAs and has also prepared local authority reports and literature reviews. She has contributed her technical skills in programming, specialist software and data analysis to a range of large-scale projects, including the third runway at Heathrow airport. Previously, Kate completed a PhD at the University of Bristol, researching atmospheric dispersion modelling and satellite remote sensing of volcanic ash. Prior to her PhD she spent a year working at the Environment Agency in Flood Risk Management. She is a Member of both the Institute of Air Quality Management and the Institution of Environmental Sciences.

George Chousos, BSc MSc AMIEnvSc AMIAQM

Mr Chousos is a Consultant with AQC, having joined in May 2019. Prior to joining AQC, he completed an MSc in Air Pollution Management and Control at the University of Birmingham, specialising in air pollution control technologies and management, and data processing using R. He also holds a degree in Environmental Geoscience from the University of Cardiff, where he undertook a year in industry working in the field of photo-catalytic technology. Since joining AQC, George has been gaining experience in undertaking air quality assessments, both qualitatively and using atmospheric dispersion modelling, to accompany planning and permitting applications. Projects have ranged in scale, from small scale residential development to Environmental Impact Assessments (EIAs). The assessments have considered the effects on both human health and ecological habitats. George also has experience completing construction dust risk assessments, Air Quality Neutral assessments, Local Authority Annual Status Reports (ASRs), as well as odour assessments.

A3 Relevant Case Law

A3.1 Interpretation of the Habitats Regulations with respect to air quality impacts and effects has been shaped by judgements and opinions of European and UK courts. Published findings of the Planning Inspectorate for England and Wales, and the advice given to this Inspectorate by Natural England, has also proven seminal in defining how air quality impacts on European sites should be assessed. A brief summary of some key cases, in chronological order, is given below.

2004 - Waddenzee[5]

A3.2 This case in the Court of Justice of the European Union (CJEU) explained the extent to which the precautionary principal must be followed in HRA. In particular, the judgement (para 61) notes: *"the competent national authorities …. are to authorise such an activity only if they have made certain that it will not adversely affect the integrity of that site. That is the case where no reasonable scientific doubt remains as to the absence of such effects".*

2009 - Boggis[6]

A3.3 This judgement explained that a breach of Article 6.3 does not occur solely because of a hypothetical risk of harm to a designated site. There must be credible evidence that the risk is real for this to require consideration (para 37).

2011 Sweetman[7]

A3.4 This judgement from the CJEU also emphasised the need for the precautionary principal. In particularly, it highlighted that the word "Likely" in LSE is unique to the English language interpretation of the Habitats Directive and should not be seen as synonymous with 'probable'. The judgement explained that an AA "*cannot have lacunae and must contain complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the works proposed on the protected site concerned".*

2013 – Lough Corrib[8]

A3.5 This case in the CJEU explained that the entirety of each European site is protected by the Habitats Directive: if a "*plan or project will lead to the lasting and irreparable loss of the whole or part of a priority natural habitat type whose conservation was the objective that justified the designation of the*

5 Case C-127/02. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:62002CJ0127:EN:PDF

6 [2009] EWCA Civ 1061. Boggis & Anor v Natural England & Anor [2009] EWCA Civ 1061 (20 October 2009) (bailii.org)

7 Case C-258/11 (Sweetman) Judgement para 44, 46 and 47

8 Case C-258/11. CURIA - Documents (europa.eu)

site concerned …, the view should be taken that such a plan or project will adversely affect the integrity of that site." (para 46).

2017 - Wealden 1[9]

A3.6 This case in the UK High Court concerned the approach to in-combination assessments pursuant to the Habitats Regulations. The principal issue was whether it was appropriate to apply a screening criterion published by Highways England (in which changes of less than 1,000 vehicles per day could be discounted as not significant) to consider the impacts of individual plans. The overall conclusion in this respect was that the criterion should have been applied to the aggregated change caused by two plans and not to each plan in isolation. This has changed the approach taken at the screening stage of HRA, which now routinely considers the effects of plans and projects in combination as well as on their own.

2018 People over Wind[10]

A3.7 The judgement of the CJEU was that it was more appropriate to consider the effects of mitigation at the AA stage rather than at the screening stage: "*it is not appropriate, at the screening stage, to take account of the measures intended to avoid or reduce the harmful effects of the plan or project on that site"*. This is particularly challenging to reconcile with the concepts of 'better by design' and 'air quality positive' which expect consideration of air quality improvement to run throughout the design of a project. Since the People over Wind judgement, most assessments consider that on-site measures to reduce emissions which are not required solely to avoid an LSE can form part of the assessment considered at the screening stage.

2018 Dutch Nitrogen Cases[11]

A3.8 These two cases highlighted several interesting points. The most relevant in terms of air quality assessment in the UK are:

1) that an AA may not take into account the existence of 'autonomous' measures[12] (i.e. measures not part of that programme), if the expected benefits of those measures are not certain;

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9 Judgment in Wealden District Council v Secretary of State for Communities and Local Government, Lewes District Council and South Downs National Park Authority) [2017]

10 C-323/17 Judgement of the Court 12 April 2018, Request for a preliminary ruling under Article 247 TFEU from the High Court (Ireland), made by decision on 10 May 2017, received at the Court on 30 May 2017, in the proceedings of People Over Wind and Peter Sweetman v Coillte Teoranta, curia.europa.eu/juris/document/document.jsf?text=&docid=200970&pageIndex=0&doclang=en&mode=req&dir=&occ=first&part=1&cid=619449.

11 Coöperatie Mobilisation for the Environment UA and Vereniging Leefmilieu v College van gedeputeerde staten van Limburg and College van gedeputeerde staten van Gelderland. Requests for a preliminary ruling from the Raad van State Joined Cases C-293/17 and C-294/17

12 i.e. measures which are not being delivered as part of the plan, project, or programme being assessed.

2) that screening thresholds may only be used to discount an LSE from a project if there is no reasonable scientific doubt that that project will not affect the integrity of a designated site in combination with other plans and projects; and

3) that recurring activities such as grazing and fertilizer use may be classified as a 'project' in the context of the Habitats Directive.

2019 - Examination of the Submission Wealden Local Plan

A3.9 This does not relate to a court case, but the judgements expressed by NE and the planning inspectorate have had significant implications for the way in which air quality impacts on nature conservation sites are assessed in the UK. In particular, they form the basis of the approach which was taken to derive the DMTs and SRTs (see Paragraph 4.18). Furthermore, the political implications for Wealden District Council (WDC) of not following NE's advice on this matter have provided a clear signal to other local planning authorities regarding the treatment of autonomous measures in planning decisions.

A3.10 In the evidence supporting its 2018 Submission Local Plan, Wealden District Council showed the impact of its Submission Plan on air quality conditions within the Ashdown Forest SAC. It quantified the PC and ICC, and also showed the net effect of forecast changes to national and international emissions (i.e. autonomous measures). These emissions were forecast using three alternative approaches, each of which assumed a different level of efficacy of the autonomous measures.

A3.11 NE advised WDC that it should base its plan-making solely on the scenario that used AQC's CURED model[13], but instead the Council took account of all three emissions scenarios, including one in which autonomous measures were assumed to have no effect[14] .

A3.12 Under NE's preferred scenario[13], improvements caused by autonomous measures were predicted to be greater than the adverse effects of the Submission Local Plan, both alone and in-combination with other predicted traffic growth (i.e. the effect of autonomous measures was greater than both the PC and ICC). Detailed habitats surveys had identified the distribution of the protected feature, and at the worst relevant location, the PC was predicted to remove 53% of the autonomous improvements, while the ICC was predicted to remove 74% of the autonomous improvements[15]. These predictions were used by NE to inform its supplementary conservation objectives for Ashdown

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13 This was termed 'Scenario B'. AQC's CURED model has since been withdrawn but the modelling presented in this report is consistent with the level of precaution which was inherent in this model scenario.

14 This was termed 'Scenario A'.

15 As documented in the executive summary of the air quality modelling report cited by Natural England (2019) which shows the maximum deposition to heath predicted using the most detailed modelling would fall from 22.7 kgN/ha/yr in 2015 to: 19.3 kgN/ha/yr in 2028 without any 'in-combination' traffic; 20.8 kgN/ha/yr in 2028 without the Submission Plan, and 21.8 kgN/ha/yr with the Plan..

Forest (Natural England, 2019). Making specific reference to the modelling published by WDC, NE stated:

"Assessment of improvements in vehicular technology and in particular Euro6/VI standards that all vehicles are currently being manufactured to, will outweigh impacts from new development. The improvements will be marginally retarded by additional development but future nitrogen deposition and concentration will continue to decline with the existing trend." *(Natural England, 2019)*.

A3.13 This statement relates to the entire SAC and thus takes account of the large area where the ICC was predicted to remove less than 74% of the autonomous improvements, as well as these worst-case impacts. NE also explained the importance of this net downward trend in its representations to the planning inspector[16,17]. The predicted improving trend related only to NOx and nitrogen deposition. The modelling published by WDC, to which NE referred, did not predict any reductions to ammonia concentrations, only adverse impacts. NE's advice took a holistic view of ambient concentrations in general in its advice relating to air quality.

A3.14 It is important to note that NE's position regarding the importance of autonomous emissions reductions at Ashdown Forest did not refer to specific habitat features, their sensitivity, or any other ecological context. The statement which is quoted in Paragraph A3.12, relates solely to air quality forecasts. A key disagreement between WDC and NE was whether the autonomous measures included in the air quality forecasts were sufficiently certain for decision making in the context of the Habitats Regulations[18]. The Submission Plan ultimately had to be withdrawn, partly because of WDC's failure to take account of NE's advice on the significance of the PC and ICC when viewed in the context of the benefits provided by autonomous measures[19].

16 e.g. Paragraphs 19 to 25, and Paragraphs 37 to 46 of Annex 1 to Natural England Comments on Proposed Submission Document 05/08/18 – Natural England ref 255168 (available on request).

17 It is important to note that the examination in public followed shortly after the judgement from the Dutch Nitrogen Cases, which were discussed at length and thus fully accounted for in advice from both Natural England and the planning inspector.

18 In particular, WDC noted that measurements showed that traffic-related nitrogen deposition had, on average, been increasing for many years despite the same forecasts showing concurrent reductions.

19 Wealden District Council concluded that the PC and ICC were both potentially significant without mitigation, while for the reasons given in Paragraph A3.12, Natural England determined that mitigation was not required.

A4 Data from (Caporn et al., 2016) Cited by National Highways

Table A4.1: Values from Table 21 of Caporn et al (2016) Relied on in National Highways' Assessment Method

Habitat	Nitrogen Deposition KgN/ha/yr						
	CLo	Background deposition					
		5	10	15	20	25	30
		Increase required to reduce measured species richness by 1					
Upland heath [a]	10-20	0.4	0.8	1.3	1.7	2.0	2.4
Upland heath [a]	10-20	1.7	2.0	2.5	3.3	5.0	20.0
Lowland heath	10-20	0.4	0.8	1.3	1.7	2.0	2.4
Bog	5-10	-	-	-	3.3	-	-
Sand dunes [a]	8-15	0.1	0.5	1.1	2.0	-	-
Sand dunes [a]	8-15	0.3	0.6	0.9	1.3	-	-
Sand dunes [a]	8-15	0.3	0.6	0.9	1.3	-	-
Acid grasslands	10-15	1.7	1.7	2.0	2.0	2.5	2.5

[a] Based on two separate studies using different quadrat sizes.

A5 Modelling Methodology

Model Inputs

A5.1 Predictions have been carried out using the ADMS-Roads dispersion model (v5). The model requires the user to provide various input data, including emissions from each section of road and the road characteristics (including road width). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the EFT (Version 11.0) published by Defra (2023). Model input parameters are summarised in Table A5.1 and, where considered necessary, discussed further below.

Table A5.1: Summary of Model Inputs

Model Parameter	Value Used
Terrain Effects Modelled?	No
Variable Surface Roughness File Used?	No
Urban Canopy Flow Used?	No
Advanced Street Canyons Modelled?	No
Noise Barriers Modelled?	No
Meteorological Monitoring Site	Iver Water Works
Meteorological Data Year	2019
Dispersion Site Surface Roughness Length (m)	0.3
Dispersion Site Minimum MO Length (m)	10
Met Site Surface Roughness Length (m)	0.2
Met Site Minimum MO Length (m)	10
Gradients?	No

A5.2 AADT flows, and the proportions of HDVs generated by the construction and operation of the Development have been provided by Robert West, who have undertaken the transport assessment work for the Development. Traffic speeds have been estimated based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction. The traffic data used in this assessment are summarised in Table A5.2. Diurnal and monthly flow profiles for the traffic have been derived from the national profiles published by DfT (2020).

A5.3 In addition, and due to the proximity of the Development to the HS2 project, the traffic generated by the construction of HS2, has been included in each of the scenarios modelled within this assessment. The data have been taken from a report prepared by HS2, report no. HS2-HS2-EV-REP-000-000240 (2022).

Table A5.2: Summary of Traffic Data used in the Assessment

Road Link	2019		2024 (Without Scheme) / Operational		2024 (With Scheme) / Operational		2024 (Without Scheme) / Construction		2024 (With Scheme) / Construction	
	AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV
North Circular Road (A412)	11,725	8.6	12,260	8.6	12,277	8.6	12,153	8.6	12,172	8.7
Moorhall Road (west of Site access)	5,089	3.2	5,317	3.2	5,351	3.2	5,271	3.2	5,307	3.2
Moorhall Road (east of Site access)	4,562	3.0	4,790	3.0	4,815	3.1	4,744	3.0	4,768	3.0

A5.4 Figure A5.1 shows the road network included within the model, along with the speed at which each link was modelled.

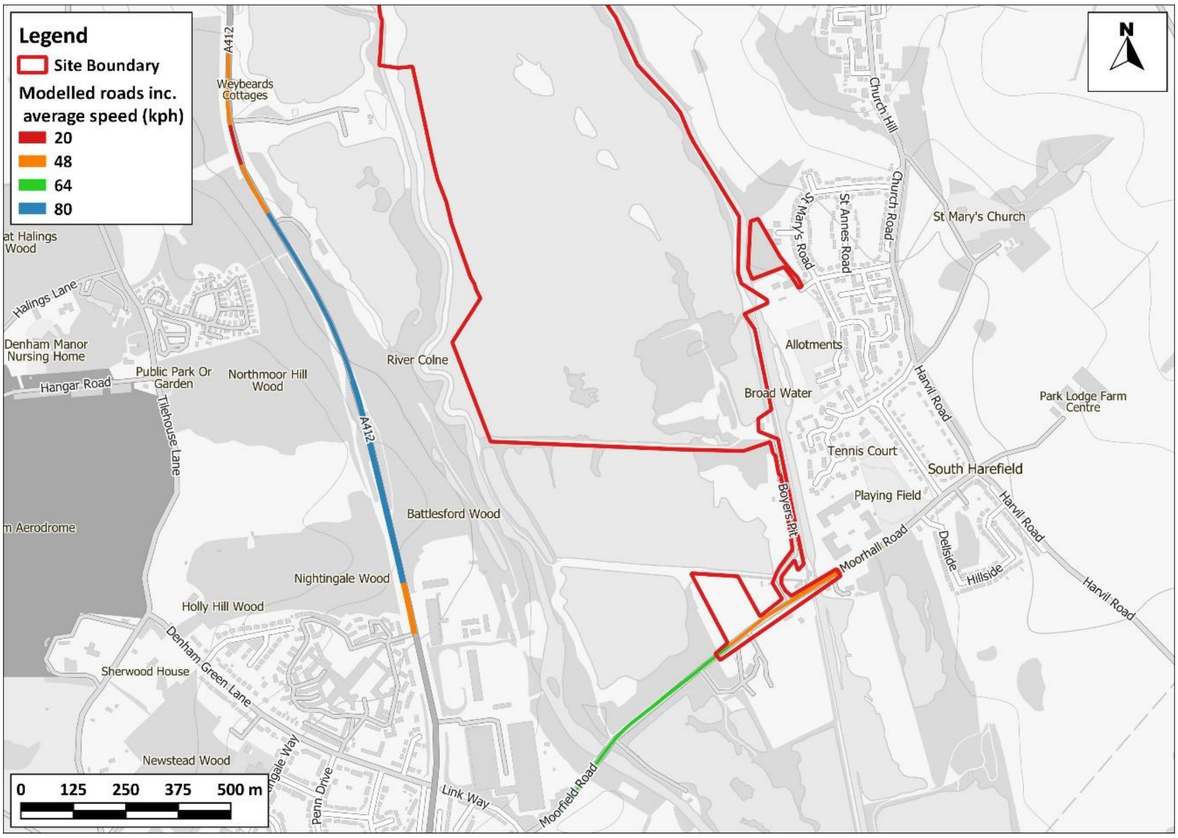

Figure A5.1: Modelled Road Network & Speed

A5.5 Hourly sequential meteorological data in sectors of 10 degrees from Iver Water Works for 2019 have been used in the model. The Iver Water Works meteorological monitoring station is located at Iver North Water Treatment Works, approximately 8.2 km to the south of the Development. It is deemed to be the nearest monitoring station representative of meteorological conditions in the vicinity of the Development; both the application site and the Iver Water Works meteorological monitoring station are located in the Greater London Area where they will be influenced by the effects of inland meteorology over urban topography. A wind rose for the site for the year 2019 is provided in Figure A5.2. The station is operated by the UK Met Office. Raw data were provided by the Met Office and processed by AQC for use in ADMS.

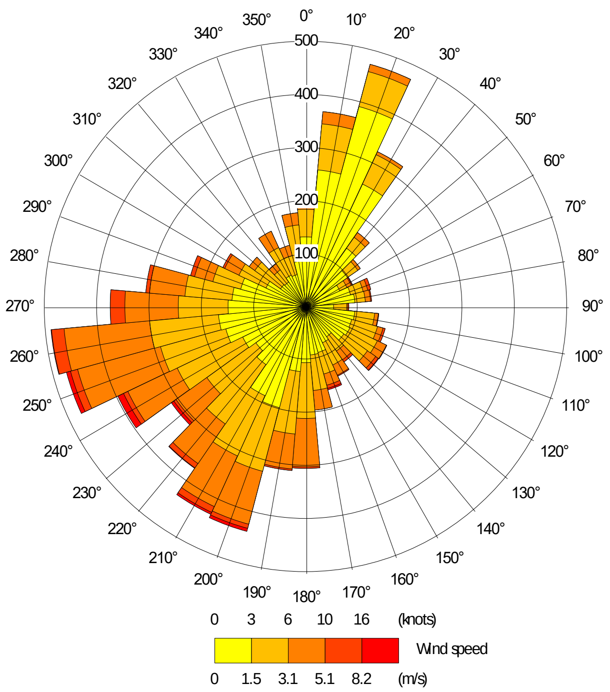

Figure A5.2: Wind Rose

Model Verification

A5.6 Evidence collected over many years has shown that, in most urban areas, dispersion modelling relying upon Defra's EFT has tended to systematically under-predict roadside nitrogen dioxide concentrations. To account for this, it is necessary to adjust the model against local measurements; however, no monitoring sites within proximity to the Development have been deemed representative of conditions found at the Site, and therefore are not suitable to use for verification purposes. An average verification factor, based on 34 air quality impact assessments carried out by AQC for 2019, has therefore been applied. This is considered to be an appropriate alternative in the absence of suitable monitoring sites for which modelling could be undertaken. The adjustment factor applied to the predicted road contributions of nitrogen oxides is 2.726.

Ammonia

A5.7 There are no local roadside ammonia monitoring sites which can be used to verify the model results for traffic-related ammonia emissions. Development of the CREAM emissions model (AQC, 2020a) included verification of concentrations predicted using the ADMS-Roads dispersion model and measured traffic data against ambient measurements from the most detailed network of roadside monitoring sites which has ever been run in the UK. No further local verification is possible, and no adjustment is considered necessary.

Post-processing

A5.8 The model predicts road-NOx concentrations at each receptor location. These concentrations have been adjusted using the adjustment factor set out above, which, along with the background NO_2, has been processed through the NOx to NO_2 calculator available on the Defra LAQM Support website (Defra, 2023). The traffic mix within the calculator has been set to "All London traffic", which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road-NOx and the background NO_2.

Deposition Rates

A5.9 Deposition has not been included within the dispersion model because the principal depositing component of concern is nitrogen dioxide, and this is calculated from nitrogen oxides outside of the model. Instead, deposition has been calculated from the predicted ambient concentrations using the deposition velocities set out in Table A5.3. Deposition velocities refer to a height above ground, typically 1 or 2 m, although in practice the precise height makes little difference, and here they have been applied to concentrations predicted at a height of 1.5 m above ground. The velocities are applied simply by multiplying a concentration (µg/m^3) by the velocity (m/s) to predict a deposition flux (µg/m^2/s) and then scaling by time and area to represent kg/ha/yr of the nitrogen component of the molecule. The rate of nitrogen deposition due to dry deposition of nitrogen dioxide has been calculated as specified by LBH in Paragraph 5.2, assuming 0.1 kg N ha^{-1} yr^{-1} nitrogen deposition from 1 µg/m^3 of road NO_2.

Table A5.3: Deposition Velocities Used in This Assessment

Pollutant	Deposition Velocity (m/s)	Reference
Ammonia	0.02 m/s (Grassland) and 0.03 m/s (Forest)	AQTAG06 (AQTAG, 2011)

A5.10 Wet deposition of the emitted pollutants close to the emission source will be restricted to wash-out, or below cloud scavenging. For this to occur, rain droplets must come into contact with the gas molecules before they hit the ground. Falling raindrops displace the air around them, effectively pushing gasses away. AQTAG06 guidance (AQTAG, 2011) is that the wet deposition of nitrogen dioxide and ammonia is not significant within a short range. It has thus not been included.

A5.11 Deposition may have an acidifying effect through the release of acid protons during chemical transformation in the soil or biota. Thus, even alkaline gases such as ammonia can have an acidifying effect. The acidity CLos are expressed as equivalents (‘eq’), referring to the molar equivalent of potential acidity. This is calculated from the mass (in g) of the deposited element, taking account of both its atomic mass and its valency. For example, the acidifying potential (in eq) of both ammonium (NH_4^+) and nitrate (NO_3^-) is 1/14 times the deposited mass in grammes (with 14 being the atomic mass of nitrogen), while for sulphate (SO_4^{2-}) it is 2/32 (with 32 being the atomic mass of sulphur). The species included in the calculation of acid deposition, and their calculated acidifying potentials, are set out in Table A5.4.

Table A5.4: Species Included in Acid Deposition Calculations

Pollutant	Calculation (kg deposition to keq)
N (from deposited NO_2, Ammonia)	0.071